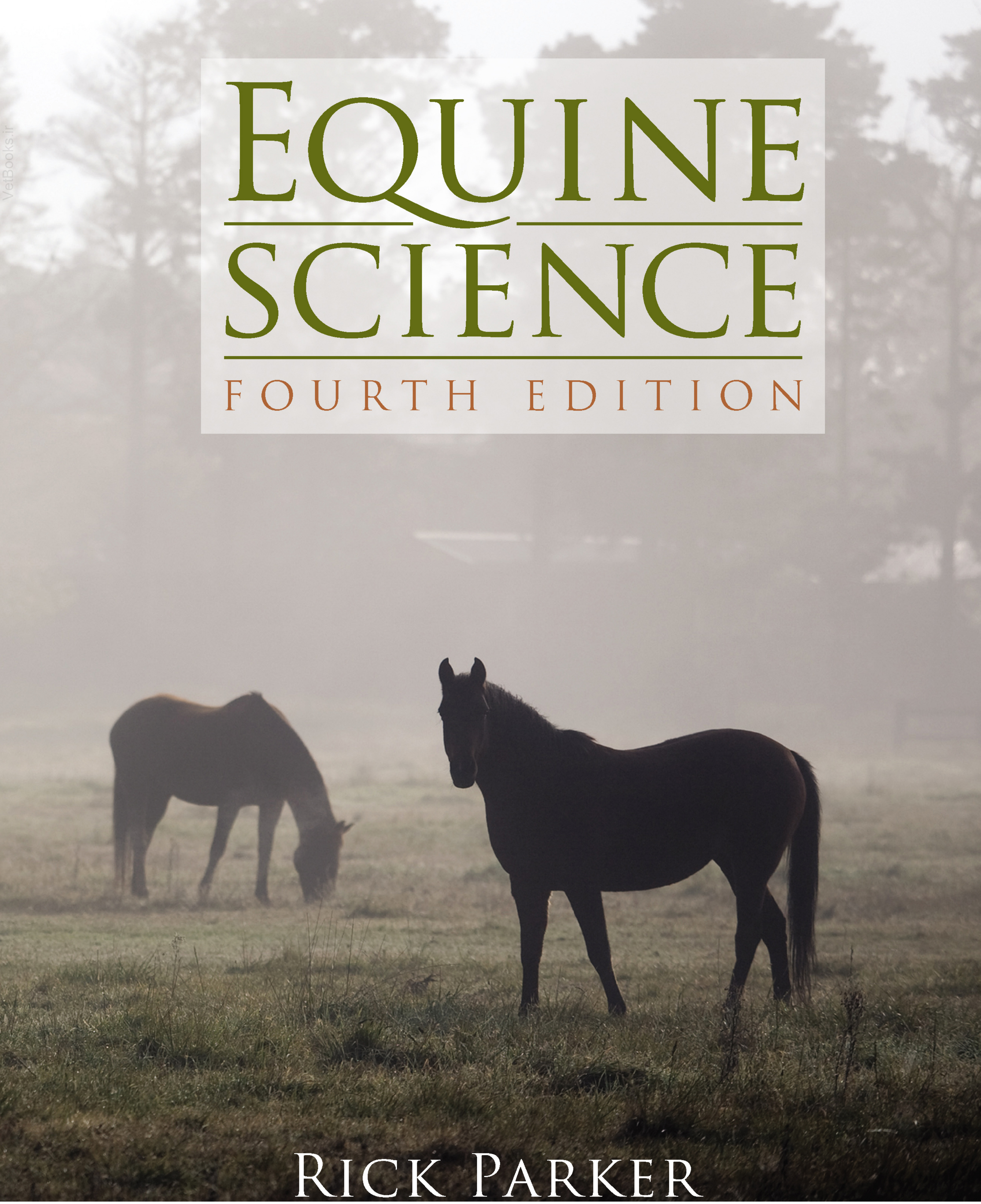

Equine Science

Fourth Edition

Rick Parker

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EQUINE SCIENCE

FOURTH EDITION

RICK PARKER

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Equine Science, Fourth Edition
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DEDICATED TO nine people who provide meaning and happiness in my life: my wife, Marilyn, and our eight children—Shaura, Sariah, Justus, Liberty, Cole, Morgan, Spencer, and Samuel, and now grandchildren.

CONTENTS

PREFACE

Horses hold a special place in North America's history and culture. As America evolved, horses contributed to the economy by providing power for transportation and industry. Today horses still contribute to the economy but in a much different way. The 9.5 million horses in the United States contribute $39 billion annually in direct economic impact and support 1.4 million jobs on a full-time basis. When indirect spending is included, the horse industry's economic impact reaches $102 billion annually. The overall economic impact of horses comes from racing, recreation, sports, rodeos, farm work, pleasure riding, and competitions.

While millions of people participate in the horse industry as spectators, almost 5 million Americans are involved in the industry as horse owners, service providers, employees, and volunteers. Horses are found in every state, and 45 states have at least 20,000 horses. The horse industry is vital and growing. With this vitality and growth comes the need for information about horses, so the numbers of horse-related educational programs, books, pamphlets, videos, and Internet sites are increasing rapidly.

CONTENT AND ORGANIZATION

The book is organized into 22 chapters. Chapter 1 describes the history and development of the horse from prehistoric times to the present. As a background for the future, Chapter 2 provides the statistics and the status of the horse industry. Chapter 3 discusses the breeds, types, and classes of horses, donkeys, and mules. Chapters 4 and 5 detail the anatomy and physiology of the horse from the cellular level through tissues, organs, and body systems. Chapters 6 through 12 apply the knowledge of anatomy and physiology to the topics of the biomechanics of movement, unsoundness, selecting and judging, age and stature, genetics, reproduction and breeding, and digestion and nutrition. Chapter 16 covers common management practices, while Chapters 13, 14, 15, 17, and 18 discuss the specific management skills of feeding, health maintenance, parasite control, shoeing and hoof care, and recommended buildings and equipment.

In the past, many people grew up around animals. They learned animal behavior by working with and observing animals every day. A textbook on any livestock species would now be considered incomplete without a chapter on behavior. This is especially true for horses. Chapter 19 covers horse behavior. Understanding horse behavior is critical to a person's success as a trainer or rider. Equitation skills are covered in Chapter 20.

Finally, many people who learn about horses want to be employed in the equine industry. This happens in either of two ways—by starting a new equine business or by getting a job or career in the equine industry. Chapters 21 and 22 provide the information to help students reach their goal of working in the industry.

NEW IN THE FOURTH EDITION

Charts, figures, tables, and resources have all been updated. New sidebars, figures, charts, and tables were added to reinforce concepts. Minor errors were corrected. Throughout the book as well as in the appendix, Internet resources, including some YouTube videos, are provided as a source of more information or as a point of contact. Specific changes or additions included expanded discussions on metabolism and the creation of energy, how muscles contract, the function of blood, genetics, male and female anatomy, energy in feedstuffs, vitamins, minerals and water, vaccinations, blood typing, types of credit, and the skills and competencies for getting a job. Also, nutritional information was updated to reflect changes in the *Nutrient Requirements of Horses, 6th Rev Edition* (2007).

Additions to the book include information about: zoonotic diseases, proteomics and nutrigenomics, sexed semen, green buildings, safety first, horse theft, equitation competitions, therapeutic horseback riding, information literacy, and personal qualities. A new table in the appendix correlates the chapters with national content standards.

SCIENCE

As the name of the book implies, its focus is on science. A scientific understanding of horses is essential. Science represents the knowledge of horses gained through investigation, arranged logically and systematized. Wherever possible, this book presents the science of horses so the reader will have a better understanding of reproduction, inheritance, development, growth, training, feeding, nutrition, aging, health, illness, and general management.

FEATURES

Throughout the book, many tables, charts, graphs, and illustrations provide quick and understandable access to information without the need to wade through excess words. Students will quickly learn how to read these features and grasp the information they contain.

Common features in each chapter make the book easy for the reader and easy for the instructor. These common features include Objectives, Key Terms, Summary, Review, Student Activities, and Additional Resources.

Learning is difficult without knowing what is required. Each chapter in this book opens with a list of learning objectives. These help the student and the instructor identify the most important concepts from all the information in the chapter.

The beginning of each chapter also features a list of key terms. Knowing the meaning of these key terms is essential to reading and understanding the chapter. Many of the words are defined within the text, and all are defined in the glossary.

Each chapter has a Summary followed by a Review that is linked to the learning objectives at the beginning of the chapter. The last section of the Review requires critical thinking to develop an answer that is not just a correct response, but an analysis and synthesis of the information. Finally, knowledge and information alone are useless unless they can be applied. In the Student Activities section at the end of each chapter, students and instructors will find opportunities for learning by doing.

For more information on horses, the teacher or the student can refer to the Additional Resources at the ends of the chapters. The appendix also contains tables directing the reader to other resources and helpful tables with information for converting units of measure, doing gestation calculations, scheduling, health maintenance, and making contact with the horse industry organizations and agencies. Also, the appendix lists the Web addresses (URLs) for organizations and other Internet sites.

ALSO AVAILABLE

Equine Science Instructor's Manual

ISBN-13: 978-1-1111-3878-3

The Instructor's Manual has been expanded to include chapter overviews, objectives, and suggested lesson development in addition to providing answers to the Review Questions found in the text.

ClassMaster CD-ROM to Accompany Equine Science, 4th Edition

ISBN-13: 978-1-1111-3879-0

The ClassMaster contains the following educational tools for instructors:

- **Instructor's Manual** to the text (in PDF format).
- **Electronic Slide Presentations** containing over 300 slides focusing on each chapter's key points to facilitate classroom presentations. The slides have been updated to correlate with the new content changes made to the 4th edition textbook.
- A **Computerized Test Bank** of over 650 questions with answers and Internet testing capability. New questions have been added to reflect the content changes of the 4th edition textbook.
- New! An **Image Library** containing all the 250+ figures illustrated in the text.

ACKNOWLEDGMENTS

An author's efforts never stand on their own merit. The genesis of this book depended on teamwork. Team members included people who were willing to go "above and beyond" to create this book. One member of the author's team, his wife, Marilyn, has been on the team for over 42 years. Without her constant help, support, and encouragement, this revision would never have been completed. Marilyn concentrated on the details of the artwork, Internet site URLs, proofreading, and assembling all the parts. She found photos and in some cases took photos for the book. Another important member of the team included the author's son, Sam, who did extra chores while his parents focused on completing the revision.

The author also appreciates the support, encouragement, and prodding of Christina Gifford and the team at Delmar Cengage Learning.

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ABOUT THE AUTHOR

R. O. (Rick) Parker grew up on an irrigated farm in southern Idaho. Because of a love of agriculture he went on in his education. Starting at Brigham Young University, he received his bachelor's degree (animal science and zoology) and then moved to Ames, Iowa, where he finished a Ph.D. in animal physiology at Iowa State University. After completing his Ph.D., he and his family moved to Edmonton, Alberta, Canada, where he completed a postdoctorate on neonatal pig physiology at the University of Alberta. Next he and his wife, Marilyn, and their children moved to Laramie, Wyoming, where he was a research and teaching associate at the University of Wyoming. Here his research focus was fetal development in sheep.

For 19 years, the author served as a division director and instructor at the College of Southern Idaho (CSI) in Twin Falls. As director he worked with faculty in agriculture, information technology, drafting, marketing and management, and electronics. Dr. Parker also taught biology, computer, and agriculture classes at CSI. Currently, he serves as the director and principal investigator (PI) for AgrowKnowledge (www.agrowknow.org), the National Resource Center for Agriscience and Technology Education, a project funded by the National Science Foundation (DUE #0802510). Additionally, he is the editor for the peer-reviewed *NACTA Journal* (www.NACTAteachers.org), which focuses on the scholarship of teaching and learning. Dr. Parker is the author of these other Thomson Delmar texts: *Aquaculture Science* (3rd edition), *Introduction to Plant Science, Introduction to Food Science,* and *Fundamentals and Applications of Plant & Soil Science*. He is also coauthor with Marihelen Glass of the text *Fundamentals of Plant Science*.

He and his wife are the parents of eight children and grandparents of twenty-two.

CHAPTER 1

History and Development of the Horse

Since prehistoric times, the swift and powerful horse has been domesticated by human beings for use as a draft animal, for transportation, and in warfare, and it has figured notably in art and mythology. Riding horses was not practical until suitable bits and other controlling devices were invented, and the horse did not replace humans and oxen at heavy farm labor until the appearance of an efficient harness. Today, horses are used primarily for sports such as racing, show competition, rodeos, and simple riding for pleasure. Horseflesh has occasionally been consumed by humans since prehistoric times, and it is used as a pet food.

A large herbivore adapted for running, the horse, *Equus caballus*, is a mammal of the family *Equidae*, order *Perissodactyla*.

OBJECTIVES

After completing this chapter, you should be able to:

- Name the major evolutionary horselike animals
- Identify the position of the horse in the zoological scheme
- Describe how humans eventually changed the way they used the horse
- Give the scientific name for the horse and three of its close relatives
- List the four evolutionary trends exhibited by horse fossils
- Identify the Romans' influences on the use of the horse
- Describe the effect of the Middle Ages and the Renaissance on the use of horses
- Name three horses in mythology or legend
- Name three famous horses of the films
- Describe the use and decline of horses in agriculture in the United States
- Discuss how racing started in the United States
- Identify the factors that changed the use of horses in the twentieth century
- Name four geologic time periods (epochs) used to discuss the evolution of the horse

KEY TERMS

Archeohippus
Calippus
cavalry
centaur
draft
Eocene epoch
Eohippus
evolution
gelding
hackamore
hybrids
Hyracotherium
Merychippus
Mesohippus
Miocene epoch
monodactyl
Morrill Land Grant Act
mules
Oligocene epoch
onagers
Paleocene epoch
Pleistocene epoch
Pliocene epoch
Pliohippus
Przewalski's horse
rodeo
steppes

EVOLUTION OF THE HORSE

Evolution of the horse did not occur in a straight line toward a goal, like the steps on a ladder. Rather, it was like a branching bush, with no predetermined end. Many horse-like animals branched off the evolutionary tree and evolved along various unrelated routes, with differing numbers of toes and adaptations to different diets. Now one genus—*Equus*—is the only surviving branch of a once mighty and sprawling evolutionary bush. Of the several species within that genus, *Equus caballus* is today's true horse. Here's how it fits into the zoological scheme:

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Perissodactyla
Family: Equidae
Genus: *Equus*

Equus asinus—the true asses and donkeys of northern Africa. (The African wild ass is sometimes called *Equus africanus.*)

Equus burchelli—the Plains zebra of Africa, including Grant's zebra, Burchell's zebra, Chapman's zebra, the half-striped Quagga, and other subspecies. The Plains zebra is what people usually think of as the "typical" zebra, with rather wide vertical stripes and thick horizontal stripes on the rump.

Equus caballus—the true horse, which once had several subspecies.

Equus grevyi—Grevy's zebra, the most horselike zebra. This is the big zebra with the very narrow vertical stripes and huge ears.

Equus hemionus—the desert-adapted **onagers** of Asia and the Mideast, including the kiang.

Equus przewalski—the oldest living species of horse, discovered in remote Mongolia. (*Equus caballus* first appeared in Central Asia, probably as **Przewalski's horse**.)

Equus zebra—the Mountain zebra of South Africa. This is the little zebra with the dewlap and the gridiron pattern on its rump.

Geologic Time Scale and the Fossil Record

Geologists and other scientists use the geologic time scale to describe the timing and relationships between events that have occurred during the Earth's history. Geologic periods are standardized by the International Commission on Stratigraphy (http://www.stratigraphy.org/) and the United States Geologic Survey (http://www.usgs.gov/) or USGS Geologic Time Online Edition (http://pubs.usgs.gov/gip/geotime/).

The Earth is very old—4.5 billion years or more. This vast span of time, called geologic time by earth scientists, is difficult to comprehend in the familiar time units of months and years, or even centuries. The geologic time of Earth's past has been organized into various units according to events that took place in each period. Different spans of time on the time scale are usually delimited by major geologic or fossil events. Earth's age is locked up in its rock layers and the fossils in those layers. Scientist studying these layers and fossils have assigned names to the divisions of geologic time. Major divisions are called eras, and eras are divided into periods, and periods are divided into epochs. Each of these divisions is expressed in terms of millions of years.

Eohippus

The earliest ancestor of the present horse, ***Eohippus*** or ***Hyracotherium***, was a small, primitive horse about the size of a fox. It had an elongated skull, a moderately arched back, and a shortened tail. There were four functional toes on each front foot, but only three toes on each hind foot. The structure of its teeth suggests that it was a browser (Figure 1–1). The earliest remains of this extinct animal are found in rocks of the late **Paleocene epoch** (about 54 million years old) in North America. More recent fossils have been found in rocks of the **Eocene epoch** (about 50 million years old) in Europe.

Mesohippus

During the **Oligocene epoch**, about 35 million years ago, Earth's temperature and climate changed; conifers began to outnumber deciduous trees. The forest thinned, grass became more prevalent, and ***Mesohippus*** appeared. This animal was larger than *Eohippus*. Its teeth had further evolved. It had only three toes on its front feet and was better suited to outrunning its enemies. As swamp gave way to soft ground, toes became less essential. On *Mesohippus*, the lateral supporting toes decreased in size while the middle toe strengthened. The toes now ended in little hooves that still had a pad behind them. In both Europe and North America, these browsing horses became extinct about 7 million years ago (Figure 1–2).

Merychippus

In the **Miocene epoch**, about 20 million years ago, a new type of horse appeared. ***Merychippus*** evolved in North America and adapted to the grasses of the plains. This was the beginning of the grazing horse of today, and its height was about 35 inches.

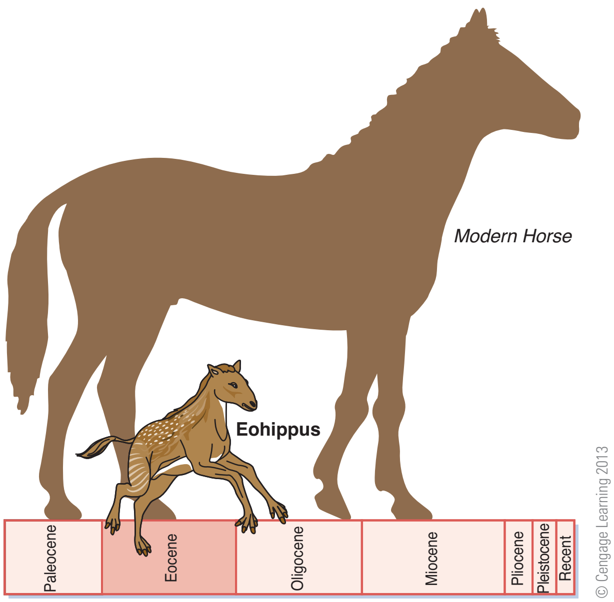


FIGURE 1–1 ***Eohippus.***

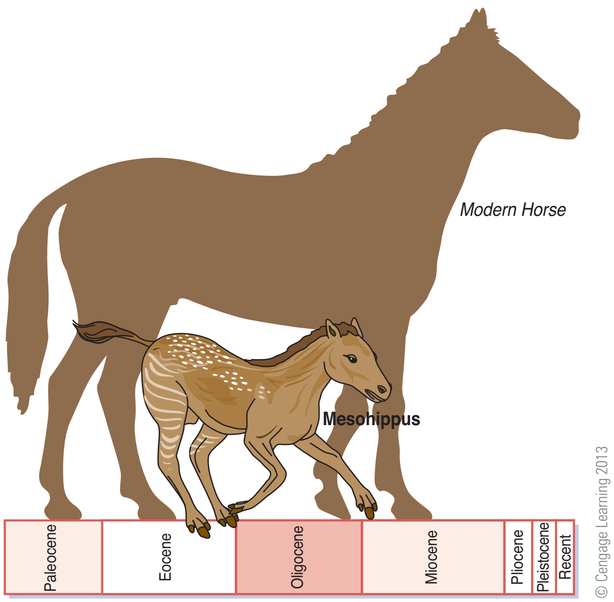


FIGURE 1–2 ***Mesohippus.***

Merychippus was increasingly gregarious and lived in herds. To chew the rough grass, *Merychippus* developed complicated grinding teeth similar to those of present-day horses. Its lateral toes shrank and no longer reached the ground. The main toe thickened and hardened for swift travel on the dry ground. The feet had no pads and the weight was carried on an enlarged single hoof on the central toe (Figure 1–3).

Pliohippus

At the beginning of the **Pliocene epoch**, about 5 million years ago, one branch of the horse ancestor crossed into Asia, quickly multiplied, and spread to Europe. Meanwhile, in North America, the horse developed into its final form. ***Pliohippus*** was the first true **monodactyl** (one-toed animal) of evolutionary history. Pliohippus needed speed to outrun its enemies, so the hoof evolved from the continued overdevelopment of the middle toe. Its teeth and limbs were the nearest approach to our present-day horses (Figure 1–4). This horse now spread into South America, Asia, Europe, and Africa.

The last 2 million years, from the present to the **Pleistocene epoch**, represent the final evolutionary stage of *Equus.* About 8,000 years ago, *Equus* became extinct in the Western Hemisphere, returning when the Spanish brought horses to the New World in the 1400s

Some examples of extinct horses that once roamed the western hemisphere include the Hagerman Horse (*Equus simplicidens*) found in the Hagerman, Idaho, Fossil Beds National Monument (Figure 1–5). Two more examples of extinct western hemisphere horses (Figure 1-6) were found in the Rancho La Brea, California, tar pits: the Western Horse (*Equus occidentalis*) and the smaller Mexican donkey (*Equus conversidens*). Both of these species died out near the end of the Pleistocene epoch, approximately 11,000 years ago.

Skeletons of the Western horses found in the tar pits at Rancho La Brea suggest that the horse stood about 14.5 hands high and probably weighed about 1,150 lbs (http://www.tarpits.org/).

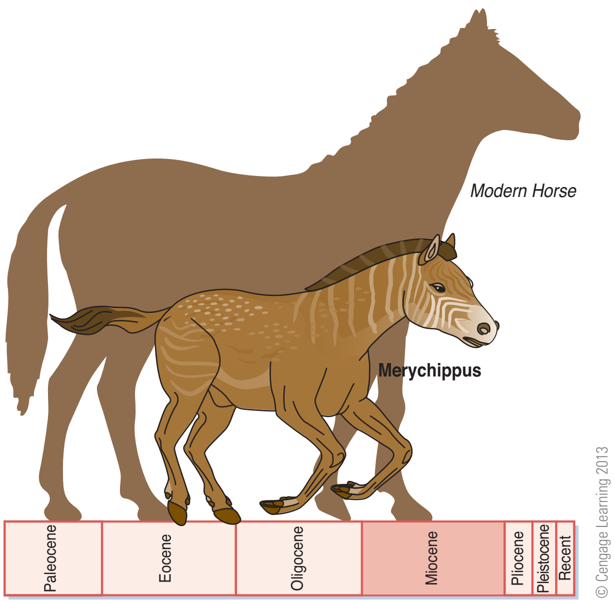


FIGURE 1–3 *Merychippus*

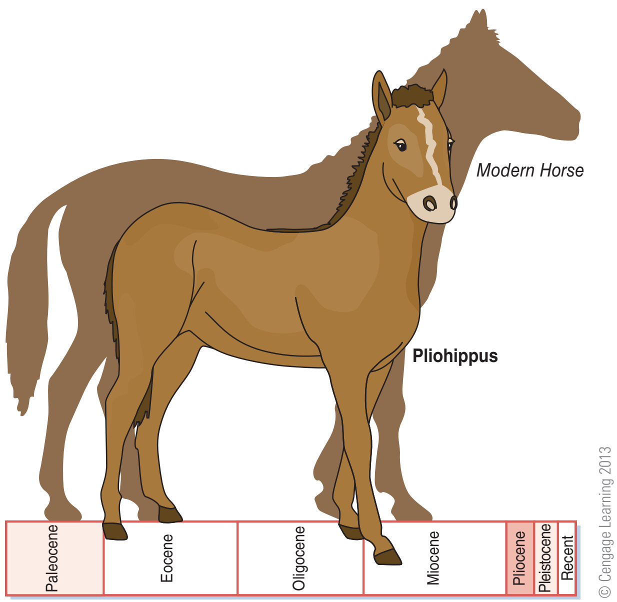


FIGURE 1–4 *Pliohippus*

FIGURE 1–5 Horse bones found in the Hagerman, Idaho, fossil beds. These have been shown at the Smithsonian Institute.

FIGURE 1–6 Skeleton of Western horse found in the Rancho La Brea "tar pits."

How Evolution Works

Because evolution is not linear but branching, common evolutionary trends are not seen in all of the horse lines. Overall, horses got progressively larger, but some (***Archeohippus***, ***Calippus***) then got smaller again. Many evolved complex pits in their facial bones only to have some of their descendants lose them again. Most of the recent (5 to 10 million years) horses were three-toed, not one-toed. One-toed animals prevailed only because all the three-toed lines became extinct.

Additionally, these traits did not necessarily evolve together, or at a steady rate. Various structural characteristics each evolved in an interrupted series of changes. For example, throughout the Eocene epoch, feet changed little, and only the teeth evolved. During the Miocene, however, both feet and teeth evolved rapidly. Rates of evolution depended on the ecological pressures facing the species.

Evolving along with the modern horse were other species of *Equus,* such as the ass, or donkey, the onager, and the various zebras.

Tracing a line of descent from *Eohippus* to *Equus,* fossils reveal four trends (Figure 1–7):

- Reduction in the number of toes
- Increase in the size of the cheek teeth
- Lengthening of the face
- Increase in body size

Przewalski's Horse

The oldest species of horse still in existence is the wild Przewalski's horse, pronounced "sheh-val-skee" *(Equus ferus przewalski).* Ironically, it was not discovered until 1879, when the Russian Army captain Nikolai Mikailovich Przewalski sighted it in the remote valleys of Mongolia. The modern Przewalski's horse resembles many of the animals appearing in the cave paintings at Lascaux, France. It stands 12 to 14 hands high, has a dun (yellowish) coloring, a light-colored muzzle, a short, upstanding mane, a dark streak along its back, and dark legs (Figure 1–8). In its native Mongolia it feeds on tamarisk, feather grass, and the white roots of rhubarb. The former Soviet

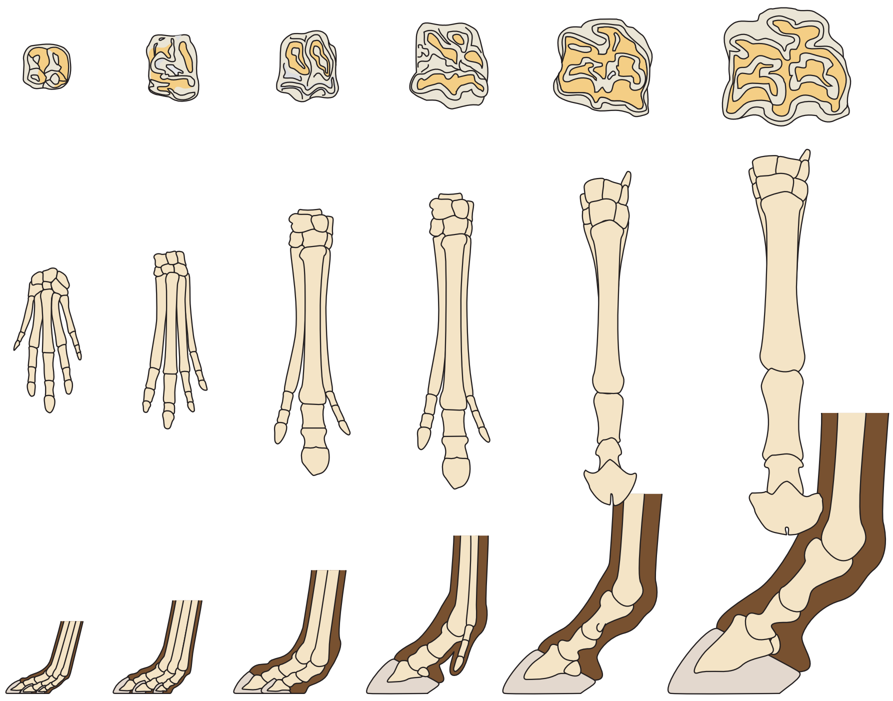


FIGURE 1–7 **Evolution of the horse hoof and tooth.**

Courtesy of Rick Parker

FIGURE 1–8 **Przewalski's horse at the Smithsonian National Zoological Park in Washington, DC.**

Union established a refuge for the horse in the late 1970s to ensure both its continued existence and its freedom.

Although held in captivity in many zoos around the world, The Przewalski's horse has never been effectively tamed or domesticated. The horse can be seen at the Smithsonian National Zoological Park in Washington, DC (http://nationalzoo.si.edu/Animals/AsiaTrail/fact-phorse.cfm).

The Hunted Horse

Humankind's first relationship with the horse comes from Stone Age paintings on the walls of caves in Western Europe. Although frequently showing the horse as an object of prey, these prehistoric cave paintings also reveal the majesty the artists saw in the horse as well as the effort to capture its beauty.

Cro-Magnons primarily considered the horse an important source of food. Lacking the speed to pursue it or a way to kill it from a distance, prehistoric hunters learned to drive the prey to its death. Evidence of this can be found at Salutre in France, where the bones of some 10,000 horses dating from that period have been found at the base of a cliff.

DOMESTICATION OF THE HORSE

For perhaps half a million years, humankind's only contact with the horse was as a hunter in search of food. Between 4000 and 3000 B.C. humans began to domesticate horses on the **steppes** north of the Black Sea. Oxen were already being yoked in draft

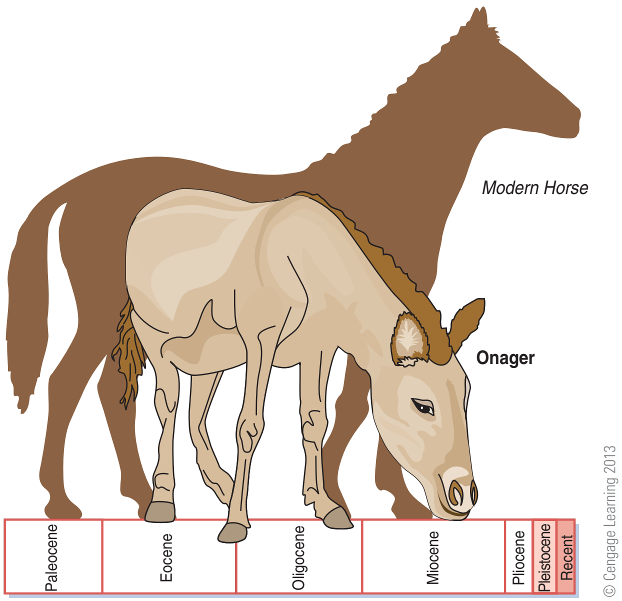


FIGURE 1–9 **Onager.**

in Mesopotamia, and by the early third millennium B.C., asses and onagers (wild donkeys of central Asia) had been similarly harnessed there (Figure 1–9). When the horse was introduced to the region in numbers during the early second millennium B.C., a tradition of driving was already well established.

While some of the history of the domestic horse is rather obscure, our knowledge of the donkey is more certain. Artifacts suggest that donkeys were first domesticated in Egypt as early as 3400 B.C., and by 1000 B.C. had spread from Egypt into Asia.

From Cow of the Plains to Pack Animal

Archaeological excavations show that the horse became progressively important in the economy of the people of the plains of Europe and Asia. Still considered a source of food, tame horses were evidently first kept for meat and possibly their milk. Later, as these domesticated animals began to carry the goods of nomadic tribes, their importance grew. The horse was now a worker—not just a meal on the hoof.

Role of the Wheel

Oxen were yoked to the pole of a plow probably early in the fourth millennium B.C., in the Near East. Toward the end of the millennium, they were yoked to sledges that were eventually mounted on rollers and then on wheels. Vehicles with disk wheels appeared near the beginning of the third millennium B.C., drawn by oxen, onagers, or donkey **hybrids** (males or hinnies). The four-wheeled war wagon from Ur, in southern Mesopotamia, of about 2500 B.C., was pulled by a yoked team of four donkeys with nose-ring control.

Probably imported from the steppes of southern Asia, the horse first appeared as a domesticated draft animal in the Near East between 3000 and 2000 B.C. Because of its speed, it soon became the favorite draft animal. By the time horses were numerous in the region, a light chariot with spoke wheels had been developed for war and hunting. Yoked to it, the horse rapidly gained favor over its other relatives in harness for these purposes.

Learning to Control and Harness Horses

The ability to control the horse and effectively connect it to useful implements depended on developing appropriate **draft** systems that would allow the horse to work at its best.

The Yoke

The first draft systems were developed for oxen and were not well adapted to equine anatomy. At first horses were harnessed in pairs, with each horse on either side of a pole and under a yoke. The yoke was secured by a strap around the throat that tended to press on the horse's windpipe. By the 15th century B.C. in Egypt, the yoke saddle was introduced. This was a wishbone-shaped wooden object, lashed to the yoke by its "handle" with its "legs" lying along the horse's shoulders. This design took considerable pressure off the horse's throat and allowed it to breathe more easily. The yoke saddles rested on pads, and their ends were joined by crescent-shaped straps that went across the lower part of the horse's throat.

Early Bits

All-metal bits were first used in the Near East around 1500 B.C. Increased use of the light chariot in warfare called for stronger and more effective control of the teams. Two types of snaffle bits appeared almost simultaneously—the plain bar snaffle and the jointed bit. Both bits usually had studs on the inner surfaces of the cheek pieces to enforce directional control when one rein was pulled.

Learning to Ride

Learning to drive horses came before learning to ride in the Near East. Large chariot forces required schooled, disciplined, and highly conditioned horses. Riding was still pursued only in a casual fashion. Disciplined military mounts, trained to function with their riders in formation, were used only after 1000 B.C. Horseback riders before 1000 B.C. were depicted as scantily clad, unarmed riders, probably grooms or messengers.

At first, riders may have controlled their mounts with no more than a rope around the jaw or some sort of **hackamore**. Antler cheek pieces, which served as toggles to soft mouthpieces of rope, rawhide, or sinew, have been found at sites of the earliest domesticated horse on the steppes north of the Black Sea.

The Scythians

The Scythians unified as a group of nomadic horsemen with common customs and interests about 800 B.C. During the seventh century B.C., they invaded the Near East, riding as far south as Palestine, and occupied part of northern Iran for some 40 years.

Scythians were primarily archers, skilled at using the powerful composite bow from horseback. One warrior technique they mastered was that of shooting backward over their horses' hindquarters as they turned away from the enemy.

The Scythians' nomadic way of life, which enabled them to burn and destroy all their property when they retreated, allowed them to survive encounters with two of the greatest invading armies of the time, those of Darius I of Persia (512 B.C.) and Alexander the Great (325 B.C.)—all made possible by the mobility provided by vast herds of horses.

Scythian horses are the first recorded **geldings**. Horses in the Near East were not castrated at that time.

A Scythian's wealth was measured in horses. Belief in the continuation of material life after death caused the wealthy to take horses (in one case, 400) with them into the grave.

The Roman Army

During the more than four centuries of its existence, the Roman army changed from essentially an infantry to a predominantly cavalry-led force. A **cavalry** is a military force mounted on horseback. The change was brought about primarily by the type of enemy the Romans faced on the frontiers. To the east, rivals such as the Persians, who employed all-cavalry armies, had inflicted serious defeats to Roman infantry. The only way to effectively counter these armies was with more and better cavalries. The same was true when facing the mounted Germanic tribes to the north and west, and eventually the mounted nomadic tribes of the steppe.

China

Horse-drawn war chariots were first used in China during the Shang dynasty (about 1450 to 1050 B.C.). But repeated invasion and devastating plunder by barbarians of the northern steppes and by the Huns led to the development of a Chinese light cavalry, which provided a more effective defense against invaders.

Despite completion of the Great Wall in 209 B.C., continued clashes with the Huns prompted China to adopt and refine their enemy's riding technique based on the use of a saddle.

The Chinese did not use the horse in great numbers until the 3rd century B.C. (well after its use was common in the West). But by the 7th century A.D., the T'ang emperors had huge stud farms holding as many as 300,000 horses, with each horse given 7 acres of pasture. Paintings from the tenth and eleventh century show the Chinese as complete horsemen. Their equipment is rather modern in appearance, and they seem at ease on their mounts.

Europe after the Romans

The fall of the Roman Empire in A.D. 476 began the Middle Ages, a period that lasted some 700 years. The early portion of this period is sometimes called the Dark Ages, since the glories of the former Roman empire had virtually vanished, with learning and invention stagnating except in a few isolated monasteries. These were times of religious wars and barbarian invasion. The horse became largely used for battle or hunting as the Roman roads, which had previously united Europe, fell into disrepair. Travel from one area to another was dangerous due to the hostile relations between kingdoms. Generally, chariots fell from use and the wagon remained a farm vehicle.

Despite a decline in the quality of technological innovation in many spheres of life during the Middle Ages, the horse adapted to new roles, particularly in agriculture.

Horses were expensive both to buy and to keep when compared to oxen and donkeys, which are foragers. The feudal system of the Middle Ages placed the farmer of the land under the control of a lord. Since the lord had the financial means to supply his farmers with horses to work his fields, the era saw the horse used on a large scale in agriculture for the first time in history.

During the Middle Ages, hunting deer on horseback became a popular sport, especially in Norman France. By the time of the Norman conquest of England in 1066, the deer hunt was enjoyed by most noble Norman gentlemen. William the Conquerer brought the sport, with all its rules and traditions, with him to Britain. "Ty a Hillaut," the old Norman phrase used to warn hunters that a deer had been found, became the "Tally-ho" familiar to the fox hunter of today (Figure 1–10).

The Renaissance

Between 1450 and 1650, as Europe experienced a cultural rebirth called the Renaissance, interest in the natural laws governing the world and the universe was renewed. Gutenberg's invention of the printing press introduced an age of study and artistic creation. The Renaissance removed the veils of mystery and ignorance that had characterized the Middle Ages.

Events affecting the history of the horse in the Renaissance grew from people's zeal for discovery. The anatomy of the horse became a subject of scientific study, and the training of horses became a disciplined art. The Renaissance enriched the quality of life for humans and the horse. Vehicle design was advanced, and horses assumed a more prominent role in transporting goods and people.

Courtesy Botts/Watson Photography

FIGURE 1–10 **A foxhunt requires good horses, good dogs, and the proper attire.**

Photo courtesy Jane Loughney, Pullman, WA 99163

FIGURE 1–11 **Carriages are still used by the Amish today.**

Hungarians emerged as supreme in the art of carriage making. Anne of Bohemia (circa 1380) made a great impression when she brought well-designed coaches from her native land to England. The coach body was constructed of a light wood frame with wickerwork attached. The wheels were light; and the singletrees, which connected the harness to the vehicle, were ingeniously secured to the rear axle—a remarkable design for the time. The coach and other vehicles developed along similar lines during the Renaissance were dramatically superior to the lumbering carts and wagons of earlier times. These are the predecessors of the refined, lightweight carriages that continue to be used today by cultures such as the Amish (Figure 1–11).

MYTHOLOGY AND THE HORSE

Ancient humans were held in awe of the horse, and placed it both among the gods and prominently in their legends. Cultures of the ancient world evolved various mythologies, bodies of legend and belief, that reflected their values, ideals, and visions of the past. Examples of the horse's place in mythology include the stories of:

- Poseidon, creator of the horse
- Pegasus, the wild-winged horse tamed with a golden bridle by Bellerophon
- the Centaur, the magnificent creature who had a body that was half horse and half man (Figure 1–12)
- Epona, an ancient Gaul goddess of horses, who lovingly protected horses and stables and kept watch over grooms and carters
- the horses in ancient warfare in Homer's *The Iliad*
- the Trojan horse—the wooden horse that got the Greeks inside the walls of Troy

FIGURE 1–12 **The centaur—half man and half horse.**

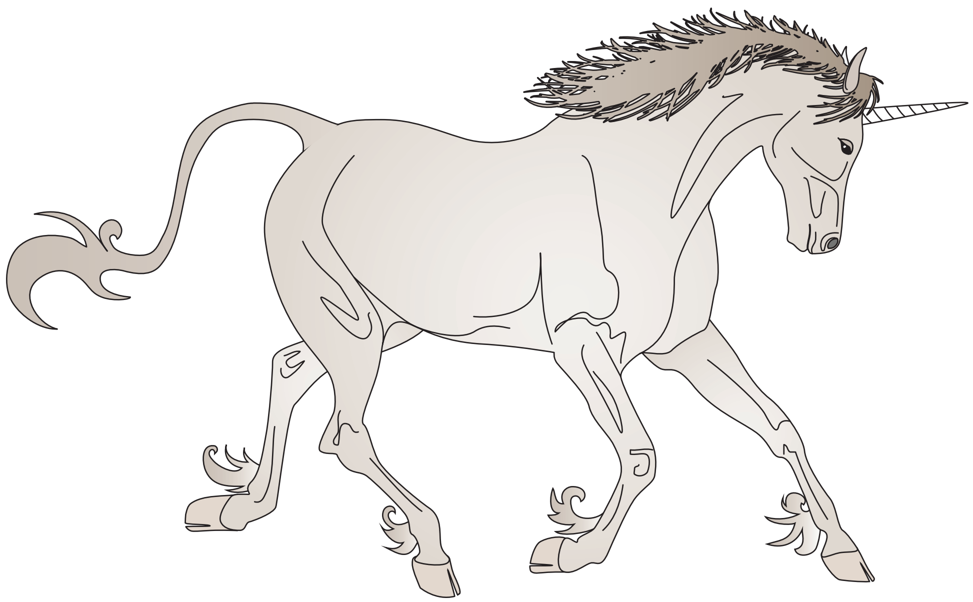


FIGURE 1–13 **A unicorn.**

- the Unicorn—an animal with the legs of a buck, the tail of a lion, the head and body of a horse, and a single horn in the middle of its forehead (Figure 1–13)
- the horse-drawn Chariot of the Sun used by the ancient gods of India
- the Four Horsemen of the Apocalypse in the Bible (Rev. 6)

HISTORY OF HORSES AND MULES IN THE UNITED STATES

When the first Spanish conquistadors came to the Americas in the early 1500s, they considered themselves the explorers and colonists of a vast new world. For the horses the Spanish brought with them, the voyage to the Americas was really a homecoming. Although the horse is believed to have originated in North America, none survived prehistoric times except possibly those that emigrated to Asia over an ancient land bridge near modern-day Alaska.

In 1519, Coronado set out for North America with 150 horsemen. DeSoto's expedition, with 237 horses, followed, in 1539. By 1547, Antoni de Mendoza, the first governor of New Spain (Mexico), had 11 haciendas and more than 1,500 horses. The Spanish colonization depended on horses, and the Spaniards recognized the tactical value of the animal. The colonized Indians were forbidden to ride horses, unless they had the specific permission of their masters.

Colonization and Settlement

With colonization, signs of the growing importance of the horse could be seen in the towns and cities—hitching posts, mounting blocks, water troughs, stables, and carriage houses. By the late 1800s, the horse was central to urban life in America. It hauled goods, pulled cabs, and moved people about in carriages. The prosperity of the urban population created a huge new market for horses. In turn, carriage makers, wheelwrights, harness makers, and feed merchants prospered because of the horse's increased prominence in everyday life.

The exploration and settlement of new frontier land in America also created an enormous need for the horse. Settlers saw the horse as a means of expansion and as power for taming the wilderness and cultivating the virgin soil. The sluggish but easily maintained ox had previously fulfilled farmers' needs. But the versatility of the horse made it an even more valuable asset to the farmer of the 1800s. Horses plowed fields, pulled wagons and carriages, and became an essential part of the rural economy. The horse population grew rapidly during the 1800s. For example, in 1867 the rural horse population in America was estimated at nearly 8 million, while the number of farmworkers was well under 7 million.

Mules

Changes in farm machinery also increased the demand for **mules**. Beginning in the 1830s, farm machinery such as mowing, reaping, and threshing machines, John Deere's steel plow, the corn planter, and the two-horse cultivator were invented. These inventions called for the heavier and stronger horse or mule. Mules were especially valued in coal mines, where the poor working conditions defeated many horses. Typical coal mules hauled between 60 and 100 tons of coal a day in two to five cars from mines. Mules also had a long career in the U.S. Army. The government used them from 1775 until 1957 to transport supplies in packs and under harness.

Commercial Uses

The draft horse played a significant role in the growth of urban America. From the end of the Civil War to the beginning of World War I, the United States was in transition from an agrarian to an urban society. As cities grew, so did the need for mass transportation.

The development of horse-powered mass transit systems allowed the cities to expand into the new suburbs. In 1880, horsecar lines were operating in every U.S. city with a population of 50,000 or more. By 1886, over 100,000 horses and mules were in use on more than 500 street railways in more than 300 American cities.

As cities grew, so did the demand for powerful horses. Heavy horses hauled cargo unloaded at city terminals by railroads, steamships, and canal boats, and they distributed the goods produced in urban factories. The vans used for cartage were 15 to 20 feet long and often carried loads of over 10 tons. Strength and endurance were prime considerations in selecting horses to haul the goods. Some businesses used brightly painted delivery wagons pulled by handsomely matched teams to advertise their products. Breweries, meatpackers, and dairies were particularly fond of this practice, assembling elaborate wagons powered by four or six regally harnessed draft horses. By 1890 draft horses averaged 2,000 pounds apiece.

These hitches soon began to compete in the show ring, especially at the annual International Livestock Show held at the Chicago Stock Yards. Their legacy is carried on today in the famous Budweiser Clydesdales and other show hitches performing in American show rings.

Fire Protection

The horse became an essential part of urban fire protection during the 1850s. As cities grew, the magnitude of destruction from urban fires increased. With the introduction of heavier and more efficient steam pumpers and ladder trucks in the 1850s, horses were required for urban fire departments. Speed was essential. When an alarm sounded, stall doors automatically opened and the horses were moved below their suspended harness. The harness, complete with hinged collars, dropped onto their backs and was quickly secured by the driver. A good crew could complete the entire operation in around two or three minutes. Fire horses were almost always draft crosses selected for speed and strength. By 1906, New York City had 1,500 fire horses (Figure 1–14).

Transportation

When roads became worn between towns and farms, a lighter wagon was needed. The "pleasure wagon" had a seat on two hickory springs, while other wagons had no springs at all. For farmers who could afford to have such a vehicle and a pair of horses, the pleasure wagon hauled the crop to town and took the family to church on Sunday.

Some people drove a one-horse shay on local errands. The shay got its name from the Yankee rendering of the French word *chaise,* meaning "chair." It had two wheels, a fixed top, and a body hung on straps. The shay's two large, strong wheels could absorb some of the roughness of a road by spanning the holes, ruts, and bumps.

Long-distance travel by public stage was quite uncomfortable. Two big horses normally pulled the stage wagon, but in bad weather four horses were needed. Nine to 12 passengers sat three abreast on backless board seats. The wagon had roll-down curtains in case of rain, but no springs to soften the ride. Schedules were often inconvenient. For example, the stage for Lancaster, Pennsylvania, left Philadelphia at 3:30 A.M. and didn't stop at an inn for breakfast until 9:00 A.M.

FIGURE 1–14 **In the early 1900s horses were used to pull fire engines.**

Agriculture

Throughout the eighteenth and early nineteenth centuries, horses in the United States were used primarily for riding and pulling light vehicles. Oxen were the preferred draft animal on many American farms. They cost half as much as horses, required half the feed, and could be eaten when they died or were no longer useful. Oxen, however, worked only half as fast as horses, their hooves left them virtually useless on frozen winter fields and roads, and physiologically they were unsuitable for pulling the new farm equipment developed in the nineteenth century. The revolution in agricultural technology, westward expansion, and the growth of American cities during the 1800s led to the emergence of the draft horse as America's principal farming work animal (Figure 1–15).

In 1862, Congress passed the **Morrill Land Grant Act** that led to the establishment of state agricultural colleges. The first of the nation's veterinary colleges opened at Cornell University in 1868. As farmers became more educated, improvement in the care, feeding, and breeding of horses ensued.

The revolution in agricultural technology between 1820 and 1870 created a demand for a larger and stronger horse. New and improved farm equipment greatly increased the productivity of the American farmer. With the McCormick reaper, which both cut and tied grains into stocks, one person could do the work of 30. New steel plows, double-width harrows and seed drills, mowers, binders, combines, and threshers decreased the need for manpower but increased the demand for horsepower. Toward the end of the century, the typical Midwestern wheat farm had 10 horses, each working an average of 600 hours per year. During harvest, it was common to see giant combines pulled by teams of over 40 draft horses (Figure 1–16).

Courtesy USDA

FIGURE 1–15 Horses were important for farming into the 1950s.

USDA, Photography Division, Office of Public Affairs

FIGURE 1–16 Combine with a 40-horse hitch.

With the use of new equipment and fertilizers, wheat yields increased seven times between 1850 and 1900. Better rail and steamship transportation opened new markets in the United States and in Europe. America came of age as a world agricultural power.

The acreage one family could cultivate increased as technology and equipment improved. The average American farm in 1790 was 100 acres. This figure more than doubled over the next 60 years. By 1910, five-hundred-acre wheat farms were not uncommon. While oxen and light horses had been adequate for tilling the long-worked fields of Europe and the eastern United States, a stronger power source was needed to work the sticky, virgin soil of the American prairie.

The first European draft horses were imported to the United States in the late 1830s. Farm labor became scarce due to westward migration and casualties from the Civil War. This created an even greater demand for the new farm equipment and the draft horses to power them. By 1900, there were over 27,000 purebred Belgians, Clydesdales, Percherons, Shires, and Suffolk Punches in the United States (Figure 1–17). Although the purebred draft stock was seldom used in the field, the infusion of its genetics resulted in an increase of the average horse size to between 1,200 and 1,500 pounds by 1900.

The offspring of these heavy farm horses soon found additional uses as the nation moved west. The railroads employed thousands of draft crosses, working side by side with mules and oxen to carry ties, rails, and supplies to the railheads and haul dirt and rock from the excavation of mountain tunnels. Many of the western stagecoach lines used up to six draft crosses to haul mail and passengers over dangerous, rough roads. Eventually large grain farms, comparable to those in the Midwest, were established on the western prairies. These farms also relied on draft horses to power their plows, threshers, and combines.

Recreation, Sports, and Shows

One of the most popular equestrian events in the United States is the National Horse Show, held each November at Madison Square Garden in New York City. The National Horse Show began in 1883 and was soon a major event of the social season.

Courtesy Botts/Watson Photography

FIGURE 1–17 **Horse power—a hitch of Clydesdales pulling a wagon for show.**

Team events began in 1911. Although interrupted by World War I, the show again thrived in the 1920s and 1930s. In the early years of the show, military teams dominated the jumping competition; but now most of the entrants are civilians. The National Horse Show includes international team jumping, competition for national hunters and jumpers, saddle seat equitation, and harness competition.

In 2011, the National Horse Show was moved to Kentucky Horse Park in Lexington. The National Horse Show Association of America (NHSAA) hopes to make the National Horse Show in Kentucky as similar to Madison Square Garden as possible.

Another notable equine event that happens every 4 years is the Olympic Games. Equestrian events include jumping, dressage, vaulting, and endurance. This is an international event where riders and horses both benefit from sharing information and experiences with other countries.

Rodeo

This once informal sport of cowboys developed into an organized event (Figure 1–18). **Rodeo** (Spanish for "cattle ring") started as an amusement among cowboys who had reached the end of the long cattle drive and had to remain with their herds until they were sold. Given a few days of freedom, it was not long before one cowhand challenged another to a calf-roping contest or dared him to ride "the meanest horse between here and the Rio Grande." The first rodeo with paid attendance was held in Prescott, Arizona, on July 4, 1886. At the turn of the twentieth century, rodeos combined with the popular Wild West show. These events became extravaganzas, including wagon races, bull riding, and steer wrestling. The Wild West show soon fell from popularity, but its influences remained in the rodeo. Rodeos steadily grew in popularity throughout the western United States and Canada. Today major events in a rodeo

Courtesy Botts/Watson Photography

FIGURE 1–18 Rodeo, once an informal sport, has become an organized series of events.

include bareback bronco riding, saddle bronc riding, tie-down roping, bull riding, team roping, and barrel racing.

Racing

Kentucky has long been recognized as a horse-breeding region. But back when Kentucky was only a remote and unknown woodland, the chief horse-breeding region of the United States was Rhode Island. From these Rhode Island farms, horses were shipped to all of the coastal colonies as well as the Caribbean islands for use on the plantations. Rhode Island was the only New England colony that allowed horse racing, and a one-mile track was maintained at Sandy Neck Beach, South Kingston. As always, competition was the key to improved breeding; Rhode Island breeders gathered the best stock from neighboring areas to upgrade their horses.

Many towns and cities in America have streets called "Race Street." Such streets gained their names from the habit of running horse races on them. In 1674, the citizens of Plymouth evidently grew tired (or frightened) of the races in their village, and passed an ordinance forbidding racing.

In colonial America, town rivalry was centered around horse racing. Often, competitors and spectators traveled far to early quarter-mile race paths in the woods and placed considerable wagers on their town's horse. Typical wagers included money, tobacco, slaves, and property. Tempers frequently ran high. Thus, the official who started the race was selected as much for his brawn and ability to defend himself as for his honesty. The race was generally started by firing a pistol, sounding a trumpet, or hitting a drum. Even after land became available for long oval tracks, the sport of quarter-mile racing remained a popular American institution (Figure 1–19).

The first Kentucky Derby was run on May 17, 1875. The Derby was sponsored by the Louisville Jockey Club and Driving Association, which owned the track now known as Churchill Downs. Colonel M. Lewis Clark founded the association after

Courtesy USDA

FIGURE 1–19 **Thoroughbred horse racing at the Maryland State Fair.**

visiting Europe to study their farms and racing regulations. Clark was particularly impressed by the English system. He called the Kentucky race a "derby" after the Epsom Derby, which was first run in 1780 under the sponsorship of the Earl of Derby.

Today, the Kentucky Derby is the most prestigious race for Thoroughbreds in the United States and the first race in the Triple Crown for three-year-olds. Each year in May, horse enthusiasts look to Churchill Downs in Louisville to see who will become the year's contender for the Triple Crown. The Kentucky Derby is the oldest continuously run race in America.

Mining

Pit ponies were used to haul coal from mines as early as the 1600s. Breeds such as the hearty Shetland ponies from northern Scotland were imported in great numbers to work in the first mines of Pennsylvania, Ohio, West Virginia, and Kentucky. In some larger mines, particularly in Europe, a pony would be bred, born, and put to work without ever having seen the light of the sun.

Old West

The original cowboys were Native Americans who tended herds on the vast rancheros of Spanish conquerors in Mexico. They wore broad sombreros to protect themselves from the burning sun and chaparejos (chaps) to protect their legs against cactus and mesquite.

Men who came from Kentucky and Tennessee to settle Texas were the first of the American cowboys. The growing population of the eastern United States in the mid-1800s created a market for beef. When construction of the western railroad provided the means of carrying the beef to the East, the cattle business began to flourish. Cattlemen raised stock and drove them great distances to the railheads. The men who tended and drove the cattle came to be known as cowboys and were as ethnically diverse as the growing nation. With the increasing demand for beef, the cowboy's domain spread northward to Canada and westward to the Rockies. His manners, dress, language, and amusements remain a symbol of the rugged independence and determination that characterized the American West.

The cattle ranges were not fenced, and the cattle had to be watched constantly. Regular chores included cutting out calves for branding and, in the earlier days of westward expansion, fighting off the Native Americans who sought to protect their hunting grounds.

In the fall of each year the cattle were rounded up in preparation for the drive to market. The riding and roping skills of the cowboy and the agility and cow-sense of his horse were especially important in the roundup and continue to be to the present day (Figure 1–20).

THE TWENTIETH CENTURY

By the turn of the century, at least half of the 13 million horses in the United States carried between 10 percent and 50 percent draft horse genetics. More than 3 million of these were in use in nonfarm capacities by 1910. With the continued growth of heavy industry and increased European immigration, American cities experienced

Courtesy USDA

FIGURE 1–20 **The Dunn Brothers from South Dakota having a discussion after herding 500 head of cattle to a new pasture.**

unprecedented growth. New interest in public health, rising real estate values, and improvements in electric- and gasoline-powered alternatives to horsepower combined to mark the rapid decline of the horse's significance in the city.

Decline of Draft Horses

Within a decade, motorized taxis, electric streetcars, and subways replaced the horse in public transportation. Large new gasoline-powered trucks had a similar impact on the transportation of goods. New trucks were three times faster (10 miles an hour) than horse-powered transportation, took less room to store, and eliminated the problem of manure disposal. One of the last urban uses of the horse to succumb to mechanization was the horse-drawn hearse, which continued to be used into the 1930s and is still used for some dignitaries and U. S. Presidents.

The market for heavy horses in agriculture went into a steady decline after World War I. Reduction in the number of domestic draft horses, an increased demand for American grain exports, and improvements in gasoline-powered tractors combined to hasten the replacement of draft horses by machines. This was especially true of purebred draft stock. For example, in 1920, there were 95,000 registered draft horses in America. By 1945, this figure had dropped to under 2,000.

Particularly hard hit were the Clydesdale and Shire populations. Both breeds had been used primarily in the city and were affected earlier than other draft breeds. Heavy feathering on the feet of the Shire and Clydesdale was considered a maintenance problem on the farm, therefore diminishing their popularity. What remained of the draft horse market was centered primarily on the farms of the Midwest. American farmers looked for a smaller, more economical animal. Belgian breeders responded by breeding a more compact horse; and by 1937, the Belgian was the most numerous draft breed in the United States.

FIGURE 1–21 **Draft horses hitched and ready to pull.**

By the early 1950s registrations for all draft breeds dropped dramatically, and many breeders went out of business. The numbers of Shires and Suffolks dropped so low that in 1985 the American Minor Breeds Conservancy listed them as rare.

Personal transportation in the early 1900s also saw the transition from horsepower to gasoline-engine power. Since many families called their faithful carriage horse "Lizzie," their first car was often dubbed "Tin Lizzie." At first, the tin lizzie was apt to get stuck or to boil over. But soon, as roads and engines improved, the automobile was used every day, and the draft horse was reserved for the recreational wagon ride (Figure 1–21). Recent interest in sustainable, organic, and local agriculture seem to have created a renewed interest in using draft horses for farmwork.

Black Jack

The profound grief of Americans at the assassination of President John F. Kennedy on November 22, 1963, was accentuated by the sight of Black Jack during the funeral procession to Arlington National Cemetery. Black Jack was the riderless horse with boots reversed in the stirrups, a symbol of a fallen hero.

Black Jack was the last horse issued to the Army by the quartermaster, and the last to carry the "U.S." brand common to all army horses. Like so many thousands of army horses, his breeding was unknown. He was foaled on January 19, 1947.

Black Jack was sent to the 3rd Infantry (the Old Guard) from Fort Reno, Oklahoma, in 1953. He was named after General John J. "Black Jack" Pershing, Supreme Commander of the American Expeditionary Force in World War I. Black Jack served in ceremonial functions, participating in the funerals of Presidents Hoover, Kennedy, and Johnson, General Douglas MacArthur, and thousands of others in Arlington National Cemetery. Black Jack was semiretired on June 1, 1973, and died February 6, 1976, at the age of 29. His ashes were placed in an urn at his monument at Fort Meyer, Virginia.

Source: International Museum of the Horse.

Horses in the Military

Cavalries have been an important part of the armies of all major powers. When used as part of a combined military formation, the main duties of a cavalry include observing and reporting information about the enemy, screening movements of its own force, pursuing and demoralizing a defeated enemy, maintaining a constant threat to an enemy's rear area, striking suddenly at detected weak points, turning exposed sides, and exploiting a break through the enemy lines.

The American cavalry traces its origin to the Revolutionary War with the formation of units known as the Light Dragoons (mounted and dismounted) or Mounted Riflemen. These units participated in wars from the Revolutionary period to the Mexican-American War, in which cavalry units played a key role in the American victory. The Mexican-American War was the first time in American history that mounted troops played such a strategic role in an army's successes.

In March 1855, Congress authorized the raising of two horse-mounted regiments, known as the 1st and 2nd Cavalry. These were the first units to be called cavalry units rather than dragoon or mounted units. Many officers in the cavalry units were from south of the Mason-Dixon Line. Cavalry units were headed by some of the great generals of the American Civil War. The cavalry played key roles in the Civil War, providing reconnaissance, security, and a show of force with small numbers (Figure 1-22).

After the Civil War, the cavalry protected citizens from warring Native Americans, and Native Americans from renegade citizens. The cavalry also watched over the new national parks and their wildlife preserves. At the end of the nineteenth century, the cavalry was epitomized by the famous Rough Riders of the Spanish-American War of 1898.

FIGURE 1–22 Reenactment of a Civil War Union calvary.

The entry of the United States into World War I in 1917 tipped the balance in favor of an Allied victory. Long before the United States sent its men into the struggle, it had sent another resource—its horses. World War I was the twilight of the cavalry. Except for limited skirmishes in the Middle East and on the western front, the cavalry now fought mostly on foot. In previous wars the cavalry swept across a battlefield to surprise an enemy force. But now, tangles of barbed wire were not easily penetrated, and the machine gun could mow down man and horse alike. The days of the horse in the military offensive had ended.

Horses were used in great numbers for noncavalry purposes during World War I as well. About 6 million horses served, and substantial numbers of them were killed. The deaths of these millions of horses depleted the world's equine population. By 1914, the British had only 20,000 horses; the United States was called upon to supply the Allied forces with remounts. In the four years of the war, the United States exported nearly a million horses to Europe. When the American Expeditionary Force entered the war, it took with it an additional 182,000 horses. Of these, 60,000 were killed and only 200 returned to the United States.

In one year, British veterinary hospitals treated 120,000 horses for wounds or diseases. Like human combatants, horses required ambulances and field veterinary hospitals. The motorized horse van was first used as an equine ambulance on the western front.

Many changes occurred in the cavalry during the twentieth century. While World War I was fought with cavalry on horseback and dismounted infantry tactics, around 1930 the cavalry began a transition from horses to armored vehicles. The last cavalry unit to fight on horseback was the 26th Cavalry, which fought during World War II in the Philippines. By the 1950s, no horse-mounted cavalry units existed in either the U.S. or British armies.

Mounted Police

Mounted police are police who do patrols on horseback (Figure 1–23). They continue to serve in remote areas and in metropolitan areas where their day-to-day function may

FIGURE 1–23 Mounted police being used in New York.

be picturesque or ceremonial, but they are also employed in crowd control because of their mobile mass and height advantage and high visibility. Mounted police may be employed for specialized duties ranging from patrol of parks and wilderness areas, where police cars would be impractical or noisy, to riot duty, where the horse serves to intimidate those whom it is desired to disperse through its larger size. Some mounted police units are trained in search and rescue due to the horse's ability to travel where vehicles cannot.

Movies and Entertainment

Some of the best-loved motion picture and television stars have been horses. Beginning with the *Great Train Robbery* (1903), the West became one of film's dominant themes and depended inevitably on the horse. The horses of the screen, and later television, became as familiar as the heroes who rode them to fame and fortune. Famous stars and horses included:

- Tom Mix and Tony
- Gene Autry and Champion
- Roy Rogers and Trigger
- The Lone Ranger and Silver
- Tonto and Scout
- Hopalong Cassidy and Topper

Motion pictures and television also produced individual equine stars, such as:

- Francis (the talking mule)
- Fury
- Flicka
- Black Beauty
- Mr. Ed (the talking horse)

The tradition of movies using horses and about horses continues in movie remakes and in new movies:

- *National Velvet* (1944)
- *Phar Lap* (1983)
- *Return to Snowy River* (1988)
- *Coyote Summer* (1996)
- *Blue Fire Lady* (1977)
- *The Mask of Zorro* (1998)
- *The Horse Whisperer* (1998)
- *The White Pony* (1999)
- *Seabiscuit* (2003)
- *Hidalgo* (2004)
- *The Legend of Zorro* (2005)
- *Secretariat* (2010)

Like their human counterparts, horses in the movie world can be divided into three classes: the stars, the stunt horses, and the extras. The brilliance of a particular horse is based more on training than on breed or pedigree. Both stars and stunt horses receive systematic schooling so that they will respond to their rider's or trainer's commands. They must be of even temperament because a film set is a mix of equipment, bright lights, and unfamiliar sounds and faces.

Horses on the set must respond to the trainer's visual commands since verbal commands interfere with the recorded sound. Stunt horses must have the skill and courage to run over cliffs or crash to the ground from a full gallop. Stunt horses are carefully watched by members of humane societies to ensure their safety. What appears to be a bone-shattering crash on rocky ground is, in reality, a well-rehearsed fall on soft mattresses covered with plowed earth. Whether star or extra, the talented movie horse has a special place in the equine world.

Circus Horses

The circus is an exciting tradition in which the horse has played a prominent role. In the early days, the circus parade announced the coming show. All the horses and rolling stock paraded through the village streets to advertise the animals and performers on the bill.

In the early 1900s, the Barnum and Bailey Circus used 750 horses in draft and performance; Ringling Brothers had 650 horses. The circus was moved almost exclusively by horses, first from town to town and later, to and from railroad yards. The dappled gray Percheron was a trademark of the Ringling Brothers Circus. By 1938 the circus was mechanized, although horses remain popular performers.

Carved carousel horses are reminiscent of the fancy circus horses. Carousels were popular in America in the 1900s, and about 7,000 carousels were created. Today, only about 300 carousels exist. Usually the most decorative horses were placed on the outer ring of the structures, to face the public. Today carousels can still be found in parks, amusement parks, and with the occasional traveling carnival (Figure 1–24).

FIGURE 1–24 **Carousel horses are reminiscent of fancy carnival horses.**

SUMMARY

Through a series of evolutionary stages involving millions of years, *Eohippus*—the small, primitive ancestor of the horse—evolved. After the horse evolved into what we know today, humans began interacting with horses. Humans first hunted the horse. Eventually, different civilizations learned to use the horse for work and transportation. The horse also played an important role in the history of the United States.

The 1800s saw an unprecedented pace of economic growth. As new markets for manufactured goods were opened, the need for horse transportation increased dramatically. As a result, many horse-drawn vehicles were built by local carriage makers or by large wagon factories. The need for new harnesses and constant repairs on old ones created a demand for skilled harness makers. Wheelwrights, farriers, and blacksmiths were essential to the livelihood of every city and town. Other horse-related crafts and occupations included saddlers, grain farmers, feed merchants, veterinarians, grooms, coachmen, and horse breeders. The revolution in agricultural technology and the growth in the economy and population created a peak of interdependence between human and horse.

The twentieth century brought radical changes in the world of the horse. With the steady rise of technology, the horse was eclipsed by the internal combustion engine. In 1915, the horse population in America peaked at over 21 million. But immense numbers of horses were sent to the battlefields of Europe during World War I. This export decreased America's horse population, which steadily declined until recently, when the horse entered new arenas as a pleasure rather than work animal. Equine numbers now continue to grow rapidly. Instead of being a beast of burden, the modern horse plays a major role in recreation and organized competition. Many breeds of horses are now being revived, and systematic breeding is raising the quality of horses to heights unknown in the past. The future promises a continued increase in the world horse population. Perhaps the ultimate "Age of the Horse" is yet to come.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. The first fossil horse, *Eohippus,* was about the size of one of today's donkeys.
2. *Equus asinus* is the scientific name for today's true horse.
3. Przewalski's horse was discovered as a fossil in 1879.
4. Prehistoric humans probably hunted and ate horses.
5. Metal bits were first used about 1810 in England.

Short Answer

6. Arrange the following geologic time periods from oldest to most recent: Pliocene, Oligocene, Paleocene, and Miocene.
7. List four trends documented in the evolution of the horse.

8. List the following ancestors of today's horse in order of their appearance on Earth: *Pliohippus, Eohippus, Mesohippus,* and *Merychippus.*
9. Where and when was Przewalski's horse discovered?
10. Name three horses or horselike animals mentioned in mythology or legend.
11. Name three horses made famous by the movies or television.
12. List the scientific name for the horse and three of its close relatives, such as the donkey or zebra.
13. Name two factors that caused an increased demand for draft horses during the history of the United States.
14. Name the zoological kingdom, phylum, class, order, family, genus, and species for the domestic (true) horse.

Critical Thinking/Discussion

15. Discuss how the development of the wheel influenced humans' uses of the horse.
16. How did horse racing start in the United States?
17. Describe how the Romans influenced the use of horses.
18. What twentieth-century events have changed how horses are used in this country?
19. Describe the events during the nineteenth and early twentieth century that caused the number of horses to steadily increase in the United States.
20. What effect did the Middle Ages have on the use of horses?
21. Discuss the concept that Spanish conquistadors actually reintroduced the horse to America.

STUDENT ACTIVITIES

1. Visit a virtual museum on the Internet and learn more about the fossil record and evolution of horses. Report your findings.
2. Read a legend or myth that involves a horse or horselike animal. Retell the story in your own words.
3. Research and report on plants and other animals that were present and evolving during the same geologic time periods as the horse.
4. Prepare a presentation showing the horse in the art of specific civilizations.
5. Report on the status and populations of feral horses in the United States today, or report on the donkeys in the Grand Canyon.
6. Make a pictorial display of the various modes of transportation that horses have pulled over the ages.
7. Choose a civilization and report on its use of horses in warfare; or compare the use of horses in the Civil War, World War I, and World War II.
8. Compare a piece of farm equipment pulled by draft horses to one now propelled by the gas-powered engines used in farming today.
9. Choose a race horse, and track its winnings for several months.
10. Horses are still used for work in some police departments, the Forest Service, and search-and-rescue operations. Find out how these horses are selected and trained.
11. Discover how horses used in the movies are selected and trained. Report your findings.
12. View an old Tom Mix, Gene Autry, Roy Rogers, *Lone Ranger,* or *Mr. Ed* video, and discuss the training and use of the horse used in the video.
13. Trace the history of horses and their use to transport people.

14. Use the Internet or other resources to find the average selling prices of horses used in rodeo events, racing, dressage, and other kinds of performance.

15. The history of horses can be used to teach geography, even though many of the place-names have changed. Obtain a world map and identify the locations discussed in the chapter. Also, the history of horses can be used as a springboard to other history lessons.

ADDITIONAL RESOURCES

Books

Apps, J. (2010). *Horse-drawn days: A century of farming with horses.* Madison: Wisconsin Historical Society Press.

Barton, F. T. (2010). *Our friend the horse: A complete practical guide to all that is known about every breed of horse in the world.* Chestnut Hill, MA: Adamant Media Corporation.

Chamberlin, J. E. (2008). *Horse: How the horse has shaped civilizations.* Mamaroneck, NY: BlueBridge Publishing.

Davidson, B., & Foster, C. (1994). *The complete book of the horse.* New York: Barnes & Noble Books.

Dossenbach, M., & Dossenbach, H. D. (1998). *The noble horse.* New York: Random House.

Edwards, E. H. (2010). *Racehorse: The complete guide to the world of horse racing.* China: Aa, Studio Cactus, Ltd.

Gonzago, P. G. (2003). *The history of the horse.* J. A. Allen & Company.

Kimball, C. (2006). *The complete horse: An entertaining history of horses.* St. Paul, MN: Voyageur Press.

Kelekna, P. (2009). *The horse in human history.* New York: Cambridge University Press.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google, or Bing, find more information by searching for these words or phrases:

Equus caballus	*Pliohippus*	draft horses
Przewalski's horse	centaur	cavalry
Calippus	Trojan horse	horses in the military
Eohippus	Epona	horses in the circus
Merychippus	unicorn	horses in the movies
Mesohippus	horsepower	
onagers	history of horses	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 2

Status and Future of the Horse Industry

The golden age of horses in the United States extended from the 1890s to the mechanization of agriculture. Industries associated with horses were essential parts of the national economy. In 1900 the automobile was still a rich man's toy, and the truck and tractor were unknown. Then, in 1908, Henry Ford began the assembly-line production of cars making them more within the economic reach of average Americans. The truck, the tractor, and improved roads soon followed. As the automobile, truck, and tractor numbers increased, horse numbers declined.

Today few horses are ever seen on the streets of cities or towns. Horses hitched to a delivery wagon or plow are a novelty. Now the horse is popular for recreation and sport.

OBJECTIVES

After completing this chapter, you should be able to:

- Identify the countries or areas with the most horses, donkeys, and mules
- Compare the population of horses, donkeys, and mules in the United States to that in the world
- Describe the rise and fall of the horse population in the United States
- Compare the total worldwide population of horses, donkeys, and mules
- Project changes in the horse population in the United States
- Identify the top 10 horse-producing states
- Name four general areas of equine research and give two specific research projects in each
- Identify activities and organizations associated with the U.S. horse industry
- Discuss the future of the U.S. horse industry

KEY TERMS

- bucked shins
- colic
- dressage
- embryo
- farrier
- Food and Agriculture Organization (FAO)
- genetic
- gymkhana
- immune system
- influenza
- jockeys
- laminitis
- protozoal
- synovitis
- tack
- Triple Crown winners
- viral

WORLD DISTRIBUTION OF HORSES, DONKEYS, AND MULES

Most of the world's horses, donkeys, and mules are not found in the United States. According to statistics maintained by the **Food and Agriculture Organization (FAO)** of the United Nations (http://www.fao.org), about 16 percent of the world's horses, are located in the United States (Table 2–1).

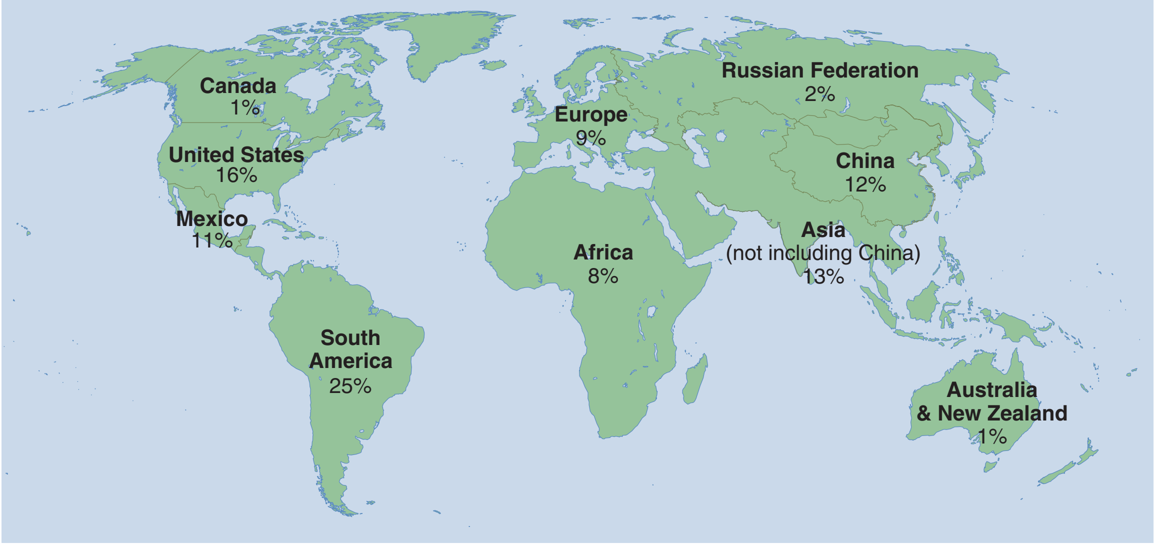
Distribution of Horses

The world population of horses is about 58.8 million. Some horses are found in almost every part of the world. As Table 2–1 shows, Argentina, Brazil, China, Mexico, and the United States all have significant (more than 5 percent of the total) horse populations compared to other countries. Colombia, Mongolia, the Russian Federation, Kazakhstan, Romania, India, and Peru represent counties with more than 1 percent of the total horse population. Mexico and China and the United States have the largest populations of horses. Horse populations ranked from a high in the United States at 9.5 million to lows in countries like Slovakia, Malaysia, Puerto Rico, Montenegro, Belize, Estonia, Luxembourg, Israel, Jamaica, Thailand, Lebanon, Saudi Arabia, Yemen, and Qatar with 3,000 to 8,000 horses per country, or somewhere near 0.01 percent of the total worldwide horse population in each of these countries.

Figure 2–1 shows how horses are distributed worldwide in Mexico, Africa, Asia (without China), China, Canada, Europe, the Russian Federation, the United States, South America, Mexico, Australia, and New Zealand. Over half (55 percent) of the world population is located in the western hemisphere.

Over the last half century, the world population of horses has fluctuated from a high of 62 million in 1961 and 1975 to a low of 56.2 million in 2002. Between 1978 and 1990 horse numbers held fairly constant. Since the low in 2002, worldwide horse numbers have gradually increased. (Figure 2–2).

Worldwide Distribution of Horses



FAO, Rome

FIGURE 2–1 **Worldwide distribution of horses by percentage.**

TABLE 2–1 Estimated Populations of Horses in Countries of the World

COUNTRY	AVERAGE[1]	PERCENTAGE
Afghanistan	151,000	0.26%
Albania	46,667	0.08%
Argentina	3,670,000	6.24%
Armenia	12,222	0.02%
Austria	86,000	0.15%
Azerbaijan	70,599	0.12%
Belarus	156,967	0.27%
Belgium	33,307	0.06%
Belize	5,367	0.01%
Bhutan	26,000	0.04%
Bolivia	463,775	0.79%
Bosnia and Herzegovina	24,741	0.04%
Brazil	5,630,957	9.57%
Bulgaria	137,090	0.23%
Cambodia	28,000	0.05%
Canada	385,000	0.65%
Chile	324,751	0.55%
China	7,140,980	12.13%
Colombia	2,377,321	4.04%
Costa Rica	118,333	0.20%
Croatia	13,298	0.02%
Cuba	507,600	0.86%
Czech Republic	26,438	0.04%
Democratic People's Republic of Korea	48,000	0.08%
Denmark	55,204	0.09%
Dominican Republic	349,167	0.59%
Ecuador	383,258	0.65%
El Salvador	96,000	0.16%
Estonia	5,000	0.01%
Finland	67,800	0.12%
France	421,780	0.72%
Georgia	42,367	0.07%
Germany	531,260	0.90%
Greece	27,272	0.05%
Guatemala	124,667	0.21%
Haiti	500,000	0.85%
Honduras	181,000	0.31%

(*continues*)

TABLE 2–1 (*continued*)

COUNTRY	AVERAGE[1]	PERCENTAGE
Hungary	63,667	0.11%
Iceland	76,709	0.13%
India	751,000	1.28%
Indonesia	397,196	0.67%
Iran	140,000	0.24%
Iraq	48,000	0.08%
Ireland	90,500	0.15%
Israel	4,000	0.01%
Italy	296,667	0.50%
Jamaica	4,000	0.01%
Japan	18,667	0.03%
Kazakhstan	1,230,067	2.09%
Kyrgyzstan	349,411	0.59%
Lao People's Democratic Republic	31,000	0.05%
Latvia	13,500	0.02%
Lebanon	3,580	0.01%
Lithuania	59,802	0.10%
Luxembourg	4,402	0.01%
Malaysia	7,000	0.01%
Mexico	6,333,333	10.76%
Mongolia	2,180,400	3.70%
Montenegro	6,293	0.01%
Myanmar	138,333	0.24%
Netherlands	131,597	0.22%
Nicaragua	268,000	0.46%
Norway	32,665	0.06%
Pakistan	346,000	0.59%
Panama	188,333	0.32%
Paraguay	344,601	0.59%
Peru	730,000	1.24%
Philippines	232,333	0.39%
Poland	320,487	0.54%
Portugal	18,667	0.03%
Puerto Rico	6,517	0.01%
Qatar	2,986	0.01%
Republic of Korea	25,258	0.04%
Republic of Moldova	64,754	0.11%
Romania	833,799	1.42%
Russian Federation	1,314,846	2.23%
Saudi Arabia	3,000	0.01%

(*continues*)

TABLE 2–1 *(continued)*

COUNTRY	AVERAGE[1]	PERCENTAGE
Serbia	18,356	0.03%
Slovakia	8,220	0.01%
Slovenia	19,291	0.03%
Spain	247,667	0.42%
Sweden	95,333	0.16%
Switzerland	57,780	0.10%
Syrian Arab Republic	14,401	0.02%
Tajikistan	76,676	0.13%
Thailand	3,912	0.01%
The former Yugoslav Republic of Macedonia	32,334	0.05%
Timor-Leste	48,000	0.08%
Turkey	200,267	0.34%
Turkmenistan	16,367	0.03%
Ukraine	528,867	0.90%
United Kingdom	385,333	0.65%
United States of America	9,500,000	16.14%
Uruguay	459,667	0.78%
Uzbekistan	164,033	0.28%
Venezuela	506,667	0.86%
Viet Nam	103,933	0.18%
Yemen	3,000	0.01%
Africa + (Total)	4,551,051	7.73%
Oceania + (Total)	413,023	0.70%
Other Counties[2]	1,179,500	0.02%
World + (Total)	58,853,372	100.00%

[1] Source is the average of the years 2006, 2007 and 2008 from FAOSTAT on Food and Agriculture Organization of the United Nations (FAO) Web site: http://faostat.fao.org/ No consistent data available for 2009

[2] Countries with 2500 horses or less

Web site: http://faostat.fao.org/ No consistent data available for 2009

DISTRIBUTION OF DONKEYS AND MULES

As Table 2–2 indicates, the largest numbers of donkeys in the world are found in countries including Afghanistan, Bolivia, Brazil, Burkina Faso, China, Egypt, Ethiopia, India, Iran, Mali, Mexico, Morocco, Niger, Nigeria, Pakistan, Peru, Sudan, and Turkey—places where the animals are still use for work and transportation. The worldwide population of donkeys and mules is about 42.8 million and 11.6 million, respectively. The United States has only about 52,000 donkeys and 28,000 mules, or 0.12 percent and 0.24 percent, respective of the world's population. China, Ethiopia, Pakistan, Mexico, and Egypt, respectively, have the largest populations of donkeys. More than half (57 percent) of the world's mules are located in China and

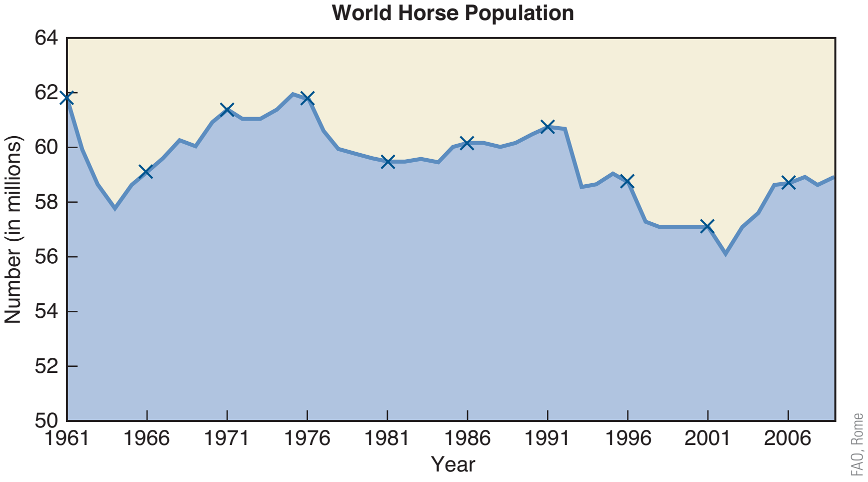


FIGURE 2–2 **History of world horse population.**

TABLE 2–2 Estimated World Population of Donkeys, Mules, and Hinnies, 2005

COUNTRY	SPECIES	AVERAGE[1] (HEAD)	PERCENTAGE
Afghanistan	Donkeys	1,016,333	2.37%
Afghanistan	Mules	23,667	0.20%
Albania	Donkeys	65,333	0.15%
Albania	Mules	12,333	0.11%
Algeria	Donkeys	151,147	0.35%
Algeria	Mules	39,747	0.34%
Angola	Donkeys	4,500	0.01%
Argentina	Donkeys	98,000	0.23%
Argentina	Mules	185,000	0.16%
Armenia	Donkeys	6,400	0.01%
Azerbaijan	Donkeys	46,287	0.11%
Belarus	Donkeys	9,000	0.02%
Belize	Mules	4,567	0.04%
Bhutan	Donkeys	18,000	0.04%
Bhutan	Mules	9,000	0.08%
Bolivia (Plurinational State of)	Donkeys	635,000	1.48%
Bolivia (Plurinational State of)	Mules	82,000	0.71%
Botswana	Donkeys	330,000	0.77%
Brazil	Donkeys	1,160,510	2.71%
Brazil	Mules	1,347,608	11.62%
Bulgaria	Donkeys	130,000	0.30%
Bulgaria	Mules	9,800	0.08%
Burkina Faso	Donkeys	1,156,817	2.70%
Cameroon	Donkeys	40,000	0.09%

(continues)

TABLE 2–2 (*continued*)

COUNTRY	SPECIES	AVERAGE[1] (HEAD)	PERCENTAGE
Canada	Mules	4,000	0.03%
Cape Verde	Donkeys	14,500	0.03%
Chad	Donkeys	419,402	0.98%
Chile	Donkeys	20,172	0.05%
Chile	Mules	7,889	0.07%
China	Donkeys	7,409,333	17.28%
China	Mules	3,336,667	28.78%
Colombia	Donkeys	268,201	0.63%
Colombia	Mules	445,497	3.84%
Comoros	Donkeys	5,000	0.01%
Costa Rica	Donkeys	7,700	0.02%
Costa Rica	Mules	5,000	0.04%
Croatia	Donkeys	4,000	0.01%
Cuba	Donkeys	9,733	0.02%
Cuba	Mules	20,733	0.18%
Cyprus	Donkeys	5,200	0.01%
Djibouti	Donkeys	8,370	0.02%
Dominican Republic	Donkeys	150,500	0.35%
Dominican Republic	Mules	140,500	0.12%
Ecuador	Donkeys	158,824	0.37%
Ecuador	Mules	124,459	0.11%
Egypt	Donkeys	3,070,000	7.16%
El Salvador	Donkeys	3,200	0.01%
El Salvador	Mules	24,000	0.21%
Ethiopia	Donkeys	4,973,965	11.60%
Ethiopia	Mules	358,634	3.09%
France	Donkeys	16,017	0.04%
France	Mules	15,100	0.13%
Gambia	Donkeys	36,633	0.09%
Georgia	Donkeys	10,000	0.02%
Ghana	Donkeys	14,000	0.03%
Greece	Donkeys	41,006	0.10%
Greece	Mules	20,300	0.18%
Guatemala	Donkeys	9,900	0.02%
Guatemala	Mules	38,700	0.33%
Guinea-Bissau	Donkeys	5,100	0.01%
Haiti	Donkeys	210,000	0.49%
Haiti	Mules	80,000	0.69%
Honduras	Donkeys	23,000	0.05%
Honduras	Mules	69,600	0.60%
Hungary	Donkeys	3,500	0.01%
India	Donkeys	650,000	1.52%

(*continues*)

TABLE 2–2 (*continued*)

COUNTRY	SPECIES	AVERAGE[1] (HEAD)	PERCENTAGE
India	Mules	176,000	1.52%
Iran (Islamic Republic of)	Donkeys	1,600,000	3.73%
Iran (Islamic Republic of)	Mules	175,000	1.51%
Iraq	Donkeys	380,000	0.89%
Iraq	Mules	11,000	0.09%
Ireland	Donkeys	5,992	0.01%
Israel	Donkeys	5,000	0.01%
Italy	Donkeys	24,000	0.06%
Italy	Mules	9,000	0.08%
Jamaica	Donkeys	23,000	0.05%
Jamaica	Mules	10,000	0.09%
Jordan	Donkeys	10,000	0.02%
Kazakhstan	Donkeys	30,000	0.07%
Kyrgyzstan	Donkeys	44,000	0.10%
Lebanon	Donkeys	15,000	0.03%
Lebanon	Mules	4,780	0.04%
Lesotho	Donkeys	160,394	0.37%
Libyan Arab Jamahiriya	Donkeys	29,000	0.07%
Mali	Donkeys	1,621,259	3.78%
Mauritania	Donkeys	160,000	0.37%
Mexico	Donkeys	3,260,000	7.60%
Mexico	Mules	3,280,000	28.29%
Morocco	Donkeys	985,533	2.30%
Morocco	Mules	518,400	4.47%
Mozambique	Donkeys	45,000	0.10%
Myanmar	Mules	9,100	0.08%
Namibia	Donkeys	140,000	0.33%
Namibia	Mules	6,700	0.06%
Netherlands Antilles	Donkeys	2,600	0.01%
Nicaragua	Donkeys	9,000	0.02%
Nicaragua	Mules	48,000	0.41%
Niger	Donkeys	1,536,950	3.59%
Nigeria	Donkeys	1,050,000	2.45%
Oman	Donkeys	28,500	0.07%
Pakistan	Donkeys	4,347,667	10.14%
Pakistan	Mules	158,667	1.37%
Panama	Mules	4,200	0.04%
Paraguay	Donkeys	35,000	0.08%
Paraguay	Mules	13,350	0.12%
Peru	Donkeys	626,667	1.46%
Peru	Mules	293,333	2.53%
Portugal	Donkeys	125,000	0.29%

(*continues*)

TABLE 2–2 (*continued*)

COUNTRY	SPECIES	AVERAGE[1] (HEAD)	PERCENTAGE
Portugal	Mules	40,000	0.35%
Romania	Donkeys	29,000	0.07%
Russian Federation	Donkeys	20,903	0.05%
Samoa	Donkeys	7,000	0.02%
Saudi Arabia	Donkeys	100,000	0.23%
Senegal	Donkeys	431,364	1.01%
Somalia	Donkeys	22,000	0.05%
Somalia	Mules	22,000	0.19%
South Africa	Donkeys	150,333	0.35%
South Africa	Mules	14,117	0.12%
Spain	Donkeys	142,000	0.33%
Spain	Mules	110,000	0.95%
Sudan	Donkeys	750,333	1.75%
Swaziland	Donkeys	14,800	0.03%
Switzerland	Donkeys	5,734	0.01%
Syrian Arab Republic	Donkeys	106,946	0.25%
Syrian Arab Republic	Mules	4,670	0.04%
Tajikistan	Donkeys	167,908	0.39%
Togo	Donkeys	3,315	0.03%
Tunisia	Donkeys	240,000	0.56%
Tunisia	Mules	82,000	0.71%
Turkey	Donkeys	307,234	0.72%
Turkey	Mules	70,472	0.61%
Turkmenistan	Donkeys	25,000	0.06%
Uganda	Donkeys	17,900	0.04%
Ukraine	Donkeys	12,000	0.03%
United Republic of Tanzania	Donkeys	182,000	0.42%
United States of America	Donkeys	52,000	0.12%
United States of America	Mules	28,000	0.24%
Uruguay	Mules	3,867	0.03%
Uzbekistan	Donkeys	290,000	0.68%
Venezuela (Bolivarian Republic of)	Donkeys	440,000	1.03%
Venezuela (Bolivarian Republic of)	Mules	72,000	0.62%
Yemen	Donkeys	500,000	1.17%
Zimbabwe	Donkeys	112,000	0.26%
Other Countries[2]	Donkeys	55,732	0.13%
Other Countries[2]	Mules	21,210	0.17%
World Total	Donkeys	42,870,691	100.00%
	Mules	11,594,068	100.00%

[1] Source is the average of the years 2006, 2007 and 2008 from FAOSTAT on Food and Agriculture Organization of the United Nations (FAO) Web site: http://faostat.fao.org/

[2] Countries with 2500 or less donkeys or mules

Mexico, with a large population also in Brazil. Almost one-half (46 percent) of all the donkeys and mules of the world are in China, according to the FAO statistics. Countries like Armenia, Ireland, Switzerland, Cyprus, Guinea-Bissau, Comoros, Israel, Angola, Croatia, Hungary, El Salvador, and The Netherlands have small populations of donkeys (2,600 to 6,400 head), representing about 0.01 percent of the world's population in each of these countries.

GROWTH AND DECLINE OF THE U.S. HORSE, DONKEY, AND MULE INDUSTRY

In the United States, the number of horses increased until 1915. At that time, statistics showed over 21 million horses in this country. As discussed in Chapter 1, horse production expanded with the growth and development of manufacturing, commerce, and farming. But by 1960, only slightly more than 3 million horses remained in the United States—the lowest number ever recorded. After 1960, as Figure 2–3 shows, horse numbers increased slightly before declining in 1995. Between 2000 and 2006 horse numbers in the United States increased to 9.2 million and have remained at 9.5 million through 2009 according to the statistics of FAO.

Numbers provided by the FAO are only estimates, and the U.S. Department of Agriculture (USDA) does not track horse numbers as it does other livestock, so an accurate estimate of horse numbers in the United States is difficult to find. The American Horse Council (http://www.horsecouncil.org/) promotes the results of a study conducted by Deloitte Consulting, LLC, commissioned by the American Horse Council Foundation and funded in part by the American Quarter Horse Association, The Jockey Club, the National Thoroughbred Racing Association and Breeders' Cup Limited, Keeneland Association, American Paint Horse Association, American Association of Equine Practitioners, U.S. Trotting Association, Thoroughbred Owners and Breeders Association, and the U.S. Equestrian Federation. This study put the total number of horses in the United States at 9.2 million, or close to the 9.5 million estimated by the FAO.

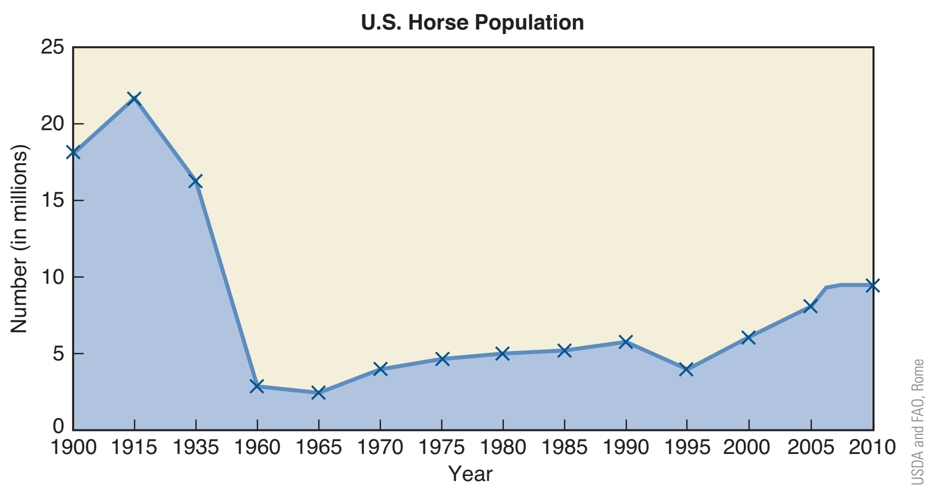
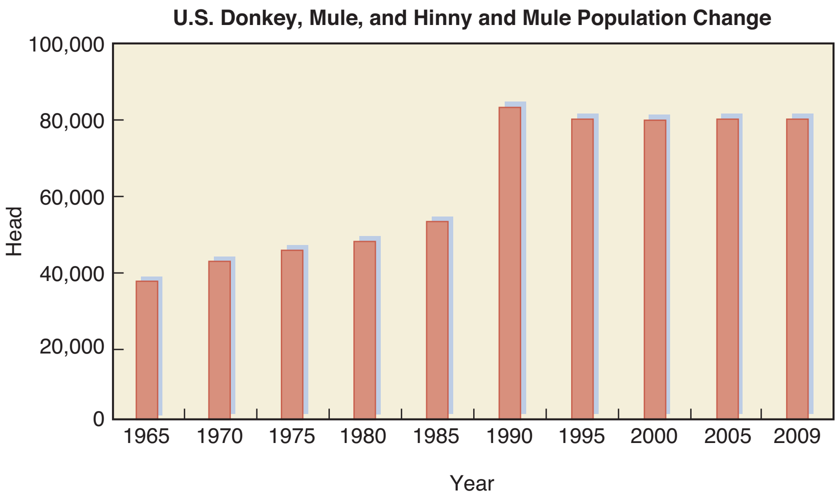


FIGURE 2–3 **History of U.S. horse population.**



FAOSTAT on the Food and Agriculture Organization of the United Nations Web site

FIGURE 2–4 **U.S. donkey and mule population change.**

According to the study commissioned by the American Horse Council Foundation, Texas (1 million), California (700,000), and Florida (500,000) are the leading horse states; but 45 of 50 states have at least 20,000 horses. Quarter horses (3,288,203) and Thoroughbreds (1,291,807) are the leading breeds; however, other breeds represent 4,642,739 horses. Recreation is the leading activity for horses (3,906,923), with showing (2,718,954) and racing (844,531) the second and third most common uses. Other activities, involving another 1,752,439 horses, include farm and ranch work, rodeo, carriage horses, polo, police work, informal competitions, and so on.

Since 1965, according to FAO statistics, the donkey and mule population in the United States steadily increased from 1965 to about 1985 and then jumped in 1990 to over 80,000. Since 1995 the population of donkeys and mules in the United States remained quite constant at 80,000 head (52,000 donkeys and 28,000 mules) according to FAO statistics (Figure 2–4).

STATUS OF THE U.S. HORSE INDUSTRY

For many people, the horse industry is a business and a way of life. According to *The Economic Impact of the Horse Industry in the United States,* published by the American Horse Council, the horse industry directly produces goods and services amounting to $38.8 billion and has a total impact of $101.5 billion on U.S. gross domestic product (GDP). Racing, showing, and recreation each contribute more than 25 percent to the total value of goods and services produced by the horse industry.

The industry's contribution to the U.S. GDP is greater than that of either the motion picture services, railroad transportation, furniture and fixtures manufacturing, or tobacco product manufacturing industries. It is only slightly smaller than the apparel and other textile products manufacturing industry. The industry pays a total of $1.9 billion in taxes to federal, state, and local governments.

In terms of employment, the industry directly employs more people than do railroads, radio and television broadcasting, petroleum and coal products manufacturing, or tobacco product manufacturing. Of the 701,946 people directly employed by the industry, some are part-time and seasonal employees, which equates to 453,612 full-time equivalent jobs. This is the standard way that the Bureau of Labor Statistics measures employment in the United States. Overall, the industry generates over 1.4 million full-time equivalent jobs across the United States both directly and in related services (http://www.horsecouncil.org/publications.php#Impact).

Revenue derived directly from horses includes the actual sale of horses, stud (breeding) fees, races, shows, rodeos, and entertainment. The indirect revenue from horses includes such items as feed, training, veterinary and **farrier** services, transportation, labor, and equipment. Money from all of these revenue sources stimulates the economy.

Sports that involve horses attract more than 110 million spectators each year. Horse racing is a leading spectator sport and, as with other sports, can lead to status and big money. Attendance at racetracks exceeds 70 million people each year, and people wager over $13 billion on the races. Leading **jockeys** can win millions of dollars a year and include great professionals such as Willie Shoemaker, Braulio Baeza, Laffit Pincay Jr., Chris McCarron, and Angel Cordero Jr.

Many small racetracks operate throughout the United States, and racing is a part of county fairs or other annual events, contributing to about 14,000 racing days each year. The three most famous races are the:

- Kentucky Derby at Churchill Downs in Louisville, started in 1875; a distance of 1.25 miles
- Preakness Stakes at Pimlico Race Course in Baltimore, started in 1873; a distance of 13⁄16 miles
- Belmont Stakes at Elmont, New York, started in 1867; a distance of 1.5 miles

Three-year-old horses winning all three of these races in one season are called U.S. **Triple Crown winners**. These horses and their owners, trainers, and jockeys make their way into sports history (Table 2–3). No horse has won the U.S. Triple Crown since Affirmed in 1978.

TABLE 2–3 Triple Crown Winners

YEAR	HORSE NAME	JOCKEY	TRAINER	OWNER
1919	Sir Barton	John Loftus	H. G. Bedwell	J. K. L. Ross
1930	Gallant Fox	Earl Sande	James Fitzsimmons	Belair Stud
1935	Omaha	William Saunders	James Fitzsimmons	Belair Stud
1937	War Admiral	Charley Kurtsinger	George Conway	Samuel D. Riddle
1941	Whirlaway	Eddie Arcaro	Ben A. Jones	Calumet Farm
1943	Count Fleet	John Longden	Don Cameron	Mrs. J. D. Hertz
1946	Assault	Warren Mehrtens	Max Hirsch	King Ranch
1948	Citation	Eddie Arcaro	Ben A. Jones	Calumet Farm
1973	Secretariat	Ron Turcotte	Lucien Laurin	Meadow Stable
1977	Seattle Slew	Jean Cruguet	William Turner Jr.	Karen L. Taylor
1978	Affirmed	Steve Cauthen	Lazaro S. Barrera	Harbor View Farm

Different nations where Thoroughbred racing is popular each have their own Triple Crown series. In England the Triple Crown includes three wins at these races:

1. 2,000 Guineas Stakes, run over 1,609 meters (1 mile) at Newmarket Racecourse in Newmarket, Suffolk
2. Epsom Derby, run over 2,423 meters (1.5 miles) at Epsom Downs Racecourse in Epsom, Surrey
3. St. Leger Stakes, run over 2,937 meters (1.82 miles) at Town Moor in Doncaster, Yorkshire

Other countries with Triple Crowns include: Ireland, Australia, Germany, Canada, Japan, Hong Kong, Macau, Chile, Puerto Rico, Uruguay, Ecuador, and Venezuela. In recent years, winning a Triple Crown has become a very rare achievement, with most horses specializing in a limited distance range.

About 800 rodeos representing over 2,200 performances are held each year in the United States, and the number continues to grow. Professional rodeos generally comprise the following events: tie-down roping, team roping, steer wrestling, saddle bronc riding, bareback bronc-riding, bull riding, and barrel racing. The events are divided into two basic categories: the rough stock events and the timed events. Depending on sanctioning organization and region, other events such as breakaway roping, goat tying, or pole bending may also be a part of some rodeos. In North America, professional rodeos are governed and sanctioned by the Professional Rodeo Cowboys Association (PRCA; http://www.prorodeo.com/) and Women's Professional Rodeo Association (WPRA; http://www.wpra.com/), while other associations govern children's, high school, collegiate, and senior rodeos. Associations also exist for Native Americans and other minority groups. The traditional season for competitive rodeo runs from spring through fall, while the modern professional rodeo circuit runs longer, and concludes with the PRCA National Finals Rodeo (NFR) in Las Vegas, Nevada, The 10 major rodeos based on prize money are given in Table 2–4.

The horse industry is a diverse activity (Figure 2–5) with stakeholders including recreational and show horse riders as well as moderate-income track, show, and stable employees and volunteers. Approximately 34 percent of horse owners have a household income of less than $50,000, and 28 percent have an annual income of over $100,000; but most horse owners (46 percent) have an income of $25,000 to $75,000. Over 70 percent of horse owners live in communities of 50,000 or less.

TABLE 2–4 Major Rodeos in North America

LOCATION[1]	MONTH	LOCATION	MONTH
Las Vegas, NV	December	Reno, NV	June
Houston, TX	March	Calgary, Canada	July
Scottsdale, AZ	October	Denver, CO	January
Pocatello, ID	March	Fort Worth, TX	January
Cheyenne, WY	July	San Antonio, TX	February

[1] Las Vegas is by far the biggest rodeo, with prize money over $2 million. Prize money at the other rodeos ranges from roughly $200,000 to $100,000.

Courtesy Botts/Watson Photography

FIGURE 2–5 **One of the diverse activities of the horse industry—carriage racing.**

Horses for the Canadian Mounted Police

On May 23, 1873, the Canadian Parliament authorized the establishment of the North West Mounted Police (NWMP) force. The force's immediate objectives were to stop the liquor trade among Native Americans, halt tribal warfare and attacks on white settlers, collect customs fees, and perform normal police duties. Their vast area of responsibility was roughly composed of today's provinces of Manitoba, Saskatchewan, Alberta, and the Northwest Territories. In the fall of 1874, the first post was established on the banks of Old Man River and was named for the force's assistant commissioner, James Macleod.

One of the first problems of the newly formed NWMP was to obtain and train horses suitable for the rigors of their western duties. The sleek black horses of today's Royal Canadian Mounted Police (RCMP) bear little resemblance to the tough work animals originally used to patrol the vast Canadian wilderness. Initially two types of horse were selected: the tough western bronco and a primarily Standardbred-type purchased in Ontario. In 1875, the NWMP first began breeding their own horses. This proved to be too expensive and was turned over to private ranchers. By 1889, specifications for the force's mounts called for "a horse standing from 14.3 to 15.2 hands, fine clean-cut head, long neck, high chest, broad round quarters with plenty of good flat bone, and strong feet."

Throughout the rest of the nineteenth century, the NWMP continued to bring law and order to the Canadian wilderness. Recognition of their outstanding contributions came in 1904 when King Edward VII proclaimed that the prefix "Royal" be added to their name.

By the outbreak of World War I, the Royal North West Mounted Police (RNWMP) had grown to 1,268 officers and men. In 1920, the RNWMP name was changed to the Royal Canadian Mounted Police (RCMP). Between 1928 and 1950, the RCMP assumed the Provincial Police duties for all Canadian provinces except Ontario and Quebec.

As the equestrian (as opposed to law enforcement) duties of the RCMP shifted from practical to ceremonial, a need was identified to provide a different type of mount. The result was the reestablishment in 1943 of the RCMP's breeding program to supply the primarily black Thoroughbred-type mares and geldings used in their famous exhibition, the musical ride.

Since the breeding program began, the force has continued to experiment, introducing the genetics of Clydesdales, Percherons, Hanoverians, and Trakehners in an effort to develop a heavier boned, well-mannered, Thoroughbred-type horse.

The Musical Ride. The origins of the famous musical ride can be traced to the intricate Prussian Cavalry drills of the eighteenth century. The first recorded riding exhibition performed by the NWMP was at Ft. Macleod in 1876, and the first performance accompanied by music was presented in 1887. Since 1966 the only RCMP members to receive equestrian training are those associated with the ride. Today's musical ride consists of 32 horses and riders performing numerous intricate figures, always ending in a charge.

People ride horses for pleasure more than ever before. More than 27 million people ride horses each year. In the national forests, horseback riding is the third most popular activity, involving about 24 million visitor-days each year. The number of 4-H club horse and pony projects is about double the number of 4-H beef cattle projects. As family pets, horses rank fourth behind dogs, cats, and pet birds.

Horse shows have also increased in size and number. In the past 20 years, their number has more than doubled. Some major shows, their location, and Web site are listed in Table 2–5.

TABLE 2–5 North American Horse Shows

SHOW	LOCATION	WEB SITE
National Western Stock Show	Denver, CO	www.nationalwestern.com
Winter Equestrian Festival	Wellington, FL	www.equestriansport.com
USEF Annual Convention	Lexington, KY	www.usef.org
Horse World Expo	Timonium, MD	www.horseworldexpo.com
Fort Worth Stock Show and Rodeo	Fort Worth, TX	www.fwssr.com
HITS Horse Shows in the Sun	Ocala, FL	www.hitsshows.com
HITS Horse Shows in the Sun	Thermal, CA	www.hitsshows.com
United States Pony Club Annual Meeting	Nashville, TN	www.ponyclub.org
American Equestrian Trade Association International Fair	Oaks, PA	www.aeta.us
HITS Horse Shows in the Sun	Tucson, AZ	www.hitsshows.com
Equine Affaire	Pomona, CA	www.equineaffaire.com
Scottsdale Arabian Horse Show	Scottsdale, AZ	www.scottsdaleshow.com
Horse World Expo	Harrisburg, PA	www.horseworldexpo.com
Illinois Horse Fair	Springfield, IL	www.horsemenscouncil.org
Rocky Mountain Horse Expo	Denver, CO	www.rockymountainhorseexpo.com
Live Oak Combined Driving Event	Ocala, FL	www.cailiveoak.com
Can-Am All Breeds Equine Emporium	London, ON	www.canamequine.ca
Equine Affaire	Columbus, OH	www.equineaffaire.com
Midwest Horse Fair	Madison, WI	www.midwesthorsefair.com
Kentucky Reining Cup	Lexington, KY	www.kentuckyreining.com
Rolex Kentucky Three-Day Event	Lexington, KY	www.rk3de.com
Minnesota Horse Expo	St. Paul, MN	www.mnhorseexpo.org
Fiesta of the Spanish Horse	Burbank, CA	www.fiestaspanishhorse.org
Three Phase Event	Harrodsburg, KY	www.threephaseevent.org
Western States Horse Expo	Sacramento, CA	www.horsexpo.com
Appaloosa National Championships/Youth World Show	Tulsa, OK	www.appaloosa.com
The Calgary Stampede	Calgary, Alberta	www.calgarystampede.com
Chagrin Valley Hunter Jumper Classic	Moreland Hills, OH	www.clevelandhorseshow.com
North American Junior/Young Rider Championships	Lexington, KY	www.youngriders.org
Arabian Youth Nationals	Albuquerque, NM	www.arabianhorses.org

(*continues*)

TABLE 2–5 *(continued)*

SHOW	LOCATION	WEB SITE
Canadian Arab Nationals	Regina, SK	www.arabianhorses.org
American Saddlebred World's Championship Horse Show	Louisville, KY	www.kentuckystatefair.org
Arabian Sport Horse Nationals	Lexington, KY	www.arabianhorses.org
Dressage at Devon	Devon, PA	www.dressageatdevon.com
All-American Quarter Horse Congress	Columbus, OH	www.oqha.com/congress
Morgan Grand National	Oklahoma City, OK	www.morgangrandnational.com
Arabian US Nationals	Tulsa, OK	www.arabianhorses.org
World Championship Appaloosa Show	Fort Worth, TX	www.appaloosa.com
The Royal Agricultural Winter Fair	Toronto, ON	www.royalfair.org
AQHA World Show	Oklahoma City, OK	www.aqha.com
Equine Affaire	West Springfield, MA	www.equineaffaire.com

FIGURE 2–6 **Mounted Park Police at the National Mall in Washington, DC.**

Despite all the mechanization in today's world, some jobs are still better suited to horses. For example, the U.S. Forest Service uses horses; remote areas inaccessible to vehicles require horses for packing and travel; and law enforcement agencies have found that mounted patrols are the most effective way to handle crowds and riots (Figure 2–6).

FUTURE OF THE U.S. HORSE INDUSTRY

Even though horse numbers in the United States may never again match those they reached at the beginning of the twentieth century, horses have never been so popular. More people are enjoying a greater variety of equestrian activities than ever before. For

Popular Equestrian Activities

- Horse shows
  - Hunter division
  - Jumper division
  - Saddle-horse division
  - Harness division
  - Western division
  - Equitation division
  - Breed divisions
- Dressage
- Rodeos
- Cutting
- Polo
- Combined training
- Fox hunting
- Driving
- **Gymkhanas** (games for horses and riders)
- Distance riding
- Riding for disabled people
- Holidays on horseback
  - Summer camps
  - Dude ranching
  - Pack trips
  - Cross-country riding
- Draft horse demonstrations

example, the art of coachman, almost lost, has made an exciting return to competitive performance trials; and sidesaddle riding, showing, hunting, jumping, and **dressage** all are attracting more devotees. Riding has never enjoyed so much popularity, and this popularity continues to grow among all ages.

A short list of some of the myriad equestrian activities provides some idea of the popularity, diversity, and promising future of the U.S. horse industry.

On the downside of the future of the horse industry, rodeo has provoked opposition from animal rights and welfare advocates, who argue that the competitions constitute animal cruelty. In the U.S. the rodeo industry has made progress in improving the welfare of rodeo animals, with specific requirements for veterinary care and other regulations that protect rodeo animals. Rodeo is still opposed by animal rights and welfare organizations in the United States and Canada. Some local and state governments have banned or restricted rodeos, certain rodeo events, or types of equipment. Internationally, rodeo is banned in the United Kingdom and the Netherlands, with other European nations placing restrictions on some events.

Another indication of the popularity and future of horses is the number of publications, videos, and organizations that support the various equestrian activities. Membership in equine organizations has grown in the past decade. Table A–17 in the appendix lists more than 50 international horse organizations with their addresses, including:

- United State Equestrian Federation (USEF; http://www.usef.org/)
- United States Dressage Federation (USDF; http://www.usdf.org/)
- United States Eventin Association (USEA; http://useventing.com/)
- National Cutting Horse Association (NCHA; http://www.nchacutting.com/)
- American Driving Society (ADS; http://www.americandrivingsociety.org/)
- Canadian Equestrian Federation (http://www.equinecanada.ca/)

Many of the breed registries have their own magazine, newsletter or newsgroup (See American Horse Publications; http://www.americanhorsepubs.org/). Almost every equestrian activity has an organization and some type of publication. The popularity of horses also caused a proliferation of books and videos on every imaginable equine-related topic. Finally, the Internet and the World Wide Web contain numerous home pages and interest groups dedicated to equestrian activities. Based on the increasing activity in all areas of publication and communication, horses in the United States have a bright future.

The making and selling of **tack** or virtually anything a horse or rider wears is a growing multimillion-dollar industry. For each type of horse-related activity, catalogs or stores sell needed equipment and apparel.

People have more money to spend and more leisure time than at any other period in history. A shorter workweek, increased automation, and more suburban and rural living contribute to more free time. Equestrian activities will continue to play a larger role in physical fitness and well-being.

RESEARCH IN THE HORSE INDUSTRY

Research in the horse industry involves four general areas—unsoundness and injury, breeding and reproduction, nutrition, and disease prevention and control. Research is slow and costly but it is necessary if the growing horse industry is to take advantage of science and technology.

Research solves many problems and increases our understanding. Good research also generates new questions and the need for more research. This progress will help move the horse industry successfully through the twenty-first century.

Current Areas of Research

Unsoundness and Injury

- Safe anesthetization of horses after strenuous exercise
- Relationship of training to the occurrence of **bucked shins**
- Molecular mechanism in **synovitis**
- Blood clots and **laminitis**
- Investigations into the skeletal muscles and the “tying up” syndrome
- Fatal muscular and skeletal injuries
- Horseshoeing and shoes associated with injury
- Types and management of surfaces for prevention of injury
- Identification, prevention, and treatment of injuries
- Best techniques for training

Breeding and Reproduction

- Pregnancy diagnosis
- Estrous cycle of the mare
- Causes of reproductive failure (Mare Reproductive Loss Syndrome [MRLS])
- Embryo transfer
- **Genetics** and Genomics
- **Cloning**

Nutrition

- Reduction and understanding of **colic**
- Grazing methods and pasture types
- Factors influencing nutritional requirements
- Interactions of nutrients
- Nutrient requirements: energy, protein, minerals, and vitamins
- Characteristics and suitability of feeds

Disease Prevention and Control

- More effective immunizations and isolation of the disease-causing agents
- Prevention and treatment of such diseases as rhinopneumonitis, influenza, viral arteritis, infectious anemia, rotaviral enteritis, strangles and other streptococcal diseases, leptospirosis, clostridial enteritis, pneumonia. and Lawsonia intracellularis enteropathy
- Better avoidance and cure for most diseases
- Improvement of resistance to disease by stimulating response of the immune system
- Improved control of parasites

Organizations that fund important research projects include:

- Grayson-Jockey Club Research Foundation, Inc. (http://www.grayson-jockeyclub.org/)
- Morris Animal Foundation (http://www.morrisanimalfoundation.org/)
- University of Kentucky Gluck Equine Research Center (http://www.ca.uky.edu/gluck/index.htm)

To review the current projects, download a copy of the annual research report from the Web site for the University of Kentucky Gluck Equine Research Center.

SUMMARY

Horses, donkeys, and mules can be found in every country of the world, where they are used for work and transportation much like they were in the United States until the 1900s. Even though the number of horses in the United States has declined drastically since the early 1900s, the industry with its 9.5 million horses is a major agricultural-based industry that combines business, sport, and recreation into a program of economic impact involving millions of people. Opportunities for expansion and participation by even more people seem unlimited. The industry involves many types of horses and horse programs and events. It may be divided into three major segments: racing, showing, and recreation. These segments involve numerous support industries including feed, veterinary, education, insurance, tack, farrier, and so on. Racing, shows, and other events also involve the general public as spectators. In the United States today, around 80 percent of all horses are kept for recreation and 40 percent of all horses are used in youth programs. Horse owners represent a wide socioeconomic group and reside in rural, urban, and suburban areas.

Opportunities are unlimited to expand the user and spectator base. Youth programs of all kinds form the foundation for sport and recreation and have wide appeal. Growing markets include new owners, suburban horse owners, senior citizens, and amateurs. Horses provide for a lifelong sport and interest for all people.

Challenges facing the industry include the need for improved marketing and more educational programs, recognition by traditional public service bureaucracies, lack of adequate census and economic analysis, expanding youth programs, the long-term agenda of animal rights extremists, lack of adequate trails and riding areas, zoning and related environmental concerns, increasing costs and profitability for the business segments, insurance issues, and the overall lack of unity and communication between the various parts of a large, complex industry.

Meeting challenges will become increasingly complex. The industry needs to enhance unity and communication and to expand advertising, promotional, marketing, and educational programs. This includes promoting the generic horse with the public, expanding support for youth programs, implementing cost-effective management, expanding trail development, and increasing riding instruction and opportunities for more people.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. The United States has more horses, mules, and donkeys than any other country in the world.
2. New York is one of the top 10 horse-producing states.
3. Horse shows have decreased in size and number over the past 20 years.
4. A gymkhana is an equestrian activity.
5. Genomics is an area of equine research.

Short Answer

6. List five of the top 10 horse-producing states.
7. According to the Food and Agriculture Organization of the United Nations, what percentage of the world's horses are located in the United States?
8. List five equine organizations.
9. List five equine activities.
10. Name four general areas of equine research.
11. Where are most of the donkeys and mules in the world?

Critical Thinking/Discussion

12. Briefly describe the changes in the U.S. horse population from 1900 to the present.
13. Describe four trends that suggest the U.S. horse industry has a bright future.
14. Using the statistics from the UN Food and Agriculture Organization, compare the worldwide populations of horses, donkeys, and mules.
15. Why does the number of equestrian activities and membership in equestrian organizations give some idea of the popularity and future of the U.S. horse industry?
16. Compare the U.S. population of horses, donkeys, and mules to that of the world.

STUDENT ACTIVITIES

1. Contact your state Department of Agriculture or Cooperative Extension Service for current statistics on horses, donkeys, and mules in your state.
2. Locate and attend an equine event. Or, instead of attending the event, check the schedule of ESPN and view several types of events on television.
3. Write to one of the equine organizations listed in appendix Table A–17 and ask how members of the organization have benefited from equine research. Also ask what type of research the organization supports.
4. The Grayson-Jockey Club Research Foundation maintains a database of equine research projects. Develop a report, written or oral, on one of these equine research areas. Describe the problem and the current progress being made through scientific research.

5. Write a report on the importance and use of horses, donkeys, or mules in other areas of the world, for example, Asia, Mexico, South America, Africa, or Europe.
6. Investigate how science has changed horse racing. Report your findings.
7. Research the Internet for information about equine associations or equine events. Report your findings.
8. Use a world map and locate all the countries in Tables 2–1 and 2–2.

ADDITIONAL RESOURCES

Books

Almos, A. (2007). *Horse Schools: The international guide to universities, colleges, preparatory and secondary schools, and specialty equine programs*. North Pomfret, VT: Trafalgar Square Publishing.

American Horse Council. (2005). *The economic impact of the horse industry in the United States.* Washington, DC: Author.

American Horse Council. (2011). *2011 horse industry directory.* Washington, DC: Author.

Chamberlin, J. E. (2008). *Horse: How the horse has shaped civilizations.* Mamaroneck, NY: BlueBridge Publishing.

Edwards, E. H. (2008). *The encyclopedia of the horse.* New York: DK Publishing, Inc.

Edwards, E. H. (2010). *Racehorse: The complete guide to the world of horse racing.* China: Aa, Studio Cactus, Ltd.

Gonzago, P. G. (2003). *The history of the horse*. J. A. Allen & Company.

Hendricks, B. L. (2007). *International encyclopedia of horse breeds.* Norman: University of Oklahoma Press.

Kelekna, P. (2009). *The horse in human history.* New York: Cambridge University Press.

Kimball, C. (2006). *The complete horse: An entertaining history of horses.* St. Paul, MN: Voyageur Press.

Mooney, B. & Ennor, G. (2009). *The complete encyclopedia of horse racing: The illustrated guide to the world of the thoroughbred.* New York: Carlton Books, Sterling.

Peplow, E. (2005). *Encyclopedia of the horse, 2nd Ed.* New York: Barnes & Noble.

U.S. Department of Agriculture. (1960). *Power to produce: The yearbook of agriculture 1960.* Washington, DC: U.S. Government Printing Office.

White-Mullin, A. J. & Tauber, C. (2008). *The complete guide to hunter seat training, showing, and judging: On the flat and over fences.* North Promfret, VT: Trafalgar Square Trafalgar Square Publishing.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

dressage	mules	Mounted Police
farrier	Kentucky Derby	horses
gymkhanas	Preakness	equestrian activities
horse jockey	Belmont Stakes	cutting horses
horse tack	horse shows	fox hunting
Triple Crown winners	police horses	equine research
donkeys	Royal Canadian	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 3

Breeds, Types, and Classes of Horses

Through selection, inbreeding, and outcrossing, humans created horses for speed, strength, endurance, size, good nature, hardiness, beauty, and athletic ability. Today, over 300 breeds exist. These breeds represent numerous types and classes. The various breeds and types of horses are also bred to donkeys to produce different types of mules.

This chapter acquaints the reader with the breeds of horses and the methods and terms used to group the breeds.

OBJECTIVES

After completing this chapter, you should be able to:

- Describe how horse breeds started with foundation stallions
- Understand the concept of breed, types, and classifications
- Describe the common height measurement for horses
- Define the terms *warmblood*, *coldblood*, *cob*, and *hack*
- Name 10 common breeds of light horses and their origin
- Name five common breeds of draft horses and their origin
- Name five common breeds of ponies and their origin
- List five color breeds of horses
- Name five lesser-known breeds of horses or ponies and their origin
- Explain the origin of feral horses
- Describe how mules are produced
- Identify the common breeds of donkeys
- List 10 uses for horses
- Describe some of the uses for miniature donkeys and horses
- List six uses for mules

KEY TERMS

breed
breed registries
breeding true
cob
coldblood
color breed
conformation
draft horses
feral
foundation sires
hack
hand
hinny
jennet
light horses
miniature
mustangs
pony
roadsters
warmblood
zebra hybrid

BREEDS

Through selective breeding, people learned to develop specific desirable characteristics in a group of horses. After a few generations of selective breeding, a **breed** of horse was born.

A breed of horses is a group of horses with a common ancestry that breed true to produce common characteristics such as function, **conformation**, and color. **Breeding true** means that the offspring will almost always possess the same characteristics as the parents.

Recognized breeds of horses have an association with a stud book and breeding records. Many recognized breeds have certain **foundation sires**, and all registered foals must trace their ancestry back to these stallions. For example, the three foundation stallions of the Thoroughbred are the Darley Arabian, the Byerly Turk, and the Godolphin Arabian. Justin Morgan is the foundation sire of the Morgan horse breed. Allen F-1, a Morgan stallion, is the foundation sire of the Tennessee walking horse. Morgan horse stallions also contributed to the development of the Standardbred, quarter horse, American albino, and the palomino breeds.

People who found particular colors appealing established registries with color requirements. Some of these registries require only color for registration, but others have conformation standards as well. The Palomino Horse Association of California was the first **color breed** registration. Other color breed registries now include the Appaloosas (Figure 3–1), albinos, paints, pintos, buckskins, whites, creams, and spotteds. Color breeds do not breed true. Table A–16 in the appendix lists the names and addresses of many **breed registries**.

FIGURE 3–1 **Appaloosa enjoying an open pasture.**

CLASSIFICATIONS AND TYPES

In addition to breed, horses can be classified several different ways. For example, horses can be grouped as light, draft, or **pony**, according to size, weight, and build. Within these groupings horses can be further divided by use, for example, riding, racing, driving, jumping, or utility. They can also be classified as **warmblood**, **coldblood**, or ponies.

Horse classifications depend on the height and weight of the horse. The common measurement of horse height is the **hand**. The height of a horse is measured from the top of the withers to the ground. A hand is equal to 4 inches. So a horse that is 15 hands is 60 inches. A horse that is 15.2 (15 hands 2 inches) is 62 inches tall from the top of the withers to the ground.

Light Horses

Light horses are 12 to 17.2 hands high (hh) and weigh 900 to 1,400 pounds. They are used primarily for riding, driving, showing, racing, or utility on a farm or ranch. Light horses are capable of more action and greater speed than **draft horses**.

Draft Horses

Draft horses are 14.2 to 17.2 hands high and weigh 1,400 pounds or more. They are primarily used for heavy work or pulling loads. Historically, when draft horses were bought and sold for work, they were classified according to their use such as wagon pulling, or plowing. (Figure 3–2).

Ponies

Ponies stand 14.2 hands high or less and weigh 500 to 900 pounds. Ponies possess a distinct conformation on a reduced scale. They are either draft, heavy harness, or saddle type (Figure 3–3).

Warmblood

Warmblood does not relate to horses with a certain blood temperature. It refers to the overall temperament of light-to-medium horse breeds. Warmblood horses are fine boned and suitable for riding. In some countries, the warmblood is distinguished as a horse having a strain of Arab breeding. Some groupings classify all light horses as

Courtesy of Rick Parker.

FIGURE 3–2 Suffolk or Suffolk Punch draft horses on the B-Bar Ranch in Montana.

FIGURE 3–3 **Welsh pony on a snowy run.**

warmbloods. According to some, all breeds that are not definitely Thoroughbred, draft, or pony are classified as warmblood.

Coldblood

Coldblood horses are heavy, solid, strong horses with a calm temperament. This term is probably best thought of as another way of describing draft horses.

Types and Uses

Types of light horses include riding, racing, showing, driving, all-purpose, and **miniature**. Riding horses are generally thought of as the gaited horses (three- and five-gait), stock horses, horses for equine sports, and ponies for riding and driving. Racing horses are running racehorses, pacing/trotting racehorses, quarter racehorses, and harness racehorses (Figure 3–4). Driving horses include the heavy and fine harness horses, ponies, and the **roadsters**. All-purpose horses and ponies are used for family enjoyment, showing, ranch work, and the like. Miniature horses and donkeys are used for driving and as pets.

Obviously, some breeds fit better into some of these types than other breeds.

The terms **cob** and **hack** are also used to describe types of horses. A cob is a sturdy, placid horse. It stands 14.2 to 15.2 hands high and is not heavy or coarse enough to be classified as a draft animal. A hack is an enjoyable, good riding or driving horse, sometimes considered a small Thoroughbred in Europe or a saddlebred in America.

COMMON BREEDS OF HORSES

Table 3–1 briefly describes some of the more common breeds of horses, their origin, classification, and height. Table 3–2 lists some of the lesser-known breeds of warmblood or light horses and their origin. Table 3–3 lists some other breeds of draft or coldblood horses and their origin, while Table 3–4 provides the name and origin of some lesser-known breeds of ponies and their origin.

FIGURE 3–4 Standardbred trotter with jockey on the sulky.

MINIATURE HORSES

Miniature horses are scaled-down versions of a full-size horse and are not dwarfs. Miniatures are not a breed but can be registered with the Miniature Horse Registry. The maximum height for registration is 34 inches at the withers.

Miniatures are often kept as pets. Some are exhibited as driving horses in single pleasure and roadster driving classes. Also, some people exhibit miniature horses in multiple hitches pulling miniature wagons, stagecoaches, and carriages. Because of their size, only a small child can ride them (Figure 3–5).

FIGURE 3–5 Miniature horse pulling a cart at the Boise Horse Show.

TABLE 3-1 Well-Known Breeds of Horses

NAME	ORIGIN	CLASSIFICATION	HEIGHT	COLOR	COMMENTS
Akhal Teke	Turkmenistan	Light	15–15.2 hh	Gold with metallic sheen; also bay, cream, chestnut	Less than 5,000 purebreds in world; Marco Polo said foundation sire was Alexander the Great's horse, Bucephalus
Albino	United States	Light	No height requirements	White only	Foals born white
Alter-Real	Portugal	Light	15–15.2 hh	Mostly bay or brown; some chestnuts and gray	High-strung temperament; does well in dressage; carries Andalusian breeding
American Buckskin	United States	Light	14 hh	Four color patterns accepted	Descendants of Norwegian Dun and Spanish Sorraia
American Cream	United States	Draft	Varies from 12.2–17 hh	Three variations of cream accepted	Color breed
American Quarter Horse	United States	Light	15.2–16.1 hh	Any solid color; mostly chestnut	Oldest of American breeds; most versatile horse in the world; largest equine registry in the world; natural cow sense (see Figure 21–12)
American Saddlebred	United States	Light	15–16 hh	Black, bay, brown; white markings on face and legs	Formerly Kentucky saddler, amiable; can perform several gaits; very showy
American Standardbred	United States	Light	14–16 hh	Any solid color, mostly brown, bay, black, chestnut	Developed as trotter/pacer; direct line can be traced to one male, Messenger
American Warmblood	United States	Light	Varies	Any color	Relatively new breed; common crosses are Thoroughbred/draft or Thoroughbred/warmblood
American White	United States	Light	Varies from 12.2–17 hh	Snow or milk white hair, pink skin; brown, black, or hazel eyes	Color breed; not true albino
Andalusian	Spain	Light	15–16.2 hh	Gray, born dark and becoming lighter over years	Oldest and purest of all horses after Arabian; breed founded in A.D. 710; almost became extinct in 1830s; saved by monks; used by mounted bullfighters in Spain; no Arab blood used in development

(*continues*)

TABLE 3-1 (*continued*)

NAME	ORIGIN	CLASSIFICATION	HEIGHT	COLOR	COMMENTS
Appaloosa	Spain, United States	Light	14–15.3 hh	White sclera, striped hooves, mottled skin and coat pattern	Bred by Nez Perce Indians; third largest breed registry in world; popular in United States and Australia (see Figure 3–1)
Arabian or Arab	Arabia	Light	14.3–16 hh	Bay, brown, chestnut, gray, black	Large nostrils and long eyelashes adapted for desert conditions; one less vertebra than any other breed; has influenced the foundation of all light breeds; can carry more weight over longer distance than can a thoroughbred or quarter horse; characteristic dished face; oldest purebred, dating to 5000 B.C.
Barb	North Africa	Light	14–15 hh	Dark brown, bay, chestnut, black, gray	One of the great foundation horses; used to strengthen other breeds; considered forerunner of Thoroughbred
Bashkir Curly	Russia	Light	13.2 hh average	All colors	Noted for long, curly coat of hair, milking ability, cold hardy
Belgian	Belgium	Draft	Up to 17 hh	Mostly roan with black points, chestnut, sometimes bay, brown, dun, gray	Descendant of medieval great horses; magnificent animal; one of most powerful of horse breeds
Chickasaw	United States	Light	13.2–14.7 hh	Bay, black, chestnut, gray, roan, sorrel, palomino	Developed by Native Americans of Tennessee, North Carolina, Oklahoma; used as cow ponies
Cleveland Bay	England	Light	16–16.2 hh	Bay, mahogany with black points, mane, tail; feet blue	Very versatile and hardy; easy keepers
Clydesdale	Scotland	Draft	16.2–18 hh	Bay, brown, black, roan; much white on face and legs and sometimes body	Displays action; popular in big hitches; much feathering on foot; regularly exported from Britain to wherever horses are needed for over 100 years (see Figure 1–16)
Connemara	Ireland	Pony	13–14.2 hh	Gray, black, brown, dun	Hardy, sure-footed
Dales	England	Pony	14.2 hh maximum	Mostly black	Very hardy; good for children; used as workhorse

(*continues*)

TABLE 3-1 *(continued)*

NAME	ORIGIN	CLASSIFICATION	HEIGHT	COLOR	COMMENTS
Dartmoor	British Isles	Pony	11.2–11.3 hh	Bay, brown, black	Used for pack ponies in the mines of England; good for children
Dutch Warmblood	Holland	Warmblood	16 hh	Any color	Mix of Groningen and Gelderland breeds; willing temperament
Fell Pony	England	Pony	14.2 hh maximum	Black, brown, bay, gray, no white markings	Very hardy, all-purpose horse
French Saddle Horse or Selle Français	France	Light	15.2–16.3 hh	Usually bay or chestnut	Descended from Anglo-Norman studs; developed as a competition horse
Friesian (West Friesian)	Holland	Draft	15 hh	Black	Used by knights of old; have heavily feathered legs; breed lightened for carriage and sport horse; tail and mane may touch ground
Gotland (or Skogsruss)	Sweden	Light	12–14 hh	Dun, black, brown, bay, chestnut, palomino	One of the oldest breeds; excellent youth horse, jumper, trotter
Hackney	England	Pony	14 hh maximum	Dark brown, black, bay, chestnut	Trotting horse; good carriage horse
Hackney	England	Light	14.2–16 hh some taller	Black, brown, chestnut, bay	Flamboyant pacers, usually used in shows and harness; distinctive trotting action
Haflinger	Austria	Pony	14.2 hh	Chestnut; white mane and tail	All of today's Haflingers are traced back to foundation sire, 249 Folic; family horse (see Figure 6–8 and 16–3)
Hanoverian	Germany	Warmblood	16–17.2 hh	Any solid color	Dominate in international competition; stable and willing temperament
Highland (or Garron)	Scotland	Pony	14.2 hh maximum	Various shades of dun; dorsal eel stripe, black points or silver hair in tail and mane; also, gray, chestnut, bay, black	Very versatile; sturdy, sure-footed
Holstein	Germany	Warmblood	15.3–16.2 hh	Any solid color, mostly black, brown, bay	One of the oldest warmbloods from great horse types; competes well; good carriage horse

(continues)

TABLE 3-1 (*continued*)

NAME	ORIGIN	CLASSIFICATION	HEIGHT	COLOR	COMMENTS
Lipizzaner	Austria	Light	15–16 hh	Mostly gray	Famous horses from Spanish Riding School of Vienna, performing haute ecole riding; great athletic ability, performing “airs above the ground” (see Figure 19–5)
Lusitano	Portugal	Light	15–16 hh	Usually gray	Bred from Andalusian stock; used for bullfighting
Missouri Fox Trotter	United States	Light	14–17 hh	Any color, usually sorrel	Natural ability for specialized gaits; comfortable ride
Morab	United States	Light	14.3–15.2 hh	Usually solid	Cross of Morgan and Arabian breeds only
Morgan	United States	Light	14–15.2 hh	Bay, brown, black, chestnut	One common foundation sire, Justin Morgan of Massachusetts; works very well under harness or saddle (see Figure 16–9)
Mustang	United States	Light	14–15 hh	All colors	Original cow pony; feral horses of American West; small but tough; Native Americans used extensively
New Forest	England	Pony	12–14.2 hh	Any color except piebald or skewbald	Very hardy; good family pony; allowed to run wild most of year; easy to train
Norwegian Fjord Pony	Norway	Pony	13–14 hh	Dun with black eel stripe down center of back; zebra stripes on legs	Primitive-looking horse, resembling Przewalski’s horse; hardy and sure-footed; still used as farm ponies in Norway; gentle
Oldenburg	Germany	Warmblood	16.2–17.2 hh	Any solid color	Tallest and heaviest of German warmbloods; based on Friesian breeding
Paint	United States	Light	Variable	Black and white in bold patches all over body	All paint horses must be sired by a registered paint, quarter horse, or Thoroughbred (see Figure 8–14)
Palomino	United States	Light	14.2–15.3 hh	Gold coat; white mane and tail; no markings	Not possible to breed true to color; first color registry (see Figure 10–6)
Paso Fino	Caribbean, Puerto Rico, South America	Light	14.3 hh	All colors	Shows the natural lateral 4-beat gaits

(*continues*)

TABLE 3-1 (*continued*)

NAME	ORIGIN	CLASSIFICATION	HEIGHT	COLOR	COMMENTS
Percheron	France	Draft	15.2–17 hh	Gray, black	Most popular cart horse in world; slight Arab features in face
Peruvian Paso	Peru	Light	14–15.2 hh	Mostly bay and chestnut	Has unique gait; can carry rider long distances, not becoming too tired
Pinto	Spain, United States	Light	Variable	Black and white in bold patches all over body	Associated with Native Americans
Pony of the Americas (POA)	United States	Pony	11.2–13 hh	Appaloosa color pattern	Cross between Appaloosa and Shetland; one of newest breeds; very good for young riders
Shetland	England	Pony	11.2 hh maximum	Variable	Popular with children; very hardy, gentle
Shire	England	Draft	17 hh average	Bay and brown most com-mon with white markings	Very docile; can be trusted with a child; tallest horse in the world; heavy feathering on foot; descended from great horses; popular as team horse
Spanish Barb	Spain, United States	Light	13.3–14.1 hh	Varied	Three strains recognized: scarface, rawhide, and buckshot
Spotted Saddle	United States	Light	14–16 hh	Spotted coloring	Good all-around horse; good disposition
Suffolk (or Suffolk Punch)	England	Draft	15.2–16.2 hh	Chestnut	Developed as workhorse; not as big as other draft breeds (see Figure 3–2)
Swedish Warmblood or Halfbred	Sweden	Warmblood	16.2 hh	Usually chestnut, bay, brown, gray	Outstanding saddle horse; competes very well in dressage
Tennessee Walking Horse	United States	Light	15–16 hh	All solid colors	Well ll known for two unique gaits—flat walk and running walk; bred for comfortable ride; good for beginners
Thoroughbred	England	Light	14.2–17 hh	Any solid color, white markings allowed	Bred mainly for racing; must be handled carefully (see Figure 1–18)
Trakehner	Germany, Poland	Warmblood	16–16.2 hh	Any solid color	Very versatile, considered most hand-some of all German warmbloods; competes well in all sports
Welsh Pony (Sections A, B, C, D)	Wales	Pony	13.2 hh maximum (height determines which section)	Any solid color	Very hardy; very good trotting ability; good jumper; influenced trotters all over the world (see Figure 3–3)
Württemberg	Germany	Warmblood	16 hh average	Black, bay, chestnut, brown	Developed to do work on small mountain farms

TABLE 3-2 Lesser-Known Breeds of Warmblood and Light Horses

NAME	ORIGIN	NAME	ORIGIN
American Remounts	United States	Gidran	Hungary
Anglo Arab	Britain, France, Poland, Hungary	Groningen	Holland
Anglo-Argentine	Argentina	Hispano (Spanish Anglo-Arab)	Spain
Bavarian Warmblood	Germany	Iberian	Iberian Peninsula
Beberbeck	Germany	Iomud	Central Asia
Brandenburg	Germany	Irish Hunter	Ireland
Brumby	Australia	Jaf	Iran/Kurdistan
Budyonny	Russia	Kabardin	Russia
Calabrese	Italy	Karabair	Uzbekistan
Campolina	Brazil	Karabakh	Azerbaijan
Charollais Halfbred	France	Kladruber	Czechoslovakia
Criollo	South America	Knabstrup	Denmark
Døle Qudbrandsdal	Norway	Kustanair	Kazakhstan
Danubian	Bulgaria	Latvian Harness Horse	Latvia
Darashouri	Iran	Libyan Barb	Libya
Don	Central Asia	Limousin Halfbred	France
East Bulgarian	Bulgaria	Lokai	Uzbekistan
East Friesian	Germany	Malapolski	Poland
Einsiedler	Switzerland	Mangalarga	Brazil
European Trotter	France, United States, Russia	Maremmana	Italy
Fox Trotting Horse	Ozarks	Masuren	Poland
Frederiksborg	Denmark	Mecklenburg	Germany
Freiburger Saddle Horse	Switzerland	Metis Trotter	Russia
French Trotter	France	Murgese	Italy
Furioso North Star	Hungary	Native Mexican	Mexico
Gelderland	Holland	New Kirgiz	Kirgiz/Kazakhstan
German Trotter	Germany	Nonius	Hungary
Gessian	Germany	Novokirghiz	Central Asia
Orlov Trotter	Russia	Tchenaran	Iran
Plateau Persian	Iran	Tersky	Russia
Pleven	Bulgaria	Toric	Estonia
Rhinelander	Germany	Waler	Australia
Salerno	Italy	Westfalen	Germany
Sardinian	Sardinia	Wielkopolski	Poland
Shagya Arab	Hungary	Yorkshire Coach	Ireland
Sokolsky	Poland/Russia	Zweibrucker	Germany
Spotted Saddle Horse	United States		

TABLE 3-3 Lesser-Known Breeds of Coldblood or Draft Horses

NAME	ORIGIN	NAME	ORIGIN
Ardennais	France/Belgium	Noriker Pinzgauer (Oberländer, South German)	Austria/Germany
Auxios	France	North Swedish	Sweden
Boulonnais	France	North Swedish Trotter	Sweden
Breton	France	Poitevin	France
Comtois	France	Rhineland Heavy Draught	Germany
Døle Trotter	Norway	Russian Heavy Draught	Ukraine
Dutch Draught	Holland	Schleswig Heavy Draught	Germany
Finnish	Finland	Schwarzwälder	Germany
Irish Draught	Ireland	Soviet Heavy Draught	Russia
Italian Heavy Draught	Italy	Swedish Ardennes	Sweden
Jutland	Denmark	Trait du Nord	France
Lithuanian Heavy Draught	Baltic States	Vladimir Heavy	Russia
Mulassier	French	Woronesh	Russia
Murakov	Hungary		

TABLE 3-4 Lesser-Known Ponies of the World

NAME	ORIGIN	NAME	ORIGIN
Acchetta	Sardinia	Huzule	Romania
Ariège	France	Icelandic	Iceland
Assateague	USA	Java	Indonesia
Australian	Australia	Kathiawari	India
Avelignese	Italy	Kazakh	Kazakhstan
Balearic	Balearic Islands	Konik	Poland
Bali	Indonesia	Landis	France
Bashkirsky	Russia	Leopard Spotted	England
Basuto	South Africa	Macedonian	Yugoslavia
Batak (Deli)	Indonesia	Manipur	Assam-Manipur
Bhutia	India	Marwari	India
Bosnian	Yugoslavia/Bosnia-Herzegovina	Merens	France
Burma (Shan)	Burma	Mongolian	Mongolia
Camarguais	France	Native Turkish	Turkey
Caspian	Iran	Peneia	Greece

(*continues*)

TABLE 3-4 *(continued)*

NAME	ORIGIN	NAME	ORIGIN
China	China	Pindos	Greece
Chincoteague	USA	Sable Island	Canada
Costeno	Spain, Peru	Sandalwood	Indonesia
Dülmen	Germany	Skyros	Greece
Exmoor	England	Spiti	India
Falabella	Argentina	Sumba	Indonesia
Fjord (Westlands)	Norway	Sumbawa	Indonesia
Fjord-Huzule	Czechoslovakia	Tarpan	Eastern Europe
Galiceño	Mexico	Tibetan (Nanfan)	Tibet
Garrano (Minho)	Portugal	Timor	Indonesia
Gayoe	Indonesia	Viatka	Russia
Huçul	Poland	Zemaituka	Russia

RARE BREEDS

Some breeds are threatened because American agriculture has changed. Many traditional livestock breeds have lost popularity and are threatened with extinction. These traditional breeds are an essential part of the American agricultural inheritance. They evoke our past and represent an important resource for the Earth's biodiversity in the future. Rare breeds are classified by the American Livestock Breeds Conservancy (http://www.albc-usa.org/). A breed's status is considered critical when fewer than 200 animals are registered annually in the United States and the estimated global population is less than 2,000. The following horse breeds are considered critical:

- American Cream
- Caspian
- Cleveland Bay
- Colonial Spanish Strains
  - Banker
  - Belsky
  - Cerbat
  - Choctaw
  - Florida Cracker
  - Marsh Tacky
  - New Mexico
  - Pryor
  - Santa Cruz
  - Sulphur
  - Wilbur-Cruce
- Hackney Horse
- Shire
- Suffolk

The Colonial Spanish Strains (descendants of a common ancestor) include horses registered by the Spanish Mustang Registry, Southwest Spanish Mustang Association, Spanish Barb Breeders Association, Horse of the Americas, and American Indian Horse Registry.

A breed's status is considered threatened when fewer than 1,000 registrations occur annually in the United States and the estimated global population is less than 5,000. According to the American Livestock Breeds Conservancy, the following horse breeds are considered threatened:

- Akhal-Teke
- Canadian
- Dales Pony
- Dartmoor
- Exmoor
- Lipizzan

Breeds with fewer than 2,500 annual registrations in the United States and estimated global population less than 10,000 are on the "watch" list. This also includes breeds that present genetic concerns or have a limited geographic distribution. Breeds on the watch list include:

- Clydesdale
- Fell Pony
- Gotland
- Irish Draught
- Mountain Pleasure/Rocky Mountain

Some breeds that were once listed as critical or threatened are now considered to be recovering. These include:

- Belgian
- Friesian
- Percheron

Breeds are classified as "recovering" when individuals or organizations have taken initiative to save a rare or critical breed.

WILD HORSES

Horses that were once domesticated and have become wild are called **feral** horses. No one knows for sure where, when, and how the first horses escaped from or were stolen from the Spaniards in America. During the 1700s and 1800s, the number of feral horses in America could have been 2 to 5 million. Most of these were located in the Southwest.

Currently, habitats for feral horses are found in California, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. These habitats are public lands administered by the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service. Some horses on these lands have been feral for many generations, but others have been recently released; for example, people release their old horses or when owners cannot afford them.

FIGURE 3–6 Wild horses from the Wyoming Red Desert penned up at the University of Wyoming, Laramie. Note height of fence.

Public concern for the plight of feral horses led to the passage of two federal laws to protect them—Public Laws 86-234 and 92-195. Feral horses are also called **mustangs** (Figure 3–6).

The BLM periodically gathers and removes wild horses to maintain each herd at its appropriate management level (AML). Excess animals are made available to the public through the National Adopt-A-Horse and Burro Program.

DONKEYS

The breeds registered by the American Donkey and Mule Society, which was founded in 1968, are the mammoth (or American standard) jack, large standard donkey (Spanish donkey), standard donkey (burro), miniature Mediterranean donkey, and American Spotted Ass.

The mammoth breed is a blend of several breeds of jack stock first imported into the United States in the 1800s from southern Europe. It is the largest of the asses, with the jacks being 56 inches or more high. The foundation sire was a jack named Mammoth. His name was given to the breed. Currently the American Mammoth is listed as “threatened” by the American Livestock Breeds Conservancy.

FIGURE 3–7 Two wild jacks registered as standard donkey/wild burros, owned by Elmer Zeiss of Valley, Nebraska.

The large standard donkey (Spanish donkey) is between 48 and 56 inches high, while the standard donkey (the burro) is between 36 and 48 inches high. The miniature Mediterranean donkey, originally imported from Sicily and Sardinia, must be under 36 inches (down from the original 38 inches) to qualify for registration. The height restriction is the only requirement for registration by the American Donkey and Mule Society (http://www.lovelongears.com/) (Figure 3–7).

The American Spotted Ass is a trademark of the American Council of Spotted Asses, founded in 1967. It can be registered as either white with colored spots or colored with white spots. However, the spots have to be above the knees and hocks, and behind the throat latch. Stockings and face markings do not qualify.

Seabiscuit

From a dubious start, Seabiscuit became an unlikely champion and a symbol of hope to many Americans during the Great Depression. Seabiscuit was foaled on May 23, 1933, from the mare Swing On and sired by Hard Tack, a son of Man o' War. Seabiscuit was named for his sire, Hard Tack. "Sea biscuit" is the name for a type of cracker eaten by sailors.

The bay colt grew up on Claiborne Farm in Paris, Kentucky. He was owned by Gladys Mills Phipps. He was undersized, knobby-kneed, and lazy. Initially, he was trained by Sunny Jim Fitzsimmons, the trainer who had taken Gallant Fox to the U.S. Triple Crown of Thoroughbred racing. Fitzsimmons saw some potential in Seabiscuit, but felt the horse was too lazy. Seabiscuit was consigned to a punishing schedule of smaller races. He failed to win his first ten races, usually finishing back in the field. As a two-year-old, Seabiscuit raced 35 times, coming in first five times, and finishing second seven times. These included three claiming races, in which he could have been purchased for $2,500, but no one wanted to buy him. The next season, Seabiscuit was again less than spectacular. His owners sold the horse to the California automobile entrepreneur Charles S. Howard for $8,000. His new trainer, Tom Smith, gradually brought Seabiscuit out of his lethargy.

In 1937, Seabiscuit won 11 of his 15 races and was the year's leading money winner in the United States. However, it was War Admiral, having won the Triple Crown that season, who was voted "Horse of the Year."

On November 1, 1938, Seabiscuit raced War Admiral in the "Match of the Century." The race was run over 13/16 miles (1.91 km), at the Pimlico Race Course in Baltimore, Maryland. Trains were run from all over the country to bring fans to the race. The estimated 40,000 at the track were joined by some 40 million listening on the radio. War Admiral was the near unanimous favorite.

When the bell rang, Seabiscuit ran away from the Triple Crown champion. Halfway down the backstretch, War Admiral started to cut into the lead, gradually pulling level with Seabiscuit, and then slightly ahead. The jockey had eased up on Seabiscuit, allowing his horse to see his rival, and then asked for more effort. Two hundred yards from the wire, Seabiscuit pulled away again and continued to extend his lead, finally winning by four lengths, despite War Admiral running his best time for the distance. (Watch Seabiscuit vs. War Admiral on YouTube [http://www.youtube.com/watch?v=WVT2MPNCqgM]).

As a result of his races that year and the victory over War Admiral, Seabiscuit was named "Horse of the Year" for 1938. Seabiscuit was also the number one newsmaker of 1938. On April 10, 1940, Seabiscuit's retirement from racing was officially announced. At the time of his retirement, Seabiscuit was horse racing's all-time leading money winner. Put out to stud, Seabiscuit sired 108 foals. He died May 17, 1947. On June 23, 2007, a statue of Seabiscuit was unveiled at his home and final resting place, Ridgewood Ranch near Willits, California.

Seabiscuit became the subject of a 1949 film, *The Story of Seabiscuit,* starring Shirley Temple; a 2001 book, *Seabiscuit: An American Legend;* and a 2003 film, *Seabiscuit.*

In the Blood-Horse magazine's ranking of the top 100 U.S. thoroughbred champions of the 20th Century, Seabiscuit was ranked twenty-fifth. War Admiral was thirteenth, and Seabiscuit's grandsire and War Admiral's sire, Man o' War, placed first.

Miniature Donkey

The Miniature Donkey Registry of the United States, founded in 1958, is currently governed by the American Donkey and Mule Society. Color and other considerations, such as ancestry, do not define the miniature donkey. The only requirement is that it be 36 inches or less in height.

The original imported donkeys had the typical gray-dun color, in which the hairs are all gray and not mixed with white hairs. All shades of brown are also common, and black, white, roan, and spots are possible. True gray is extremely rare in donkeys of any size, and is distinguished from gray-dun because true gray donkeys are born with a dark coat that lightens to almost white over the years. One other characteristic of the donkey is the cross, consisting of a dorsal stripe from mane to tail and a cross stripe between the withers. In black animals the cross marking may be difficult to detect.

The miniature donkey with good conformation should give the impression of being small, compact, and well rounded; with four straight, strong legs; and all parts in symmetry and balance. The coat of the miniature donkey is not as thick in winter as the coat of larger donkeys, probably because of its ancestry from climates in the Mediterranean.

Although the most obvious use of these little donkeys is as pets, they can also be used as companions to foals at weaning time to relieve foal stress. Their calm also serves when they are used as companions for nervous horses or horses recovering from surgery. They do not take up much room in the stall, but have a great calming effect.

Miniature Donkeys are on the "recovering" list of the American Livestock Breeds Conservancy.

MULES

A cross between a donkey and a horse is called a mule or a **hinny**, depending on its parentage. A mule is the offspring of a male donkey (jack) and a female horse (mare). It is like the horse in size and body shape but has the shorter, thicker head, long ears, and braying voice of the donkey. Mules also lack, as does the donkey, the horse's calluses, or chestnuts, on the hind legs.

The reverse cross—between a male horse (stallion) and a female donkey (called a **jennet** or jenny)—is a hinny, sometimes also called a jennet. A hinny is similar to the mule in appearance but is smaller and more horse like, with shorter ears and a longer head. It has the stripe or other color patterns of the donkey.

Classifications of Mules

Historically, mules were classified as draft, sugar, farm, cotton, and pack and mining. Draft and sugar mules were the largest, being 17.2 hh (hands high) to 16 hh and 1,600 to 1,150 pounds. Farm and cotton mules were intermediate in size (16 hh to 13.2 hh and 1,250 to 750 pounds). Pack and mining mules were smaller but could range from 16 hh to 12 hh and 1,350 to 600 pounds.

Photo courtesy of Meredith Hodges and American Donkey and Mule Society, Lewisville, TX

FIGURE 3–8 **Meredith Hodges cross-country jumping with her mule.**

Today mules are classified as draft, pack/work, saddle, driving, jumping, or miniature (Figure 3–8). The type of mule produced depends on the breed or type of horse and breed or type of donkey used to produce the mule.

Zebra Hybrids

Zebra hybrid is an all-encompassing term for a zebra crossed on any other equine. The term *zorse* is to used to describe the cross of a zebras stallion to a horse mare. Other terms seen are zebroid, zony (zebra x pony), or zeony. Zebra-donkey crosses are termed zebroid, zebrass, or ze-donk.

Zebras may appear to have "ponyish" bodies, but the hip shape does differ as well. Zebras ears are larger and rounder than horse ears. The Mountain zebras have almost donkey-like ears, while the Grevy's zebra sports a huge flared conical ear. The necks are characteristically straighter in the longears, and most donkeys and all zebras lack a true wither. The manes are stiff and upright, and zebras, like donkeys, have no forelocks. Zebras have variety of noises, most commonly the "qua-ha" or "barking" sound. These traits are all passed along, in part, just as they are in mules, to zebra hybrid offspring. Most zebrasses (Zebra x donkey crosses) look just like donkeys with zebras striping on the colored coat.

Zebra hybrids, depending on the parents, will be either more horselike or more ass-like in body shape. They also are typically smaller than most horses or mules. Most zebra breeds are small, even the largest variety, the Grevys, is only about 13 hands high.

SUMMARY

Worldwide, about 300 breeds of horses exist. They range in size from the gentle giant draft horses at almost 6 feet in height to the miniature horses at barely 3 feet in height. People have bred and selected horses for specific, common characteristics such as function, conformation, and color. Horses breeding true or with a common ancestry are registered in breed registry associations. These horses meet the standards defined by the registry. Besides breeds, horses are classified by type, such as light, draft, and pony; and by use, such as riding, driving, harness, sport, gaited, stock, and all-purpose. Some breeds have specific purposes while other breeds serve a variety of uses.

Five breeds of donkeys are recognized. Donkeys are crossed with horses to produce mules. The type of mule that results depends on the breed and type of donkey and horse used in the cross. Both donkeys and horses have miniatures. These miniatures are used for pets and exhibition hitches and as companions to sick or nervous horses.

Any equine crossed with a zebra is referred to as a zebra hybrid or depending on the species can be called zebroid, zony (zebra x pony), or zeony. Zebra-donkey crosses are termed zebroid, zebrass, or ze-donk.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Feral horses were commonly bred by the early Spaniards.
2. Coldblood horses and draft horses are similar classifications.
3. Warmblood horses exhibit a body temperature 3 degrees above normal.
4. A mule is the offspring of a stallion bred to a female donkey or jennet.
5. Mules are ridden in contests.

Short Answer

6. Name the three foundation stallions of the Thoroughbred breed.
7. Name five color breeds of horses.
8. Name five common breeds of light horses and give their place of origin.
9. How long is the measurement of one hand?
10. Name five common breeds of draft horses and give their place of origin.
11. How many chromosomes do horses, donkeys, and mules possess?
12. Name two common breeds of donkeys.
13. List five lesser-known breeds of horses and give their classification and country of origin.
14. List six uses for mules.

Critical Thinking/Discussion

15. What is a breed?

17. Describe 10 uses for horses.
18. Discuss some of the uses for miniature donkeys and horses.
19. Compare light horses to draft horses.
20. Compare a mule to a horse.

STUDENT ACTIVITIES

1. Choose a competitive event such as racing, driving, dressage, or riding. Research the breed of horse most commonly used for this event, and explain why the breed is appropriate for the event.
2. Write to a breed registry association listed in Table A–16 of the appendix, and request more information and pictures of a breed of light horse, draft horse, or pony.
3. Use the Internet to discover more information about five horse breeds of your choice. Write a report comparing the five breeds.
4. Construct a family tree for a famous Thoroughbred showing how this horse's ancestry can be traced to the foundation stallions.
5. Some horse breeds have their own magazine or newsletter. Select two common breeds from Table 3–1, and obtain sample copies of their newsletter or magazine. Next, read an article of your choice in the magazine or newsletter and write a summary.
6. Create a poster showing the color markings of the Appaloosa, the paint, the pinto, and the buckskin horse. Describe how horses are bred to produce these color breeds.
7. Explain why the process of blood typing could be important to breed registration, and diagram how blood typing is done.
8. Watch Seabiscuit vs. War Admiral on YouTube (http://www.youtube.com/watch?v=WVT2MPNCqgM). Then make a video of yourself giving a report on the race as if it occurred today.

ADDITIONAL RESOURCES

Books

Barton, F. T. (2010). *Our friend the horse: A complete practical guide to all that is known about every breed of horse in the world.* Chestnut Hill, MA: Adamant Media Corporation.

Dossenbach, M., & Dossenbach, H. D. (1994). *The noble horse.* New York: Crescent Books.

Dutson, J. (2005). *Storey's illustrated guide to 96 horse breeds of North America*. North Adams, MA: Storey Publishing.

Draper, J. (2008). *The illustrated guide to horse breeds: A comprehensive visual guide to the horses and ponies of the worlds, with over 300 color photographs.* London: Lorenz Books, Arness Publishing, Ltd.

Evans, J. W. (2000). *Horses: A guide to selection, care, and* enjoyment, 3rd ed., New York: Owl Books.

Hendricks, B. L. (2007). *International encyclopedia of horse breeds.* Norman: University of Oklahoma Press

Knight, L. W. (2009). *The breeding and rearing of jacks, jennets and mules-1902.* Ithaca, NY: Cornell University Library.

McBane, S. (2008). *The illustrated encyclopedia of horse breeds: A comprehensive visual directory of the world's horse breeds.* Edison, NY: Wellfleet Press.

Mills, F. C. (1971). *History of American jacks and mules.* Hutchinson, KS: Hutch-Line.

Peplow, E. (2005). *Encyclopedia of the horse,* 2nded. New York: Barnes & Noble.

Sponenberg, D. P. (2009). *Equine color genetics*. Ames: IA: Wiley-Blackwell.

Associations and Registries

Any of the associations or registries in appendix Table A–16 can be contacted for more information about a specific breed.

Magazines

Magazines such as *Horse Illustrated, Horse & Rider, Western Horseman,* and *Horse and Horseman* often feature articles on single breeds.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as, Google, or Bing, find more information by searching for these words or phrases:

specific name of any horse breed	draft horses	mules
foundation sires	miniature horses	types of mules:
horse color breeds	cob	draft
warmblood horses	hack	pack/work
coldblood horses	roadster	saddle
pony	feral or wild horses	driving
light horses	mustangs	jumping
	donkeys	miniature

Some good Web sites for learning more about the many breeds and types of horses, mules, and donkeys include the following:

Horse World Data (http://www.horseworlddata.com/breed.html)
Breeds of Livestock (http://www.ansi.okstate.edu/breeds/HORSES/)
The International Museum of the Horse (http://www.imh.org/imh/bw/home2.html/)
BloodHorse.com (http://www.bloodhorse.com/)

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 4

Cells, Tissues, and Organs

Functional anatomy begins with the cell, and an understanding of cell types and cell processes. Depending on their location, cells develop specialized functions. Next, groups of cells form tissues and then organs. These organs become parts of systems that function together to produce a healthy, productive animal.

OBJECTIVES

After completing this chapter, you should be able to:

- Explain the importance of cells and their function to the horse
- Identify the parts and organelles of animal cells
- List and describe the functions of each of the major types of specialized animal cells
- List the cell organelles and the functions of each part
- Describe how specialized cells are organized to form a tissue type
- List and describe the six types of specialized animal tissues and their individual functions
- Describe the difference between meiosis and mitosis
- Describe blood and its function

KEY TERMS

adenosine triphosphate (ATP)
adipose
axon
blastula
cells
centrioles
chromatids
citric acid cycle
cristae
cytoplasm
epithelial
fertilization
gametes
gastrulation
glycolysis
Golgi apparatus
granules
hemostasis
histogenesis
interphase
lysosomes
meiotic cycle
mitochondria
mitosis
morphogenesis
myelin
myofibrils
nucleus
organelles
ovum
oxidative phosphorylation
plasma membrane
receptors
ribonucleic acid (RNA)
ribosomes
sarcolemma
spermatozoa
stimuli
synapses
tissue
vacuoles

CELLS

All living material is made of **cells** or the chemical products of cells. Understanding the cell as the fundamental unit of life is the basis for an understanding of living organisms such as the horse.

Modern cellular biology makes six assumptions:

1. All living material is made up of cells or the products of cells.
2. All cells are derived from previously existing cells; most cells arise by cell division, but in sexual organisms they may be formed by the fusion of a sperm and an egg.
3. A cell is the most elementary unit of life.
4. Every cell is bounded by a **plasma membrane**, an extremely thin skin separating it from the environment and from other cells.
5. All cells have strong biochemical similarities.
6. Most cells are small, about 0.001 cm (0.00004 inches) in length.

The three general functions of most cells include:

- Maintenance
- Synthesis of cell products
- Cell division

These functions require the cell to take in nutrients and excrete waste products. The nutrients are used either as building blocks in synthesizing large molecules, or they are oxidized—burned—producing energy for powering the cell's activities. Nutrients commonly used by animal cells in respiration include sugars, amino acids and fatty acids, and a common oxidizing agent (electron acceptor) is molecular oxygen (O_2). Synthesis, maintenance, and mechanical and electrical activity all require energy.

Cellular Respiration

Cellular respiration is the process in which the chemical bonds of energy-rich molecules such as glucose are converted into energy (**adenosine triphosphate; ATP**) usable for life processes. Here is the equation for the oxidation of glucose:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy (ATP)}$$

Cellular respiration occurs in gradual steps through glycolysis, the citric acid cycle, and the electron transport chain that result in conversion of the energy stored in glucose to usable chemical energy in the form of adenosine triphosphate (ATP). ATP is known as the universal currency. ATP is constantly used or converted to adenosine diphosphate (ADP) and regenerated into ATP (Figure 4–1). Waste products of cellular respiration (carbon dioxide [CO_2] and water [H_2O]) are released through exhaled air, sweat, and urine.

Glycolysis is a metabolic pathway that is found in the **cytoplasm** of cells in all living organisms. The process converts one molecule of glucose into two molecules of pyruvate (pyruvic acid), and makes energy in the form of two net molecules of ATP.

Citric acid cycle, also called Krebs cycle or the tricarboxylic acid cycle, produces acetyl-CoA from the pyruvate when oxygen is present. Once acetyl-CoA is formed, two processes can occur, aerobic or anaerobic respiration. When oxygen is present, the

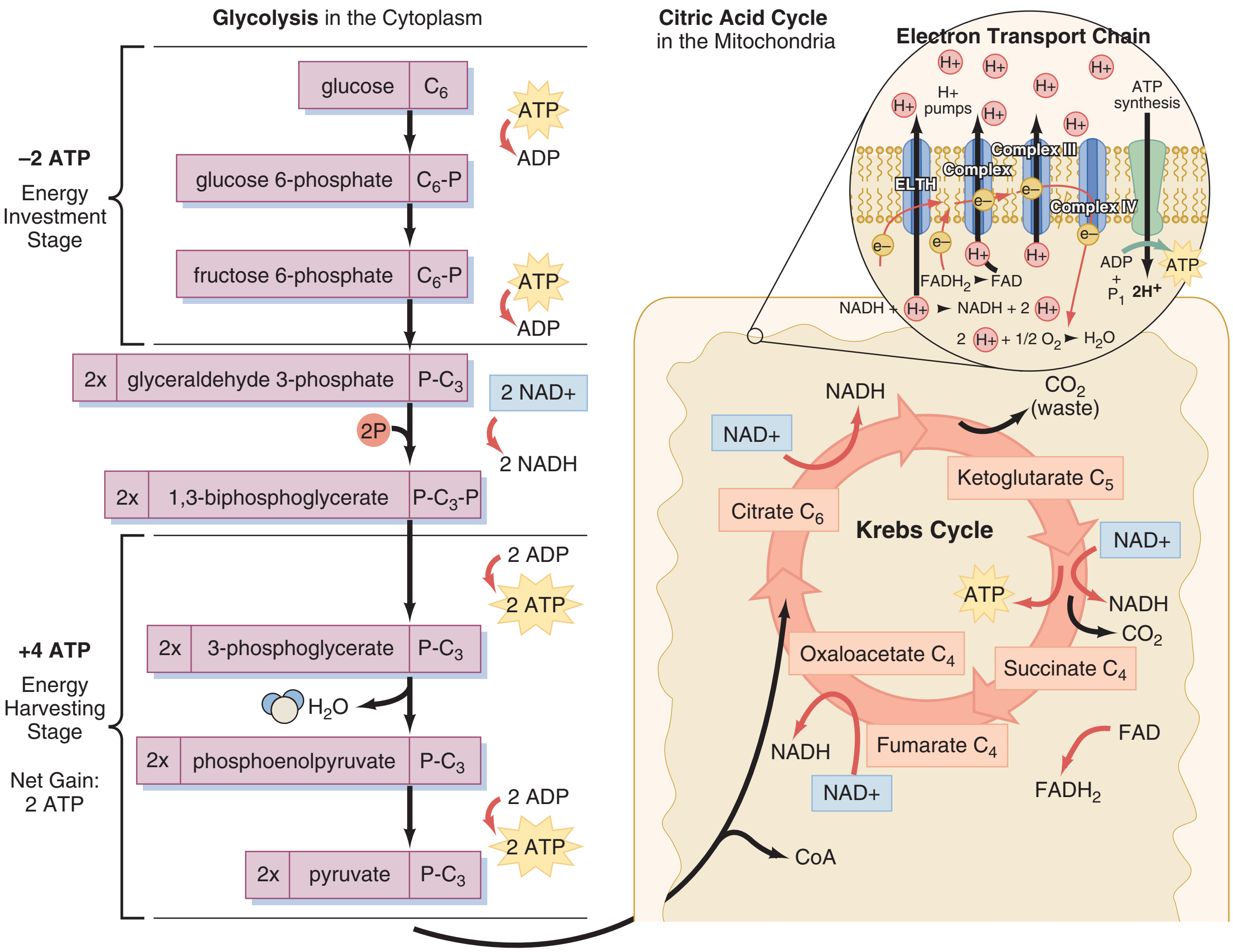


FIGURE 4–1 **Energy-producing reactions of cellular respiration in a typical cell. ATP acts as an energy carrier for those reactions in the cell that release energy and those reactions that consume energy.**

mitochondria will undergo aerobic respiration, which leads to the Krebs cycle. However, if oxygen is not present, fermentation of the pyruvate molecule will occur. In the presence of oxygen, when acetyl-CoA is produced, the molecule then enters the citric acid cycle (Krebs cycle) inside the mitochondrial matrix, and gets oxidized to CO_2

Oxidative phosphorylation occurs in the mitochondrial **cristae**. It comprises the electron transport chain that establishes a proton gradient (chemiosmotic potential) across the inner membrane by oxidizing the NADH produced from the Krebs cycle. ATP is synthesized by the ATP synthase enzyme when the chemiosmotic gradient is used to drive the phosphorylation of ADP. The electrons are finally transferred to exogenous oxygen and, with the addition of two protons, water (H_2O)is formed.

The complete oxidation of each glucose molecule to CO_2 and H_2O produces 38 ATPs.

Components of Cells

A cell is enclosed by a cell membrane. The material known as the **cytoplasm** lies within the cell membrane and contains several **organelles** and **granules** in suspension (Figure 4–2). Major components of the cell include:

- Plasma membrane
- **Nucleus**

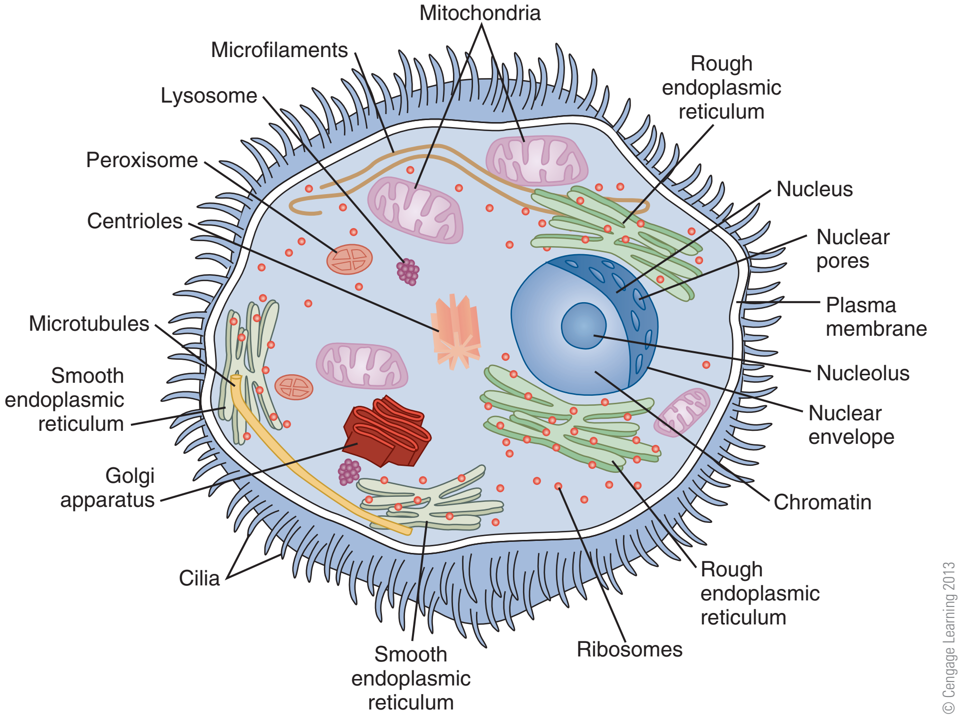


FIGURE 4–2 **A model animal cell and its components.**

- **Ribosomes**
- Endoplasmic reticulum (smooth and rough)
- **Golgi body**
- **Centrioles**
- Microfilaments, microtubules, **lysosomes**, and storage particles

Plasma Membrane

Cells are surrounded by a thin membrane of lipid (fat) and protein. This membrane controls the transport of molecules in and out of the cell, serving as a boundary between the cell and the surrounding **tissue**. Other membranes also occur in a cell's interior, for example, as part of the endoplasmic reticulum, nucleus, and mitochondria. The exterior portions of the cell surfaces determine cell-to-cell interactions, so they are important in formation and control of tissues. The extracellular material also acts as a glue that holds cells together in tissues.

Nucleus

Most cells have a single nucleus enclosed by a nuclear envelope, or membrane, with pores. Pores provide continuity between the nucleus and the cytoplasm. The nucleus contains one or more discrete structures, known as nucleoli, which are sites of ribosomal **ribonucleic acid (RNA)** synthesis. Hereditary information is carried in the DNA contained within the chromosomes in the nucleus. In the nucleus, this information is transcribed into the RNA, which serves as a messenger. The messenger then moves outside of the nucleus to the ribosomes, where it guides the synthesis of proteins. Thus, the nucleus directs the activity of the cell.

Ribosomes

Ribosomes are tiny particles within the cell. Made of RNA and protein, they are present in large numbers in most cells and are the site of protein synthesis (the manufacture of large protein molecules from amino acid subunits).

Endoplasmic Reticulum

Within most cells is a complex set of membranous structures. When viewed with an electron microscope, the membranes are either rough—covered with granules or ribosomes—or smooth. Generally, the rough endoplasmic reticulum is highly developed in cells that make large amounts of protein.

Golgi Apparatus

A special type of membrane mixture is often found near the nucleus. This collection of membranes is called the Golgi apparatus. In cells that synthesize and secrete lipids and proteins, the Golgi apparatus is the site of accumulation.

Mitochondria

Mitochondria are composed of an outer membrane and a winding inner membrane. A series of chemical reactions that occur on the inner membrane, called cristae, convert the energy of oxidation into the chemical energy of ATP. In this process, called oxidative phosphorylation, the predominant energy transfer molecule is ATP. Almost all of the energy passes through this molecule before being used in cell function. Cells with high rates of metabolism usually have a large number of mitochondria.

Centrioles

Most cells have two cylindrical bodies, called centrioles, located near the nucleus. The centrioles appear as sets of triple tubules. Centrioles play a part in cell division.

Other Organelles

The material containing the organelles is called ground substance, or cytoplasm. It contains proteins, small molecules, and a group of entities organized as microfilaments and microtubules. Microfilaments are long, thin, contractile rods that appear to be responsible for the movement of cells, both external and internal.

Microtubules are hollow, cylindrical groupings of tubelike structures that help give the cell shape and form. They are also involved in other cell processes.

Lysosomes are small bodies where large numbers of enzymes are stored. Some cells may also have particularly large liquid-filled areas known as **vacuoles**. The vacuoles are believed to be involved in digestion or excretion, or both.

Storage particles comprise a diverse group of structures and contain lipid droplets and glycogen granules whose function is the long-term storage of energy.

Morphogenesis

All organisms, regardless of their complexity, begin as a single cell. By repeated cell growth and **mitosis**, or division, the organism eventually develops into an adult containing thousands of billions of cells. This process of development is called **morphogenesis**. Because many different types of cells exist in fully grown animals,

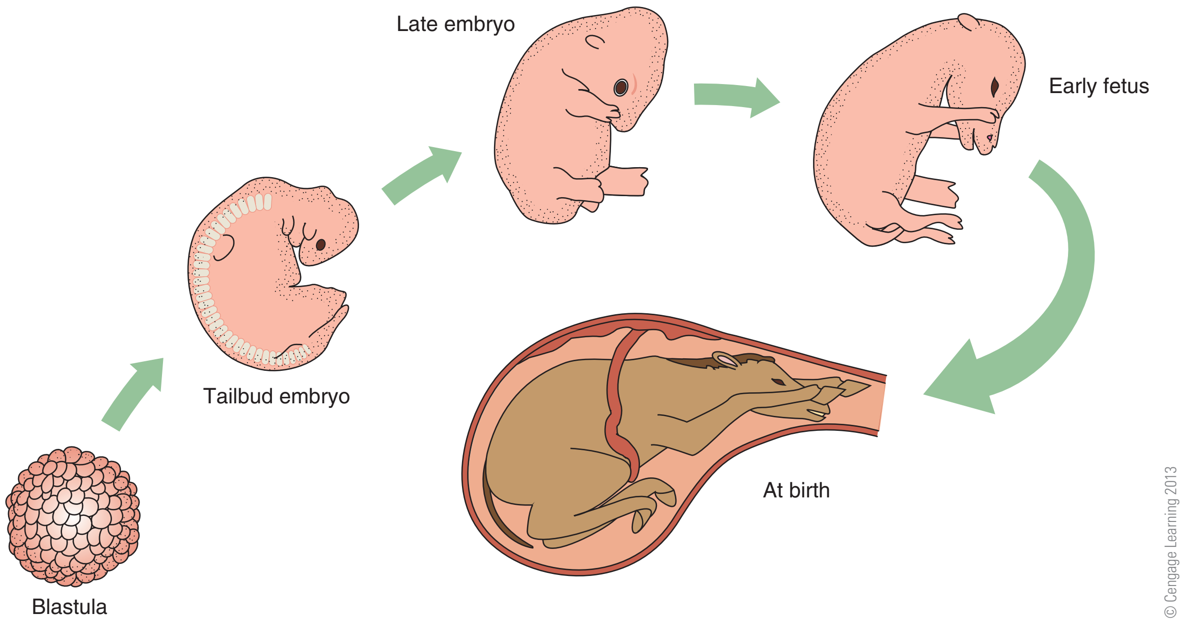


FIGURE 4–3 **Changes of horse from embryo to fetus to horse.**

morphogenesis involves not only cell growth but differentiation into specialized types of cells (Figure 4–3). This differentiation is controlled by the genes. The information needed to program and guide the growth is contained within the chromosomes. Size, shape, and chemical activity of the cells are governed to some extent by the function of the tissue in which they are found.

Each cell contains the same total genetic information that was present in the fertilized egg. The cells are not identical, because in different types of cells, groups of genes are controlled—switched on and off—by various biochemical processes. Each cell manufactures the proteins and structures needed for it to function. Blood cells make hemoglobin to carry oxygen. Sperm cells make flagella, and so forth. On average, only about 10 percent of the genes of any cell are functional—which genes, in particular, vary with the type of cell. Although morphogenesis has been scientifically described in great detail for a number of organisms, all of the processes involved at the cellular level are still not understood.

Cell Division

The nucleus controls cell division; cell division depends on two events:

1. The replication (copying) of the DNA molecules that make up the basic genetic material of all cells.
2. The orderly separation of the products of this replication.

To survive, each new cell must have the same genetic code as its parent cell. For cells to reproduce, both the division of the nucleus and the division of the cytoplasm are necessary.

Mitotic Cycle

Mitosis is part of a more complex cycle that includes a long phase, called **interphase**. Due to the syntheses that take place during interphase, each chromosome consists of

MEASURING THE CHEMICAL ACTIVITY OF CELLS

Metabolism is the sum of all the chemical reactions in the living cell. These reactions produce useful work and synthesize cell constituents. Almost all cellular reactions are catalyzed by complex protein molecules, called enzymes, that speed reaction rates by a factor of hundreds to millions.

Many structures in the living cell must be periodically replaced. This process of building new molecules is called anabolism. Structures that are worn out or no longer needed are broken down into smaller molecules and either reused or excreted. This process is called catabolism. Great quantities of energy are required not only to produce the work needed for pumping the heart, for muscular contraction, and for nerve conduction but also to provide the chemical work needed to make the large molecules characteristic of living cells. Anabolism and catabolism are aspects of overall metabolism. They occur interdependently and continuously.

In the digestion and metabolism of feed, oxygen is used and carbon dioxide is given off. The rate of oxygen consumption indicates the energy expenditure of a horse, or its metabolic rate. The metabolic rate of a horse at any given time is highly variable and is influenced by many factors, including muscular activity, diet, digestion, lactation, pregnancy, time of day or year, sexual activity, and stress.

To fix a point of reference, a convention has been adopted to serve as the standard metabolic rate. The ideal standard established is the metabolism of an animal under the least physiologically demanding conditions. In the case of humans and livestock, this minimal-rate-of-energy metabolism is called the basal metabolic rate (BMR). It is defined as the rate of metabolism of a fasting animal at rest and under no heat stress.

two sister chromosomes, called **chromatids**, that are identical in their structural and genetic organization and joined at the centromere. Chromatids become visible when mitosis sets in; the remainder of the mitotic cycle involves their separation into two offspring nuclei (Figure 4–4). Mitosis depends on four major events—coiling, orientation, movement, and uncoiling. The six essential stages of the mitotic cycle are:

1. Interphase
2. Prophase
3. Metaphase

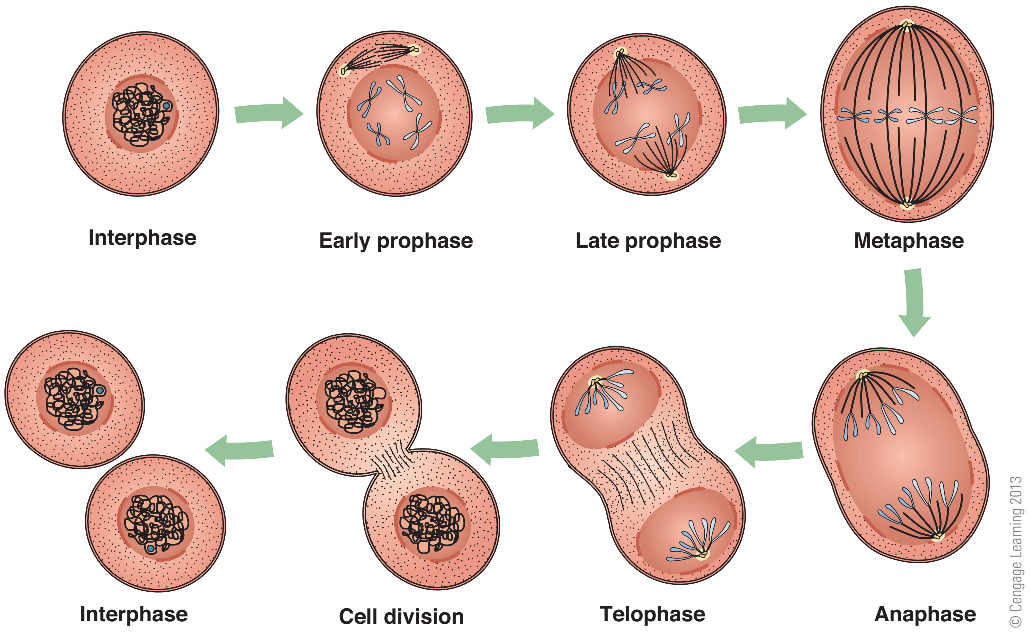


FIGURE 4–4 **Stages of mitosis**

4. Anaphase
5. Telophase
6. Cytokinesis or cell division

Meiotic Cycle

Mitosis rarely lasts more than two hours, but the **meiotic cycle (meiosis)** that produces **gametes**, or sex cells, may take days or weeks, since it involves two successive sequences of cell division and a reduction in the number of chromosomes. Each cell resulting from meiosis has one-half the number of chromosomes contained in the parent cell or other body cells (see Figure 4–5). Also, the chromosomes in the resulting cells are sorted. The stages of the meiotic cycle include:

- Parent cell
- Prophase 1

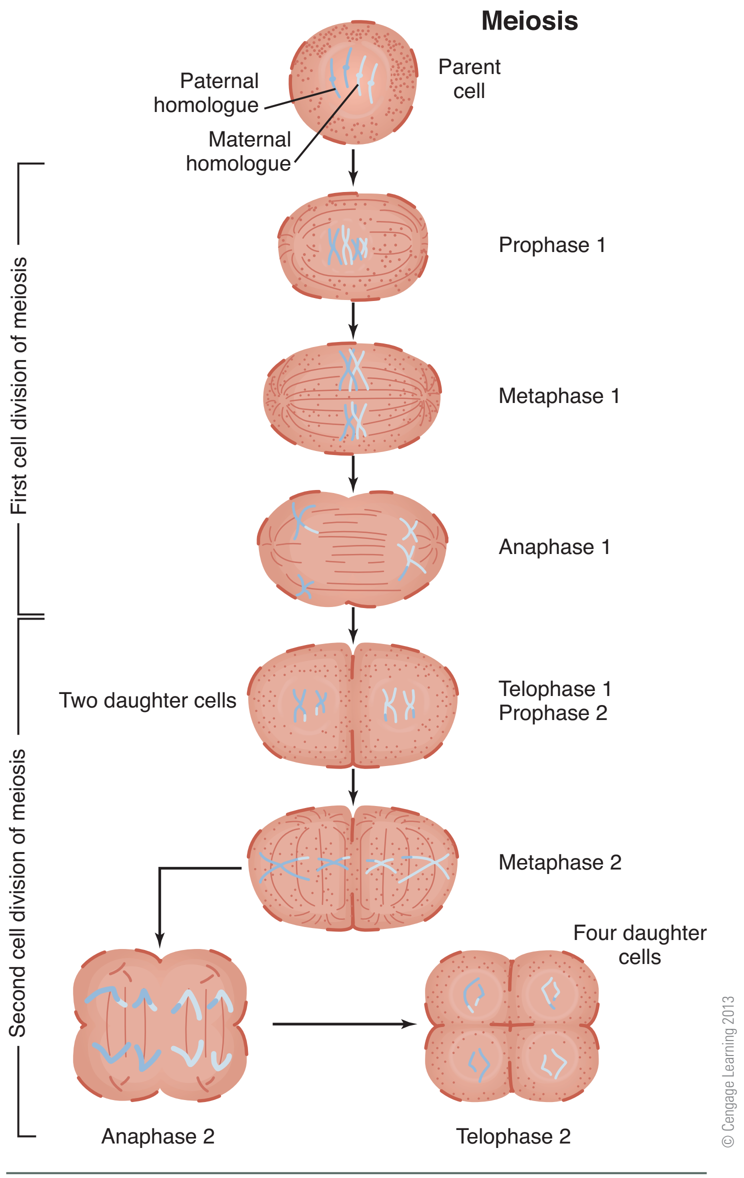


FIGURE 4–5 **Stages of meiosis.**

- Metaphase 1
- Anaphase 1
- Telophase 1
- Prophase 2
- Metaphase 2
- Anaphase 2
- Telophase 2

Types of Cells

During morphogenesis, several major types of animal cells form, including absorptive, secretory, nerve, sensory, muscle, and reproductive cells. All must arise during morphogenesis from cells that are less differentiated.

Absorptive Cells

Absorptive cells often occur as continuous sheets on surfaces where material is transported to the cells. For example, the single layer of **epithelial** cells lining the surface of the small intestine selectively absorbs food molecules from the gut into the bloodstream. These cells have a free surface that faces the digestive tract and a base surface that is in contact with the capillaries. The free surface is covered with many projections called microvilli, which vastly increase the area available for molecular flow (Figure 4–6).

Similar cells are found in the kidney, where a large surface area is needed for the absorption of protein, water, salts, and other materials. The microvilli are an example

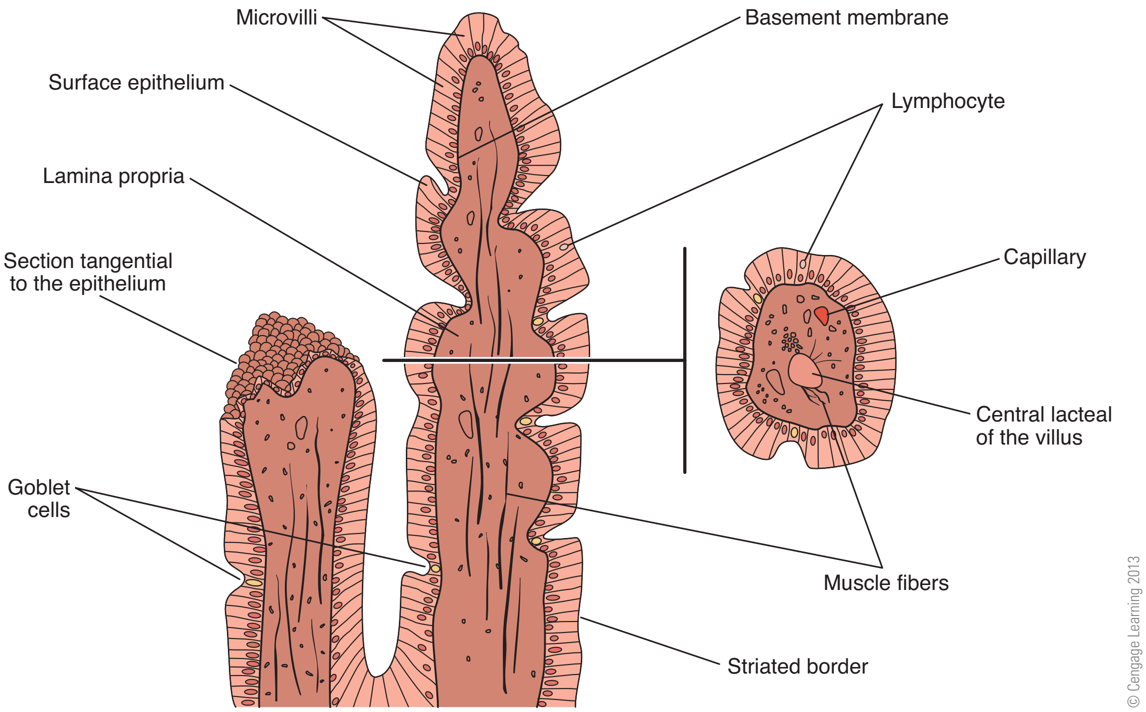


FIGURE 4–6 **Diagram of absorptive cell.**

of a cell structure fitted to the function of the cell. Because an absorptive cell needs maximum area for transport, the shape of the cell surface is altered to achieve the optimum transfer of molecules.

Secretory Cells

Secretory cells produce products that are subsequently deposited in either the bloodstream or a special duct to an organ, where they are used. The pancreas and pituitary are glands that have large numbers of secretory cells. Proteins and other cell products are synthesized throughout the cytoplasm of these cells and transported to the Golgi apparatus, where they are packaged in membrane-bounded vesicles that come to a cell's surface and discharge the secretion outside the cell. Secretory cells in the spleen, lymph nodes, and other sites synthesize antibodies for the recognition and destruction of foreign molecules.

Nerve Cells

A nerve cell consists of a main cell body and a long, thin structure known as an **axon** (Figure 4–7). The function of nerve cells is to transmit electrical messages from one part of the cell body to another. These cells function like telephone transmission lines. The connections between nerve cells are called **synapses**. When these structures are combined, they form an electrical network known as the nervous system. The processes that occur at the synapses are both electrical and chemical. The axon is covered with a layer of insulation called **myelin**. Axons carry electrical signals called nerve impulses.

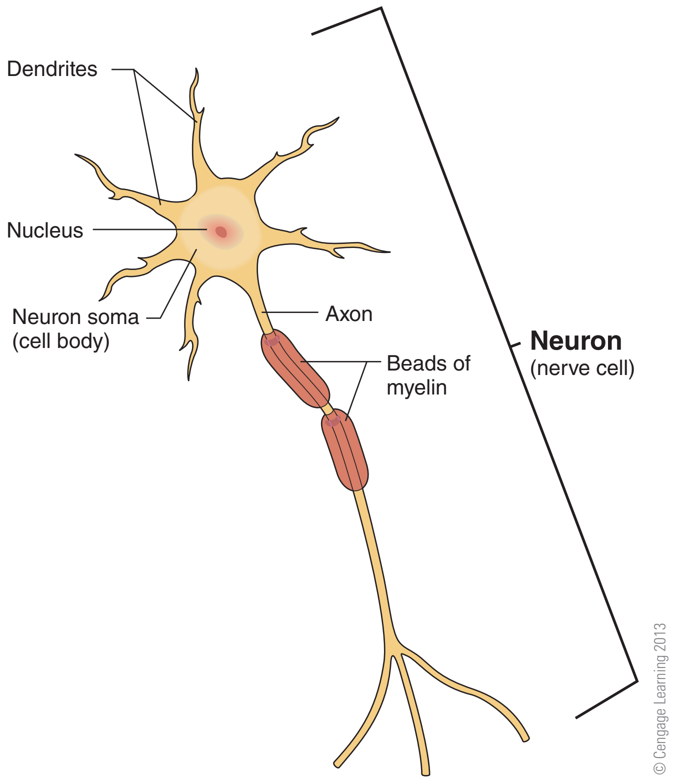


FIGURE 4–7 **Diagram of nerve cell.**

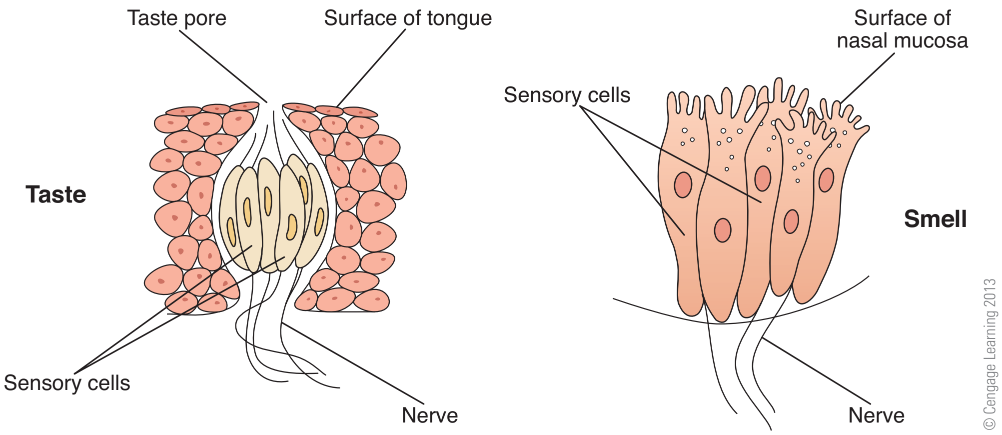


FIGURE 4–8 **Diagram of sensory receptors.**

Sensory Cells

Sensory cells respond to impulses by emitting electrical signals. An example is the rod cell of the eye, in which the central cell body has two long, thin appendages. One appendage has an outer segment consisting of specialized stacked membranes for the reception of light. At the other end is a long, thin connection to a nerve cell that leads to the optic nerve fiber. About half of the material in the outer segment consists of rhodopsin, the pigment used in detecting light. Other sensory **receptors** include free nerve endings, pacinian corpuscles, ruffini corpuscles, taste buds, hearing receptors, and smell receptors (Figure 4–8).

Muscle Cells

Muscles are of three types—skeletal (voluntary), cardiac, and smooth or involuntary (Figure 4–9). Contraction of muscle fibers generates a mechanical force. The skeletal muscle is a multinucleate structure with an outer envelope known as the **sarcolemma**. Skeletal muscle cells are actually a tissue in which the cells have merged. Most of the interior consists of long, thin **myofibrils** that are actually the contractile elements.

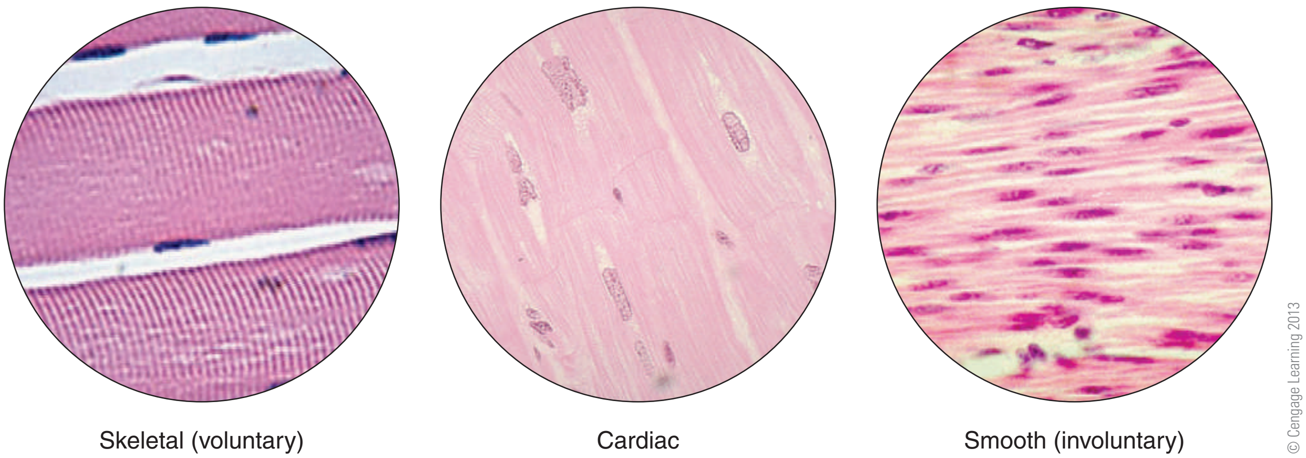


FIGURE 4–9 **Diagram of three types of muscle cells.**

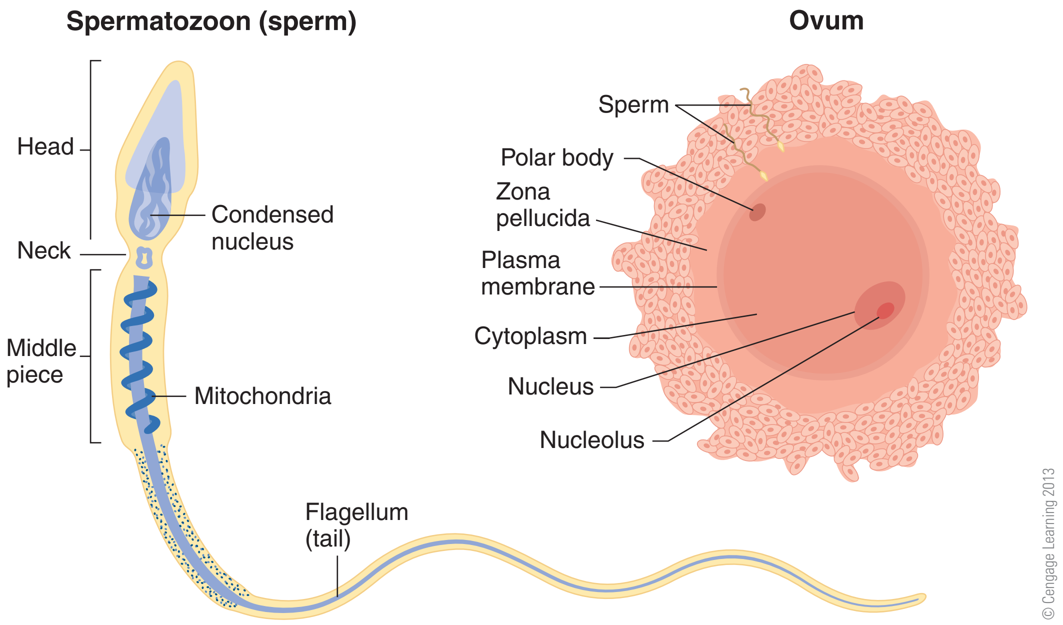


FIGURE 4–10 **Diagram of equine sperm and egg cell.**

Reproductive Cells

Gametes are formed after completion of the process of meiosis, which halves the number of chromosomes in each cell. Stallion gametes or **spermatozoa** (sperm) are motile, whereas a mare's gamete or **ovum** (egg) is larger and stationary. **Fertilization** occurs when a sperm is fused with an egg. This stage is followed by morphogenesis (Figure 4–10).

TISSUES

Tissues are structured groupings of cells specialized to perform a common function necessary for the survival of the horse—a multicellular animal. The process of tissue formation or **histogenesis** evolves from the earlier process of cell differentiation.

The fertilized ovum or egg, a single cell, divides to form the **blastula**, in which tissues are not yet defined (Figure 4–11). As growth continues, the cells of the blastula begin to form three germ layers— ectoderm, mesoderm, and endoderm—through the process of **gastrulation**. Cell differentiation during gastrulation begins the process of histogenesis and continues into the formation of organs.

The cells in a tissue look more or less alike and contribute the same type of service. Five general classifications of tissues are:

1. Nerve
2. Epithelial
3. Muscle
4. Connective
5. Fluid

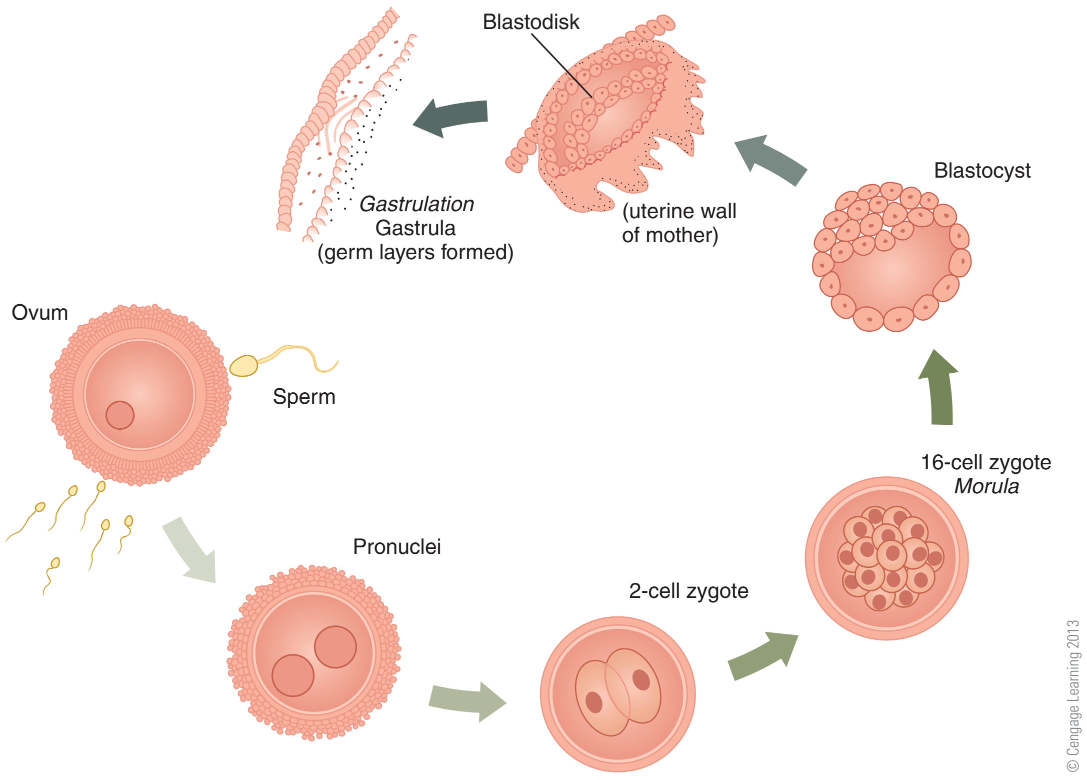


FIGURE 4–11 **The early stages of embryology.**

Nerve Tissue

Nerve tissues consist of extraordinarily complex cells called neurons. The neurons respond in a specific way to a variety of **stimuli** so as to transfer information from one part of the body to another (Figure 4–12).

Epithelial Tissue

Epithelial tissue consists of a layer of cells covering the external surfaces of an animal and lining its internal tubes for digestion, respiration, circulation, reproduction, and excretion. This layer controls what is absorbed into and lost from the organism. The epithelium is composed of continuous sheets of adjacent cells. Outgrowths and ingrowths of epithelium form the sensitive surfaces of sensory organs, glands, hair and nails, and other structures.

Muscle Tissue

The ability to contract and relax and thus provide movement is characteristic of muscle tissue. Muscle tissue is of three types. Smooth muscle is activated by the autonomic nervous system (controlled automatically without thought processes). Skeletal muscle is controlled by the central nervous system and, to a certain extent, by thought processes (the will) that choose to contract a muscle or group of muscles (Figure 4–12). Cardiac muscle is characterized by its ability to contract rhythmically.

Courtesy of Botts/Watson Photography, Ontario, Canada

FIGURE 4–12 **Contraction of skeletal muscles produces force for locomotion. Barrel racing requires the nervous system of the horse to coordinate the contraction of many muscles.**

Connective Tissue

Connective tissues contain large amounts of extracellular material modified into different types. They are varied in structure to permit them to support the entire body and to connect its parts. Connective tissue includes fibrous tissue found in tendons and ligaments; elastic tissue found in ligaments between the vertebrae, arterial walls, and trachea; cartilaginous tissue found in joints and in the development of bone; and **adipose** tissue that, with its fat deposits, cushions and supports vital organs and stores excess food.

Fluid Tissue

Fluid tissues are the blood and lymph. These tissues function to distribute food and oxygen to other tissues, carry waste products from the tissues to the kidneys and lungs, and carry defensive cells and other substances to destroy disease-producing agents (Figure 4–13). Blood also helps to keep the body at a constant temperature.

Blood consists of white blood cells, red blood cells, and platelets suspended in plasma, a watery, straw-colored fluid (Figure 4–13). Plasma makes up about 55 percent of the blood, while blood cells and platelets make up the remaining 45 percent.

Plasma

Plasma is made up of 92 percent water, 7 percent proteins, salts, and other substances it transports. Fibrinogen is an important protein involved in blood clotting. Albumins

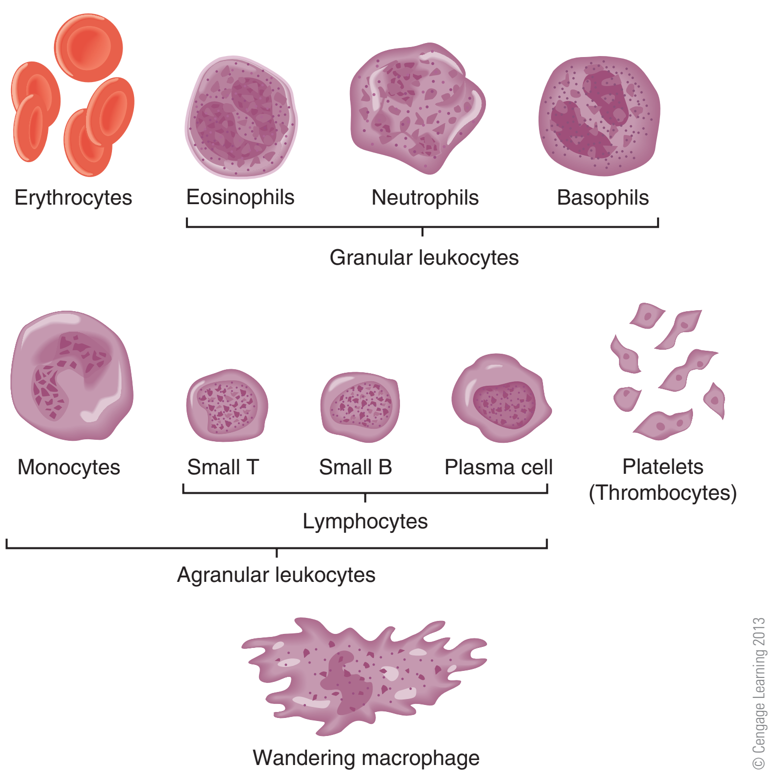


FIGURE 4–13 **Example of blood cells and platelets.**

and globulins are proteins that aid in the regulation of fluid in and out of the blood vessels. Proteins called gamma globulins act as antibodies and help protect the body against foreign substances, called antigens.

The salts present in plasma include sodium, potassium, calcium, magnesium, chloride, and bicarbonate. They are involved in many important body functions such as muscle contraction, the transmission of nerve impulses, and regulation of the body's acid-base balance. The remaining substances in plasma include nutrients, hormones, dissolved gases, and waste products that are being transported to and from body cells. These materials enter and leave the plasma as blood circulates through the body.

Red blood cells

The main function of red blood cells, or erythrocytes, is the transport of oxygen from the lungs to body tissues. Erythrocytes are tiny disk-shaped structures that are hollowed out on either side. Their small size allows them to squeeze through microscopic blood vessels called capillaries. Red blood cells are formed in the bone marrow of certain bones, where they produce a substance called hemoglobin. Hemoglobin is a protein pigment that contains iron and that gives red blood cells their color. The hemoglobin in red blood cells combines with oxygen in the lungs, transporting that oxygen to the tissues throughout the body. It also carries carbon dioxide from the tissues back to the lungs, where some of the carbon dioxide is exhaled. Each red blood cell lives only about four months. New red blood cells are constantly being produced in the bone marrow to take the place of old ones.

White blood cells

White blood cells, or leukocytes are part of the immune system. They defend the body against viruses, bacteria, and other invading microorganisms. There are five kinds of white blood cells in blood: neutrophils, eosinophils, basophils, monocytes, and lymphocytes. Each plays a specific role in the body's immune or defense system. Lymphocytes make up roughly one-fourth of all white blood cells in the body. They are divided into two classes: T- lymphocytes and B- lymphocytes. The letter T refers to the thymus, an organ located in the upper chest region where these cells mature. The letter B refers to the bone marrow where these specific lymphocytes mature. Macrophages are white blood cells produced by the differentiation of monocytes in tissues.

Platelets

Platelets are small, disk-shaped fragments of cells that are broken off from other cells in the bone marrow. They help to control bleeding in a complex process called **hemostasis**. When an injury to a blood vessel causes bleeding, platelets stick to the ruptured blood vessel and release substances that attract other platelets. Together they form a temporary blood clot. Thrombocyte is another name for platelet.

ORGANS

Groups of specialized tissues performing a specific function are called organs. The stomach is an organ of digestion. The uterus is an organ of reproduction. A group of organs working together is known as a system. For example, the stomach is only one of the organs in the digestive system, and the uterus is only one organ in the reproductive system.

Chapter 5 discusses the systems formed by the organs in the body of the horse.

SUMMARY

All living material is made of cells or the chemical products of cells. Most of the cells in the body of the horse carry on the processes of maintenance, synthesis, and cell division. As cells carry on these life processes, they require energy and produce waste products.

All cells contain the same genetic information, but through morphogenesis cells grow and develop into specialized cells. Tissues are structured groupings of cells specialized to perform a common function necessary to the survival of the horse. The five basic tissue types include nerve, epithelial, muscle, connective, and fluid. Tissues combine to form organs, and organs group to form functional body systems.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Prophase occurs in both mitosis and meiosis.
2. Axons are a part of absorptive cells.
3. Groups of specialized cells are called organs.
4. An end product of mitosis is sperm cells or an egg.
5. The pancreas and pituitary are glands that have large numbers of secretory cells.

Short Answer

6. List five of the ten major components of a cell.
7. Name three general functions of all cells.
8. Name two gametes.
9. Identify five general types of tissues.
10. What general type of tissue includes fibrous, elastic, cartilaginous, and adipose tissue?
11. Give an example of a fluid tissue.
12. What type of information is carried in DNA?

Critical Thinking/Discussion

13. Describe six assumptions that make the cell the fundamental unit of life.
14. Discuss the concept of morphogenesis.
15. Explain the difference between mitosis and meiosis.
16. Discuss the differences between skeletal, smooth, and cardiac muscle.
17. Describe the two events that cell division depends upon.
18. What is the importance of ATP?

STUDENT ACTIVITIES

1. From a biological supply company, obtain prepared microscope slides of epithelial tissue, muscle tissue, nerve tissue, connective tissue, and blood. View these through a microscope, and make sketches of each type. As an alternative, search the Internet for sites with photographs of tissue cross sections and histological (tissue) discussions.
2. Draw and label your own diagram of an animal cell. Label all of the components of the cell.
3. Develop a report on the production of ATP in the body. How is it produced, and where is it used? Briefly, outline the biochemistry involved in producing and using ATP.
4. Obtain a blood smear and staining kit. Using your own blood, make and stain some blood smears, and observe these through the microscope. Make drawings of your observations.

ADDITIONAL RESOURCES

Books

Asimov, I. (1954). *The chemicals of life.* New York: New American Library.

Aspinall, V., & Capello, M. (2009). *Introduction to veterinary anatomy and physiology textbook*. Oxford, UK: Butterworth-Heinemann

Frandson, R. D., Wilke, W. L. & Fails, A. D. (2009). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.

Hafez, E. S. E. (2000). *Reproduction in farm animals* (7th ed.). Philadelphia: Lippincott, Williams & Wilkins.

Kahn, C. M. (Ed.), & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

Thomas, L. (1978). *The lives of a cell: Notes of a biology watcher.* New York: Penguin Books.

Equipment and Supplies

Carolina Biological Supply Company, Carolina Science and Math Catalog 66, 2700 York Rd., Burlington, NC 27215-3398 <http://www.carolina.com>

Fisher Science Education, 4500 Turnberry, Hanover Park, IL 60133 <http://www.fisheredu.com/>

NASCO Agricultural Sciences, 901 Janesville Ave., Fort Atkinson, WI 53533-0901 <http://www.enasco.com//>

Nebraska Scientific, 3823 Leavenworth St., Omaha, NE 68105-1180 <http://www.nebraskascientific.com/>

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as, Google, or Bing, find more information by searching for these words or phrases:

- cellular biology
- components of the cell
- plasma membrane
- nucleus
- ribosome
- endoplasmic reticulum
- Golgi apparatus
- centrioles
- microfilaments
- microtubules
- lysosome
- organelles
- morphogenesis
- cell division (mitotic cycle, meiotic cycle)
- absorptive cells
- secretory cells
- nerve cells
- sensory cells
- muscle cells
- reproductive cells
- histology
- nerve tissue
- epithelial tissue
- muscle tissue
- connective tissue
- fluid tissue

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 5

FUNCTIONAL ANATOMY

A basic understanding of the functional anatomy of the horse is essential before discussing growth, aging, movement, selection, nutrition, health, breeding, behavior, management, and even facilities. An understanding of the functional anatomy provides a basis for the "why" of everything else involved in modern scientific equine production and equitation.

OBJECTIVES

After completing this chapter, you should be able to:

- List the nine systems of animals and the major organs that make up each system
- Explain the functions of the skeletal, muscular, digestive, urinary, respiratory, circulatory, nervous, reproductive, and endocrine systems
- Identify the components of the skeletal, muscular, digestive, urinary, respiratory, circulatory, nervous, reproductive, and endocrine systems
- List the five divisions of the vertebral column
- Name the bones in the foreleg and hind leg
- Describe three types of joints
- Identify three types of muscles and their locations in the body
- Trace the circulation of blood through the body
- Identify the endocrine glands and the hormones they secrete

KEY TERMS

anaerobic
androgens
anterior
aorta
arteries
articulation
capillary
cartilage
caudal
cecum
cervix
cranial
cryptorchid
dorsal
estrus
expiration
extensor
flexor
ganglia
gastric juice
goiter
homeostasis
hormone
hypercalcemia
hypothyroid
inspiration
insulin
joint
joint capsule
ligament
lymph
nerves
peristalsis
plasma
posterior
pulse

ANIMAL SURFACES AND BODY SYSTEMS

Any discussion of the structure and function of animals begins with an understanding of the terms **dorsal**, **ventral**, **cranial** or **anterior**, and **caudal** or **posterior**. Dorsal pertains to the upper surface of an animal. Ventral relates to the lower or abdominal surface. Anterior or cranial applies to the front or head of an animal. Posterior or caudal pertains to the tail or rear of an animal (Figure 5–1).

Physiology, or the life functions of horses, occurs in body systems. Nine body systems are found in animals, including horses. These systems are:

1. Skeletal
2. Muscular
3. Digestive
4. Urinary
5. Respiratory
6. Circulatory
7. Nervous
8. Reproductive
9. Endocrine

THE SKELETAL SYSTEM

The skeletal system is the rigid framework giving the body shape and protecting the internal organs. It is composed of bone and **cartilage**. Bones are composed of about one part organic matter and two parts inorganic matter. The inorganic matter is mineral, mainly lime salts. The surface of each bone is covered by a dense connective tissue called the periosteum. A union of two bones is called an **articulation** or **joint**. **Ligament**, **tendons**, and a tough, fibrous capsule provide stability or tightness to the joint. Tissues and organs attach to the skeleton.

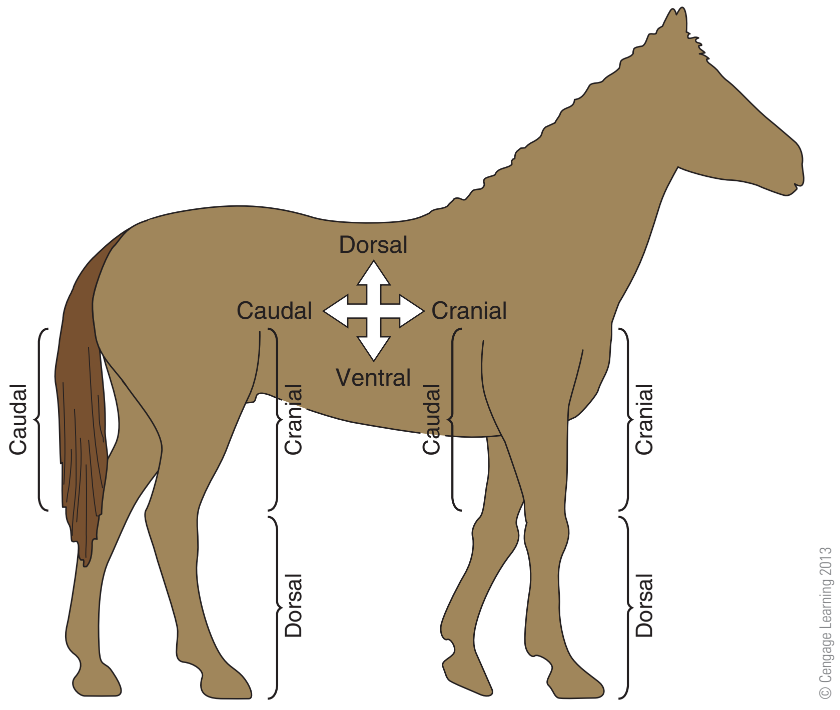


FIGURE 5–1 **The surfaces or planes of a horse.**

KEY TERMS

ridgling
saliva
spinal cord
steroids
tendons
veins
ventral
vertebrae
visceral
zygote

The bones and joints together compose a complex system of levers and pulleys that, combined with the muscular system, give the body the power of motion. The skeleton also stores up needed minerals, mainly calcium and phosphorus; acts as a factory for the manufacture of blood cells; and, in the adult animal, stores fat in the limb bones.

The relative size and position of the bones determine the form (or conformation) of the horse and its efficiency for any particular work (Figure 5–2). Bones are classified by their shape as long, short, flat, and irregular.

- Long bones are found in the limbs. They support the body weight and act as the levers of propulsion.
- Short bones occur chiefly in the knee and hock and aid in the dissipation of concussion (the shock of impact).
- Flat bones, such as the ribs, scapula, and some of the bones of the skull, help to enclose cavities containing vital organs.
- Irregular bones are unpaired bones, such as the vertebrae and some of the bones of the skull.

All bones, except at their points of articulation, are covered with a thin, tough, adherent membrane called the periosteum, which protects the bone and partially influences its growth. This latter function is of particular interest since we know that an injury to this membrane often results in an abnormal bony growth, called exostosis, at the point of injury. Other bony growths, such as splints, spavins, and ringbone, are often the result of some injury to the periosteum. The bone is nourished partially through blood vessels in the periosteum, which also contains many nerve endings.

The articular or joint surfaces of bones are covered with a dense, smooth, bluish-colored substance known as cartilage. The cartilage diminishes the effects of concussion and provides a smooth joint surface that minimizes frictional resistance to movement.

FIGURE 5–2 **Students often learn about the features of the horse skeleton by studying one mounted in a classroom.**

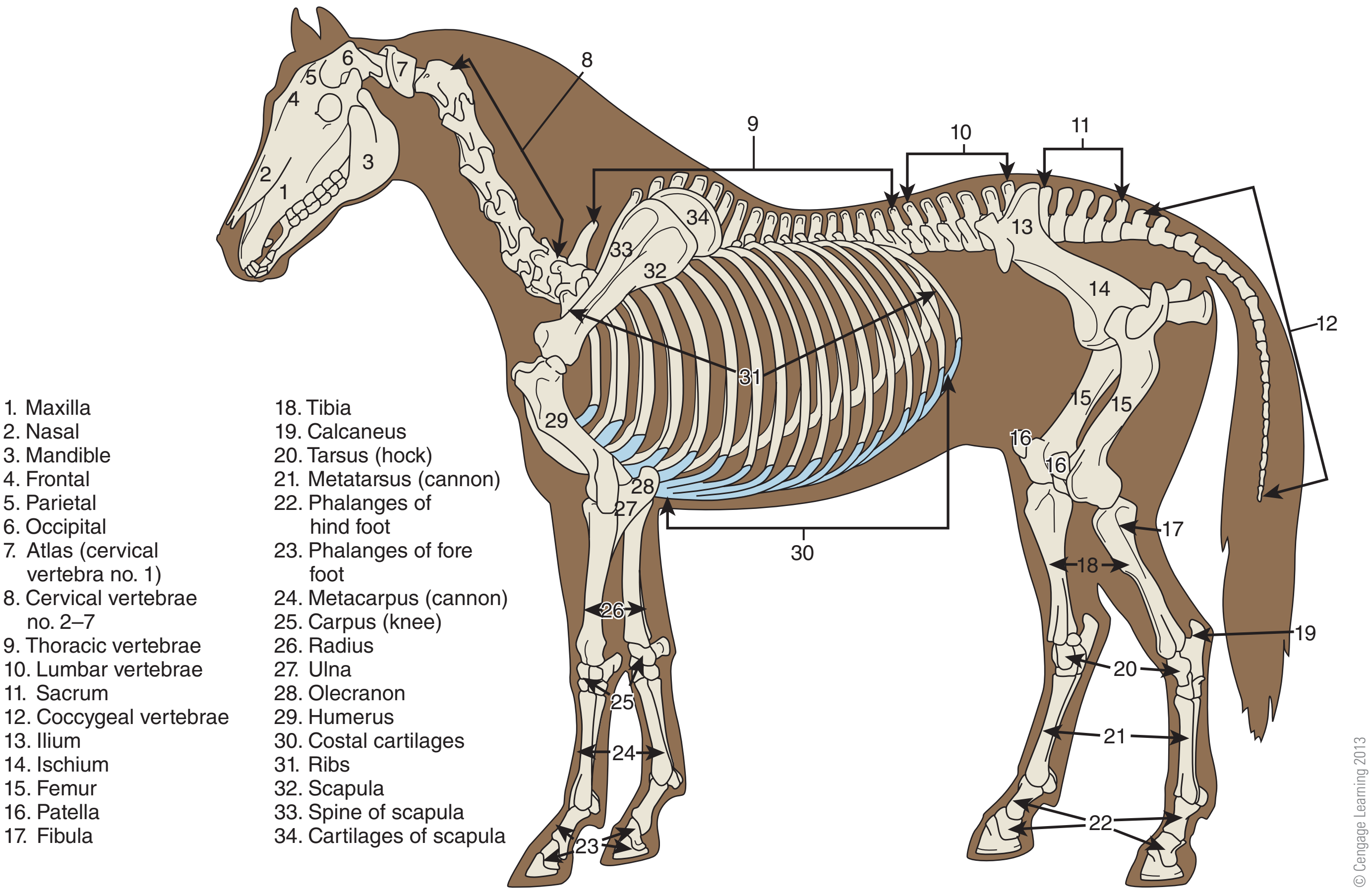


FIGURE 5–3 **The complete skeleton of a horse. The axial skeleton, as noted, consists of the skull, spine, ribs, breastbones, pelvis, and tail.**

The two main divisions of the skeleton are the trunk, or axial skeleton, and the limbs, or appendicular skeleton.

Axial Skeleton

The axial skeleton consists of the skull, spine (or vertebral column), ribs and breastbone, pelvis, and tail (Figure 5–3).

Bones of the Skull

The skull is divided into two parts—the cranium surrounding the brain, and the face enclosing the entrances to the digestive and respiratory systems. The skull is attached to the first vertebra of the spine and has a large opening, the foramen magnum, through which the **spinal cord** passes.

The bones of the cranium are flat or irregular bones surrounding the cranial cavity, which houses the brain. These bones join each other at immovable joints. The bone forming the poll (head area) has an articulating surface where the head joins the vertebral or spinal column. Together with the bones of the face, the cranial bones form the orbital (eye) and nasal cavities (Figure 5–4).

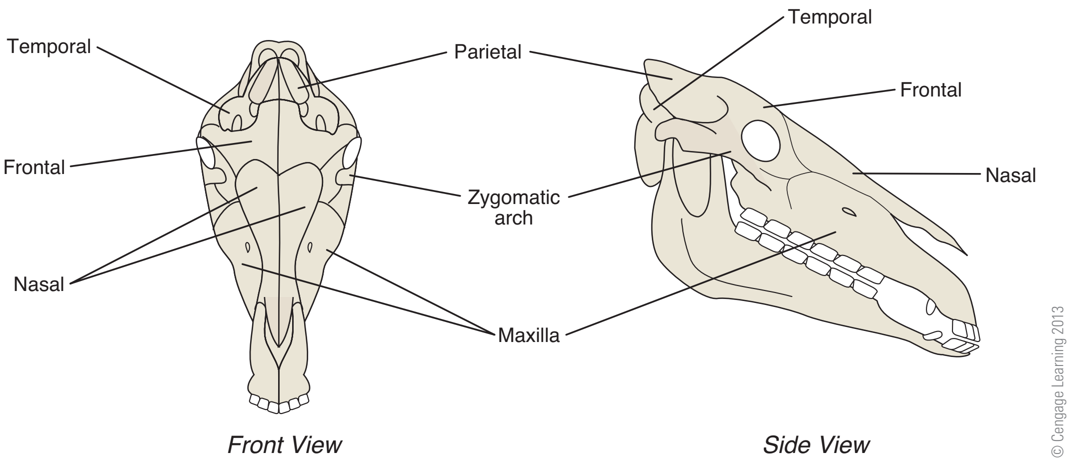


FIGURE 5–4 **Bones of the horse skull.**

The bones of the face form the framework of the mouth and nasal cavities. They include the more important bones of the upper and lower jaws, known as the maxillae and mandible, respectively. Each maxilla has six irregular cavities for the cheek or molar teeth. From the maxillae forward, the face becomes narrower and terminates in the premaxilla, which contains cavities for the six upper incisor teeth. Enclosed in each maxilla is a cavity known as the maxillary sinus, which opens into the nasal passages. This sinus contains the roots of the three back molar teeth and may become infected from diseased teeth.

The mandible, or lower jaw, is hinged to the cranium on either side by a freely movable joint in front of and below the base of the ear. The mandible has cavities for the six lower incisors. Behind the incisors and ahead of the six lower molars in each branch of the mandible is a space known as the interdental space. In this space, injuries to the periosteum or possible fracture of the mandible may occur from rough usage of a bit (Figure 5–4).

Vertebral or Spinal Column

The spine is a flexible column of small bones called **vertebrae**. The vertebral column may be thought of as the basis of the skeleton from which all of the internal organs and passageways are suspended. It is composed of irregularly shaped bones bound together with ligaments and cartilage that form a column of bones similar to an elastic suspension bridge. An elastic pad or cushion separates each vertebra along the length of the column, from the base of the skull to the tip of the tail. Through the length of this column runs an elongated cavity or passageway, called the neural canal or spinal canal, that contains the main trunk line of **nerves** to the brain—the spinal cord. The bones of the vertebral column (Figure 5–5) are divided into five groups:

1. Cervical: 7 vertebrae
2. Thoracic: 18 vertebrae
3. Lumbar: 6 vertebrae (sometimes 5)
4. Sacral: 5 vertebrae (fused together to form the sacrum)
5. Coccygeal or tail: 15 to 21 vertebrae

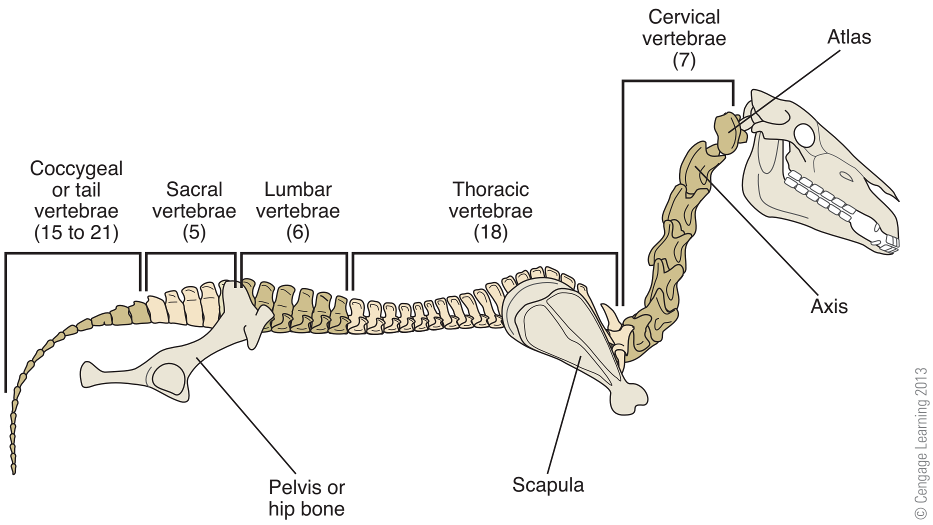


FIGURE 5–5 **Bones of the vertebral column of the horse.**

The hip bones are two large, flat, paired bones that form the pelvis or pelvic girdle. Each hip bone is firmly attached to the spine at the sacrum and circles around to meet at the midline below the sacrum and enclose the pelvic cavity. Each hip bone contains a cavity on its outside where the femur, or first bone of the hind leg, forms a joint. The upper front angle, together with the sacrum, forms the point summit of the croup. The back angle of the hip bone is the point of the rump.

The chest is the large cavity formed by the thoracic vertebrae, the ribs on the sides, and the sternum, or breastbone, on the bottom or floor. This cavity contains the heart, lungs, large blood vessels and nerves, and part of the trachea and esophagus. The 18 pairs of ribs, all jointed to the thoracic vertebrae at their upper ends, determine the contour of the chest by their shape and length.

The sternum is a canoe-shaped prominence in the midline of the breast consisting of 7 or 8 bony segments connected by cartilage. The sternum forms the floor of the thorax.

Appendicular Skeleton

The appendicular skeleton of the horse consists of the forelegs and hind legs. It is used for locomotion, grooming, and to some extent for defense and feeding. The forelimbs have no skeletal attachment to the axial skeleton, or trunk, of the horse. The connection is made only by muscles.

The bones of the foreleg of the horse (Figure 5–6), named from the top downward, include:

- Scapula
- Humerus
- Ulna and radius
- Carpal bones
- Splint bones
- Cannon
- Sesamoids
- First phalanx
- Second phalanx
- Coffin bone

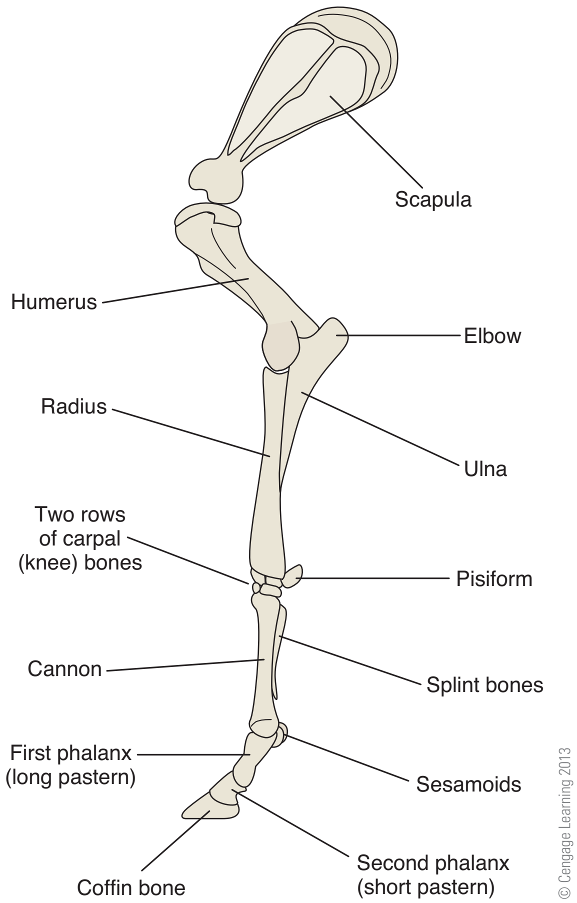


FIGURE 5–6 **Bones of the foreleg of the horse.**

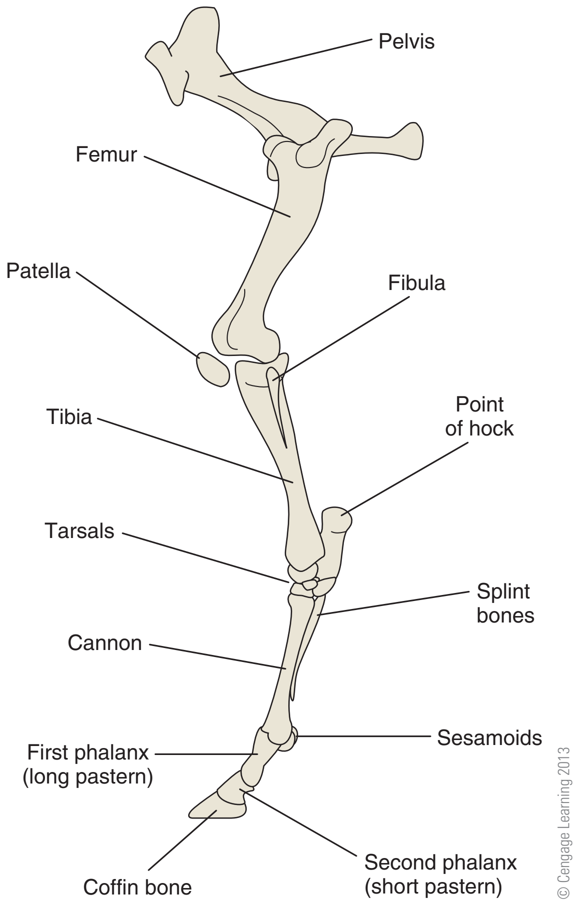


FIGURE 5–7 **Bones of the hind leg of the horse.**

Bones of the hind leg (Figure 5–7), named from the top downward, include:

- Femur
- Patella
- Tibia and fibula
- Tarsals
- Splint bones
- Cannon
- Sesamoids
- First phalanx
- Second phalanx
- Coffin bone

The hind limbs are attached to the bony pelvis at the hip joint, unlike the forelimbs, which have no bony connection to the trunk.

Functional anatomy of the hoof is discussed in more detail in Chapter 17.

JOINTS OR ARTICULATIONS

A joint or articulation is the union of two or more bones or cartilages. Joints are classified into three types according to their structure and movability—immovable, slightly movable, and freely movable.

Immovable joints are those in which the opposed surfaces of bone are directly united by connective tissue or fused bone and permit no movement, such as the bones of the cranium.

Slightly movable joints are those where a pad of cartilage, adhering to both bones, allows only slight movement due to the elasticity of the interposed cartilage. Many joints of the vertebrae are of this nature.

Freely movable joints are those where a joint cavity exists between the two opposed surfaces, such as the joints of the legs. The freely movable joints are the truest examples of joints. The ends of the bones entering into a freely movable joint are held in opposition by strong bands of tissue, called ligaments, that pass from one bone to the other. Ligaments possess only a slight degree of elasticity and a limited supply of blood, which explains why they heal slowly and often imperfectly following injury.

In freely movable joints, the ends of the bones are covered with a smooth cartilage (articular hyaline cartilage) that absorbs concussion and provides a smooth bearing surface. The entire joint is enclosed in a fibrous sac known as a **joint capsule** that assists the ligament in holding the bones in position (Figure 5–8). The inner surface of this sac is lined with a thin membrane, called the synovial membrane, that secretes a fluid known as synovia or joint water. Synovia is a clear, slightly yellowish fluid with the appearance and consistency of the white of a watery egg. It lubricates the joint in the same way that oil lubricates a mechanical bearing.

The joints of the foreleg, in order from the top downward, include:

- Shoulder, formed by the scapula and humerus
- Elbow, formed by the humerus, radius, and ulna
- Knee, formed by the radius, carpal bones, and three metacarpal bones—splints and cannon bones
- Fetlock, formed by the cannon, two sesamoid bones, and the first phalanx, or long pastern
- Pastern, formed by the first and second phalanges or long and short pasterns
- Coffin, formed by the second phalange or coffin bone and the navicular bone

The joints of the hind leg, named in order from the top downward, are:

- Hip, formed by the hip bone and the femur
- Stifle, formed by the femur, patella, and tibia
- Hock, formed by the tibia, tarsal or hock bones, and the metatarsal bones—splint and cannon bone
- Fetlock, pastern, and coffin joints are named and formed the same as the corresponding joints of the foreleg

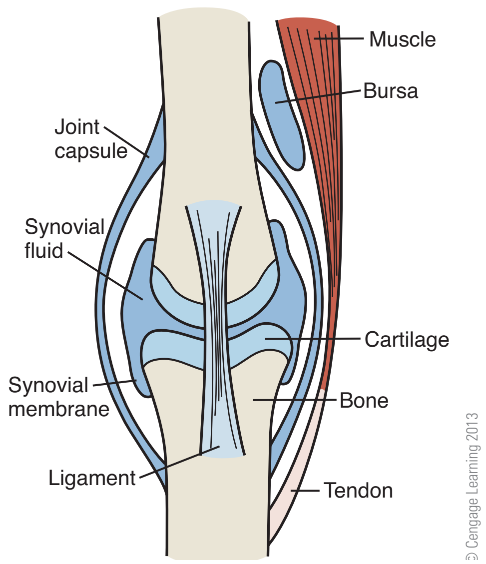


FIGURE 5–8 **Bone, muscle, cartilage, synovial fluid, tendon, and ligament. Ligaments are tough, fibrous tissue connecting bones at a joint. Tendons connect muscle to bone.**

In addition to the ligaments that form a part of the joints, there are certain other important suspensory and check ligaments. The suspensory ligament of the foreleg is a very strong, flat ligament running from the back of the knee and upper end of the cannon bone down the back of the leg in a groove between the splint bones. Just above the fetlock, this ligament divides into two diverging, rounded branches that are attached to the upper and outer part of the corresponding sesamoid bone. The branches pass downward and around to the front of the long pastern bone to connect with the **extensor** tendon attached to the front of the coffin bone. From the lower part of the sesamoids, bands of ligaments pass downward and attach to the backs of the long and short pastern bones.

The check ligament is a short, strong ligament running from the back side of the upper end of the suspensory ligament at a point just below the knee downward and backward for a short distance to attach to the deep **flexor** tendon, which in turn passes down the back of the leg to attach on the undersurface of the coffin bone. When the suspensory ligament is relaxed, the check ligament converts the tendon below

Bad Timing for a Broken Leg

In May 2006, at Preakness Stakes, favored horse Barbaro broke his right hind leg shortly after leaving the starting gate. The leg broke in three places: a cannon bone above the ankle, a sesamoid bone behind the ankle, and a long pastern bone below the ankle. After a successful 5-hour surgery using almost 24 screws and titanium plate metal implants to stabilize his bones, Barbaro had only a 50 percent chance of surviving. Here's why:

- With little blood circulation and little muscle in the lower part of a horse's leg, a break below the knee could easily destroy these fragile vessels and deprive the animal of its full immune response at the site of the injury. Any soft-tissue damage at all can cut off blood flow and create a haven for bacteria. If infection occurs, it is not easy to treat a horse with antibiotics. Using the large amount of antibiotics required can destroy the natural flora of the horse's intestinal tract and lead to life-threatening, infectious diarrhea.
- Even if it manages to avoid early infection, the animal might not make it through the recovery. The large animal must wake up from anesthesia without reinjuring itself. (Barbaro was revived by being suspended in a warm swimming pool in a quiet room and then kept there for as long as possible.) Then not all horses are willing to hang in a sling, and the antsy ones can thrash about and break their limbs all over again.
- If a horse starts favoring his wounded leg post-surgery, he may overload his other legs, causing laminitis. If that happens, the hooves on the other legs will start to separate from the bone, and his weight will be driven into the soft flesh of the feet.
- A horse may develop life-threatening constipation as a side effect of the anesthetic.

Veterinarians will often put down a horse that develops a nasty infection, reinjures its broken leg, or develops laminitis in its other hooves.

Barbaro was one of the lucky ones for a time. By August 2006, Barbaro's broken right leg had fused to the point where they would have replaced the cast with a brace if his left hind leg had not been affected by laminitis. Still, the coronary band on his left leg appeared healthy, and all signs were encouraging. As long as Barbaro was not suffering, his owners continued with the decision of aggressive treatment and a lengthy convalescence. On November 6, 2006, the cast was removed from Barbaro's leg and he continued to strengthen his leg. Unfortunately after an eight-month struggle to recover and heroic efforts by veterinarians, Barbaro was euthanized on January 29, 2007. He succumbed to laminitis that had developed in three legs and the recent surgery on his right hind leg for an abscess that left Barbaro without a healthy leg to stand on.

The racing industry reacted to the death of Barbaro with the creation of the Barbaro Memorial Fund, an initiative to raise money for research into laminitis and other equine health and safety issues. The National Thoroughbred Racing Association took the lead by organizing fundraisers.

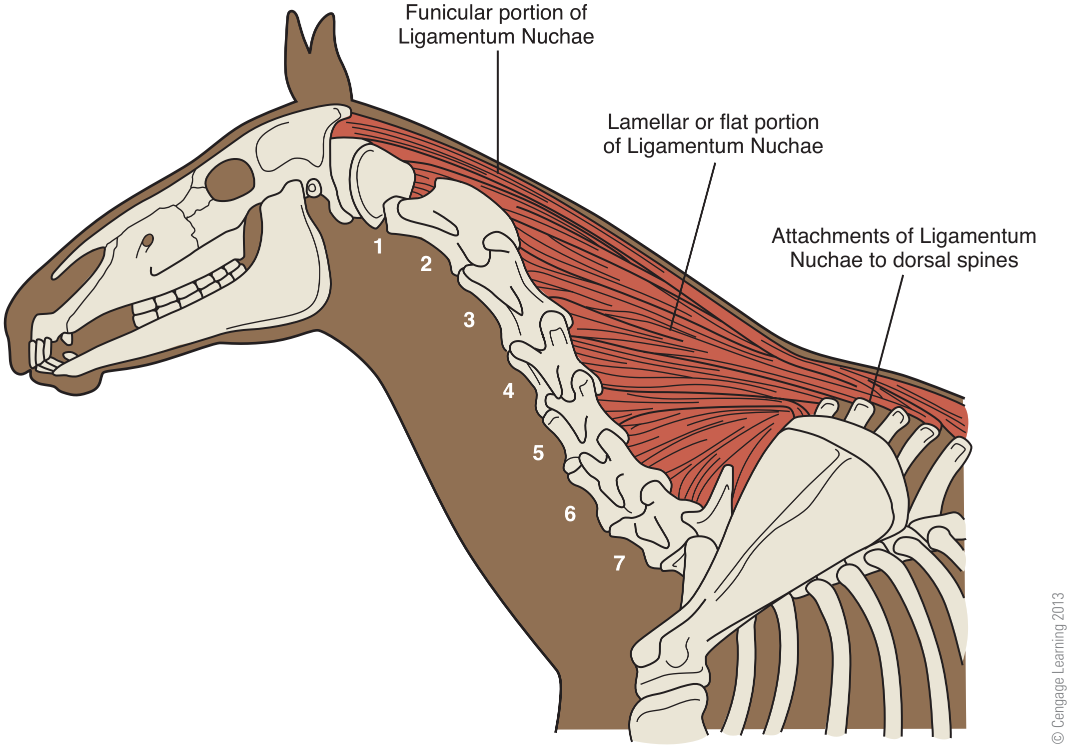


FIGURE 5–9 **The *ligamentum nuchae* or nuchal ligament is a fan-shaped ligament of elastic tissue that assists the muscles of the neck in holding the head and neck in position.**

it into a functional ligament to assist the general action of the suspensory ligament. The suspensory ligament is considerably more elastic than the binding ligaments of the joints. Its supporting, springlike action absorbs a great deal of concussion. This ligament is the most frequently injured in horses that do a great deal of their work at the gallop. In the hind leg, this suspensory ligament is very similar to that in the foreleg, but the check ligament in the hind leg is less perfectly developed.

The plantar ligament is a strong band of ligamentous tissue on the back of the hock bones. It extends from the point of the hock to the upper end of the metatarsus or cannon bone and, because of its strong attachment to the small hock bones, braces the hock against the strong pull of the Achilles tendon.

The ligamentum nuchae or ligament of the neck is a fan-shaped ligament of elastic tissue extending from the poll and upper surfaces of the cervical vertebrae downward and backward to attach to the longest spines of the thoracic vertebrae or withers (Figure 5–9). It assists the muscles of the neck in holding the head and neck in position.

THE MUSCULAR SYSTEM

The muscular system provides movement both internally and externally. Muscles, the active organs of motion, are characterized by their property of contracting or changing shape when stimulated. Each muscle is supplied by one or more nerves that not only bring commands from the brain to make it contract but also carry back to the brain impulses that tell of the degree of contraction. This correlation results in smooth, even movements instead of jerky or staggering movements. Muscles are red flesh or lean meat and compose about 50 percent of the total body weight.

The muscular system is made up of three types of muscles:

1. Smooth or involuntary muscle
2. Cardiac or involuntary striated muscle
3. Striated or skeletal muscle

Smooth Muscle

Smooth muscle is sometime called **visceral** muscle. It is found in the digestive system and in the uterus of females. Smooth muscles are capable of prolonged periods of activity before becoming fatigued. The visceral muscles of the digestive system perform wavelike contractions called **peristalsis** for many successive hours. Contraction of smooth muscle is involuntary (Figure 5–10).

Cardiac Muscle

Cardiac muscle is found only in the heart. Contraction of the cardiac muscle is inherent and rhythmic, requiring no nerve stimulus. The rate of contraction is controlled by the autonomic nervous system and requires no conscious control. The heart must continue ceaselessly contracting throughout the horse's lifetime with only split-second intervals of rest.

Striated or Skeletal Muscle

Skeletal muscles are usually attached to the bony levers of the skeleton and move the body voluntarily, under the direct control of the will. Skeletal muscle may attach its fleshy fibers directly to a bone; but usually the main part, or belly, of the muscle terminates at either or both ends in a strong, cordlike structure called a tendon that transmits the pull of the muscle as it contracts. This tendon arrangement avoids inefficient and bulky thickenings at knees, hocks, and fetlocks and permits several large muscles to be attached on one small area of bone.

Skeletal muscles are generally arranged in opposing sets—one set bends the limb or body, the other set straightens it. Usually both sets are active at the same time but to different degrees, one acting as a brake on the other. Voluntary muscles can contract for only a short time before becoming fatigued and requiring rest.

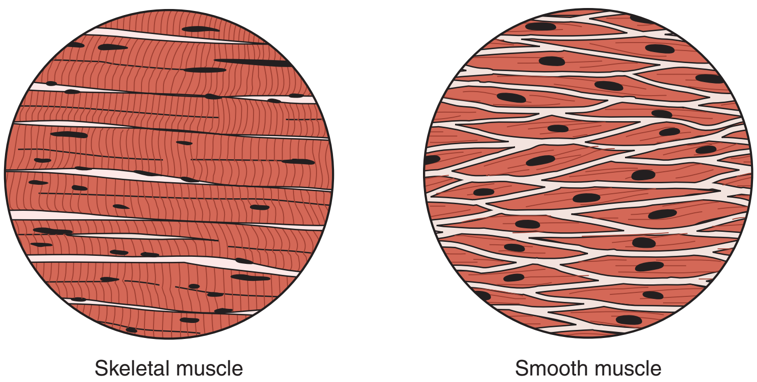


FIGURE 5–10 **Typical skeletal and smooth muscle fibers as viewed under a microscope**

The contractile portion, or belly, of voluntary muscles consists of many elongated muscle cells side by side and lengthwise of the muscle. When stimulated, this portion becomes shorter and thicker. The tendon of a muscle is quite similar to a ligament in structure and transmits the power of the muscle to some definite point of movement. The contractile portion of a muscle has a large supply of blood, but the supply to the denser tendons is rather limited. The body of most muscles is attached to some bone at a point called the origin. The tendon of the muscle may pass one or more joints and attach (or insert) to some other bone.

The extensor and flexor muscles of the legs are an example of muscles in sets, one group having a certain general action and the other group the exact opposite action. A muscle is an extensor when its action is to extend a joint and bring the bones into alignment. A muscle is a flexor when its action is to bend the joint. Some muscles, if their points of origin and insertion are separated by two or more joints, may act as a flexor of one joint and an extensor of another joint. Except to establish fixation and rigidity of a part, such opposed muscles do not act simultaneously in opposition to each other but act successively (Figure 5–11).

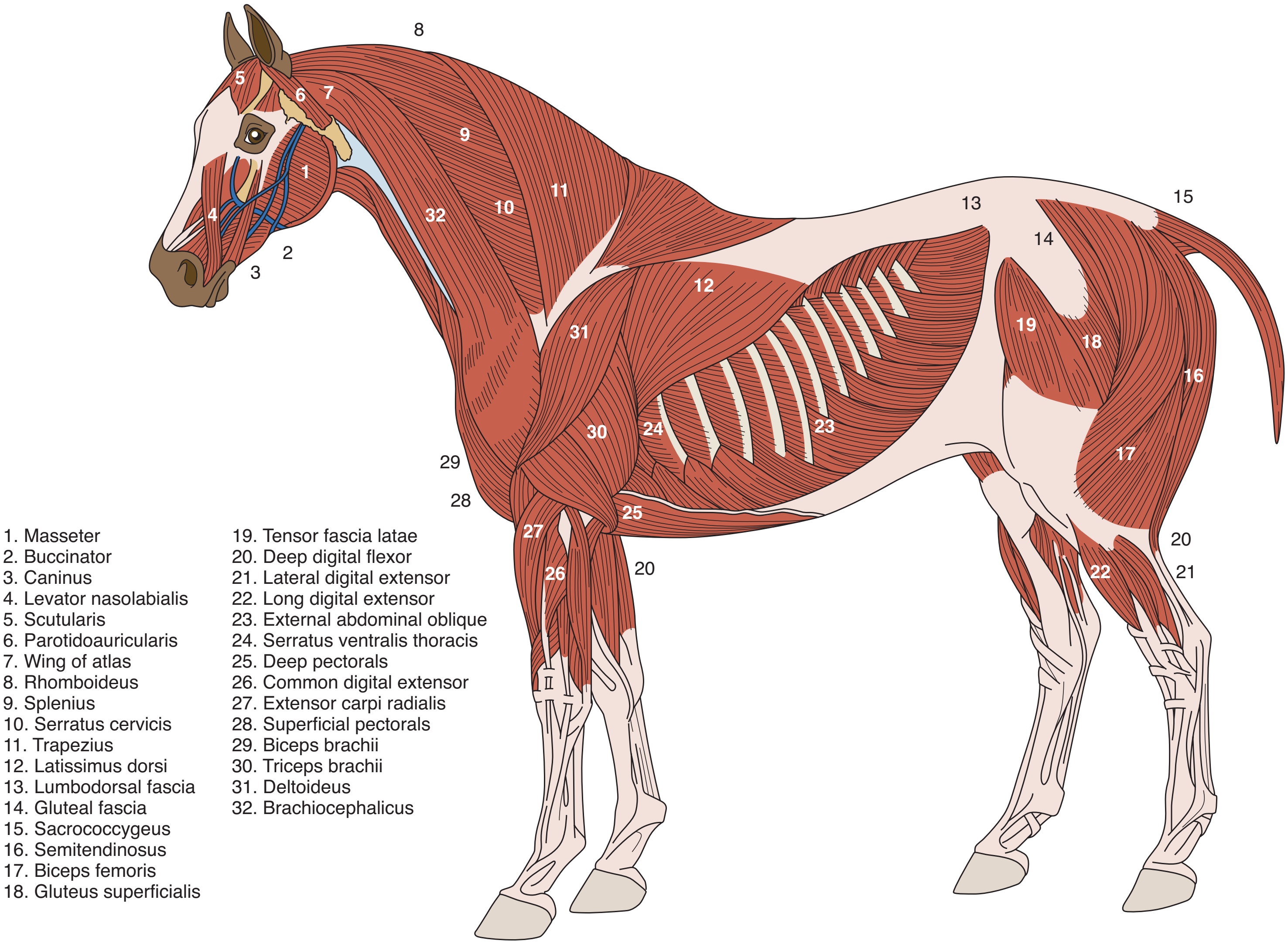


FIGURE 5–11 **Muscles of the horse.**

Fueling the Muscles

Muscle contraction occurs as an all-or-nothing reaction in response to nerve stimulation, and it requires energy in the form of adenosine triphosphate (ATP). All forms of energy must first be converted to ATP before contraction can occur. It is the only form of energy acceptable to muscle. Three basic fuel systems provide material to produce ATP for muscle contraction:

1. Phosphagen system
2. Glycogen or lactate system
3. Citric acid or Krebs cycle

The phosphagen system is a rapidly available source of energy, stored in muscle cells, with the ability to support **anaerobic** work for approximately 30 seconds at maximum output. This process is quick and efficient and does not need oxygen. Any event done at maximum effort and lasting less than 30 seconds is supported almost entirely by this fuel system.

The glycogen or lactate system can produce energy for up to 5 minutes from glycogen stored in the muscle. The glycogen system takes over ATP production at about when the phosphagen system is depleted. The stored glycogen, a polymer of glucose, is mobilized from its storage site in the muscle and converted to ATP through a process called glycolysis. This process does not require oxygen.

The citric acid or Krebs cycle requires oxygen and produces the largest amount of ATP. It takes over where the glycogen system ends and has the potential to last for hours, assuming that oxygen can be promptly and efficiently delivered to the muscle. The amount of oxygen that can be delivered to the tissue and used is called the VO_2 max. The higher the VO_2 max, the more endurance a horse has. The fuel for this system can be either pyruvic acid generated from glycolysis or fatty acids mobilized from adipose tissue or absorbed from the diet. The end products of this system are carbon dioxide, which is eliminated through the lungs, and water, which can be eliminated through either sweat or urine. (Refer to Chapter 4 for more details of cellular respiration.)

Tendons, Sheaths, and Bursae

Many muscles, especially those of the legs, have long tendons that pass one or more joints and undergo changes of direction or pass over bony prominences before reaching their point of insertion. Tendon sheaths and tendon bursae at various points of friction along the length of the tendon eliminate undue friction to allow the muscle to act more efficiently. A tendon sheath is a synovial sac through which a tendon passes. This sheath secretes synovia to lubricate the tendon. A tendon bursa is a synovial sac located between the tendon and the surface over which it passes in a change of direction. It serves the same purpose as a tendon sheath but differs from a sheath in that the tendon is not surrounded by the synovial sac. Tendon sheaths and bursae are found chiefly near joints. The synovial membrane and the synovia secreted in these sacs are the same as those found in the joints.

THE DIGESTIVE SYSTEM

The digestive system converts feed into a form that can be used by the body for maintenance, growth, and reproduction. It consists of all the parts of an organism involved in taking food into the body and preparing it for assimilation—incorporation into the body. In its simplest form, the digestive system is a tube extending from the mouth to the anus with associated organs. This includes the mouth, esophagus, stomach, intestines, anus, and other associated organs like the liver, teeth, pancreas, and salivary glands. Digestive systems vary according to whether the animals are herbivores (eating only plants), carnivores (eating only animals), or omnivores (eating plants and animals). Horses are herbivores.

The entire digestive tract of a mature light horse is approximately 100 feet long. This length is coiled and looped many times but is usually very small in diameter and has a capacity of about 40 to 50 gallons.

The stomach of the adult horse makes up less than 10 percent of the total capacity of the digestive tract; the small intestine, the site of most nutrient absorption, makes up only 30 percent. About 65 percent of the capacity of the digestive system is in the **cecum** and colon, which digest the forages consumed by the horse (Figure 5–12).

Feed passes rapidly through the stomach and small intestine. Particle size affects the rate of passage; grinding or chopping increases the rate of passage and decreases absorption of nutrients by the horse. Any feed not digested and absorbed in the small intestine is passed on to the cecum and colon within two to four hours. Because of this relatively low volume capacity and rapid rate of passage through the upper gut, it is easy to overwhelm the digestive capacity of the horse's stomach and small intestine.

The horse's cecum and colon contain large microbial populations allowing for digestion of fibrous feeds. If large amounts of concentrates reach the cecum, they will quickly become fermented and may produce excessive gas or lactic acid and cause colic or founder.

Mouth

The mouth extends from the lips to the pharynx and is bounded on the sides by the cheeks, above by the hard palate, and below by the tongue. Separating the mouth

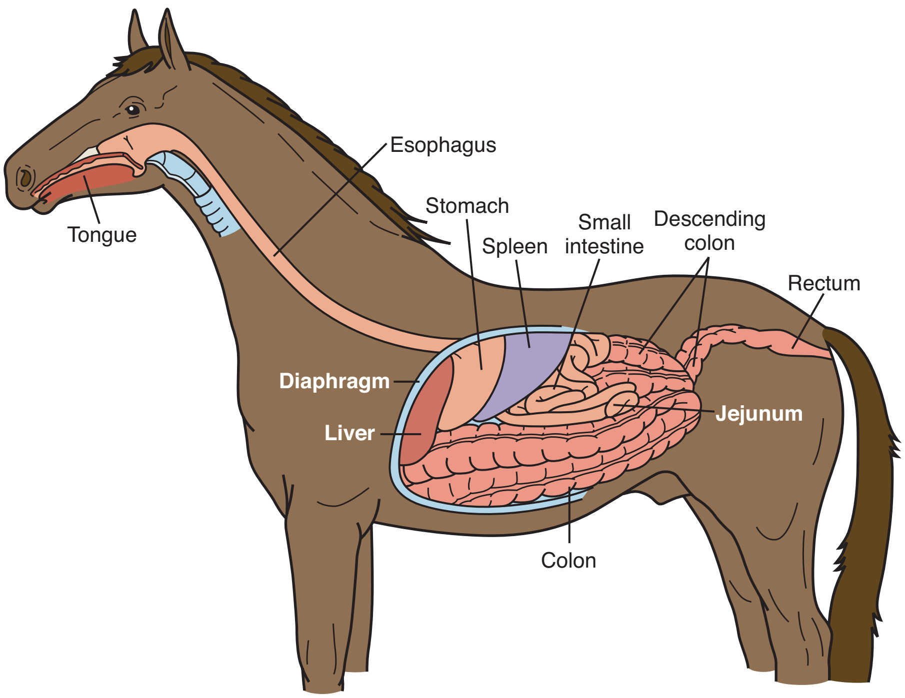


FIGURE 5–12 **Digestive system of the horse.**

from the pharynx is the soft palate, a fleshy curtain suspended from the back part of the hard palate, which permits the passage of food and water from the mouth to the pharynx but prevents passage in the opposite direction. The lips pick up loose feed, which is passed into the mouth by the action of the tongue. When horses graze, they grasp food with their incisor teeth. The food is masticated, or ground up, between the molar or cheek teeth and mixed with **saliva**. The saliva is secreted into the mouth by the salivary glands, the largest of which is the parotid, lying below the ear and back of the jaw.

Saliva moistens and lubricates the mass of food for swallowing and, as a digestive juice, acts on the starches and sugars in feed. The ball of masticated food is forced past the soft palate into the pharynx by the base of the tongue.

Horses drink by drawing the tongue backward in the mouth and using it like the piston of a suction pump. A horse usually swallows slightly less than a half-pint at each gulp. The ears are drawn forward at each swallow and drop back between swallows.

Pharynx

The pharynx is a short, somewhat funnel-shaped, muscular tube between the mouth and the esophagus. It also serves as an air passage between the nasal cavities and the larynx. The muscular action of the pharynx forces food into the esophagus. Food or water, after entering the pharynx, cannot return to the mouth because of the traplike action of the soft palate. (For the same reason, a horse cannot breathe through its mouth.) Food or water returned from the pharynx passes out through the nostrils.

Esophagus

The esophagus is a muscular tube extending from the pharynx down the left side of the neck and through the thoracic cavity and diaphragm to the stomach. Food and water are forced down the esophagus to the stomach by a progressive wave of constriction of the circular muscles of the organ. The return of food or water through the nostrils is an almost certain indication that the horse has choked because the esophagus has been blocked by a mass of food or a foreign object. The esophagus enters the stomach through an oblique angle, making regurgitation impossible.

Stomach

The stomach is a U-shaped, muscular sac in the front part of the abdominal cavity close to the diaphragm. Food entering the stomach is arranged in layers, with the end next to the small intestine filling up first. The contents of the stomach are squeezed and pressed by the muscular activity of the organ. The digestive juice secreted by the walls of the stomach is known as **gastric juice**.

Small Intestine

Extending from the stomach to the cecum, the small intestine is a tube about 2 inches in diameter and 70 feet long. It holds about 12 gallons and is composed of three parts: the duodenum, the jejunum, and the ileum. After leaving the stomach, the small intestine is arranged in a distinct U-shaped curve. It lies in folds and coils near the left flank, being suspended from the region of the loin by an extensive fan-shaped membrane called the mesentery.

Large Intestine

The large intestine is divided into the cecum, large colon, small colon, rectum, and anus. The horse, unlike humans or dogs, consumes large quantities of cellulose in its diet. The usual digestive enzymes are not effective against cellulose, so the horse must rely upon bacteria to break down the cellulose into substances it can absorb into its body. To give the bacteria time to act on the cellulose, the cecum and the large colon in the horse have been greatly enlarged so that the food moves slowly through this part of the digestive tract.

The cecum is an elongated sac extending from high in the right flank downward and forward to the region of the diaphragm. The openings from the small intestine and to the large colon are close together in the upper end of this organ. The contents of the cecum are always liquid. The cecum is about 4 feet long, with a capacity of about 8 gallons.

The large colon is about 12 feet long, has a diameter of 10 or 12 inches, and holds about 20 gallons. It extends from the cecum to the small colon and is usually distended with food. Bacterial action and some digestion of food takes place here also.

The small colon is about 10 feet long and 4 inches in diameter. It extends from the large colon to the rectum. The contents of the small colon are usually solid; here the balls of dung are formed. Most of the moisture in the food is reabsorbed in this portion of the large intestine.

The rectum is about 12 inches long. It is the part of the digestive tract that extends from the small colon through the pelvic cavity to the anus, where the digestive tract ends.

THE URINARY SYSTEM

Life processes produce waste products. The urinary system is composed of the kidneys, ureters, bladder, and urethra. The kidneys are paired organs located on each side of the backbone opposite the eighteenth ribs. The chief function of the kidneys is to maintain water and mineral balance and excrete the wastes of metabolism. The urinary bladder holds the wastes until they are excreted. (Figure 5–13).

The kidneys are from 6 to 7 inches long, 4 to 6 inches wide, and about 2 inches thick. The right kidney is roughly triangular with rounded corners, but the left is more bean-shaped and longer and narrower. In the course of a day, all the blood in the body of the horse passes through the two kidneys more than 400 times and is filtered of nitrogenous wastes each time.

Nephrons, the tiny functional units of the kidneys, filter the blood received by the kidneys (Figure 5–14). The outer portion or cortex of each kidney has several million tiny nephrons that filter approximately 200 gallons of liquid a day, rejecting blood cells and proteins but permitting fluid salts and other chemicals, including nitrogenous wastes, to pass through them. The kidneys also act in reverse and return to the bloodstream such valuable substances as the salts, sugars, and most of the fluids—all but about 2 gallons of the 200 gallons of fluid are returned to the blood.

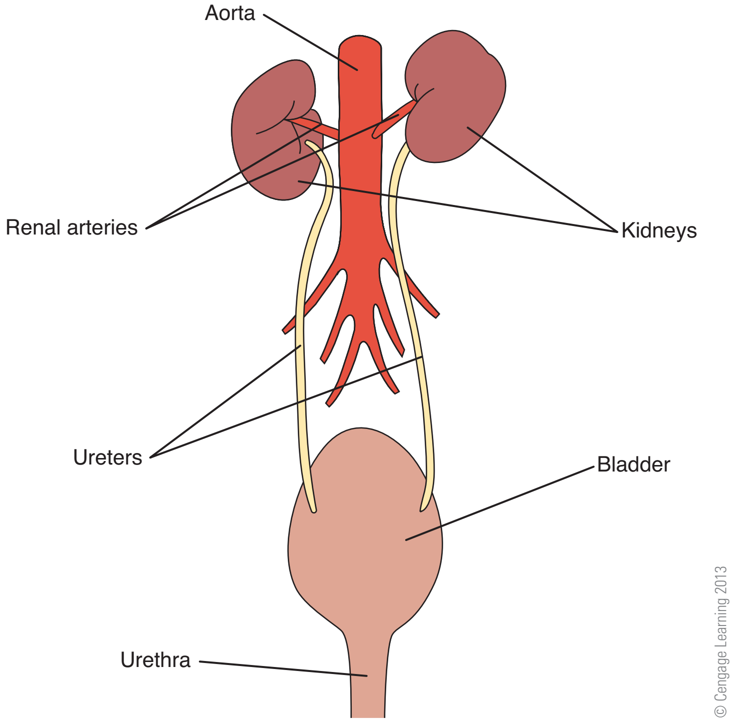


FIGURE 5–13 **Diagram of the urinary system of the horse.**

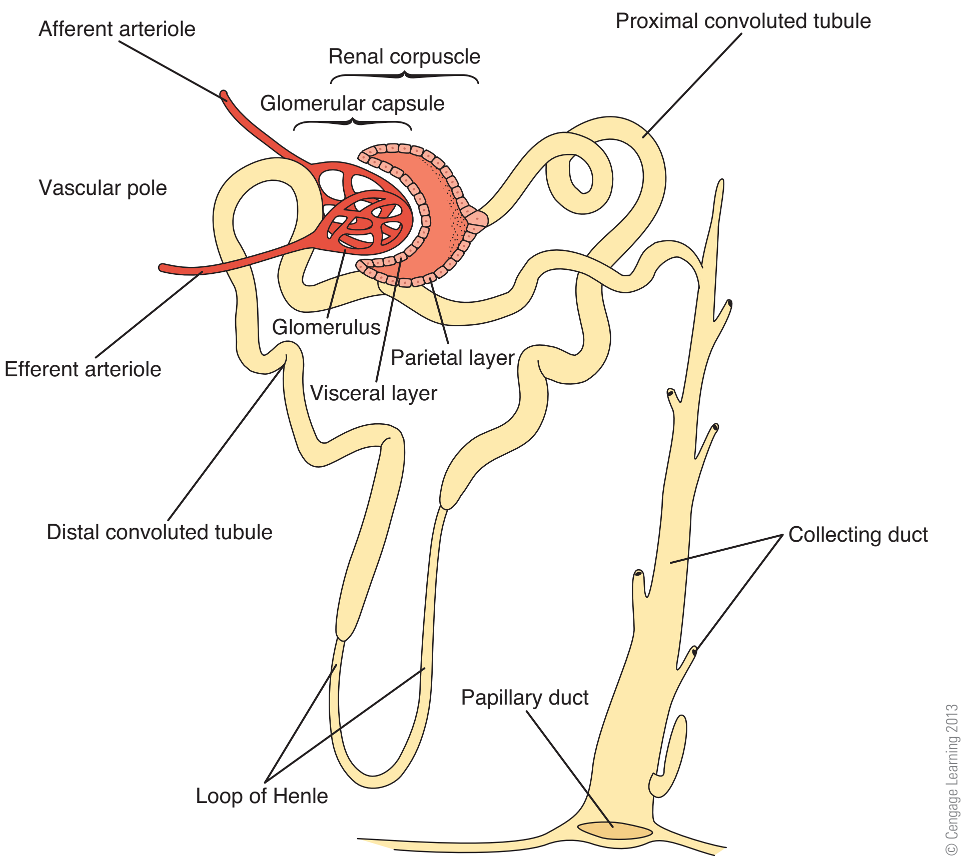


FIGURE 5–14 **A microscopic diagram of a nephron.**

Urine, containing the nitrogenous waste and any excess salts or sugars not required by the body, is collected in the inner portion of the kidney, the renal pelvis, and then drained from the kidney drop by drop through the ureter to the bladder. The bladder is a sort of muscular balloon, which in the horse can expand greatly without bursting. As urine collects in the bladder, nerve endings signal that the bladder needs to be emptied. Then the urine flows from the bladder to the outside environment through the urethra. In mares the urethra is short and wide. In males the urethra is long and narrow, since it travels the length of the penis.

THE RESPIRATORY SYSTEM

The respiratory system takes in oxygen from the environment and delivers it to the tissues and cells of the body; it also picks up carbon dioxide from the tissues and cells and delivers it to the environment. Organs of respiration include the nasal cavity, pharynx, larynx, trachea, bronchi, and lungs. The lungs are the essential organs of respiration; the other parts are simply passages carrying air to and from the lungs. Air is taken into the lungs, where oxygen is removed by diffusion into the blood (Figure 5–15).

The pharynx is common to both the respiratory and digestive tracts. The larynx, commonly is a short, tubelike organ between the pharynx and the trachea. Known as the voice box, commonly Stretched vertically within this cartilaginous box are the vocal cords, two folds of elastic tissue. By contracting the lungs and forcing air past these folds of tissue, the horse sets them into vibration and produces the sound known as neighing, whinnying, or nickering. The larynx also regulates the amount of air passing into or out of the lungs and aids in preventing the inhalation of foreign objects.

The trachea is a long tube connecting the larynx with the lungs and is located along the lower median border of the neck. It is composed of a series of cartilaginous rings held together by elastic, fibrous material.

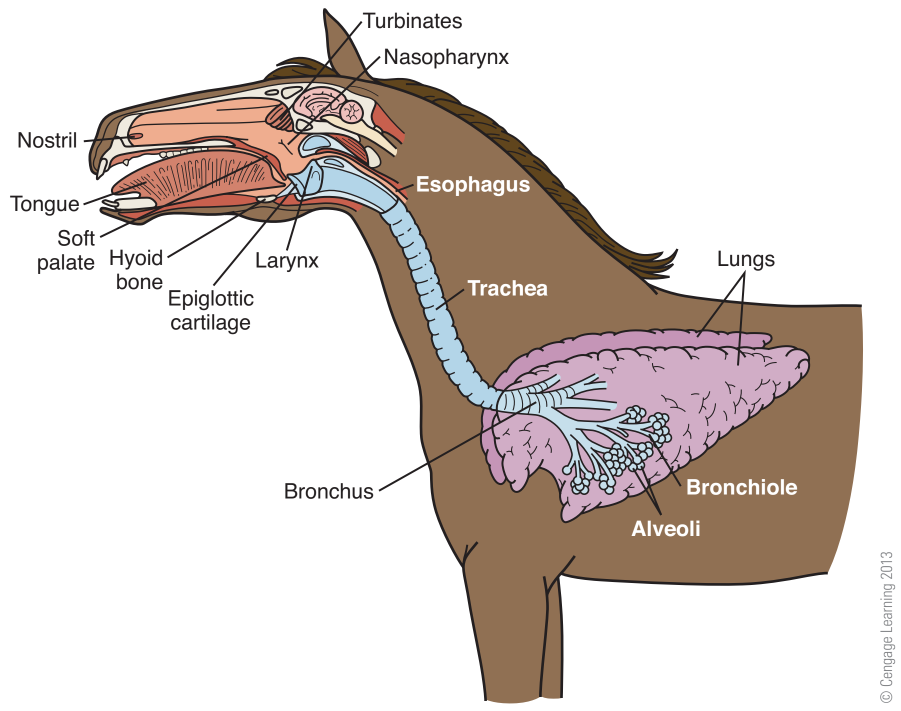


FIGURE 5–15 **Diagram of the respiratory system of the horse.**

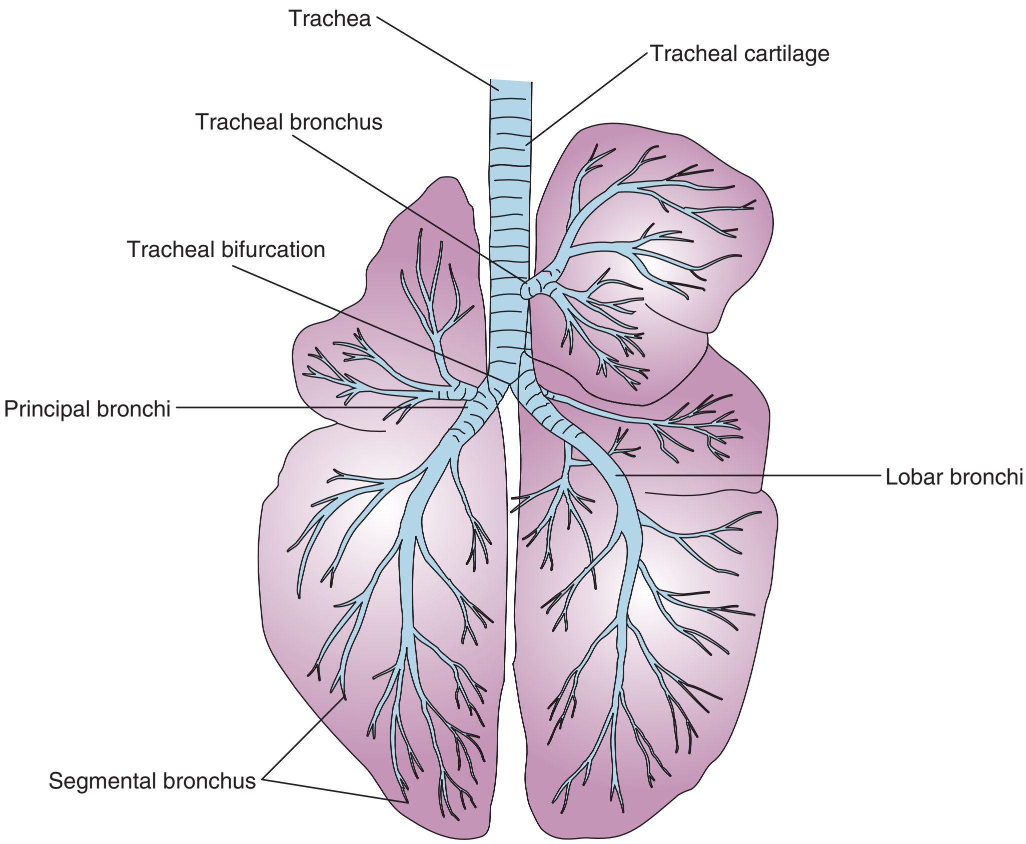


FIGURE 5–16 **Diagram of the lungs and bronchial tree of the horse.**

Bronchi are branches of the trachea that connect the trachea with each lung. Each bronchus in turn divides into a number of minute tubes that penetrate every part of the lung tissue (Figure 5–16). The branching bronchi end in groups of minute air sacs similar to bunches of grapes, called alveoli. Here the gaseous exchange of carbon dioxide and oxygen takes place between the circulating blood and the air.

Physiology of Respiration

Respiration is the act of breathing. It consists of the exchange of oxygen in the air for carbon dioxide in the blood, and the interchange of these gases between the blood and the body tissues. The former is known as external respiration and the latter as internal respiration. External respiration consists of two movements—**inspiration** and **expiration**. Inspiration is brought about by a contraction of the diaphragm and an outward rotation of the ribs. The diaphragm bulges into the airtight thoracic cavity as a dome-shaped muscle. It works like a piston, drawing air into the lungs.

Expiration is effected by a relaxation of these muscles and a contraction of rib and abdominal muscles to force air out of the lungs. Abdominal muscles are used extensively in labored breathing. Since the diaphragm plays such an important part in respiration, it follows that the distention of the digestive tract with bulky food material interferes with normal breathing, especially when the horse is being worked at fast gaits.

The lungs of the average horse contain about 1.5 cubic feet of air. The normal horse at rest breathes at the rate of 8 to 16 times a minute and inhales at each respiration approximately 250 cubic inches of air. The amount of air required by the horse depends upon the extent of muscular work being performed.

THE CIRCULATORY SYSTEM

The circulatory system distributes blood throughout the body. This system consists of the heart, **veins**, and **arteries**. Pumping action of the heart causes blood to flow through the arteries to the lungs, where it picks up oxygen and carries it to the rest of the body. Oxygen is necessary for all cells of the body. As the blood delivers oxygen to the cells of the body, it picks up carbon dioxide, a waste product, which is carried in the blood back through the veins to the heart and lungs. The lungs release the carbon dioxide to the environment and pick up more oxygen. The blood also carries food substances and waste products (Figure 5–17).

HEART

The heart is situated in the left half of the thorax, between the lungs and opposite the third to sixth ribs. In the ordinary-sized horse, the heart weighs from 7 to 8 pounds. It is enclosed in a sac called the pericardium. The heart is a muscular pump composed of four chambers:

- Right atrium
- Right ventricle
- Left atrium
- Left ventricle

Right and left sides of the heart are separated by a muscular wall. Four valves in the heart keep the blood flowing in one direction.

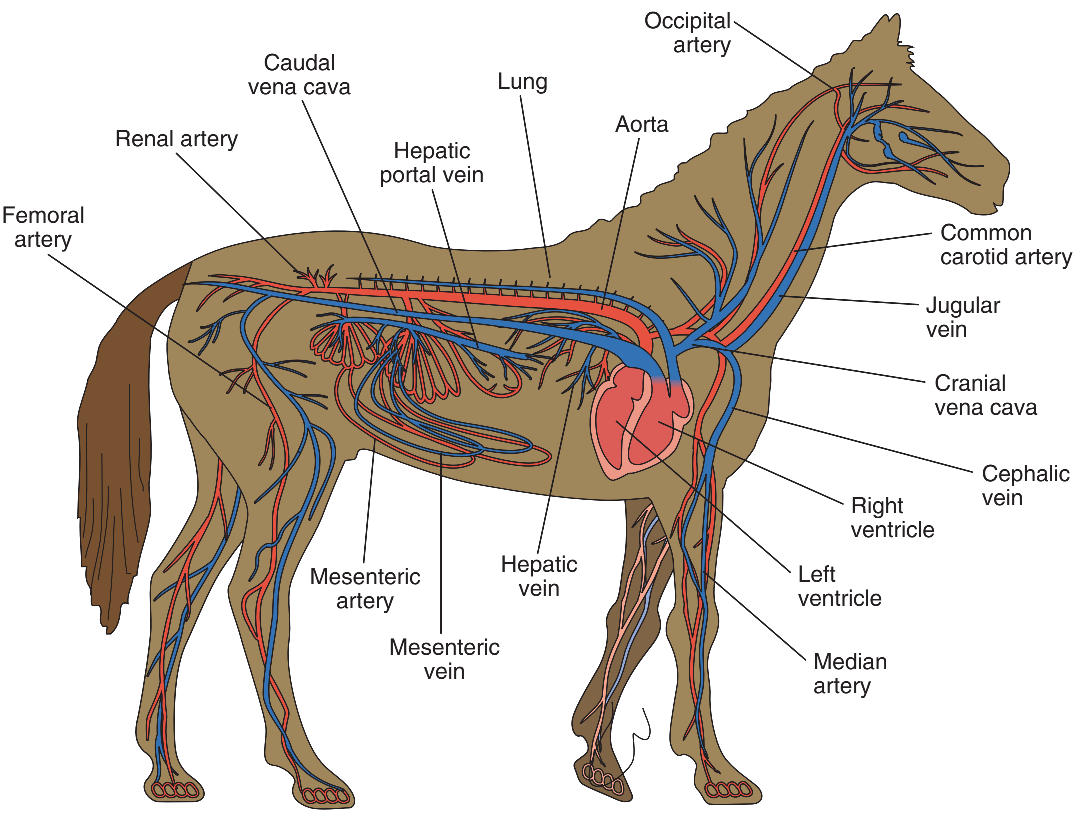


FIGURE 5–17 **Diagram of the circulatory system of the horse.**

Blood pumped out of the left ventricle into the **aorta** passes through arteries of progressively smaller diameters until it reaches the **capillary** beds of the skin, muscles, brain, and internal organs. Here oxygen and nutrients are exchanged for carbon dioxide and water. The blood is then conducted back to the heart through veins of progressively larger diameter. Finally, the blood reaches the right atrium through the venae cavae.

Blood next passes into the right ventricle, which pumps it out to the pulmonary circulation and finally into capillaries around the air sacs in the lungs. Here the carbon dioxide is exchanged for oxygen; the blood returns to the left side of the heart by the pulmonary vein and then to the left ventricle, where the cycle begins again.

Beating of the heart is controlled internally, but the force and rate of the heartbeat are influenced by the nervous system and endocrine system. Heart rate speeds up when a horse exercises, becomes excited, runs a fever, overheats, or experiences any circumstance when its tissues need more blood.

The heart is a muscle and, as such, requires its own blood supply. The coronary vessels that provide this nourishment encircle the heart like a crown at the juncture of the atria and the ventricles, sending branches to both these structures (Figure 5–18).

BLOOD

The fluid tissue of the body—blood—carries food substances and oxygen to each cell of the body and takes waste products formed there away from the cells. Blood is a red, alkaline fluid composed of blood **plasma** and red and white blood cells. It clots almost immediately upon exposure to air. The total amount is about 7 percent of the horse's weight. The white blood cells are the active agents in combating disease germs in the body. Red blood cells originate in the bone marrow, liver, and spleen and carry oxygen from the lungs to the tissues and carbon dioxide from the tissues back to the lungs.

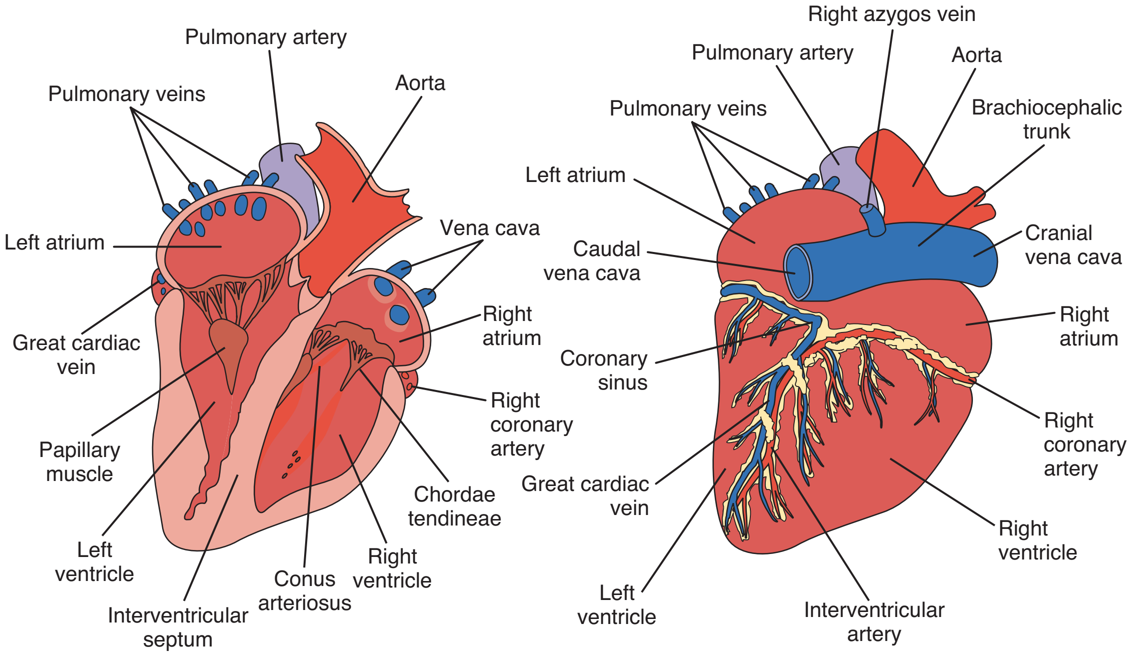


FIGURE 5–18 **Diagram of the horse heart.**

The blood is the body's regulator. It carries food to the tissues and waste products away from the tissues, distributes heat, assists in regulating the temperature, and neutralizes or destroys bacterial and viral invaders. (For more about the blood refer to Chapter 4.)

Vessels and Lymphatics

Arteries have rather thick, elastic walls and carry the blood from the heart to the tissues of the body. When the heart forces blood into the arteries, they expand and, in returning to their unexpanded state, force the blood onward. The expansion and contraction of the arteries is the **pulse**.

Veins have much thinner walls and, in many cases, are equipped with one-way valves at frequent intervals, opening toward the heart. The veins of the horse's legs have such valves. The veins carry the fluid from the tissues to the heart. Veins are located between muscle masses so that, as the horse moves, the veins are squeezed. The blood, having to go somewhere, is directed back to the heart by way of the venae cavae, the great veins from the front and back portions of the horse.

Capillaries are microscopic in size and function as numerous connecting tubes between the arteries carrying blood to the cells and the veins carrying blood away from the cells. Through the walls of the capillaries, exchange of food and oxygen for waste products of the body takes place.

Lymph vessels and lymph nodes, or lymphatics, consist of many well-defined groups of lymph nodes and connecting vessels. The vessels all converge to form one large duct lying parallel to the aorta, the main artery from the heart, and emptying into one of the large veins near the heart. Lymph glands are strategically located along the main vessels and act as filters for the **lymph**, which assists in carrying food from the digestive tract to the tissues and waste products back to the bloodstream.

Physiology of Circulation

Heart movements are controlled by an intricate group of nerves. The heartbeat is a combined cycle of contraction and relaxation of the organ. In the normal horse at rest, the heart beats from 38 to 40 times a minute. Pulse rate is determined by counting the rate of pulsation in some artery that is easily palpitated, for example, the one at the angle of the lower jaw.

The pressure and rate of flow in the veins, compared with the arteries, is very low. Movement of blood in the veins is also aided by respiration movements and muscular contraction, so good circulation is made possible by exercise. The heart, however, is the main pump of the circulatory system.

THE NERVOUS SYSTEM

The nervous system supplies the body with information about its internal and external environment. This system conveys sensation impulses—electrical-chemical changes—back and forth between the brain or spinal cord and other parts of the body. It is a complex system consisting of the brain, spinal cord, many nerve fibers, and sensory receptors.

The nervous system is divided into two main portions: the autonomic (automatic) nervous system and the central nervous system, each controlling different functions of the body. The autonomic nervous system is concerned with control over

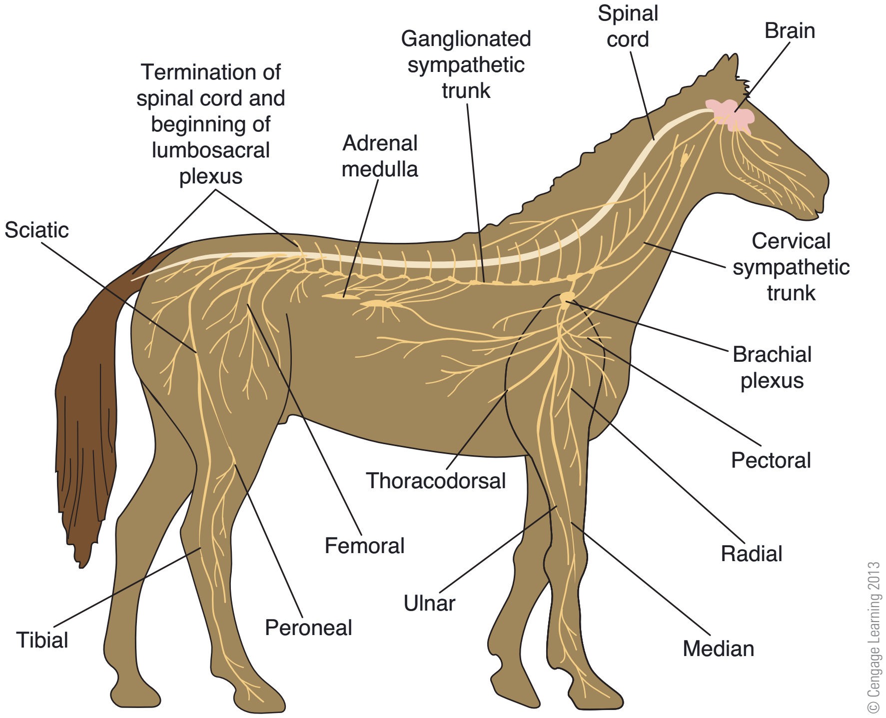


FIGURE 5–19 **Diagram of the nervous system of the horse.**

the respiratory and digestive systems, eyes, heart and blood vessels, glandular products, and other automatic functions directed by the brain stem. The central nervous system controls the conscious or voluntary actions of the body. In general, the nervous system is the communication system of the body and consists of the brain, spinal cord, **ganglia**, and nerves (Figure 5–19).

The brain and spinal cord are the most important parts of the central nervous system. The brain lies in the cranial cavity of the skull. Considering the size of the horse, the brain is small when compared with the relative brain size of other animals. Brain size relative to body size cannot be considered an absolute indication of the degree of reasoning intelligence; however, there is a distinct correlation. The horse is considered to occupy the mid-position in the scale of intelligence of domesticated animals.

The brain is divided into three major portions: the brain stem, the cerebrum, and the cerebellum. The brain stem—the primitive brain—is the slightly expanded cranial end of the spinal cord. It contains the specific nerve centers absolutely essential for the life of the animal, such as the centers controlling the heartbeat, respiration, and temperature, among others. The cerebrum, what is normally thought of as the brain, performs the functions of memory, intelligence, and emotional responses. The cerebellum controls muscular coordination, balance, and equilibrium; it is smaller than the cerebrum and is situated under the caudal part of the cerebrum.

The sense organs or receptors receive stimuli and convey them via electrical impulses over sensory nerve fibers to the brain. The brain analyzes this information and sends commands back via the spinal cord, usually over the same peripheral nerve trunks along motor nerve fibers to motor or effector nerve endings, usually located in the muscles.

Ganglia—secondary nerve centers located chiefly along the spinal cord—act almost like a subexchange in a telephone system. They receive and dispatch nerve impulses that do not have to reach the brain, including such stimuli as heat, pain, excessive pressure, and others. These impulses are immediately switched over to motor filaments and cause certain muscles to react instantaneously. For example, if a horse steps on a nail, the whole leg is pulled away immediately, before the brain becomes aware of the action, in an effort known as a reflex.

Nerves are bands of white tissue emanating from the central nervous system and ganglia and extending to all parts of the body. These are the peripheral nerves, or nerve trunks, consisting of thousands of tiny filaments or wires insulated one from the other by a myelin sheath and ending in tiny specialized knobs, coils, knots, and sprays distributed widely inside the body as well as on its surface.

There are two kinds of nerves, one sending impulses to the brain over sensory fibers and the other carrying commands back from the brain over motor fibers. Those nerve endings receiving stimuli from the outside are called sense organs or receptors. General sense organs are responsive to pain, touch, and temperature. Special sense organs are concerned with smell, sight, taste, and hearing. In general, nerves follow the courses of the arteries and are similar to telephone wires: the larger nerves, like telephone cable, contain many separate lines in a bundle.

THE REPRODUCTIVE SYSTEM

Sexual reproduction is the process of creating new organisms of the same species through the union of the male and female sex cells—sperm and eggs. Males and females exist in most species. Testes in the males produce sperm. Ovaries in the females produce eggs or ova. Fertilization occurs when the sperm unites with an egg, forming a **zygote**. During a period of pregnancy, the zygote develops into a fetus and eventually a new organism. An understanding of the reproductive process is important to the success of horse breeding.

Mare

The reproductive organs of the mare are shown in Figure 5–20. The ovaries produce eggs that unite with the sperm to start the new individual. They also secrete the **hormone** estrogen, which induces **estrus**, or heat, and progesterone, which conditions the reproductive tract for implantation and maintenance of the fetus.

The fallopian tubes or oviducts are the customary site of fertilization of the ovum (egg) by the sperm. They serve as a connecting link between the ovary and uterus.

The uterus consists of a body, **cervix**, and two horns, one of which receives the fertilized ovum for development.

The vagina receives the sperm during mating and functions as a passageway during parturition, or birth.

All reproductive functions in the mare are directed by hormones produced in the glands of her endocrine system; hormonal balance controls all phases of reproductive tract stimulation and inhibition. The mare's reproductive cycle is discussed in detail in Chapter 11.

Stallion

The reproductive organs of the stallion are shown in Figure 5–21. The male reproductive system consists of two testes, three accessory sex glands, and a series of tubules through which spermatozoa are transported to the female reproductive tract.

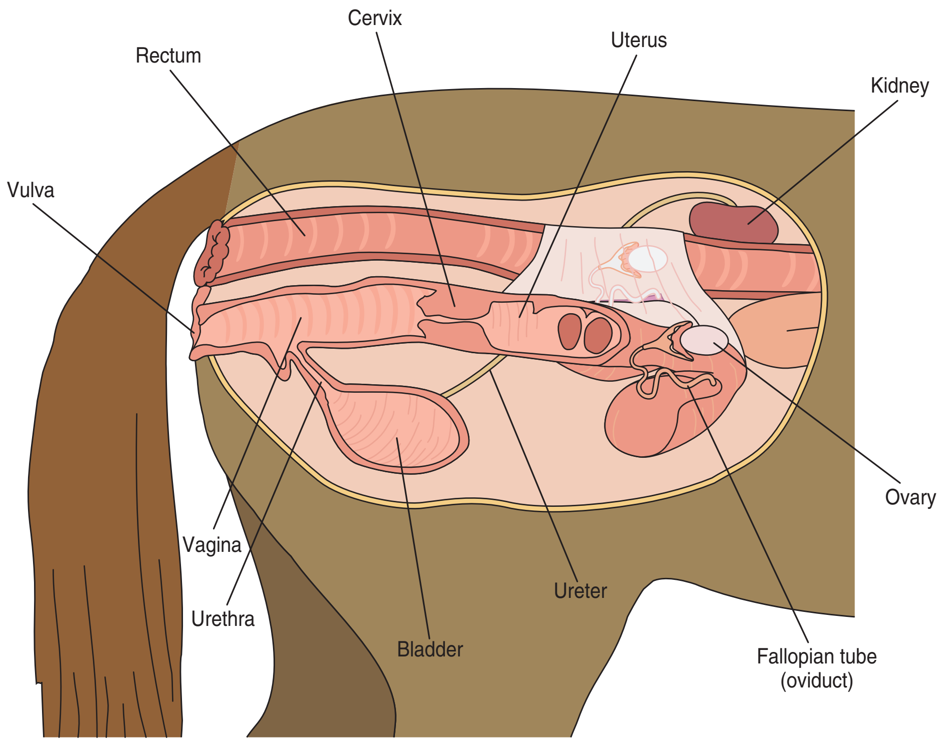


FIGURE 5–20 **Reproductive tract of a mare.**

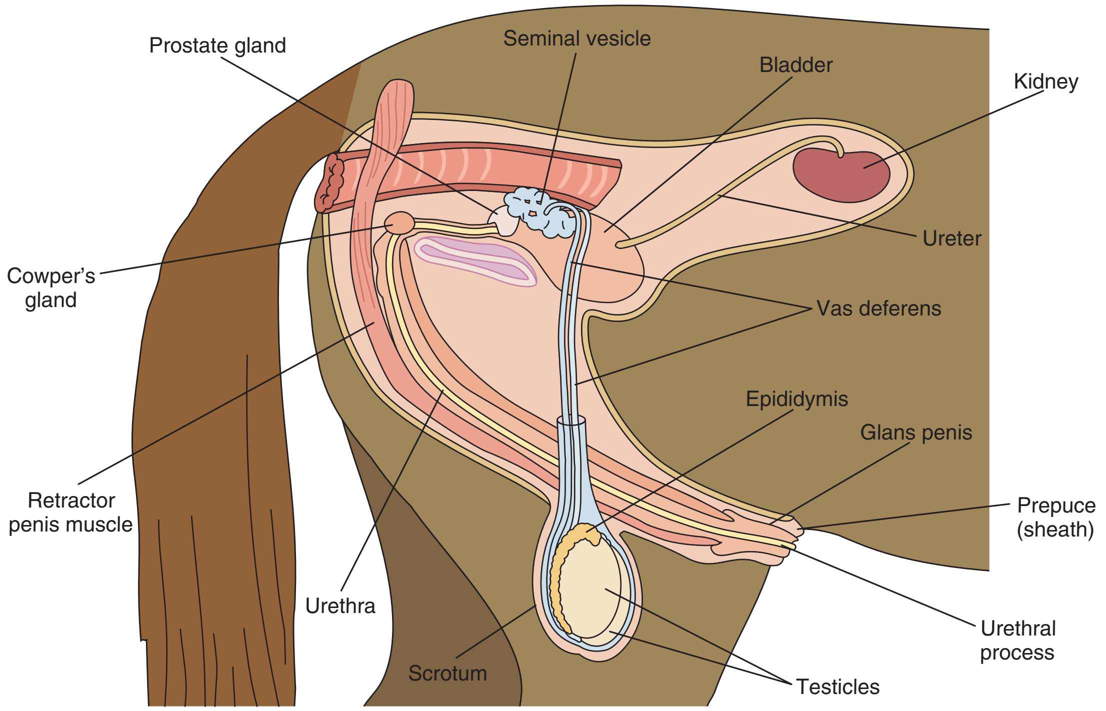


FIGURE 5–21 **Reproductive tract of a stallion.**

Spermatozoa are produced in the testes in small, coiled, seminiferous tubules that when extended are 400 to 500 feet long. Since developing sperm cells cannot live at body temperature, heat regulation of the testes is critical. Scrotal muscles contract and expand in the normal process of regulating the temperature of the testes.

Ridgling or **cryptorchid** horses are those in which one or both testes have not descended into the scrotum. The testis maintained in the body cavity is sterile, but the suspended testis is fertile. This condition is hereditary and should not be propagated; castration of a cryptorchid horse is usually a serious operation.

The accessory sex glands are the seminal vesicles, prostate, and bulbourethral gland (also called the Cowper's gland). These furnish alkaline fluid secretions to transport and neutralize the urethra. Spermatozoa are transported from the epididymis through the urethra, which terminates at the end of the penis.

THE ENDOCRINE SYSTEM

The ductless glands producing internal secretions, or the endocrines, form a system that influences the vital functions of the horse from before birth until death. Endocrine secretions control the events leading up to and including conception, gestation (pregnancy), parturition (birth), digestion, metabolism, growth, puberty, aging, and many other physiologic functions. **Homeostasis**, or balance, in the horse is largely under the control of the endocrine system.

Secretions of the endocrines are called hormones. Hormones are secreted without a duct directly into the circulatory system, where they travel to their target organ or tissue to influence its function.

Recent discoveries in endocrinology have blurred the lines between hormones and enzymes, and the definition of a hormone is being broadened as scientists gain a better understanding of endocrinology. Major components of the endocrine system of the horse are shown in Figure 5–22.

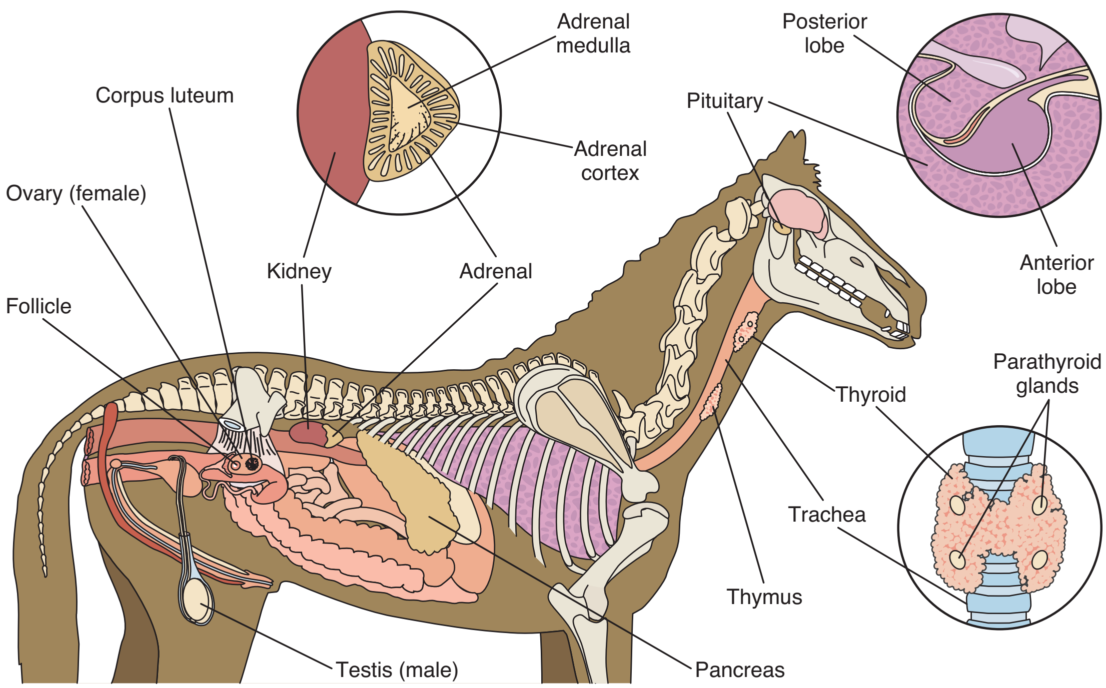


FIGURE 5–22 **Major endocrine organs of the horse.**

Hormones and Their Actions

Hormones aid in the integration of body processes by stimulating or inhibiting target organs. Although the time lapse between release and effect is longer than for the nervous system, the complementary function of the two systems provides for full coordination of body responses of horses. The ultimate purpose of hormones is to provide a means of adaptation between the body and its external or internal environment.

Hormones may be classified into two categories by their chemical composition. Steroid hormones are secreted by the adrenal cortex and the gonads. Protein or protein-like hormones are secreted from the pituitary gland, the thyroid, the pancreas, and the adrenal medulla.

Hormones regulate bodily reactions through their effects on target organs. They do not cause a reaction or event that could not otherwise occur; they merely modify the rate at which target organs perform functions. Hormones function at extremely small levels in the body, and the rate of secretion varies according to the level of stimulation required.

Hormonal output is often controlled through a feedback system from the target organ. This is most evident through the interaction of the anterior pituitary gland with other endocrine glands. Hormones released by the anterior pituitary control the level of activity of several other endocrine glands (adrenal cortex, thyroid, gonads). Increased hormone production by these glands serves as a negative feedback on the pituitary, causing in it a reduced rate of secretion of the stimulatory hormone.

The pituitary and the hypothalamus work together as a functional unit to coordinate the endocrine and nervous systems in their actions. The hypothalamus is the “center” of the autonomic nervous system and “master” of the pituitary. Through direct nervous connection and the releasing of hormones (factors), the hypothalamus controls the pituitary.

Posterior Pituitary

Hormones of the posterior pituitary (neurohypophysis) differ from other pituitary hormones in that they do not originate in the pituitary, but are only stored there until needed. Two hormones, vasopressin (antidiuretic hormone, or ADH), and oxytocin (milk letdown hormone), are actually produced in the hypothalamus. Their method of transfer from the hypothalamus to the pituitary is unique because it is not through the vascular system, but along the axons of the nervous system.

ADH

Vasopressin, or antidiuretic hormone (ADH), is a small polypeptide (chain of amino acids). ADH does not always function under everyday events. Hemorrhaging, trauma, pain, anxiety, and some drugs will trigger its release, and low environmental temperatures will inhibit it. ADH exerts its effects on the distal tubules and collecting ducts of the loops of Henle of the kidney, resulting in increased water absorption.

Oxytocin

Oxytocin controls lactation and reproductive phases of the mare. A neural stimulus, such as suckling, causes the hypothalamus to stimulate the posterior pituitary into releasing oxytocin, which is circulated through the blood until it comes into contact with the myoepithelial cells surrounding the alveoli of the mammary gland. Oxytocin causes the myoepithelial cells to contract, effectively squeezing the milk out of the secreting alveoli and releasing it into the milk ducts, cistern, and teats of the mammary gland.

Oxytocin also plays a role in reproductive processes. During the estrous cycle, oxytocin stimulates uterine contractions that facilitate the transport of sperm to the oviduct at estrus; during the late stages of gestation, it aids parturition.

Anterior Pituitary

Hormones of the anterior pituitary (adenohypophysis) are produced within the pituitary gland itself. They consist of the follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin, adrenocorticotropic hormone (ACTH), thyroid-stimulating hormone (TSH), and growth hormone.

FSH and LH

The two pituitary gonadotropins, FSH and LH, are necessary for the maintenance of gonadal functioning. FSH in the mare stimulates overall follicular growth. Follicle maturation is achieved through the combined actions of FSH, LH, and the female sex hormones, which are discussed in more detail later in this chapter.

The action of LH on a follicle is to increase the growth rate and stimulate the secretion of estrogen. Ovulation (the release of an egg) is triggered by this process. As a result of LH activity the follicle is converted to a corpus luteum (a gland formed on the ovary after ovulation that produces progesterone). LH controls the continued secretion of progesterone from the corpus luteum. Progesterone maintains pregnancy by keeping FSH and estrogen in check.

The actions of these hormones in stallions are analogous to those in mares. FSH in the male stimulates the formation of sperm by exerting its effect on small tubules in the testes. Full sperm production cannot be accomplished without the joint effort of LH, known as interstitial cell-stimulating hormone (ICSH) in the male, and certain levels of testosterone. ICSH facilitates the production of testosterone from specialized cells of the testes.

Prolactin

Prolactin, the lactogenic or luteotropic hormone (LTH), is vital for the proper development of lactation in horses. It cannot initiate the secretory process, and it requires estrogen and progesterone to "prime" the mammary system. Prolactin does not seem to be as necessary for the continuation of lactation as it is for its initial development and for stimulating the corpus luteum. To date, prolactin has not been demonstrated to have specific effects in male reproduction. Figure 5–23 illustrates the location in the brain of the thalamus, third ventricle, hypothalamus, pituitary gland, and infundibulum.

ACTH

Adrenocorticotropic hormone (ACTH) secreted from the anterior pituitary causes several events to occur. Of primary importance is the release of adrenocorticoid **steroids** from the adrenal cortex into the bloodstream. Other effects include a reduction of lipid levels from the adrenocortical cells, a lowered concentration

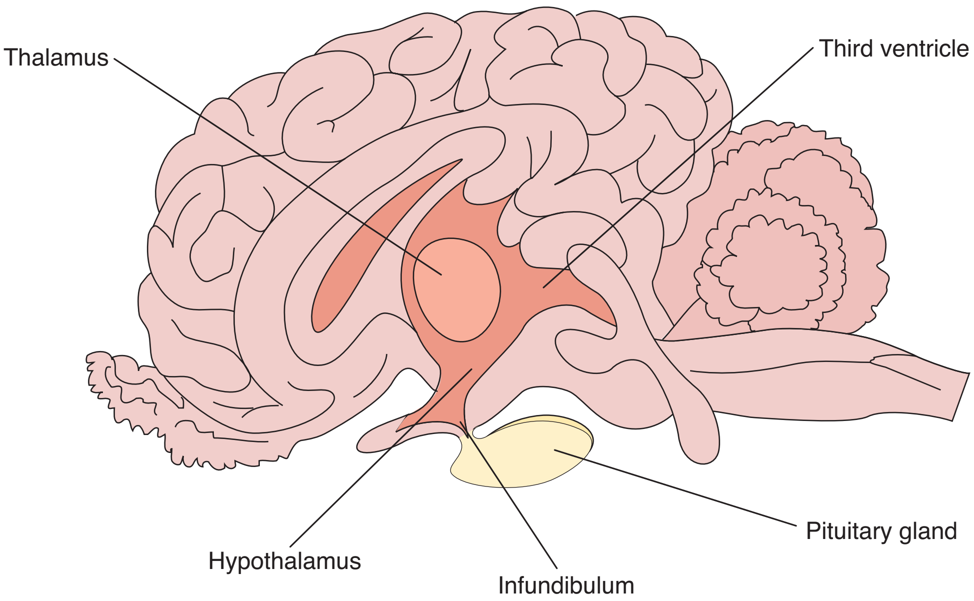


FIGURE 5–23 **Location of the hypothalamus, infundibulum, and pituitary in the brain.**

of adrenal cholesterol and ascorbic acid, a general increase in adrenal cell size and number, and an increase in adrenal blood flow. ACTH promotes the secretion of aldosterone, especially following body stress, such as loss of blood. (Hormones produced by the adrenal cortex are discussed later.) ACTH also influences processes not related to adrenal function, including movement of fatty acids and neutral fats from fat deposits, ketogenesis, muscle glycogen levels, hypoglycemia, and amino acid levels of the blood.

TSH

The thyroid-stimulating hormone (TSH) promotes the release of thyroxin from the thyroid gland. It also increases the rate of binding of iodine within the thyroid. The release of thyroxin serves as a general metabolic control, with higher levels of thyroxin producing an increased metabolic rate.

STH

The basic function of the growth or somatotropic hormone (STH) is to stimulate an increase in body size. Growth hormone, along with other pituitary hormones, is important in protein synthesis and provides high intracellular concentrations of amino acids. It exerts its effects on bone, muscle, kidney, liver, and adipose (fat) tissues in bones; in particular, the epiphyseal plates—long bone growth sites—are sensitive to it. Growth hormone regulates, along with the thyroid hormone, the filtration rate and blood flow through the kidney.

Growth hormone mobilizes fat from adipose tissue, resulting in increased blood levels of ketone bodies, together with stimulation of the alpha cells of the pancreatic islets, causing glucagon secretion. Growth hormone also exerts a stimulating influence on milk production in lactating mares, either partly or entirely due to an increased amount of mammary gland tissue.

Pineal

The pineal gland in horses and most other mammals is responsible for melatonin synthesis. It functions on a photoreceptive basis, causing different levels of melatonin production depending on light intensity. The pineal also affects the development and function of the gonads.

Thyroid

The thyroid gland secretes thyroxin. This hormone controls the rate of metabolism. Another hormone, calcitonin, also produced by the thyroid, aids in the metabolism of calcium and is essential for general bone development. The thyroid is interrelated to other endocrine glands, the adrenals, and the gonads through the pituitary.

Thyroxin

The structure of the thyroid hormone, thyroxin, is unique because the element iodine is essential for biological activity and release of the hormone from the gland. Thyroxin is necessary for the maturing of animals. While growth hormone is responsible for physical growth, thyroxin is necessary for the proper differentiation of body structures. Growth and eruption of the teeth of horses is under thyroid control. Even the skin and hair are affected by thyroid changes. A lack of thyroxin will cause a thinner coat of hair, with individual hairs being more coarse and brittle.

Reproductive failures and deficiencies in both sexes may be at least partly attributed to a lack of thyroxin, causing a variety of problems from abortions and stillbirths in mares to impaired sperm production and lowered libido in stallions.

The thyroid hormone affects temperature-regulating processes. By increasing the general rate of oxygen consumption at the cellular level, heat production is increased. Thyroxin stimulates general nervous functions at all levels, decreases the threshold of sensitivity to many stimuli, shortens reflex time, and increases neuromuscular irritability.

Low levels of thyroxin during developmental stages have detrimental effects on the nervous system.

Goiter, enlargement of the thyroid area, can be brought about by either hyperthyroid or **hypothyroid** conditions. The most common cause in animals is a deficiency of iodine, making the animal hypothyroid. Many feedstuffs have goitrogenic (goiter-producing) effects that inhibit thyroid activity. Vegetables such as cabbage, soybeans, lentils, linseed, peas, peanuts, and all of the mustard-like plants possess goitrogens. In the thyroid, these interfere with the process of trapping iodine.

Parathyroid

The parathyroid gland is located dorsal to the thyroid in horses and is responsible for maintaining proper calcium levels in the blood and extracellular fluids. Parathormone, the secretion of the parathyroid, increases calcium levels in the blood and affects calcium and phosphate levels of the bones and kidneys.

Thyrocalcitonin from the thyroid has the opposite effect, causing a decrease in blood serum levels of calcium during events of **hypercalcemia**. Parathormone affects bones directly by mobilizing calcium from the bones into the bloodstream. Parathormone also lowers the ability of the kidney to excrete calcium, thereby increasing calcium retention. Parathormone and vitamin D work together on calcium release from bone and in increased absorption of calcium from the intestine.

Pancreas

The pancreas is primarily an organ of digestive secretions, although mixed throughout the pancreas, there are functionally different groups of cells known as the islets of Langerhans. These cells have rich blood supplies and consist of so-called alpha and beta cells. Beta cells are the most common, and they produce the hormone **insulin**. Insulin lowers the blood glucose and gets glucose across the cell membrane to where it can be metabolized. Alpha cells are responsible for the production of glucagon, which increases the blood glucose.

Adrenal Cortex

The adrenal cortex is the outside layer of the adrenal glands, located near the kidneys. The adrenal cortex produces steroid hormones. These hormones bear some structural resemblance to cholesterol. Adrenal cortical hormones include glucocorticoids, mineralocorticoids, and **androgens**. Secretion of the glucocorticoids from the adrenal cortex is stimulated by ACTH. The glucocorticoids influence metabolic functions; the mineralocorticoids influence metabolism of minerals like sodium and potassium. Androgens are masculinizing sex hormones.

Deficiencies in glucocorticoid levels have detrimental effects on general body metabolism. A primary function of the glucocorticoids is as a catalyst in the gluconeogenic process—the formation of glucose from proteins and fats. Together with the mineralocorticoids, glucocorticoids also help regulate water metabolism.

Increase in the size of the adrenals can be observed in animals that are involved in stress situations. The stress of crowding is a major factor in adrenal enlargement, and adrenal weights of wild animals are used as a measure of population density. Overactivity of the adrenals produces androgens that inhibit the production of gonadotropins and thereby lower reproductive performance.

Other sources of steroid hormones, besides the adrenal cortex, are the ovaries, testicles, and placenta. Steroids are inactivated by their target organs as well as in the liver and kidney. These inactivated hormonal substances are water soluble and are readily eliminated through the urine.

Adrenal Medulla

The adrenal medulla, located at the center of the adrenal glands, produces two hormones—epinephrine and norepinephrine. Epinephrine (also known as adrenaline) helps the horse adjust to stress situations and activates the fight-or-flight mechanism. Norepinephrine helps maintain the tone of the vessels in the circulatory system. Release of these two hormones is controlled by nerves that enter the adrenal medulla.

Gonads

Sex hormones are primarily secreted by the ovaries and testes and, to some extent, by nongonadal organs such as the adrenals and the placenta. There are four types of hormones: androgens, estrogens, progesterone, and relaxin. The first three types are steroids, while the fourth is a protein.

The strongest and most predominant of the androgens is testosterone, which is produced by the interstitial or Leydig cells of the testicles. Testosterone and related hormones are responsible for male secondary sex characteristics of stallions, body conformation, muscular development, and libido. They are also responsible for the growth and development of secondary sex glands of the male, as well as maintaining the viability of the spermatozoa and stimulating penile growth. Testosterone is rapidly used by target organs or degraded by the liver and kidneys.

The ovaries produce two steroid hormones, estradiol and progesterone, and another protein hormone, relaxin. Estrogen comes from the Graafian (mature) follicles of the ovary. Progesterone comes from the corpus luteum on the ovary. A mature follicle ruptures at ovulation to release an egg. This ruptured follicle then develops into a second endocrine structure, the corpus luteum, and primary production shifts from estrogen to progesterone. The function of progesterone is to prepare the uterus for implantation and maintenance of pregnancy. Progesterone also suppresses the formation of new follicles and new estrus, and it prepares the mare for lactation through increased mammary development.

Relaxin is a hormone related specifically to the birth process and does not appear until late in pregnancy, just before parturition. It acts on the ligaments and musculature of the pelvis, cervix, and vagina. The precise site of formation of this hormone is not known, yet it is speculated that production may occur in the cells located in the boundary region of the cortex and medulla of the ovaries.

During pregnancy, the uterus itself takes on hormonal functions through the production of placental hormones: pregnant mare serum gonadotropin, estrogens, and progesterone. These hormones serve to maintain the uterus in a way that is favorable for the continued growth and development of the mammary gland.

Pregnant mares excrete estrogen in their urine. In 1942, a pharmaceutical company introduced estrogen extracted from the urine of pregnant mares as an estrogen replacement therapy (ERT) for human females. Estrogen from this source is still prescribed today for treatment of menopausal symptoms (see <http://www.premarin.com/>).

When mares are 115 to 125 days pregnant, the urine collection period begins. Estrogen production in their urine peaks between days 200 to 275 of pregnancy and then decreases as the mare approaches parturition, so the mares' urine is collected for a period of 150 to 160 days. Mares are specifically bred and housed for the purpose of collecting their urine. This has created some ethical issues with animal rights groups.

Gastrointestinal Tract

All hormones secreted by the gastrointestinal mucosa and small intestine are related to the digestive process. Five of these have been chemically identified, with the possibility of more existing, making the small intestine a major site of hormonal production, second only to the pituitary.

One hormone, secretin, is responsible for stimulating pancreatic bile and small intestine secretions. While causing an increase in fluid levels of the intestine, secretin has no effect on actual enzymatic increases. It also seems to have negative effects on the activity of the stomach.

A second hormone, enterokinin, causes an increased rate of secretion of digestive juices and enzymes of the small intestine.

Enterogastrone and cholecystokinin are two hormones related to fat levels in the diet. Enterogastrone inhibits rates of gastric secretion; in response to feed fat in the intestine, it slows down the rate of feed passage so that more time can be spent in the digestion of feed.

Table 5–1 summarizes the hormones of the horse and their origin and functions.

TABLE 5-1 Major Endocrine Glands and Hormones

GLAND	HORMONE	FUNCTION
Hypothalamus	Releasing hormones	Controls the pituitary gland
Posterior pituitary	Oxytocin	Stimulates uterine contractions and milk letdown
	Vasopressin or ADH	Increases water absorption in kidney
Anterior pituitary	Growth hormone (STH)	Promotes growth of most tissues
	Prolactin (LTH)	Promotes lactation; stimulates corpus luteum
	Adrenocorticotropic hormone (ACTH)	Stimulates adrenal cortex
	Thyroid-stimulating hormone (TSH)	Stimulates thyroid gland
	Follicle-stimulating hormone (FSH)	Stimulates follicle growth on the ovaries and sperm production in the male
	Luteinizing hormone (LH)/ Interstitial cell-stimulating hormone (ICSH)	LH stimulates ovulation, corpus luteum function, secretion of progesterone, and secretion of estrogen in the female; ICSH facilitates production of testosterone in the male
Pineal	Melatonin	Aids in adaptation to light-dark cycles
Thyroid	Thyroxine	Controls metabolism and affects growth, reproduction, and nutrient assimilation
	Thyrocalcitonin	Decreases blood serum levels of calcium
Parathyroid	Parathormone	Regulates metabolism of calcium and phosphorus
Pancreas	Insulin and glucagon	Regulate glucose metabolism
Adrenal cortex	Glucocorticoids	Stimulate conversion of protein to carbohydrates for energy; decrease inflammation and immune response
	Androgens	Regulate masculine secondary sexual characteristics
	Mineralocorticoids	Regulate sodium and potassium metabolism
Adrenal medulla	Epinephrine and norepinephrine	Prepare animal for emergencies; mobilize energy
Testes	Testosterone	Develops and maintains accessory sex glands; stimulates secondary sexual characteristics, regulates sexual behavior and sperm production
Ovary	Estrogen	Promotes female sexual behavior; stimulates secondary sexual characteristics, growth of reproductive tract, mammary growth, and feedback control
	Progesterone	Prepares uterus, maintains pregnancy and prepares mammary glands for lactation, and provides feedback control
	Relaxin	Facilitates dilation of birth canal
Gastrointestinal tract	Secretin, enterokinin, cholecys tokinin, enterogastrone	Control secretions and motility of digestive tract

SUMMARY

The nine body systems of the horse are skeletal, muscular, digestive, urinary, respiratory, circulatory, nervous, reproductive, and endocrine. Proper function and control of each of these systems is essential to the survival, growth, and health of the horse. While the systems are generally discussed individually, they are interrelated and function in concert with each other.

For individuals working with horses, a basic understanding of the functional anatomy of the horse is essential before discussing growth, aging, movement, selection, nutrition, health, breeding, behavior, management, or even facilities.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. The digestive system provides a large store of calcium and phosphorus.
2. The mouth is not part of the digestive system.
3. Food passes from the mouth through the trachea to the stomach.
4. Blood carries carbon dioxide and oxygen.
5. Capillaries are the largest of the blood vessels.
6. The pituitary produces the steroid hormone testosterone.

Short Answer

7. List the bones in the foreleg of the horse, from the shoulder joint down to the hoof.
8. Name six types of cells that form during morphogenesis.
9. List the nine body systems.
10. Identify the four surfaces of an animal.
11. What are the two major divisions of the skeletal system?
12. List the five divisions of the vertebral column.
13. What organ transports food from the mouth to the stomach?
14. What organ filters the waste products out of the blood and helps maintain water and mineral balance?
15. Name the two movements of external respiration.
16. What is the name for the air sacs at the end of branching bronchi in the lungs?
17. List the two main divisions of the nervous system.
18. List five reproductive organs in the mare.
19. List five reproductive organs in the stallion.
20. Name three accessory sex glands in the stallion.
21. Identify the hormones from each of the following: posterior pituitary, anterior pituitary, thyroid, pancreas, adrenal, testes, and ovaries.

Critical Thinking/Discussion

22. Identify the four classifications of bones according to their shape, and describe their location and function based on shape.

23. Describe three types of joints.

24. Explain the concept of extensor and flexor muscles.

25. Describe one cycle of external respiration.

26. Briefly outline the circulation of blood through the body of the horse, including the heart and lungs.

27. Define a hormone.

28. Describe the relationship of the anterior pituitary to the other endocrine glands.

29. Why is the nervous system like a communication system?

30. From where does energy come for muscle contraction?

STUDENT ACTIVITIES

1. Dissect a fresh or preserved heart. Ideally, this should be from a horse, but one from another livestock species will work. Identify all parts of the heart, and trace the flow of blood through the heart.
2. Construct a model of the visible horse. Hobby shops often sell a model called the visible horse. (Contact a hobby shop or an online source such as Amazon.com for a model.) This model reinforces understanding of the structure of many of the systems.
3. Find a mounted skeleton of a horse or some other species. Identify the bone shapes and joint types. Or, instead of the whole skeleton, obtain a model of the front or hind leg and carefully study the relationship of each bone and the joints formed.
4. From a biological supply company, obtain a three-dimensional model of the kidney to study for a better understanding of its function. As an alternative, dissect a fresh or preserved kidney from any of the livestock species.
5. Draw and label your own diagram of the reproductive tracts of the mare and stallion.
6. Develop a report on the senses: sight, smell, hearing, touch, and taste. Describe how these sensations are transmitted to the brain and interpreted. How is pain sensed and interpreted? In the report, draw diagrams of the various sensory receptors.
7. Create a crossword puzzle of the various hormones, using their site of origin and action as the hints. (Free crossword puzzle makers can be found on the Internet.)
8. Construct a model of the lungs using a bottle, some tubing, and balloons. Demonstrate how the movement of the diaphragm fills the lungs. Details can be found on a variety of websites; for example eHow.com or Answers.com.

ADDITIONAL RESOURCES

Books

Aspinall, V., & Capello, M. (2009). *Introduction to veterinary anatomy and physiology textbook*. Oxford, UK: Butterworth-Heinemann.

Budras, K-D., Rock, W., Rock, S., & Sack, W. (2004). *Anatomy of the horse*. London: Manson Publishing.

Frandson, R. D., Wilke, W. L., & Fails, A. D. (2009). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.

Hafez, E. S. E. (2000). *Reproduction in farm animals* (7th ed.). Philadelphia: Lippincott Williams & Wilkins.

Kahn, C. M. (Ed.), & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

McCracken, T. O., & Kainer, R. A. (1998). *The coloring atlas of horse anatomy.* Loveland, CO: Alpine Publications.

McKinnon, A. O., Squires, E. L. Vaala, W. E., & Varner, D. D. (2010). *Equine reproduction.* Ames, IA: Wiley-Blackwell.

Pavord, T. & Pavord, M. (2009). *The complete equine veterinary manual* (3rd ed.). Cincinnati, OH: David & Charles Book.

Equipment and Supplies

Carolina Biological Supply Company, Carolina Science and Math Catalog 66, 2700 York Rd., Burlington, NC 27215-3398 <http://www.carolina.com>

NASCO Agricultural Sciences, 901 Janesville Ave., Fort Atkinson, WI 53533-0901 <http://www.enasco.com/>

Nebraska Scientific, 3823 Leavenworth St., Omaha, NE 68105-1180 <http://www. nebraskascientific.com/>

Fisher Science Education, 4500 Turnberry, Hanover Park, IL 60133 <http://www. fisheredu.com/>

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases relating to physiology or life functions of horses:

circulatory	muscular	respiratory
digestive	nervous	skeletal
endocrine	reproductive	urinary

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 6

Biomechanics of Movement

Movement of a horse requires the complex integration of several physiological systems. The bones and joints together compose a complex system of levers and pulleys that, combined with the muscular system, imparts the power of motion to the body. Nerves and sensory organs control the movement. Movement is affected by a horse's conformation, or structure.

OBJECTIVES

After completing this chapter, you should be able to:

- Describe muscle contraction
- Describe the nervous control of muscle contraction
- List four functional groups of muscles
- Explain why the heat generated by muscular contraction affects performance
- Contrast aerobic to anaerobic metabolism during muscular contraction
- Name three types of muscle fibers and identify their function
- Name three extensor and three flexor muscles on the hind and front leg
- Describe the two phases of a stride
- Name three factors of a gait that determine a horse's speed
- Define height, directness, spring, regularity, and balance as they relate to gaits
- Describe the walk, trot, gallop, rack, and canter
- Explain the role of conformation in the movement or performance of a horse
- List and describe six common defects in a horse's way of going
- Describe how the center of gravity may affect the movement of a horse

KEY TERMS

abductors
adductors
afferent
amble
balance
beat
center of gravity
collected
cross-firing
directness
dwelling
efferent
forging
gait
interfering
neurotransmitter
pace
paddling
pointing
pounding
proprioceptors
reflexes
rolling
scalping
speedy-cutting
spring
step
stepping pace
stride
stride stance
stride suspension
swing
tetanus
trappy
twitch
way of going
winding
winging outward

NERVOUS SYSTEM CONTROL

A walk, trot, gallop, or any other gait requires the simultaneous contraction and relaxation of muscles. Muscular contraction is a complex interaction of many parts of the nervous system and the muscular system. As Figure 6–1 shows, muscle action starts in the brain, where information received through a variety of sensory inputs is processed. For example, the eyes may sense a jump, the ears hear a cluck, or the sides feel a nudge from the rider's heels. The horse's brain interprets this information along with internal sensory organs like the joint **proprioceptors**, which give the horse a sense of the positions of its limbs. Next, the brain determines the appropriate muscles to contract or relax. This information is sent down the spinal cord and then to **efferent** nerves that end on muscle cells. The muscle contracts or relaxes, and the bone and joint respond to produce the action.

After this, the cycle starts again. The **afferent** nerves send information from the joint proprioceptors back to the brain. As before, the sensory information to the brain is interpreted and another signal is sent back down the spinal cord and efferent nerves to the muscle producing movement in the bone and joint. Of course, this process occurs many times and very rapidly for every movement.

Some signals traveling on the afferent nerves never reach the brain. Instead they go directly to the spinal cord and then back to the efferent nerves and the muscles. These signals are called **reflexes**. An example is a kick in response to a surprise or a twitch of the skin in response to an insect.

HOW MUSCLES CONTRACT

Skeletal muscles attach to the bone and come in pairs—one muscle to move the bone in one direction and another to move it back the other way. These muscles usually contract voluntarily—meaning that thought processes acting through the nervous system tell them to do so. They can do a short, single contraction (**twitch**) or a long, sustained contraction (**tetanus**). Figure 6–2 illustrates how muscles are organized starting with the muscle and moving to the muscle bundles, the muscle fibers, and finally the myofibrils. Muscular contraction occurs at the myofibril level.

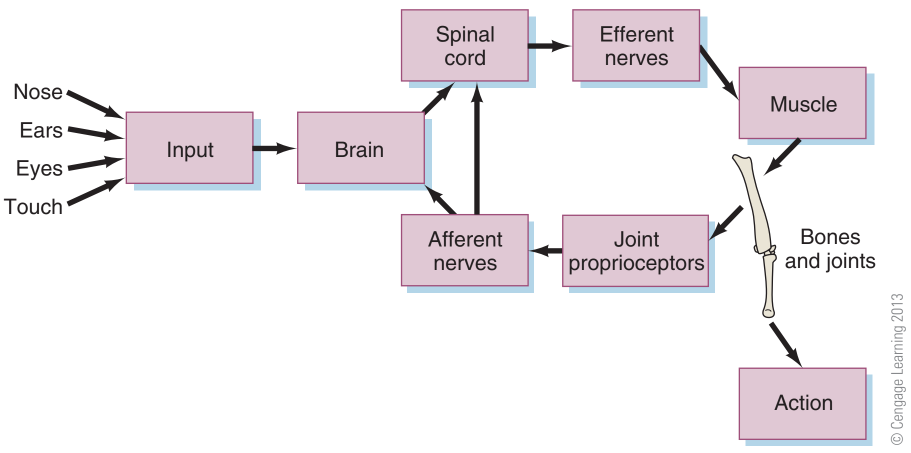


FIGURE 6–1 **How information received by the brain produces action.**

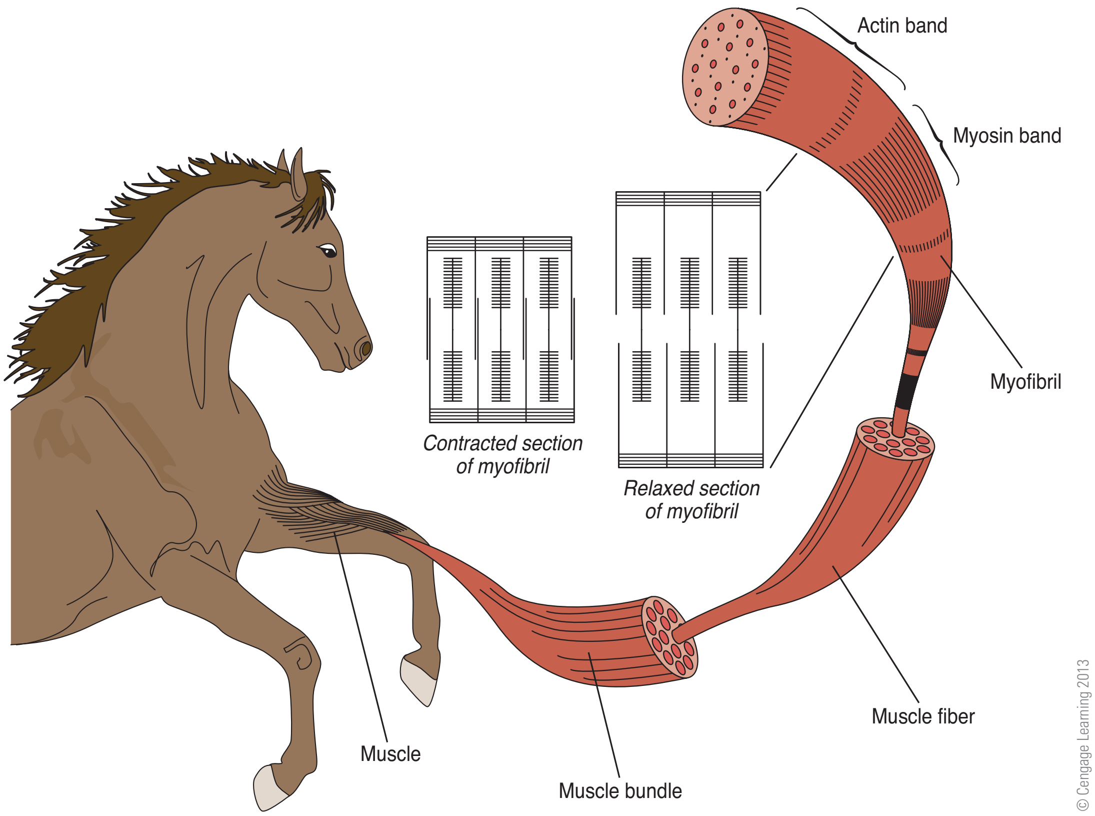


FIGURE 6–2
How the parts of a muscle work.

Figure 6–2 also shows a muscle filament, or myofibril, in cross section at various states of contraction. Each muscle is made up of thousands of these filaments. Contraction or relaxation is controlled by the nervous impulses received by the muscle cells.

When a muscle contracts, a **neurotransmitter** called acetylcholine (ACH) excites the muscle cells. This causes the release of calcium ions, which bind to a special protein called troponin. In turn, two other muscle proteins, actin and myosin, are free to bind to each other and form bridges. This causes the muscle to contract. When the calcium concentration drops and the muscle is no longer excited by ACH, actin and myosin no longer bind, and the muscle relaxes (Figure 6–2).

The force a muscle can generate is a function of three factors:

1. Short periods of stimulation causing contraction
2. Length of the muscle when stimulated to contract
3. Number of actin and myosin filaments acting

Short periods of stimulation that cause contraction provide for more calcium to be present in the muscle, thus taking longer to overcome elastic elements. If the stimulus is only of short duration, some of the force is taken up in overcoming the elastic elements of the tendons and other connective tissue.

Muscle force is also a function of the number of actin and myosin bridges formed. Muscle length alters the relationship between actin and myosin. If the muscle is stretched, the number of bridges decreases. When the muscle is stimulated to contract, the amount of force produced is decreased.

Actin and myosin molecules in the muscle fiber also affect the number of bridges. These filaments align in a parallel formation. The greater the number of filaments that

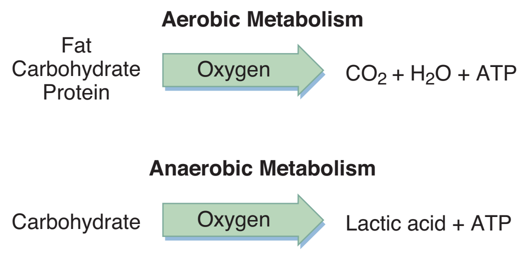


FIGURE 6–3 **The chemical reactions for anaerobic and aerobic metabolism.**

are parallel, the greater the force of contraction. This occurs as either recruitment of more muscle fibers or by actually increasing the number of filaments in cross section. In the latter case, the increased force requirements of an exercise regime produce hypertrophy, an increase in the number of filaments in cross section. The horse will appear "bulked up" or will show larger muscles.

Muscle contraction requires energy. This energy is derived from metabolic processes that produce adenosine triphosphate (ATP). ATP is produced from fats, carbohydrates such as glucose or glycogen, and protein. Oxygen from respiration (breathing) is required to produce ATP (Refer to Chapter 4 for a complete discussion on the formation of ATP.). As long as sufficient oxygen is available to produce ATP, muscle contraction is called aerobic. When muscle contraction is of such high intensity or long duration that adequate oxygen is not available, the products of metabolism are converted to lactic acid to produce ATP. This type of muscular work is called anaerobic. Exercise and training can alter the efficiency of the muscles by increasing the animal's ability to deliver oxygen to the tissues. YouTube provides some great video clips explaining muscle contraction; for example: http://www.youtube.com/watch?v=ren_IQPOhJc

Figure 6–3 presents simplified chemical reactions for aerobic metabolism and anaerobic metabolism. In the horse's body, each of these reactions involves numerous series of reactions, all linked together and catalyzed by enzymes.

MUSCLE FIBERS

Muscle fibers require nutrients to contract. Different energy sources can be used by horses performing different types of activity, depending on the type of muscle fiber involved in the activity. Three different muscle fiber types are associated with the athletic horse:

- Type I (slow-twitch fibers, aerobic)
- Type IIa (fast-twitch fibers, aerobic)
- Type IIb (fast-twitch fibers, anaerobic)

Type I fibers are in use during relatively slow or light activity and use carbohydrates, fat, or protein. Type IIa fibers are the stamina or endurance fibers used during periods of aerobic work such as jogging or long-distance riding. These fibers can use carbohydrates, fat, or protein for energy. Type IIb fibers are the speed or power fibers used for periods of strenuous anaerobic work such as sprinting, jumping, or cutting. These fibers use carbohydrates only.

For example, the quarter horse is born with a relatively large proportion of type IIb fibers and does best on a diet of carbohydrates—hay and grain. The endurance horse, such as the Arab, is born with a higher proportion of type I and IIa fibers and does best on a diet of both carbohydrates and fat—hay, grain, and oil.

FATIGUE OF MUSCLES

Fatigue of muscles follows continued work, principally due to the accumulation of waste products in the muscle cells. Recovery requires removal of the accumulated waste products by the blood and lymph, and a fresh supply of nutrition brought to the muscles. Hand-rubbing the legs of a horse after exercise stimulates the blood and lymph vessels in the removal of waste products. It also causes the blood to circulate more freely. Fatigue may also be overcome in part by feeding easily digested carbohydrates for a maximum of energy.

An untrained horse, one not accustomed to steady work, fatigues more easily than a trained horse, mainly because the muscles, respiration, and circulation do not operate as efficiently. There is a limit to the amount of continued muscular effort a horse can expend; harmful fatigue can be avoided by working the horse at a moderate rate in order to maintain the proper balance between the products of muscular activity and the ability of the blood to remove waste material. An animal should never be worked until exhausted.

HEAT

Heat is a by-product of muscle contraction. To prevent an excessive increase in core body temperature, heat must be dissipated. In the horse, heat is dissipated through sweating (evaporation) and by air movement across the body. Blood transports heat from the working muscles and the core to the skin, where it is cooled.

During exercise in hot environments, the need to control body temperature causes a large shift in blood flow to the skin. This may adversely affect the exercising horse by decreasing the blood flow to the muscles. Fluid losses during exercise in hot environments can also significantly decrease plasma (blood) volume. This too may negatively impact the horse, making it harder to maintain adequate blood flow to the muscles. Finally, exercise in hot environments increases the amount of electrolytes (sodium chloride, potassium, calcium, and sodium bicarbonate) lost in the sweat. These electrolytes are important for fluid balance, acid-base balance, muscle contraction, and nerve function.

MUSCLES INVOLVED IN GAITS

Muscles that the horse uses to execute the various gaits form four functional groups (Figure 6–4):

1. Flexors
2. Extensors
3. Abductors
4. Adductors

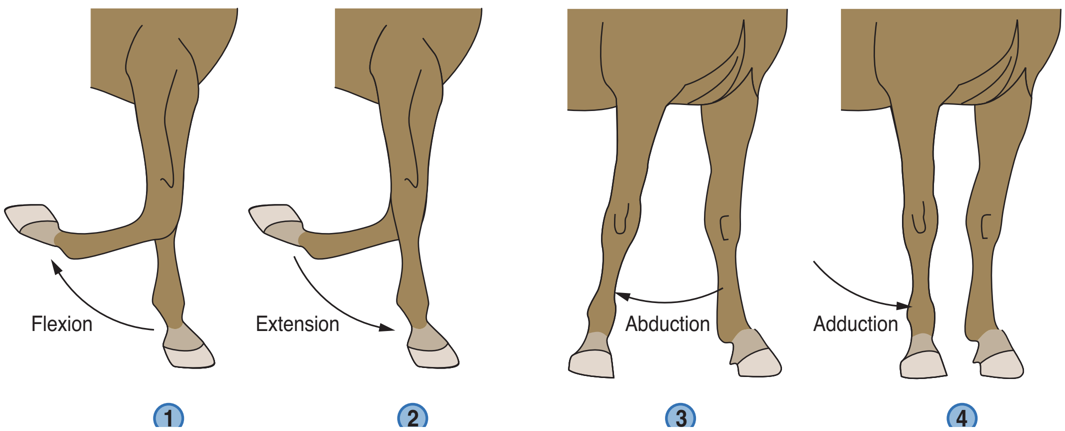


FIGURE 6–4
(1) Flexion;
(2) extension;
(3) abduction; and
(4) adduction.

Contraction and relaxation of these groups in the limbs and the attachment of the limbs to the body create the horse's gaits and other movements. Flexors decrease the angle of a joint, while extensors increase the angle of a joint. **Abductors** move a limb away from the center plane of the horse; **adductors** pull a limb toward the center plane of the horse.

Extensor muscles of the front leg include:

- Brachiocephalicus
- Supraspinatus
- Triceps brachii
- Oblique carpal extensor
- Lateral digital extensor
- Common digital extensor

Flexors of the front leg include:

- Teres major
- Latissimus dorsi
- Biceps brachii
- Flexor carpi radialis
- Flexor carpi ulnaris
- Deep digital flexor

Adductors of the front legs are the pectoral muscles. The abductor of the front leg is the deltoid.

On the hind leg, the extensors include:

- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gluteus medius
- Quadriceps femoris
- Gastrocnemius
- Long digital extensor
- Lateral digital extensor

Flexors of the hind leg include:

- Iliacus
- Popliteus
- Deep digital flexor
- Superficial digital flexor

For a review of the muscular system, see Chapter 5.

GAITS AND ACTION

A **gait** may be defined as a horse's **way of going** or the way of moving its legs during progression. The horse is more versatile in selecting gaits than is any other four-legged animal, and it uses several gaits unique to the species. A gait is characterized by distinctive features, regularly executed. Action refers to flexion of the knees and hocks, the height the horse lifts his feet from the ground, the speed or rate of movement, and the length of the stride.

An understanding of gaits is important to detect lameness, to train a performance horse, or to signal a horse for a specific gait. Some gaits of a horse are natural, while others are learned or artificial. Most horses must be trained to execute the artificial gaits.

When describing the various gaits, a **beat** refers to the time when a foot—or two feet simultaneously—strikes the ground. Beats may or may not be evenly spaced in time. A **step** is the distance between imprints of the two front legs or the two back legs. A **stride** is the distance between successive imprints of the same foot.

Components of a Stride

The stride has two phases—**stride stance** and **stride suspension**. Stride stance is the weight-bearing phase, while the stride suspension or **swing** is the non-weight-bearing phase. The speed of a horse is determined by:

- Length of stride
- Rapidity or frequency of stride
- Overlap time or the time on the ground versus time off the ground

For example, the famous racehorse Secretariat ran faster because he spent less time with his legs in the stance and overlap phases. In other words, Secretariat's legs completed their ground contact quicker, and more time was spent in the airborne (suspension) phase.

Other terms used to describe a horse's gait include:

- **Directness**, or trueness, which is the line in which the foot is carried forward during the stride. A horse that paddles does not carry its feet straightforward during the stride (Figure 6–5).
- Power or the pulling force exerted to create the stride.
- Height, which is indicated by the radius of the arc created from the point of the foot's takeoff to the point of the foot's contact again with the ground (Figure 6–6).

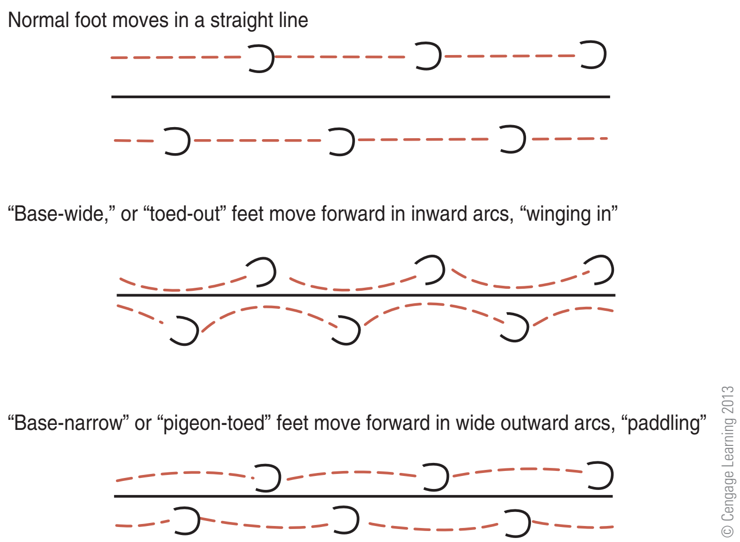


FIGURE 6–5 **Directness versus winging in and paddling.**

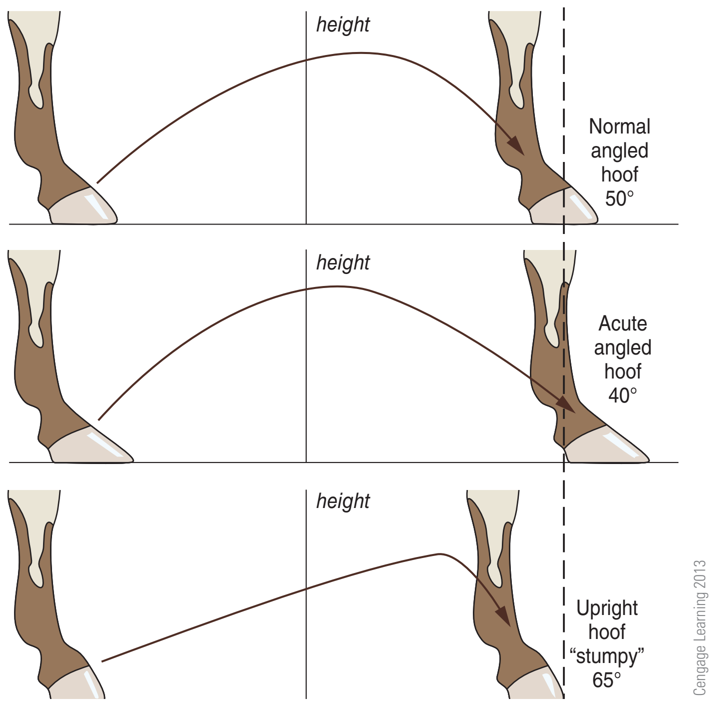


FIGURE 6–6 **The desired arc is created when the hoof is angled**

- **Spring**, or the manner in which weight settles back on the supporting leg at the completion of the stride.
- Regularity, or the rhythmic precision of each stride.
- **Balance**, which is the ability of a horse to coordinate action, go composed, and remain in form.

COMMON GAITS

Historically, six gaits were considered natural for the horse—walk, trot, pace, canter (or lope), run, and back. Now all horses are considered to have four natural gaits—walk, trot, canter, and gallop (or run). Any gait that a horse executes without training is natural. Some common gaits are described briefly in this section (Figure 6–7).

Walk

This is a slow, even, four-beat gait. The sequence of hoofbeats for the walk is (1) left hind, (2) left fore, (3) right hind, and (4) right fore. This sequence of beats is considered lateral because both feet on one side strike the ground before the feet on the opposite side strike the ground (Figure 6–7).

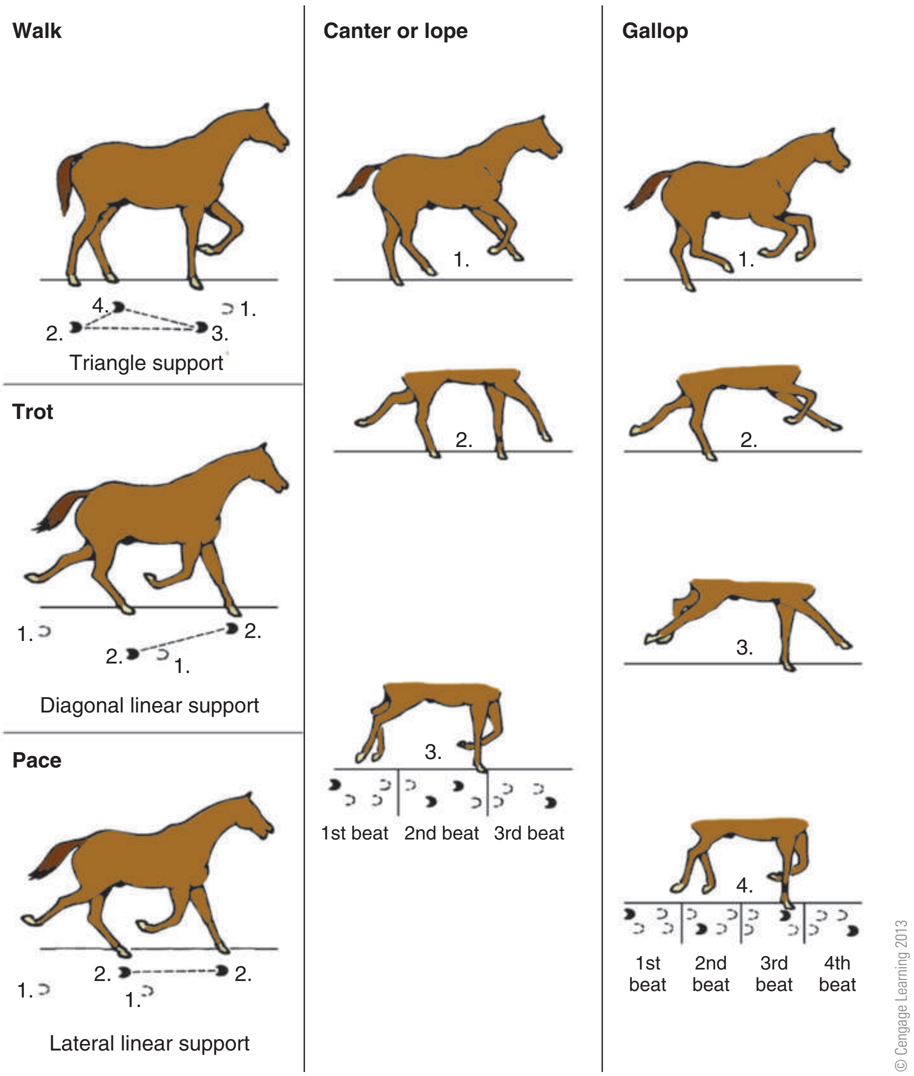


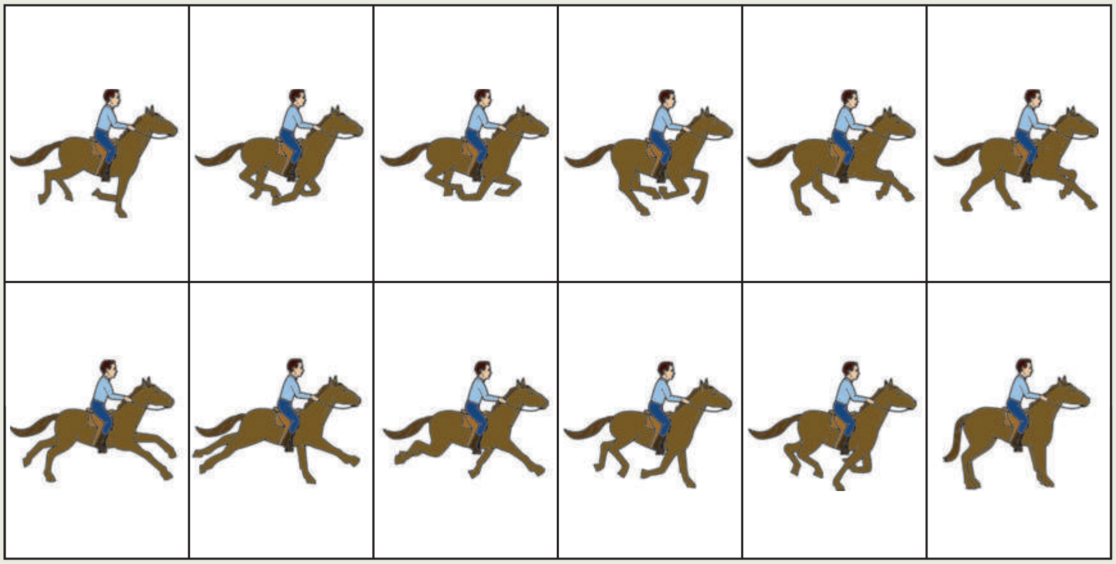
FIGURE 6–7 **Basic gaits: walk, trot, pace, canter, and gallop.**

Horses Had Role in Development of Moving Pictures

Because of his fame, his success at publicizing his activities, and his habit of patenting machines before actually inventing them, Thomas Edison received most of the credit for inventing the motion picture. As early as 1887, he patented a motion picture camera, even though it could not produce images.

Actually, many inventors contributed to the development of moving pictures, and horses helped too. Perhaps the first important contribution was the series of motion photographs made by Eadweard Muybridge between 1872 and 1877. He was hired by the governor of California, Leland Stanford, to capture on film the movement of a racehorse. Stanford had bet someone $25,000 that when a horse is at a fast trot, all four of its feet are off the ground. To prove his point, he hired Muybridge to make a photographic study documenting animal motion. At an elaborately designed experiment station on Stanford's farm (later site of Stanford University), Muybridge set up a series of stereoscopic cameras.

Muybridge tied a series of wires across the track, connecting each wire to the shutter of a still camera. The running horse tripped the wires and exposed a series of still photographs. Muybridge mounted the photos on a stroboscopic disk and projected them with a magic lantern to reproduce an image of the horse in motion. Stanford won the bet. Muybridge continued his research into various forms of animal locomotion, from crawling infants to elephants. For more information about Eadweard Muybridge and to view his photos of a horse in action go to http://en.wikipedia.org/wiki/Eadweard_Muybridge, or the movie Muybridge made can be viewed on YouTube (http://www.youtube.com/watch?v=UrRUDS1xbNs)



Note: Historically, safety helmets were not used at the time this experiment took place. Whenever a rider is on a horse, using an approved helmet is advised.

Trot

The trot is a two-beat gait with the diagonal fore and hind legs acting together (Figure 6–8). A period of suspension in which all four feet are off the ground occurs between each beat. The road horse trot is a fast-stepping trot characterized by length and rapidity and executed with extreme degree of extension, or length of stride. Heavy harness trot and hackney trot are high-stepping gaits with a high and springy stride, very **collected** (controlled), and executed with each step showing extreme flexion and precision (Figure 6–7).

FIGURE 6–8 **Haflinger horse trotting.**

Canter

The canter or lope is a three-beat collected gait. The sequence of beats is (1) the right rear hoof, (2) left rear and right front hoofs striking simultaneously, and (3) the left front hoof (Figure 6–7). When cantering, the horse carries more weight on its haunches, or rear quarter. The gait is executed in a slow, animated, collected, rhythmic way in which the lead changes on command. If moving to the left, the horse should lead with its left leg, and vice versa. If a horse is cantering to the right and leading with its left foot, the horse is exhibiting what is known as a counter canter.

Gallop

The gallop or run is a fast, four-beat gait (Figure 6–7). One hind foot makes the first beat, followed by the other hind foot. The diagonal forefoot is the third beat, and the remaining forefoot is the fourth. A period of suspension follows the four beats. If the horse changes leads, it will do so in the period of suspension. The run is the gait of a racehorse.

Pace

This is a two-beat, lateral (side-to-side) gait with the fore and hind legs on the same side moving together (Figure 6–7). A period of suspension occurs between each beat. Since the horse is shifting its weight from side to side, the gait has a rolling motion. It requires a smooth, hard footing and a minimum of draft. Trotting downhill will cause some trotters to pace; pacing uphill will cause some pacers to trot. The **pace** is a speed gait. The **amble** is a lateral gait distinguished from the pace by being slower and more broken in cadence. It is not a show gait.

Slow Gait

The slow gait or **stepping pace** is a show gait. This is a lateral, four-beat gait done under restraint in showy, animated fashion with the forefoot on the right followed by the hind foot on the right. In the stepping pace, the break in rhythm is between the lateral fore and rear foot.

Rack

The rack is an even, fast, flashy, four-beat lateral gait. It is sometimes called a single foot and is characterized by quite a display of knee action and speed. The rack is hard on the horse but easy on the rider. Its excessive leg movement increases the amount of concussion and trauma to the forelegs.

Running Walk

The running walk is the fast walk of the Tennessee walking horse. It is faster than the ordinary or flat-foot walk. It is a single-foot or four-beat lateral gait with a break in the impact or rhythm occurring between the lateral fore and hind feet. The horse travels with a gliding motion because it extends the hind leg forward to overstep or overreach the forefoot print.

Back

When a horse backs, it is actually trotting in reverse. Backing is a two-beat gait in which the diagonal pairs of legs work together.

CONFORMATION AND ACTION

Conformation, the form or structure of a horse, has a bearing on how well it functions or performs. While Figure 6–9 illustrates desired traits, irrespective of breed, this does not mean the illustration is a true representation of all breeds.

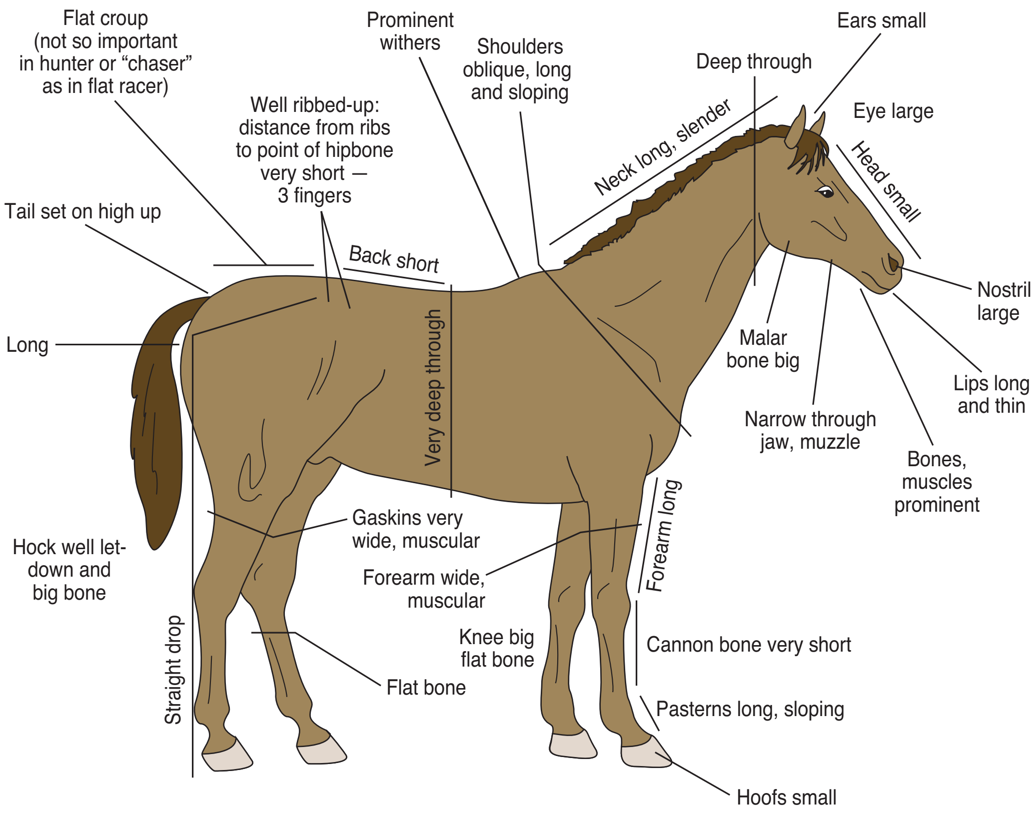


FIGURE 6–9
Desired horse traits.

Courtesy of Rick Parker.

FIGURE 6–10 Horses in action.

How a horse stands is indicative of how it will move. The normal stance, with width between the legs in proportion to the width of the chest, and feet placed straight, results in the legs and feet moving in a straight line. A base-wide horse, particularly if it also toes out, wings inward or moves its feet and legs in with each stride. If the condition is severe, the horse is apt to strike one leg with the other (interfering), resulting in injury and even unsoundness. Base-narrow, with toes pointing in, results in a horse that paddles. This is unsightly and results in excessive hoof wear on the outside quarters and excessive strain on the knee, fetlocks, and tendons.

If a horse stands straight, it is likely to move straight and true. If the legs are set properly, it is better able to move with collected action (Figure 6–10). A horse with crooked legs cannot move true. Regardless of a horse's excellent head, neck, shoulder, top, and general balance and conformation, if it is crooked on its legs, it is not a top horse.

Unsoundnesses in the pasterns, cannon bones, knees, and especially the hocks also affect movement. The following conformation features affect action and gaits and may predispose an animal to certain unsoundnesses:

- A long forearm contributes to a long stride.
- Sloping shoulders and pasterns are associated with a springy stride. Straight shoulders are associated with a rough ride.
- A calf-kneed (back at the knees) posture is associated with hard concussion or a pounding gait; it predisposes a horse to bone chips.
- Low, rounding withers are associated with a defective gait called forging. A horse with low withers commonly hangs in the bridle, moves with its head low, and handles its front feet awkwardly.
- A pigeon-toed horse will paddle or wing out. Conversely, a splayfooted (heels in, toes out) horse will wing in, and the striding leg may actually strike the supporting leg. Further, its hooves will wear unevenly (see Figure 6–5).

- Short, steep ankles and pasterns result in a stilted stride, hard concussion, and a tendency to cocked ankles and unsoundness.
- Front legs out at the corner or legs set too far apart in front are a structural defect associated with a rolling motion when the horse moves.
- A short, thick, bulky neck too often goes with a straight shoulder and reduces neck suppleness and mobility and the rider's ease in controlling the horse.
- A short, straight shoulder and forearm, accompanied by steep pasterns, results in a short stride and a tendency toward sidebones.
- Buck knees and long toes cause stumbling.

For more information on conformation, refer to Chapters 7 and 8.

COMMON GAIT DEFECTS

How the horse moves its feet and/or legs while executing the gaits may involve defects. Some defects cause limb interference and may be severe enough to cause injury. Other defects are not serious, but they prevent top performance from the horse. Defects and peculiarities in the gait include **forging**, **interfering**, brushing, striking, **paddling**, **winding**, **scalping**, **speedy-cutting**, **cross-firing**, **pointing**, **dwelling**, **trappy**, **pounding**, and **rolling**. These defects can be related to conformation, injuries, or improper shoeing and trimming of the feet.

FORGING

Forging is striking the end of the branches of the hoof or the undersurface of the shoe of the forefoot with the toe of the hind foot (Figure 6–11). This is the diagonal foot in pacers and the lateral foot in trotters.

INTERFERING

Interfering is striking the supporting leg, usually at the fetlock, with the foot of the striding leg. Interference commonly occurs between the supporting front leg

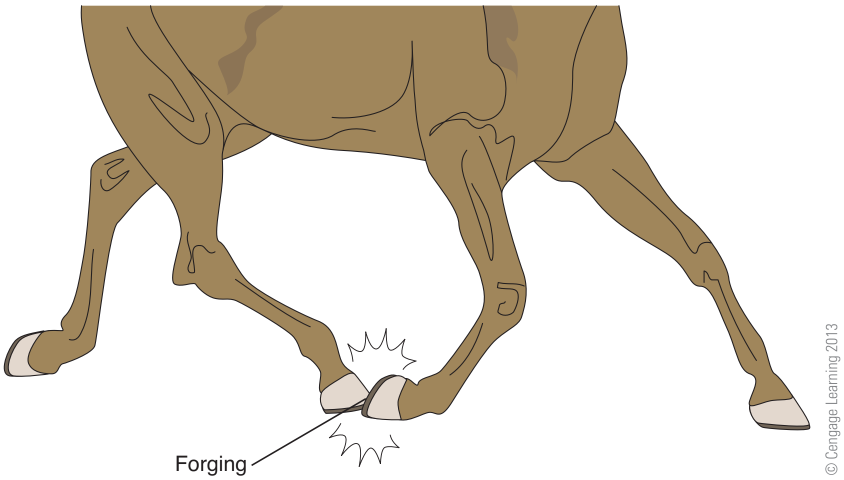


FIGURE 6–11 **Forging occurs when the toe of the hind foot hits the sole of the forefoot.**

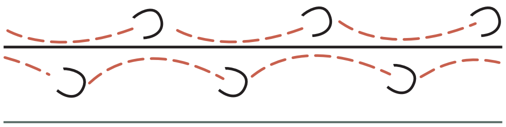


FIGURE 6–12 **Interfering occurs when the foot of the striding leg strikes the supporting leg.**

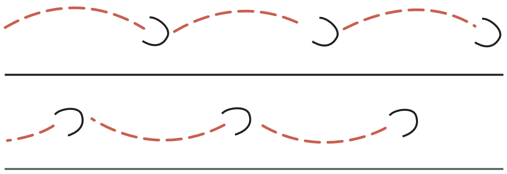


FIGURE 6–13 **Paddling occurs when feet move forward in wide outward arcs. Base-narrow or pigeon-toed feet also cause paddling.**

and a striding front leg or between a supporting hind leg and a striding hind leg (Figure 6–12). Brushing is a slight interference. Striking is a severe interference resulting in an open wound.

Paddling

Paddling or **winging outward** is an outward deviation in the direction of the stride of the foreleg (Figure 6–13). It is the result of a narrow or pigeon-toed standing position. Winging outward is exaggerated paddling and very noticeable in high-stepping horses. Paddling almost always causes interference.

Winding

Winding is twisting the front leg around in front of the supporting leg as each stride is taken. Sometimes it is called threading, plaiting, or rope-walking. Wide-chested horses tend to walk in this manner. Winding increases the likelihood of interference and stumbling.

Scalping

Scalping occurs when the hind foot hits above or at the line of the hair (coronet) against the toe of a breaking-over (beginning the next stride) forefoot (Figure 6–14).

Speedy-Cutting

Speedy-cutting occurs when a trotter or pacer traveling at speed hits its hind leg above the scalping mark against the shoe of a breaking-over forefoot (Figure 6–14). In trotters, legs on the same side are involved. In pacers, diagonal legs are involved.

Several faults in conformation predispose a horse to scalping and speedy-cutting: short backs and long legs, leg weariness or hind legs set too far under the body, short front and long back legs, and toes too long on the forefeet.

Cross-Firing

Cross-firing is essentially the same as forging in a pacer in which the inside of the fore and hind foot strike in the air as the stride of the hind leg is about completed and the stride of the foreleg is just beginning (Figure 6–15).

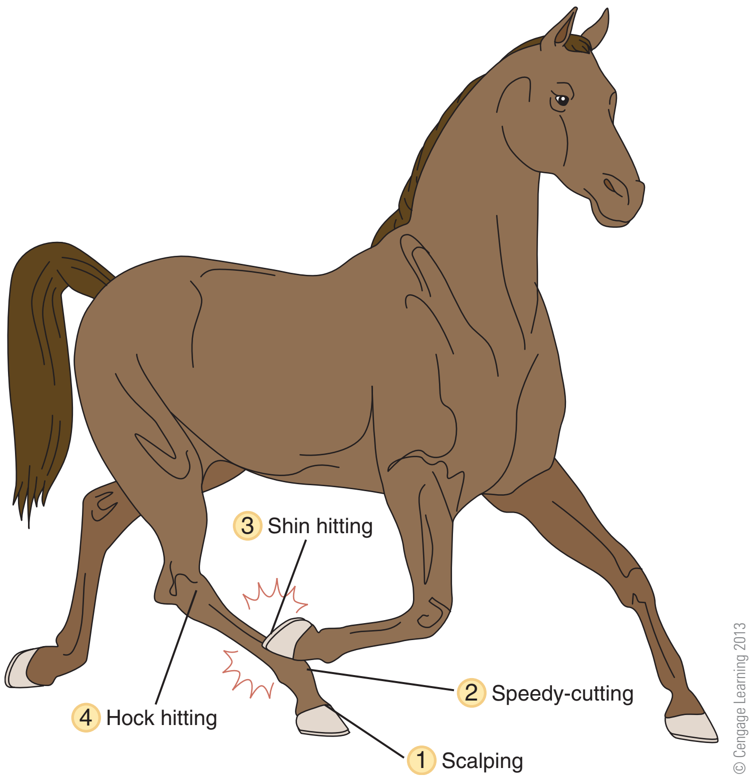


FIGURE 6–14 (1) Scalping; (2) speedy-cutting; (3) shin hitting; and (4) hock hitting.

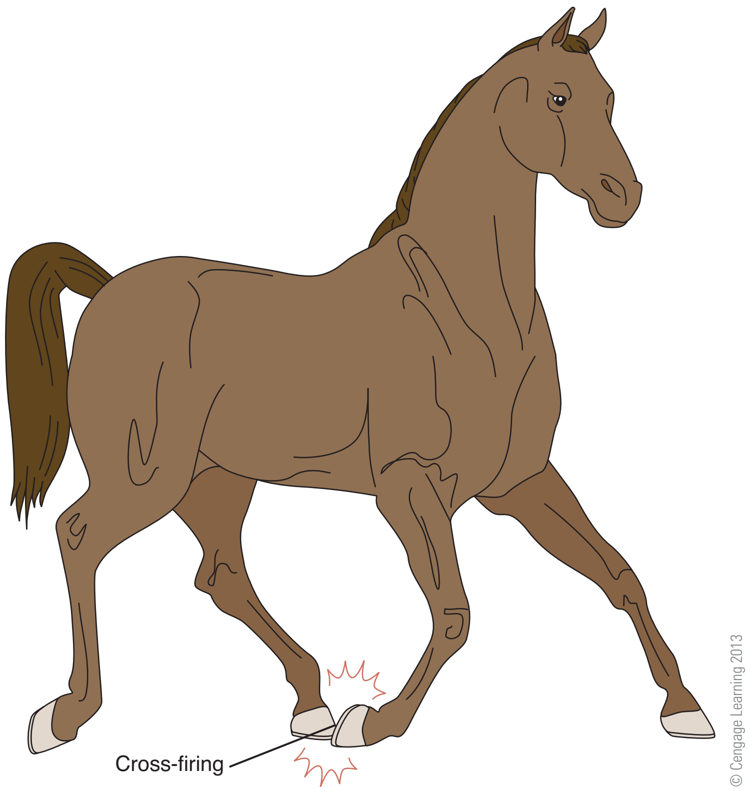


FIGURE 6–15 Cross-firing occurs when the hind foot hits the opposite forefoot.

POINTING

Pointing is a stride in which extension is more pronounced than flexion. A horse with a pointed stride breaks or folds its knees very slightly and is low-gaited in front. Thoroughbreds at the trot are pointy-gaited. The term *pointing* is also used to indicate the standing position pose a horse frequently takes when afflicted with navicular bone disease or injury to the foot or leg: It stands on three legs and points with the fourth.

DWELLING

Dwelling is a perceptible pause in the flight of the foot, as though the stride had been completed before the foot strikes the ground. It may occur either front or rear and is particularly common in heavy harness horses, heavy show ponies, and some saddlers.

TRAPPY

Trappy is a gait that is a short, quick, choppy stride. Horses with short and steep pasterns and straight shoulders tend to have a trappy gait.

POUNDING

Pounding is heavy contact with the ground, usually accompanying a high, laboring stride. Faults in conformation that shift the horse's center of gravity forward tend to create pounding.

ROLLING

Rolling describes excessive side-to-side shoulder motion. Horses wide between the forelegs and lacking muscle development in that area tend to roll their shoulders. The toe-narrow fault in conformation can also cause rolling.

CENTER OF GRAVITY

The **center of gravity**, where the mass of the horse is centered, is another important feature affecting the gait. Even though the center of gravity will vary with the horse's shape, it is most commonly located in the middle of the rib cage just caudal to the line separating the cranial and middle thirds of the body. Because the center of gravity is located more cranially, the forelimbs bear 60 to 65 percent of the body's weight. This puts increased stress on the forelimbs, resulting in an increased incidence of lameness in those limbs. The horse that is taller over the croup than in the withers has an additional disadvantage because this shifts its center of gravity even further forward. Young horses that are growing may be higher in the withers, but this will change as they develop.

SUMMARY

The nervous, muscular, and skeletal systems work together to produce movement. The nervous system gathers information about the internal and external environment and provides the stimuli causing muscle contraction. As muscles contract and others relax, they act on the joints and bones to produce movement. Muscle contraction requires oxygen and energy in the form of ATP. Muscle contraction produces waste products and heat, both of which must be removed from the muscles.

Muscles that produce the gaits in horses can be grouped according to their function—flexors, extensors, abductors, and adductors. All horses are capable of the four natural gaits: walk, trot, canter, and gallop. Other gaits require training and are said to be unnatural. Gaits can be described by the number of beats and the characteristics of the stride. Conformation can affect the gait, as can the horse's center of gravity. How the horse moves its feet and/or legs while executing the gaits may involve defects.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. An adductor muscle decreases the angle of a joint.
2. Heat is a by-product of muscle contraction.
3. During a gallop, all four of a horse's feet are off of the ground at the same time.
4. A pigeon-toed horse will exhibit a trappy gait.
5. ATP is a neurotransmitter that excites muscle cells.

Short Answer

6. List four functional groups for muscles.
7. Contrast aerobic to anaerobic metabolism during muscle contraction.
8. List four natural gaits common to all horses.
9. What three factors of a horse's gait determine its speed?
10. Name three extensor and three flexor muscles on the hind leg.
11. Name the two phases of a stride.
12. Identify three types of muscle fibers.

Critical Thinking/Discussion

13. In relation to muscle contraction, why do working horses sweat?
14. Describe the sequence of events during muscle contraction.
15. How can conformation affect the movement or performance of a horse?

16. Describe six common defects in a horse's way of going.
17. Compare the walk, trot, canter, gallop, and rack.
18. Explain how the center of gravity affects the movement of a horse.

STUDENT ACTIVITIES

1. View videos of horses in motion showing different gaits; for example this one on YouTube, http://www.youtube.com/watch?v=LrmWtGXK4Q4 or this one, http://www.youtube.com/watch?v=xCWMI09F5O8
2. Attend a horse show or view a television broadcast of a horse show and learn to identify the gaits.
3. Using a drawing of the horse skeleton, draw in the muscles of the limbs and attach them to the proper location on the bones of the legs.
4. Research muscle contraction and make several drawings showing how the myofibril contracts. Specifically, show how ATP and calcium (Ca) are involved in contraction.
5. Learn about proprioceptors by closing your eyes or putting on a blindfold. Move your arms or legs to new positions and describe these without looking. Knowing where your arms and legs are in time and space without looking is proprioception.
6. Visit with a horse trainer and discuss how horses are trained to perform gaits.
7. Using numbered hoofprints for the left and right and front and hind legs, diagram the hooves on the ground through one complete cycle of a walk, trot, canter, and gallop.
8. Develop a rapid-fire game using the gaits and common defects matched to their descriptions.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). *Horse industry handbook: A guide to equine care and management.* Lexington, KY: Author.

Back, W., & Clayton, H., Eds. (2000). *Equine locomotion*. Philadelphia, PA: Saunders.

Budras, K-D., Sack, W. O., & Rock, S. (2010). *Anatomy of the horse*. Hannover, Germany: Schlurersche Verlagsgesellschaft mbH & Co.

Clayton, H.M. (2004). *The dynamic horse: A biomechanical guide to equine movement and performance*. Mason, MI: Sport Horse Publications.

Edwards, E. H. (2008). *The encyclopedia of the horse.* New York, NY: DK Publishing, Inc.

Evans, J. W. (2000). *Horses: A guide to selection, care, and enjoyment* (3rd ed.). New York: Owl Books.

Frandson, R. D., Wilke, W. L., & Fails, A. D. (2009). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.

McCracken, T. O., & Kainer, R. A. (1998). *The coloring atlas of horse anatomy.* Loveland, CO: Alpine Publications.

Pilliner, S., & Elmhurst S. (2002). *The horse in motion: The anatomy and physiology of equine locomotion*. Oxford, UK: Blackwell.

Raynor, M. (2005). *The Horse Anatomy Workbook*. London, UK: J.A. Allen

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases:

biomechanics	acetylcholine	muscle fatigue
nervous system	metabolism	gait of a horse
muscle contraction/ relaxation	anaerobic	horse conformation
	aerobic	
neurotransmitter	muscle fibers	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 7

Unsoundness

Unlike other farm animals, the horse is serviceable only when in motion. Any abnormal deviation in the structure or action of a horse can render it partly or completely useless. Any defect that affects serviceability, for example, lameness, blindness, faulty wind, and so on, is considered an unsoundness.

Those defects that detract from appearance but do not impair serviceability are considered blemishes, for example, scars, capped hocks, and elbows. Blemishes are looked down upon in gaited, parade, and some pleasure horses. They are more common in stock horses and tend to detract less from their value than from other types of horses.

An important part of selecting a horse is the ability to recognize common unsoundnesses and blemishes and faulty conformation that tends to predispose the animal toward unsoundness and blemishes.

OBJECTIVES

After completing this chapter, you should be able to:

- Distinguish between a blemish and an unsoundness
- Describe the common treatment for many of the problems that could develop into an unsoundness
- Name four common unsoundnesses associated with the head
- List five common unsoundnesses or blemishes that can be found on the body
- Describe two types of unsound lungs
- Name and describe 10 unsoundnesses or blemishes of the front or hind leg
- Differentiate between a sprain and a fracture
- Name two types of sprains and two types of fractures
- Identify four conditions that predispose a horse to developing unsoundnesses
- Name and describe six stable vices affecting usefulness
- Describe how to methodically examine a horse for soundness

KEY TERMS

allergy
anti-inflammatory
atrophy
bars
blemish
boot
bowed tendons
calcification
calks
collar
congenital
conservative treatment
cribbing
degree of finesse
fibrosis
flexion tests
founder
fracture
heaving
high ringbone
hobble
hock
hoof testers
hydrotherapy
implants
laminitis
lateral cartilages
low ringbone
malocclusion
ossify
patella
plates
plumb line
poll
sensitization
shoe boil roll
sidebones
sprain

BLEMISHES VERSUS UNSOUNDNESS

Basically, an **unsoundness** is any condition that interferes or is apt to interfere with the horse's function and performance. In horse show halter classes, horses with an unsoundness usually do not place. In performance classes, if the apparent unsoundness is not interfering with the horse's action, it is given little consideration. A **blemish** differs from an unsoundness in that it is unattractive, but it does not and is not apt to interfere with the horse's performance.

Blemishes are usually an acquired physical problem that may not make the horse lame but may still interfere with the action of the horse. An unsoundness is usually caused by poor conformation and will tend to be a problem throughout the horse's lifetime. Often an unsoundness is also a blemish. Both are usually caused by stress and strain placed unevenly on the legs. The location and severity of the problem determines how the horse will be affected.

A blemish may or may not affect the level of performance. An unsoundness usually affects the performance of the horse, at least temporarily. How the horse is used must be considered when evaluating the importance of the problem. A pleasure horse that receives minimal stress and is ridden infrequently will have a different evaluation than a horse that is at a high level of competition and is being shown and trained vigorously.

Treatment methods vary for these problems. Basic treatment for an injury usually consists of rest to stop further trauma, **hydrotherapy**—applying cold water to the affected area, usually hosing the leg for a while—and medications to help reduce swelling. Pain relievers may also be given if necessary. A veterinarian can inject medications into areas to reduce inflammation and swelling. Some problems also have surgical treatments. A veterinarian needs to be consulted to determine the amount and location of damage and the best treatment for the horse.

CAUSES OF UNSOUNDNESS

Horses may be lame due to some disease or affliction in the joints, tendons, ligaments, or muscles. Usually lameness from these causes cannot be seen and calls for a diagnosis by a veterinarian. Conversely, many unsoundnesses or indications of unsoundness can be seen. Many unsoundnesses and blemishes are due to excessive stress and strain beyond the endurance of the bone or muscle, injury to a bone or joint, inherited conditions, or nutritional deficiencies.

LOCATION OF COMMON BLEMISHES AND UNSOUNDNESSES

For discussion purposes, some of the common blemishes and unsoundnesses are grouped here according to their location on the body—the head, body, lungs, and limbs.

Studying Figure 7–1 to become familiar with the location of some blemishes and unsoundnesses and reviewing the muscular and skeletal systems in Chapter 5 will aid your understanding of this chapter.

KEY TERMS

stifled
straight shoulders
tail board
ulcerate
umbilicus
unsoundness
upright pasterns
vices

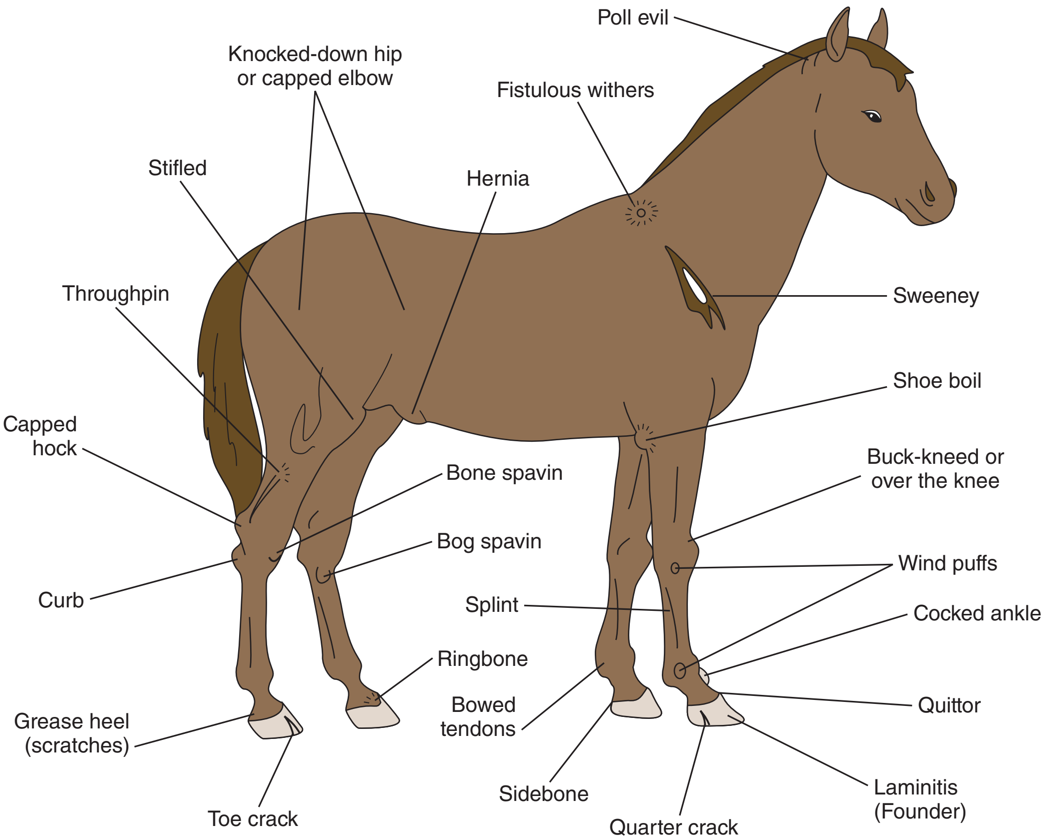


FIGURE 7–1 **Locations of some unsoundnesses on the horse.**

Unsoundness of the Head

Unsoundnesses around and relating to the head include blindness, bad mouth, poll evil, and quidding.

Blindness

Blindness seriously affects the usefulness of a horse. It is usually characterized by cloudiness of the cornea or complete change of color to white. Pale blue, watery eyes may indicate periodic ophthalmia (moon blindness). Watery eyes may appear as a result of vitamin A deficiency. These conditions are not common in horses on pasture.

Moon Blindness

Periodic ophthalmia or moon blindness is an inflammation of the inner eye due in part to a vitamin B deficiency. It usually impairs vision, and treatment is usually unsuccessful.

Bad Mouth

Bad mouth is a term used to describe various jaw or tooth misalignments. Bad mouth may be a **malocclusion** where the top and bottom teeth do not meet, or a monkey mouth (undershot jaw) where the lower jaw and tooth structure extend beyond the top teeth. Parrot mouth, or overshot jaw, is another example. In this case the top

Xenophon Treatise on Horsemanship

Xenophon (430 B.C. to 357 B.C.) was an Athenian soldier, writer, and disciple of Socrates. Besides many other writings, Xenophon wrote *On the Art of Horsemanship.* This is the earliest preserved book on the care and training of horses. He had a clear understanding of the nature of horses. Much of his advice is still good today. From his translated works, here is what Xenophon had to say about the conformation of a colt.

> *For judging an unbroken colt, the only criterion, obviously, is the body, for no clear signs of temper are to be detected in an animal that has not yet had a man on his back.*
>
> *In examining his body, we say you must first look at his feet. For, just as a house is bound to be worthless if the foundations are unsound, however well the upper parts may look, so a war-horse will be quite useless, even though all his other points are good, if he has bad feet; for in that case he will be unable to use any of his good points.*
>
> *When testing the feet first look to the hoofs. For it makes a great difference in the quality of the feet if they are thick rather than thin. Next you must not fail to notice whether the hoofs are high both in front and behind, or low. For high hoofs have the frog, as it is called, well off the ground; but flat hoofs tread with the strongest and weakest part of the foot simultaneously, like a bow-legged man. Moreover, Simon says that the ring, too, is a clear test of good feet: and he is right; for a hollow hoof rings like a cymbal in striking the ground.*
>
> *Having begun here, we will proceed upwards by successive steps to the rest of the body.*
>
> *The bones [of the pastern] above the hoofs and below the fetlocks should not be too upright, like a goat's: such legs give too hard a tread, jar the rider, and are more liable to inflammation. Nor yet should the bones be too low, else the fetlocks are likely to become bare and sore when the horse is ridden over clods or stones.*
>
> *The bones of the shanks should be thick, since these are the pillars of the body; but not thick with veins nor with flesh, else when the horse is ridden over hard ground, these parts are bound to become charged with blood and varicose; the legs will swell, and the skin will fall away, and when this gets loose the pin, too, is apt to give way and lame the horse.*
>
> *If the colt's knees are supple when bending as he walks, you may guess that his legs will be supple when he is ridden too, for all horses acquire greater suppleness at the knee as time goes on. Supple knees are rightly approved, since they render the horse less likely to stumble and tire than stiff legs.*
>
> *The arms below the shoulders, as in man, are stronger and better looking if they are thick.*
>
> *A chest of some width is better formed both for appearance and for strength, and for carrying the legs well apart without crossing.*
>
> *His neck should not hang downwards from the chest like a boar's, but stand straight up to the crest, like a cock's; but it should be flexible at the bend; and the head should be bony, with a small cheek. Thus the neck will protect the rider, and the eye see what lies before the feet. Besides, a horse of such a mould will have least power of running away, be he never so high-spirited, for horses do not arch the neck and head, but stretch them out when they try to run away.*
>
> *You should notice, too, whether both jaws are soft or hard, or only one; for horses with unequal jaws are generally unequally sensitive in the mouth.*
>
> *A prominent eye looks more alert than one that is hollow, and, apart from that, it gives the horse a greater range of vision.*
>
> *And wide open nostrils afford room for freer breathing than close ones, and at the same time make the horse look fiercer, for whenever a horse is angry with another or gets excited under his rider, he dilates his nostrils.*
>
> *A fairly large crest and fairly small ears give the more characteristic shape to a horse's head.*
>
> *High withers offer the rider a safer seat and a stronger grip on the shoulders.*

Reading Xenophon's translation lets us know how much we rely on the knowledge of generations in the past. For the person interested in reading the entire translated text, it can be found on the Internet and downloaded at http://www.fullbooks.com/On-Horsemanship.html or http://www.gutenberg.org/ebooks/1176.

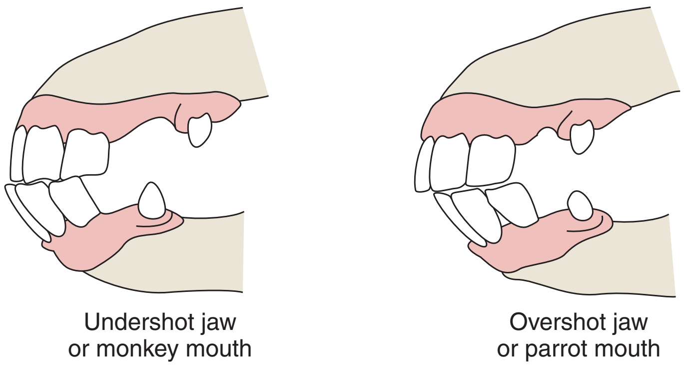


FIGURE 7–2 **Examples of a bad mouth—undershot jaw or overshot jaw.**

jaw and incisor teeth extend beyond the lower jaw. A bad mouth is considered an inherited unsoundness (Figure 7–2).

Poll Evil

Poll evil is a fistula—a lesion or sore—on the **poll** that is difficult to heal. Poll evil (Figure 7–1) is an acquired unsoundness resulting from a bruise or persistent irritation in the region of the poll. Its cause is *Brucella abortus,* the same organism that causes Bang's disease in cattle. Early symptoms are swelling and touchiness around the head and ears when the horse is being bridled. Severe inflammation, eruption, and bad scars may result if the wound is neglected.

Quidding

Quidding is seen when horses drop food from the mouth while chewing. This is usually caused by bad teeth or bad gums (stomatitis or gingivitis). It can also be caused by paralysis of the tongue. If there are sharp edges or points on the teeth, chewing will cause the horse pain when the points rub or cut the tongue and/or gums. Floating (filing) the teeth to remove the points and local treatment of sores will help. Soft palatable feed can be given to soothe sore gums.

When quidding is accompanied by pain while eating or when the bit is in the mouth, dental problems or the absence of teeth should be suspected. If quidding is accompanied by bad breath and weight loss, gum disease is a likely cause. Routine dental care and mouth washing will help. In severe cases, **anti-inflammatory** drugs and pain relievers may help the horse feel more comfortable.

Unsoundness and Blemishes of the Body

Fistulous withers, sweeney, knocked-down hip, scars, and hernias are considered unsoundnesses and blemishes of the body.

Fistulous Withers

This is an inflammation affecting the withers in much the same way as poll evil affects the poll. It may be present on one or both sides of the withers (Figure 7–1). It should be treated early. Otherwise the disease can linger on, resulting in severe infection and occasionally a crestfallen condition of the neck immediately in front of the withers.

Sweeney

Sweeney (Figure 7–1) applies to a wasting away of the shoulder muscle overlying the scapula of the horse. This is muscle **atrophy** of the shoulder caused by damage to a nerve in the shoulder. The damage is usually from direct trauma to the shoulder from a kick, running into a wall or solid object, or even running into another horse. It is characterized by the loss of muscle on either side of the spine of the scapula. The spine of the scapula is normally not seen but will become visible as the muscles atrophy. Depending on the amount of nerve damage and the resulting muscle loss, there will be varying amounts of lameness. The gait of a horse with sweeney is usually characterized by swinging the leg out as it comes forward due to lack of support from the atrophied muscles. Nerve damage is almost always permanent.

Knocked-down Hip

This is a fracture of the external angle of the hipbone (ilium). It results in a lowering of the point of the hip that can be identified best by standing directly behind the horse. Hurrying through narrow doors, crowding in trailers, falling, and injury from other causes may be responsible. Usefulness is seldom impaired, but appearance is greatly affected.

Scars

Scars are marks left on the skin after the healing of a wound or sore. They may appear on any part of the body. A scar is often noticed because of the presence of white hairs. Working stock horses with scars are not discriminated against very much, but gaited and parade horses are seriously faulted for them.

Hernias

A hernia is generally the passage of a portion of the intestine through an opening in the abdominal muscle (see Figure 7–1). It may appear on any portion of the abdomen, but is more common near the **umbilicus**. Hernias are usually not serious enough to cause an unsoundness.

Unsoundness of the Lungs

Any permanent abnormality in the respiration process is a serious unsoundness. Two well-known conditions include roaring and **heaving**.

Roaring (whistling)

A paralysis or partial paralysis of the nerves that control the muscles of the vocal cords may result in a roaring or whistling sound when air is inhaled into the lungs. The condition is seldom apparent when the horse is at rest, but it becomes obvious upon exertion. Roaring may be limited to one nostril and can be determined by plugging each nostril alternately.

Heaving

Heaving is caused by a loss of elasticity in the lungs resulting from a breakdown in the walls of a portion of the air cells. The condition is characterized by a visible extra contraction of the flank muscles during expiration. The expiration process can be seen, and often heard, to proceed normally to about two-thirds of completion, when it is stopped. The flank and lower rib muscles contract briefly, then expiration continues to completion. Dusty hay and/or atmosphere, severe exertion of horses out of condition, and respiratory infections are common causes of the condition.

Unsoundness of the Limbs

The **hock** is the most vulnerable, and the most important, joint of the body. All of the power of a pulling horse is generated in the hindquarters and transmitted to the **collar** by contact with the ground via the hocks. Working stock horses must bear most of the weight on the hind legs by keeping their hocks well under them if they are to attain maximum flexibility. **Degree of finesse** is determined with gaited and parade horses by how well they "move" off their hocks.

Structurally sound hocks should be reasonably deep from top to bottom; well supported by fairly large, flat, straight bone; characterized by clean-cut, well-defined ligaments, tendons, and veins; and free from induced unsoundness and blemishes.

There are many unsoundnesses and blemishes to the limbs. Some conditions are correctable; some are not. The following discussion does not identify and discuss every blemish or unsoundness of the limbs. For more detail and additional unsoundnesses, the reader should follow up with some of the sources identified in the Additional Resources at the end of the chapter.

Bog Spavin

This is a serious unsoundness. Bog spavin (Figures 7–1 and 7–3) is a soft, fluctuating enlargement located at the upper part of the hock due to a distention of the joint capsule. It is the result of horses trying to straighten the hock and trauma such as quick stops and turns or getting kicked by another horse.

Bone Spavin

A bone or jack spavin (Figures 7–1 and 7–3) is a bony enlargement at the base and inside back border of the hock. It is a common unsoundness of light horses, especially those with sickle hocks or shallow hock joints from top to bottom surmounting fine, round bone. Such conformation should be seriously faulted in a working stock horse. In the early stages, lameness may be apparent only when the horse has remained standing for a while. Bone spavins, like ringbones, may fuse bones and render joints inarticulate.

Bowed Tendons

Bowed tendons (Figures 7–1 and 7–3) are apparent by a thickening of the back surface of the leg immediately above the fetlock. One or more tendons and ligaments may be affected, but those commonly involved are the superflexor tendon, deep flexor tendon, and suspensory ligament of one or both front legs. Predisposing causes are severe strain, wear and tear with age, and relatively small tendons attached to light, round bone. Bowed tendons usually cause severe unsoundness.

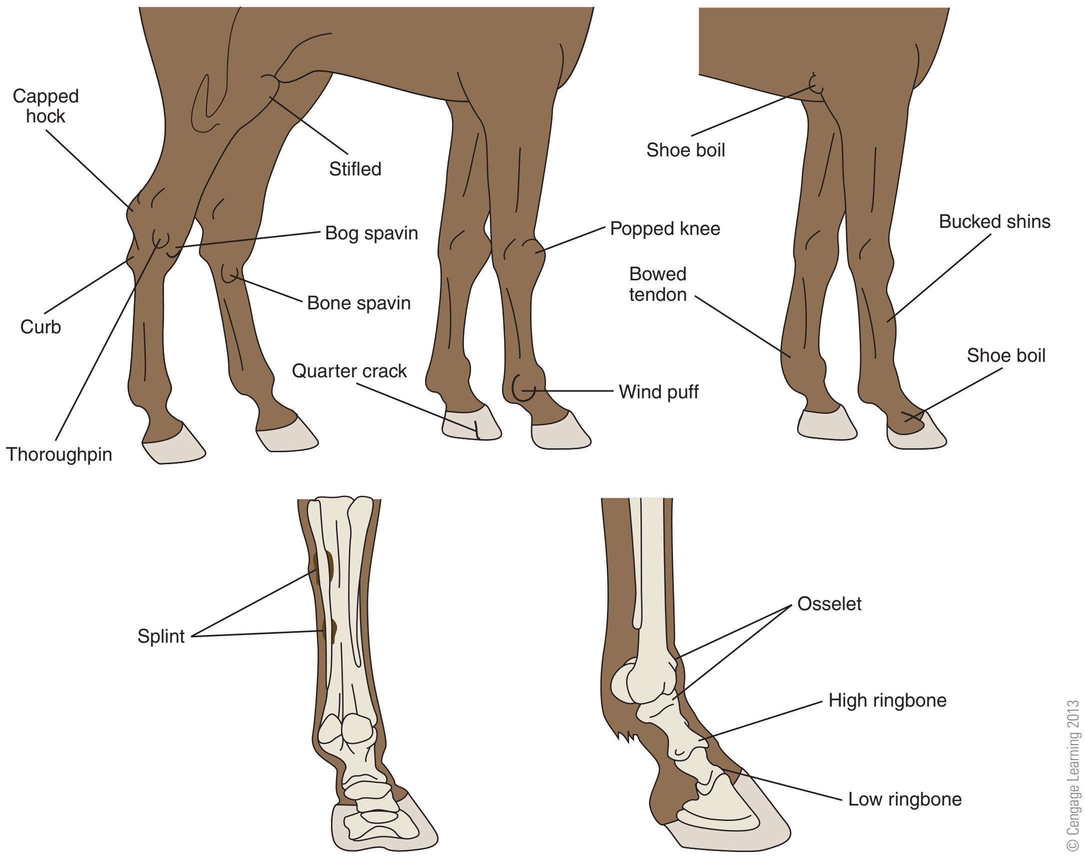


FIGURE 7–3 **Locations of some unsoundnesses on the legs of the horse.**

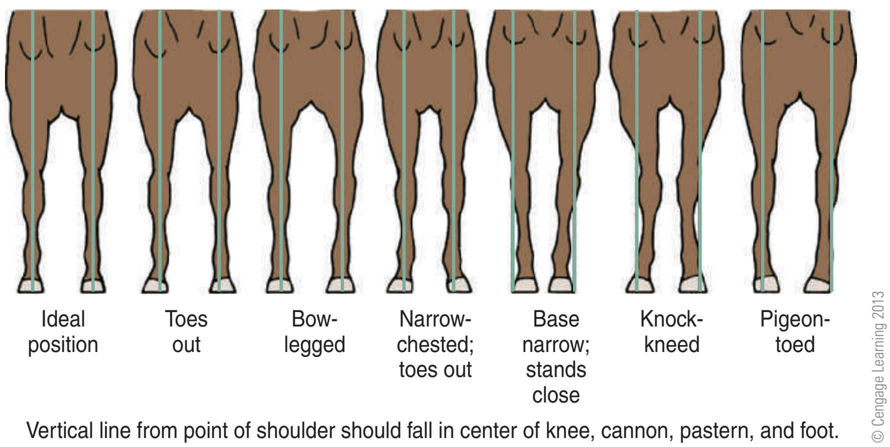


FIGURE 7–4 **Front view of the chest and leg of the horse.**

Buck-kneed

Buck-kneed (Figures 7–1 and 7–4) is also called over-at-the-knee. Because the knee is in front of the **plumb line**, the leg is not straight. This can be the result of a shortening of the muscles on the front of the knee. It can be present in foals, but usually disappears by about 3 to 4 months. If it is **congenital** and a permanent condition, the forwardness will cause excessive strain on the leg.

Bucked Shins

Bucked shins (Figure 7–3) occur on the front, top part of the cannon bone, below the knee. The forelimbs are affected more often than the hind limbs. Bucked shins are caused by trauma to the surface of the bone, possibly from stress on the tendons that run down the cannon bone or possibly from the forces distributed up the bone during fast work. This is usually the result of overwork and overtraining, especially in young racehorses. It is seen most commonly in racing Thoroughbreds, quarter horses, and Standardbreds.

Bucked shins can be mild to severe depending on the amount of stress applied to the bone. If severe, the bone may have a fracture. Because of this, the prognosis depends on the amount of injury. A swelling exists over the area that is affected and lameness may be present. In a mild case, rest and mild hand-walking are recommended. When the pain has decreased, a horse should be put on a controlled exercise program to get back into shape.

The greater the severity of the bucked shin, the longer the rest and controlled exercise program will need to be extended. A variety of surgical procedures are available to correct fractures, if necessary.

Calf-kneed

Calf-kneed (Figure 7–5) is a deviation of the knee joint behind the plumb line (the opposite of buck-kneed) so the leg is not straight. This places great strain on the tendons and ligaments running down the back of the leg. Compression of the bones in the knee joint also increases, leading to chip fractures. This is a serious problem. The horse is generally unable to tolerate heavy work.

Camped-out

The camped-out leg (Figures 7–5, 7–6 and 7–7) is too far back and behind the plumb line. Usually the whole leg is involved and the plumb line is at or in front of the toe instead of behind the heel. This is often seen accompanied by upright pasterns and straight hocks in the hind limbs, which causes increased concussion on the navicular bone, pastern, fetlock joint, and hock. Camped-under is the opposite condition.

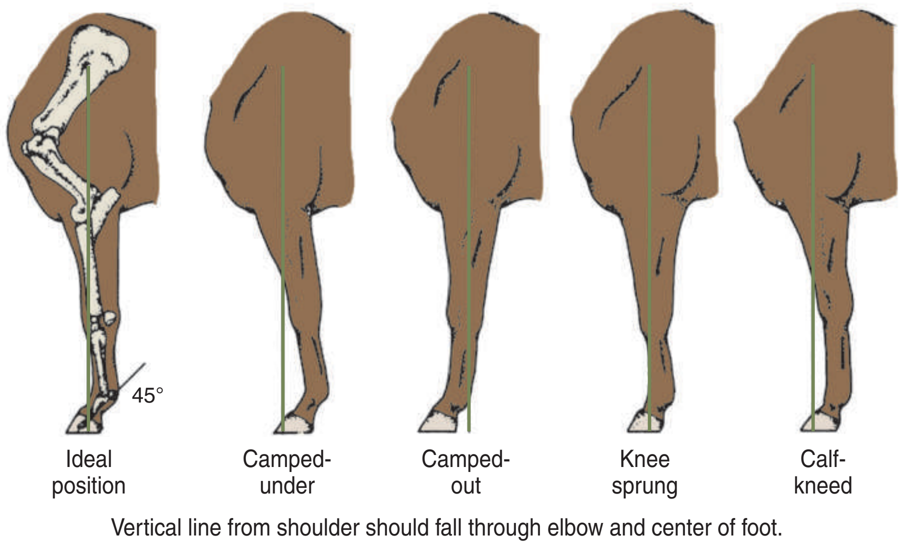


FIGURE 7–5 Side view of the front leg of the horse

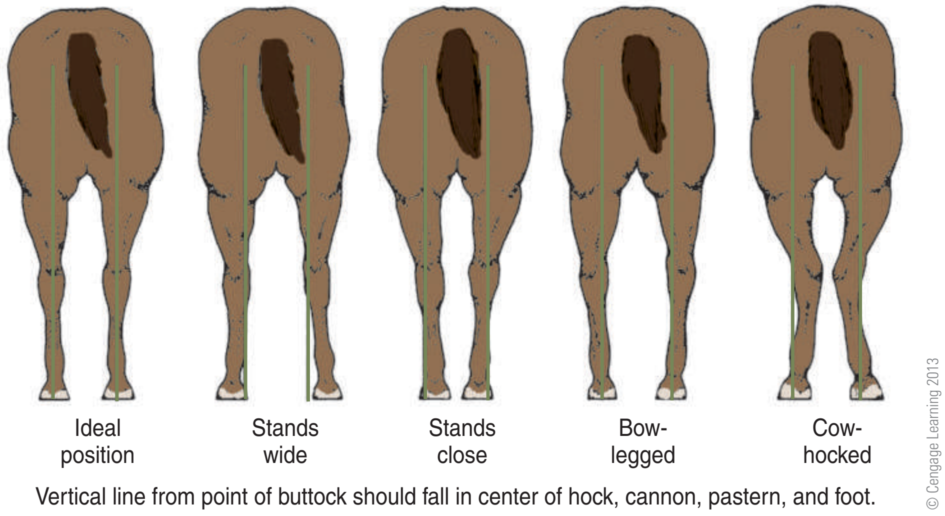


FIGURE 7–6 **Rear view of the hindquarters and legs of the horse.**

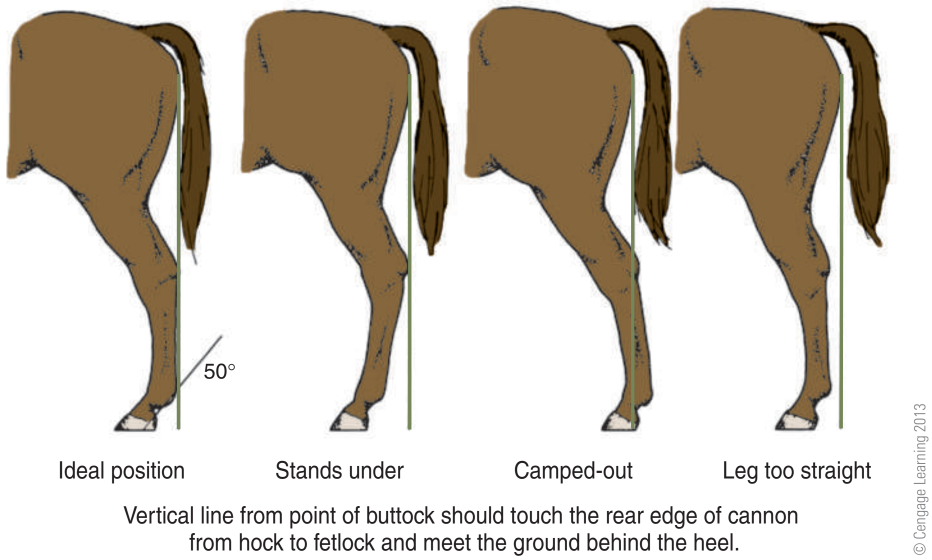


FIGURE 7–7 **Side view of the back legs of the horse.**

Capped Elbow

Sometimes called a shoe boil (Figure 7–3), this is a blemish at the point of the elbow. Capped elbow is usually caused by injury from the shoe when the front leg is folded under the body while the horse is lying down. Shoes with **calks** (heels) cause more damage than those with **plates**.

Capped Hock

This is a thickening of the skin or large callus at the point of the hock. It is a common blemish. Many capped hocks (see Figures 7–1 and 7–3) result from bumping the hocks when the horse is being transported in short trailers or in trailers with unpadded tail gates.

Chip Fractures

Chip fractures can occur in several different places but are most common at the knee, and they are the most common problem that affects the knee. Chip fractures are small fractures that break off one of the bones in the knee. They are usually caused by high amounts of concussion and stress on the knee and are seen most frequently in racehorses: Thoroughbreds, Standardbreds, and quarter horses. They also can be seen in any highly athletic horse, such as barrel racers, steeplechasers, hunters, and jumpers.

The knee is able to absorb a great deal of shock due to the many joint spaces and fluid within it. Normally, the horse is able to distribute shock by correctly lining up the bones of the knee. However, as the horse extends the knee and becomes fatigued while performing, the position of the bones may shift slightly. This decreases the knee's ability to disperse the forces. Additionally, as the horse fatigues, the flexor muscles on the back of the leg tire and allow for overextension of the knee. This compresses the front of the knee and creates high forces on the front of the bones.

The amount of damage that occurs depends on:

- Age of the horse (younger horses' bones have not matured as much and are more likely to be injured)
- Activity of the horse and its training level (the more strain put on the knee, the more likely it is to get a fracture)
- Conformation (horses with knees that do not line up properly at any time, will have greater strain on the knee all the time)
- Improper trimming and shoeing (an uneven foot or broken hoof-pastern axis will change the distribution of the forces across the knee)

Most chip fractures occur in the front of the bones at the radial carpal bone, intermediate carpal bone, and third carpal bone. Chip fractures are generally small. Names for other types of fractures indicate an increase in size, for example, corner fractures and slab fractures.

The horse with a chip fracture will show inflammation, swelling, pain, and lameness at the knee. The nature of the signs generally depends on the amount of trauma to the bones. If the fracture is new, the swelling tends to be diffuse across the knee; but over time, the swelling accumulates over the area of the chip. By feeling the knee, a veterinarian can usually find signs of tenderness. **Flexion tests** help to determine the extent and location of the fracture. X-rays and lameness tests are also used to diagnose the problem (Figure 7–8).

Two types of treatments are available—surgical or conservative. Treatment is usually dictated by the location and severity of the fracture and the amount of lameness. **Conservative treatment** is usually chosen for small fractures that do not appear to be troubling the horse much and are not affecting the joint. Treatment is stall confinement and hand-walking for a period of weeks or months. Anti-inflammatory drugs can be used to lessen the pain and decrease inflammation. Surgery is reserved for large fractures or fractures that have been displaced and are adversely affecting the horse and the joint.

The recovery of the horse is based on the amount of damage to the joint caused by the fracture. Mild cases generally have a very good prognosis. If the horse is not able to recover to its original athletic level, it may be suited for a less strenuous exercise program. A veterinarian will be able to provide advice.

Photo courtesy of Veterinary Technology Program, College of Southern Idaho, Twin Falls, ID

FIGURE 7–8 **A horse leg and hoof X-ray.**

Cocked Ankles

Cocked ankles (see Figure 7–1) may appear in front but are more common in hind legs. Severe strain or usage may result in inflammation or shortening of the tendons and a subsequent forward position of the ankle joints. Advanced cases impair movement and decrease usefulness.

Contracted Feet

Contracted feet are caused by continued improper shoeing, prolonged lameness, or excessive dryness. The heels lose their ability to contract and expand when the horse is in motion. Horses kept shod, those with long feet, and those with narrow heels are susceptible to the condition. Close trimming, going barefooted, or corrective shoeing usually produces sufficient cure to restore the horse to service.

Contracted Heel

Contracted heel (Figures 7–9a and 7–9b) results when the back of the foot, or the heel region, becomes narrower than normal. It is more common in the front feet than the

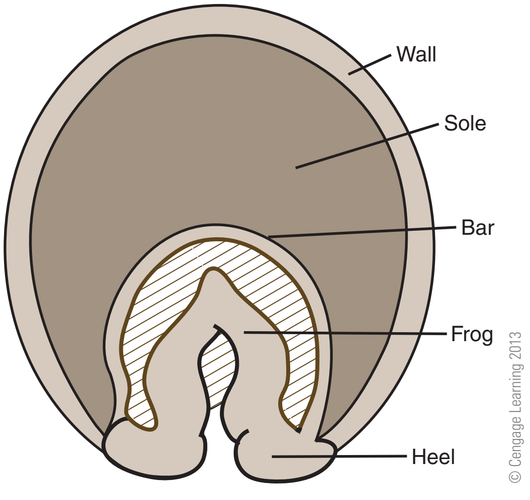


FIGURE 7–9A **Normal heel.**

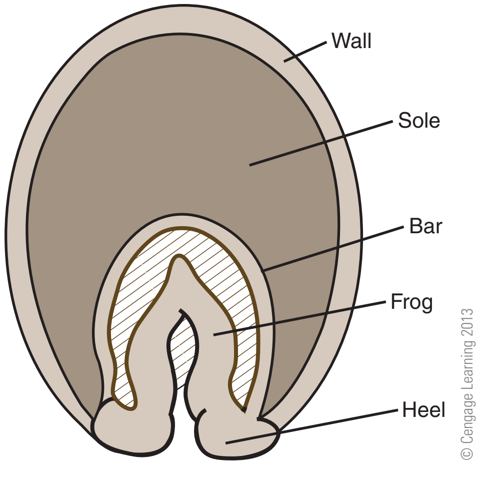


FIGURE 7–9B **Contracted heel.**

hind feet. Contracted heel is usually accompanied by a small frog (an elastic formation on the sole of the foot) and a sole that is concave or "dished." A small frog indicates that the frog is not being compressed when the horse is walking.

As the frog shrinks in size with decreased use or overtrimming, the heel contracts. If the heels become too contracted, lameness may result. Contracted heels are usually caused by improper shoeing/trimming and hoof growth. Lameness can also cause this condition if the horse is not applying weight to the foot. The treatment is corrective shoeing. Depending on the severity of the problem, it may take a year or more to get the heels spread to the correct width for the foot.

Corns

Corns appear as reddish spots in the horny sole, usually on the inside of the front feet, near the **bars**. Advanced cases may **ulcerate** and cause severe lameness. The causes are many, but bruises, improper shoeing, and contracted feet are the most common. Corns respond to treatment and proper shoeing.

Club Foot

In this condition the foot axis is too straight and the hoof is too upright. Club foot is usually associated with a problem such as contracted deep digital flexor tendon. It may be due to injury (one foot), improper nutrition (two or more feet), or possibly heredity. The upright foot causes the horse to be stiff and rough in its gait and may make it unrideable. Additionally, because the horse cannot flex and extend its foot correctly, it has a tendency to stumble. The nutritional condition may be correctable. The horse that inherits the problem should not be bred, to prevent the further passage of the problem.

Curb

Curb (see Figures 7–1 and 7–3) is an enlargement on the back of the leg, just below the hock. It is caused by trauma that causes the plantar ligament to become inflamed and then thickened. Curb is seen with faulty conformation (such as in sickle- and cow-hocked animals) and with horses that slide too far, too fast in deep ground.

Direct trauma, such as a kick from another animal or the horse kicking a hard object, may also stress the ligament and cause a curb. At first, a curb causes pain; then heat and swelling.

The horse should be rested until the swelling and pain have decreased. Anti-inflammatory drugs may be used. If the trauma does not affect the hock joint, there is often a good prognosis following treatment. The swelling will diminish, and often just a blemish is left. If the horse has conformation problems that are causing the curb, it is unlikely to heal completely and permanent lameness may persist.

Flat Foot

This type of conformation lacks the natural concave curve to the sole. Instead, the sole is flat and predisposed to more contact with the ground. Flat foot increases the chances for sole bruises and resulting lameness. To avoid pain and pressure from hitting the ground with the sole, the horse may learn to place its heel down first. This is more common in the front feet than in the rear. Generally, this conformation is not seen in light horse breeds, but may be seen naturally in some draft breeds. Corrective shoeing may help alleviate some of the contact with the ground.

Founder or Laminitis

Founder or **laminitis** is an inflammation of the sensitive laminae that attach the hoof to the fleshy portion of the foot. Its cause is probably a **sensitization (allergy)**. When horses gain access to unlimited amounts of grain, founder often results. Other conditions conducive to founder are retained placenta after foaling and sometimes lush grass. All feet may be affected, but front feet usually suffer the most. Permanent damage usually can be reduced or eliminated with immediate attention by a veterinarian. Permanent damage results from dropping of the hoof sole and upturn of the toe walls when treatment is neglected. Laminitis causes the horse to develop a characteristic stance (Figure 7–10).

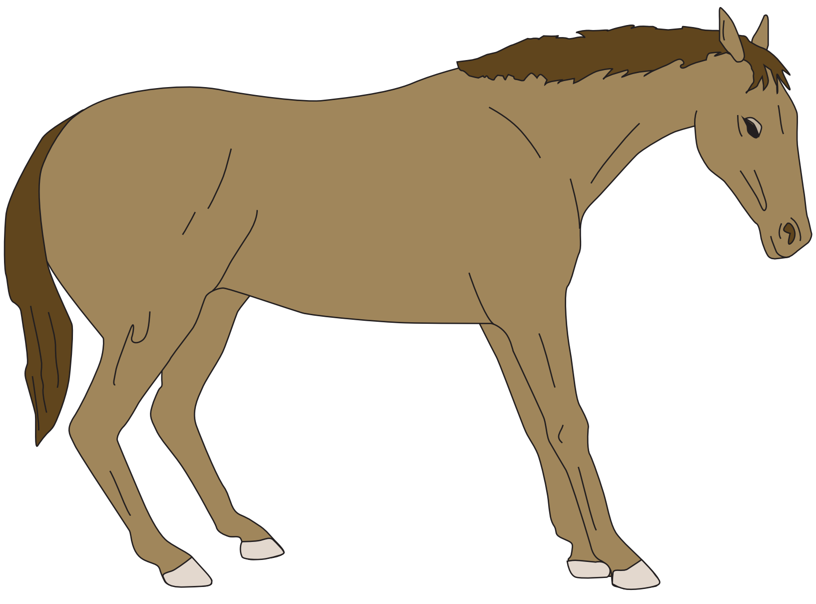


FIGURE 7–10 **Characteristic stance of a horse with laminitis in all four feet.**

Fractures

A **fracture** is a broken bone. These breaks range in degrees of seriousness. A fracture of any kind usually causes some degree of lameness, depending on the bone that is fractured. In the past, fracture healing in horses often caused an altered function. With a greater demand for improved techniques, fracture repair has evolved. Some serious fractures of the long bones can be repaired with **implants** that can withstand massive mechanical force applied to a bone.

Navicular Disease

Navicular disease is an inflammation of navicular bone and bursa. The condition causes lingering lameness and should be diagnosed and treated by a veterinarian. Often the exact course is difficult to determine. Hard work, upright pasterns, small feet, and trimming the heels too low may predispose a horse to navicular disease. Special shoeing, bar shoes, or pads may help. If not, the navicular nerve can be cut so the horse has no sensation in the foot. The horse then may be dangerous to ride because it cannot feel the ground. Many horses, however, have had the nerve cut and remained useful for many years.

Osselets

These are soft swellings on the front and sometimes sides of the fetlock joint. Osselets (see Figure 7–3) are due to injury to the joint capsule of the fetlock. This trauma affects the surface of the bone where the joint capsule attaches to it. Tearing of the joint capsule causes inflammation that stimulates the bone to heal by laying down more bone. During the inflammation stage, pain, heat, and swelling are present. The horse is almost always lame and will have a shortened stride.

Osselets are often seen in racehorses, especially in young horses under a lot of strain from training. The earlier the injury is treated, the better the prognosis. Rest and hydrotherapy are important in the early stages to decrease pain and swelling. X-rays are often taken to check for complications, such as fractures. A veterinarian should be consulted for the best treatment. If the joint is not affected by the bony growth, the prognosis is often good. If the joint is involved, decreased joint movement, leading to decreased performance, often results.

Pedal Osteitis

This condition is caused by chronic inflammation to the coffin bone, usually of the front foot. It is usually due to persistent pounding of the feet, chronic sole bruising, or laminitis. Pedal osteitis is usually detected over the toe of the coffin bone and is caused by a decrease in the density of the bone in response to the trauma. Pedal osteitis is commonly associated with laminitis.

Clinically, the horse may be lame at all gaits depending on the progression of the bone demineralization. **Hoof testers** will pick up increased sensitivity, commonly over the toe. X-rays may show a roughening of the edge of the toe or wings of the coffin bone and an increased size of the channels of the blood vessels that run through the bone. Pedal osteitis can be hard to diagnose with X-rays. Clinical signs of lameness and location of the sensitivity are important clues.

Treatment usually consists of corrective shoeing to take pressure off the sole and toe. Pads may be used to help cushion the feet. Anti-inflammatory drugs can also help relieve some of the pain.

Pointing

The front legs bear about 60 percent of the weight of a horse. Healthy horses stand at rest with weight equally distributed on both front legs. Lameness in the foot or leg will cause "pointing." Pointing refers to a state of rest with one foot positioned about 10 to 12 inches ahead of the other in an effort to reduce weight on the affected side. Weight is shifted habitually from one hind limb to the other by healthy horses during rest and does not indicate lameness (Figure 7–11).

Cracks

Quarter, toe, or heel cracks (see Figures 7–1 and 7–3) can indicate poor owner management of the feet. These cracks can appear in either the toe, quarters, or heel of the hoof wall, or in any combination of these locations. Toe and quarter cracks are the most common. Usually these are associated with a hoof wall that is too long and has not been trimmed frequently enough. Cracks can also develop with horses that are in rain and mud for long periods of time. The mud draws water out of the hoof wall, and when the hoof dries it often cracks.

The cracks can be small and cause no problems. If cracks extend up the wall and into the sensitive lamina of the hoof wall, the horse is usually lame. Cracks often worsen if left untended because the weight of the horse, especially when moving, puts pressure

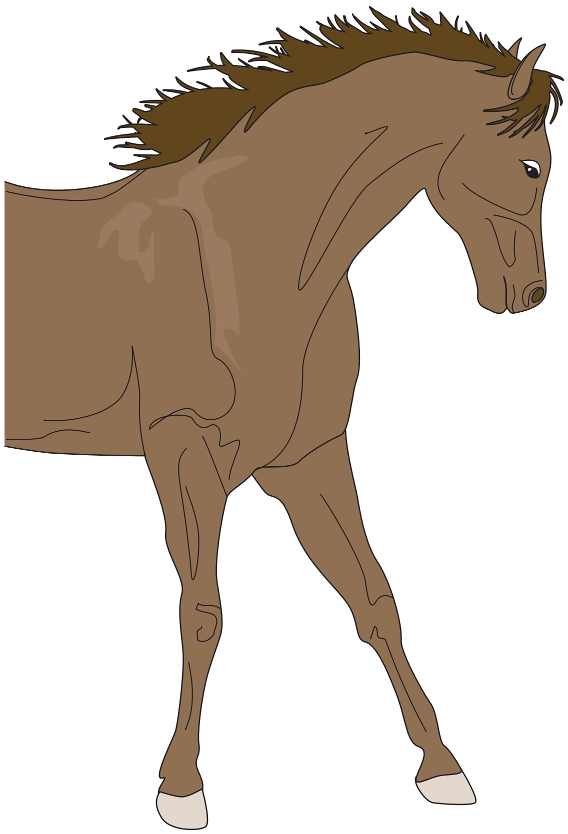


FIGURE 7–11 **Pointing—one foot positioned about 10 to 12 inches ahead of the other.**

on the hoof and the crack. For treatment, the hoof should be kept moist and treated as soon as cracks are detected to stop any permanent damage. If cracks are extensive, the veterinarian may need to remove the cracked area to promote new hoof growth.

Quittor

A quittor is a festering of the foot anywhere along the border of the coronet (see Figure 7–1). It may result from a calk wound, neglected corn, gravel, or nail puncture.

Ringbone

Ringbone (see Figures 7–1 and 7–3) is a bony enlargement on the pastern bones, front or rear. It occurs in two locations distinguished by the names **high ringbone** and **low ringbone**. They both occur around the pastern bone (the second phalanx). High ringbone occurs at the pastern joint. Low ringbone occurs at the pastern-coffin bone joint at about the level of the coronet band. Ringbone is caused by bony development around these joints due to tearing and damage of the ligaments and tendons at these bones.

Tearing damages the surface of the bone and stimulates production of new bone in these areas. Typically, this occurs in the forelimbs. It can occur on the front and sides of the joints, but rarely on the back of the joint. Damage to the tendons and ligaments can occur from overuse, due to excess stress placed on the structures.

Conformation problems often worsen the stress placed on the tendons and ligaments. Especially stressful are **straight shoulders** and **upright pasterns**, and base-narrow toe-in or base-wide toe-out conformations. Direct trauma to this area can also lead to the development of ringbone. Ringbone usually occurs in the older horse unless it is due to trauma.

Ringbone typically causes heat, swelling, and pain. Lameness may not be seen in mild cases but is usually seen if the joint itself is also affected. It is hard to resolve the bony production of the joint because of the constant trauma and strain placed on the tendons and ligaments. Initially, treatment is rest and hydrotherapy to try to decrease the pain and swelling. Treatment then generally involves fusing the joint since these are low-motion joints. The earlier treatment is initiated, the better the prognosis. If the joint is affected, the horse often progresses to degenerative joint disease and the prognosis is poor.

Scratches

Scratches or grease heel (see Figure 7–1) is a low-grade infection or scab in the skin follicles around the fetlock. It is caused by filthy stables and unsanitary conditions. Response to cleanliness and treatment is usually prompt and complete.

Shoe Boil

Shoe boil (see Figures 7–1 and 7–3) is seen mostly in horses that are stabled and lie down for extended periods of time. The horse lies with the foot tucked up against the elbow. This irritates the elbow from the trauma of being hit by the foot. The result is a swelling at the point of the elbow, which is also called capped elbow.

Lameness is uncommon, and a shoe boil is usually just a blemish. The treatment is aimed at trying to reduce the swelling. Hydrotherapy and medicines to reduce the swelling are commonly used. **Fibrosis**, a thickening of the affected skin, may develop in chronic cases. This may leave a permanent blemish but usually does not affect the performance of the horse. If the boil occurs because of the shoe striking the elbow when lying down, a **shoe boil roll** or a **boot** can be applied to prevent the foot from injuring the elbow.

Sidebones

This is a common unsoundness resulting from wear, injury, or abuse. On each side of the heel extending above the hoof are elastic cartilages just under the skin that serve as part of the shock-absorbing mechanism. They are commonly termed **lateral cartilages**. When they **ossify** (turn to bone) they are called **sidebones** (see Figures 7–1 and 7–3). In the process of ossification they may be firm but movable inward and outward by the fingers. The horse is then considered "hard at the heels." Sidebones are more common to the front outside lateral cartilage than to other locations.

Splints

These are inflammations of the interosseous ligament that holds the splint bones to the cannon bone (see Figures 7–1 and 7–3). They are most common on the forelimbs and usually occur on the inside of the leg. Splints most commonly occur at the top of the splint bones, below the knee. They may also occur at the middle or end of the cannon bones. Splints are usually associated with conformation problems such as bench knees that place increased stress on the inside of the legs, trauma, or hard training. Trauma usually occurs due to slipping, being kicked, jumping, and playing hard.

Splints are seen most in horses 2 to 3 years old. Older horses can "throw" splints from overwork. Damage to the interosseous ligament causes it to swell. The degree and size of the swelling is directly related to the area that is injured. Other signs include inflammation, pain, and swelling associated with the early splint. Lameness is often present at the trot or faster gait in the early stages, but it depends on the extent of the splint.

A horse with splints should be rested, given hydrotherapy, and possibly receive other medications to reduce the size of the splint. The ligament heals by **calcification** of the injured area. The result is a bony area after healing that becomes a blemish. The calcification in the healing process may also intrude on the tendons in the back of the leg. This occurs most commonly when the splint is at the end of the splint bone.

If the pain seems intense or if the pain and swelling do not decrease, the splint bone actually may have fractured and injured the tendons in the back of the leg. X-rays can be used to verify the problem.

Stifled

Stifled (see Figure 7–3) refers to a displaced **patella** of the stifle joint. It sometimes cripples the horse permanently.

Stringhalt

Stringhalt, also called stringiness or crampiness, is considered an unsoundness. It is an ill-defined disease of the nervous system characterized by sudden lifting or jerking upward of one or both of the hind legs. Stringhalt is most obvious when the horse takes the first step or two (Figure 7–12).

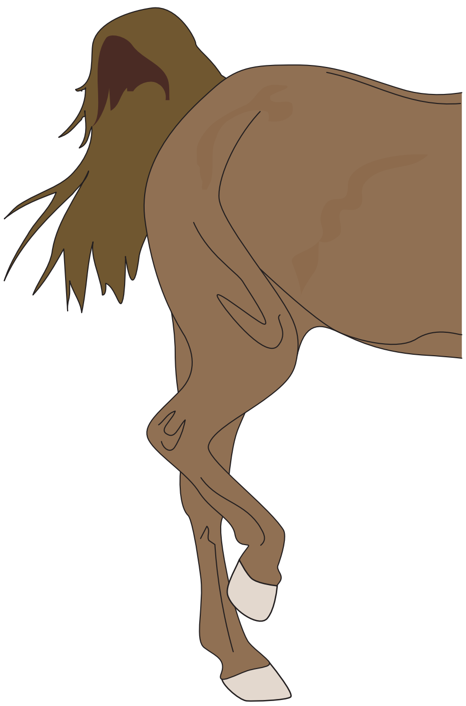


FIGURE 7–12 **Stringhalt—sudden lifting or jerking upward of the hind leg.**

Sprain

A **sprain** refers to any injury to a ligament. It usually occurs when a joint is carried through an abnormal range of motion such as in splints.

Thoroughpin

This is a soft, fluctuating enlargement located in the hollows just above the hock. They can be pressed from side to side, hence the name. Thoroughpins (see Figure 7–3) are due to a distention of the synovial bursa and considered a discrimination.

Thrush

Thrush is an inflammation of the fleshy frog of the foot. It is blackish in color, foul smelling, and associated with filthy stalls. It may cause lameness. Response to cleanliness and treatment is usually prompt and complete.

Upward Fixation of the Patella

This occurs when the patella is moved above its normal position and locks into place. It prevents the horse from flexing its stifle, and the stifle and hock are extended. The horse will drag its leg since it cannot flex it and bring it back under the body. The young horse may outgrow this problem. In the older horse, the knee may be popped backed into place, but this must be done carefully and correctly. Surgery can be done if this becomes a recurring problem.

Upward fixation of the patella is thought to be an inherited problem due to a straight-hocked conformation. The hock and stifle are straighter than desired. Upward fixation of the patella may also be seen in the poorly muscled horse. Conditioning may be enough to stop the problem in this case.

Wind Puffs

Wind puffs, windgalls, or road puffs (see Figure 7–3) are soft enlargements located at the ankle joints and due to enlargement of the synovial (lubricating) sacs.

STABLE VICES AFFECTING USEFULNESS

Although they are not really an unsoundness or blemish, **vices** affect the usefulness, desirability, and value of horses. Vices are habits acquired by some horses that are subjected to long periods of idleness. Hard work and freedom from close confinement are distinct preventives. Bad habits should be corrected or prevented early before they become confirmed.

Wind-sucking, cribbing, weaving, and stall-walking horses are hard to keep in condition. And the latter two vices cause horses to be fatigued when they are needed.

Wind-sucking

A wind-sucking horse identifies an object on which it can press its upper front teeth while pulling backward and sucking air into the stomach, usually accompanied by a prolonged grunting sound. The habit is practiced while eating, thus causing loss of food. Confirmed wind-suckers will identify an object in the pasture on which to suck wind, and will practice the habit when tied with bridle or halter as the opportunity is presented.

Cribbing (crib biting)

Cribbing horses (Figure 7–13) grasp an object (edge of a feed box or manger) between their teeth and apply pressure, gradually gnawing the object away if it is not metal. Wind-sucking and cribbing are usually associated, although a horse may practice one

Courtesy of Rick Parker

FIGURE 7–13 **Cribbing horse with evidence of past cribbing on top of fence.**

without the other. Cribbing wears away the teeth to a point of decreased efficiency when grazing. Both habits may be partially prevented and sometimes stopped by a wide strap fitted sufficiently close about the throat to compress the larynx when pressure is borne on the front teeth. Normal swallowing is not impaired. The strap must be placed with care; it should be loose enough to prevent choking and tight enough to be effective.

Weaving

Weaving is a rhythmical shifting of the weight from one front foot to the other. It is not a common vice, but when carried to extremes it renders a horse almost useless. Its cause is obscure, but its occurrence is correlated with enforced idleness in confined quarters. Some horse owners condemn vertical bars that can be seen through; others consider chain halter shanks, which rattle when moved, as predisposing causes.

Stall Walking

Stall walking is just what it sounds like. It is uncommon but reduces a horse's condition and induces fatigue.

Kicking

Occasionally horses will learn to destroy partitions or doors in stalls by kicking. Some kick only at feeding time, to vent their impatience. They usually do not kick outside the stall. Padding the stall has been known to stop some kickers.

Biting

Stallions often acquire the habit of nipping at the attendant just for something to do. Gentle horses can be encouraged to nip when too much pressure is applied in grooming or during cinching the saddle girth. Many show horses use biting to defend themselves when agitated by pokes from well-wishers as they rest in their stalls on the show circuit. Removing the cause usually corrects the condition.

Tail Rubbing

Tail rubbing starts by agitation from parasites and continues from habit. Parasite control and **tail boards** prevent it.

Halter Pulling

Halter pulling develops when a horse becomes confident that it is stronger than the rigging that secures it. Young horses in training will not gain such confidence when secured by strong halter equipment tied to stationary objects. Bridles should not be used in tying young horses. The habit may be broken in early stages by a slip noose around the flank, with the rope shank passing between the forelegs, through the halter ring, and being fastened securely. Pain experienced by the horse from hard backward pulling is usually given consideration before tightening a halter shank afterward. A second rather successful method is to pass the halter rope through a tie ring in the stall and fasten it to a **hobble** placed on a fore pastern.

EXAMINING HORSES FOR SOUNDNESS

Accurately diagnosing a horse's soundness is never easy. Sometimes professional assistance is needed. Whenever possible, a potential buyer should take the horse on a trial basis for use under the conditions to which it will be subjected under new ownership. Some guarantees of soundness are useful. Most horse owners can increase their competence in identifying unsoundness and blemishes by practice and by using a system of inspection (Figure 7–14).

Natural Surroundings

Whenever possible, examine the horse in its stall under natural surroundings. Note the manner of tying—the horse may be a halter puller. If metal covers the manger or feed box, cribbing should be suspected. Look for signs of a strap around the throat latch. Note the arrangement of bedding. If the horse paws, bedding will be piled up near its back feet. Slight lameness may be detected by movement of bedding caused from pointing. Signs of kicking may be noted. Move the horse around and observe signs of slight founder, stiffness, crampiness, and stable attitude.

Courtesy of Rick Parker

FIGURE 7–14 **Horse owner and trainer Lawrence Valdez checking a horse for blemishes and unsoundnesses.**

Leading

Lead the horse from the stall, and observe the eyes closely for normal dilation and color. Test eyesight further by leading the horse over obstacles such as bales of hay, immediately after coming out of the stall into brighter light. Back the horse and observe hock action for stringhalt and crampiness. Stiff shoulders and/or stiff limbs are indicated by a stilted, sluggish stride.

In Motion

Examine the horse for lameness in motion. Lameness in a forelimb is indicated by a nod of the head when weight is placed on the sound limb. The croup drops when weight is shifted from a lame hind limb to a sound one. Splint lameness usually gets worse with exercise, whereas spavin lameness may improve. The horse should be examined when cool, when warmed up, and when cooled off again, at both the walk and trot. Soundness of wind should be checked under conditions of hard work. Be alert for roaring and heaves or the appearance of a discharge from the nose. Cocked ankles may appear after sharp exercise, and weak fetlocks and knees may tremble.

Overall

Make a general examination with the horse at rest. It should not point or shift its weight from one forelimb to the other. Stand directly in front of the horse and observe the eyes for signs of cloudiness, position of the ears for alertness, and scars or indentations indicating diseased teeth. Pay particular attention to the knees, cannons, and hoof heads for irregularities. Move to the side at an oblique angle and note strength of back and coupling, signs of body scars, and shape and cleanness of hocks, cannons, fetlocks, and hoof heads.

Look for capped hocks, elbows, and leg set from a side view. Chin the horse at the withers for an estimation of height. Stand behind the horse and observe symmetry of hips, thighs, gaskins and hocks, and position of the feet. Move to the opposite side and the oblique angle previously described for final visual inspection before handling any part of the horse.

Determine age according to the instructions in Chapter 9.

The wall of a good hoof is composed of dense horn of uniform color with no signs of cracks in it or rings around it. The slant of the toe should be about 45 degrees and should correspond with that of the pastern. The heels should be deep and reasonably wide. Pick up each foot and look at the bearing surface. The frog should be full and elastic and help bear weight. The bars should be large and straight. The sole should be arched and should not appear flat as in dropped sole. Check for hard heels or sidebones, ringbone, corns, contracted feet, and thrush. If the horse is shod, check for wear on the shoe from contraction and expansion of healthy heels.

Examine the hocks for swellings, spavins, puffs, curbs, or other irregularities, by feeling when necessary.

A thorough examination combined with a week's trial will identify almost any unsoundness or blemish. Many horses serve faithfully for a lifetime without developing unsoundness, vices, or bad manners. Such service can come to horse owners only through patience, knowledge, and detailed attention to the needs of the animal.

SUMMARY

Some horses become unsound at an early age because of coarse, crooked legs, whereas others remain useful for years. As with cars, abusive treatment, excessive use, and poor care will render any horse unsound. Unsoundness interferes with the performance of the horse. A blemish is unsightly, but it is not apt to influence the horse's performance. An evaluation of an unsoundness or blemish is influenced by how the horse is used, for example, pleasure versus competition. Many conditions leading to an unsoundness or blemish are preventable or treatable. The prognosis for treatment can also depend on the intended use of the horse. Unsoundnesses and blemishes can be found on any part of the body. For obvious reasons, those of the limbs are the most common.

Unsoundnesses and blemishes decrease the value and may alter the use of a horse. Stable vices may also decrease the value and use of a horse. Using a methodical inspection, unsoundnesses, blemishes, and stable vices can be spotted in an unknown horse.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. A blemish will always interfere with the performance of a horse.
2. Poor conformation has little to do with unsoundness.
3. Unsoundness interferes with the function and performance of a horse.
4. Thrush is caused by unclean stables.
5. Quittor is the name for horses dropping feed out of their mouth while they are chewing.

Short Answer

6. Name six stable vices that can affect the use and value of a horse.
7. An unsoundness of the lungs or respiratory tract includes _________, a partial paralysis of the nerves to the muscles of the vocal cords, and _________, a loss of elasticity in the lungs.
8. Name two types of sprains and two types of fractures.
9. List four unsoundnesses associated with the head of the horse.
10. List five common unsoundnesses or blemishes that can be found on the body of a horse.
11. List four blemishes of the limbs.
12. Name six unsound conditions of the limbs.
13. Give two conditions caused by unclean stables.

Critical Thinking/Discussion

14. Describe the difference between a blemish and an unsoundness.
15. What is the common treatment for an injury that could develop into an unsoundness?
16. Identify four conditions that could predispose a horse to developing an unsoundness.
17. Briefly describe a system of inspection to check unknown horses for unsoundness, blemishes, and possible stable vices.
18. Describe the cause, diagnosis, and possible treatment of bucked shins, chip fractures, osselets, quarter cracks, and ringbone.

STUDENT ACTIVITIES

1. Visit a veterinarian's office or invite a veterinarian to class. Ask the veterinarian to show and explain some X-rays of bone injuries.
2. Develop a report or presentation on new technologies used to treat leg fractures in horses.
3. Diagram the bones of the front or hind leg of a horse. Indicate on the diagram where an unsoundness can develop. Use the unsound conditions discussed in this chapter.
4. Visit a farrier or invite a farrier to class. Ask the farrier to describe how shoeing can correct some conformation problems and unsoundnesses.
5. Find a video on conformation and/or lameness on YouTube and share it with your classmates.
6. Search the Internet for photos of the most common types of blemishes and unsoundnesses.
7. Tape small blocks of wood on your shoes. Make a video of yourself trying to walk. Describe the direction that it turns your feet. Compare this to how a good farrier can correct feet and leg problems through corrective trimming.

ADDITIONAL RESOURCES

Books

Duncan, S. (2007). *Lameness*. Shrewsbury, UK: Kenilworth Press

Evans, J. W. (2000). *Horses: A guide to selection, care, and enjoyment* (3rd ed.). NewYork: Owl Books.

Frandson, R. D., Wilke, W. L. & Fails, A. D (2009). *Anatomy and physiology of farm animals.* (7th ed.) Philadelphia: Lippincott Williams & Wilkins.

Gore, T., Gore, P., & Griffin, J. M. (2008). *Horse owner's veterinary handbook.* Hoboken, NY: Wiley Publishing, Inc.

Hill, C., & Klimesh, R. (2009). *Horse hoof care*. North Adams, MA: Storey Publishing, Inc.

Kahn, C. M., & Line, S. (Eds.). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

McCracken, T. O., & Kainer, R. A. (1998). *The coloring atlas of horse anatomy.* Loveland, CO: Alpine Publications Pavia, A., & Posnikoff, J. (2005). *Horses for dummies, 2nd Edition.* Hoboken, NJ: Wiley Publishing, Inc.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google, or Bing, find more information by searching for these words or phrases:

conformation	hydrotherapy	sprain
leg fractures	founder	stable vices
horse unsoundness	laminitis	
horse blemishes	navicular disease	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 8

SELECTING AND JUDGING HORSES

Selecting and judging horses requires combining and using knowledge and information about breeds, functional anatomy, age, height, weight, soundness, and movement. This is true when selecting a horse for personal use as well as when serving as a judge.

The phrase general appearance refers to and includes the horse's balance and symmetry of body parts, carriage of head and ears, and style. Each owner hopes these traits add up favorably. While appearance is mostly aesthetic, it is probably the largest single factor contributing to the value of a horse and the pleasure of being a horse owner.

OBJECTIVES

After completing this chapter, you should be able to:

- Describe 10 factors to consider when selecting a horse to purchase
- Explain how expected use influences the selection of a horse
- Discuss why the age and sex of a horse are important considerations in selecting a horse
- Describe costs associated with owning a horse after the initial purchase
- Discuss why conformation is a more important consideration than breed when selecting a horse
- List five steps in judging a horse
- Name the views used and traits looked for in judging the conformation of a horse
- Describe 10 qualities of a good judge
- Identify typical markings for the face and legs of horses
- List the terms used to describe common body colors of horses
- Discuss why the proper selection of a horse is so important

KEY TERMS

ankle
bald face
barrel
blaze
cannon
coronet
coupling
crest
croup
dam
distal spots
elbow
fetlock
flank
gaskin
girth
grade
half-stocking
hock
leg cues
overo
pastern
pedigree
performance record
poll
puff
registered
sires
snip
star
stifle
stock
stocking
stocking plus
strip
stripe
tobiano
white spots
withers

PARTS OF A HORSE

Figure 8–1 shows the parts of the horse and the terms used in referring to them. Familiarity with these terms and their ideal or function will benefit the owner and anyone wanting to learn to select and judge horses. A brief explanation of these parts follows:

- The poll is the bony prominence lying between the ears. Except for the ears, it is the highest point on the horse's body when it is standing with its head up.
- **Crest** is the curved top line of the neck. It should be moderately lean in mares but inclined to be more full in stallions.
- Forehead should be broad, full and flat.
- The nostrils should be capable of wide dilation to permit the maximum inhalation of air, yet be rather fine.
- The head should taper to a small muzzle, the lips should be firm, and the lower lip should not have the tendency to sag.
- The point of shoulder is a hard, bony prominence surrounded by heavy muscle masses.
- The breast is a muscle mass between the forelegs, covering the front of the chest.
- An ideal chest is deep and contains the space necessary for vital organs. A narrow chest can lead to interference with the front legs. Chest muscles

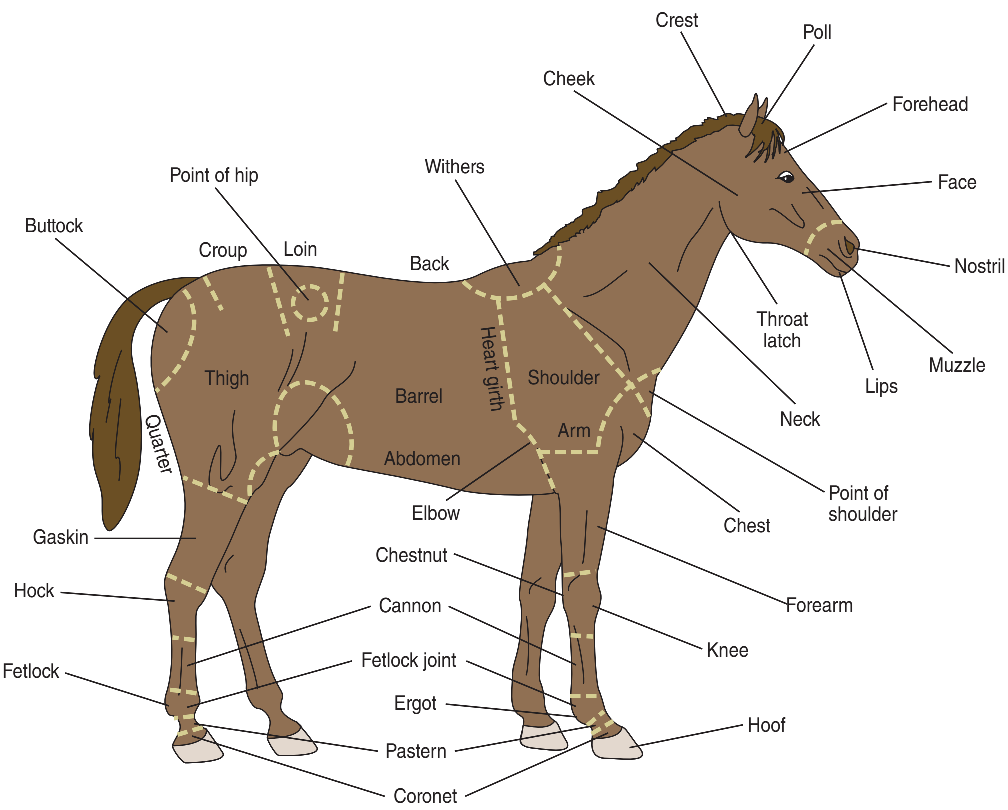


FIGURE 8–1 **Parts of a horse.**

should be well developed and form an inverted V. The prominence of chest muscling depends on the breed.

- The forearm should be well muscled. It extends from the elbow to the knee.
- The knee is the joint between the forearm and the cannon bone.
- The **coronet** is the band around the top of the hoof from which the hoof wall grows.
- The hoof refers to the horny wall and the sole of the foot. The foot includes the horny structure and the pedal bones and navicular bones, as well as other connective tissue.
- The **pastern** extends from the fetlock to the top of the hoof.
- The flexor tendons run from the knee to the fetlock and can be seen prominently lying behind the **cannon** bone, when it runs parallel to the cannon bone it constitutes the desired "flat bone."
- The **fetlock** is the joint between the cannon bone and the pastern. The fetlock joint should be large and clean.
- The cannon bone lies between the knee and fetlock joint, and is visible from the front of the leg. It should be straight.
- The **hock** is the joint between the gaskin and the cannon bone, in the rear leg. The bony protuberance at the back of the hock is called the point of hock.
- The **gaskin** is the region between the stifle and the hock.
- The **stifle** is the joint at the end of the thigh corresponding to the human knee.
- The **flank** is the area below the loin, between the last rib and the massive muscles of the thigh.
- The loin or **coupling** is the short area joining the back to the powerful muscular croup (rump).
- The **croup** (rump) lies between the loin and the tail. When one is looking from the side or back, it is the highest point of the hindquarters.
- The back extends from the base of the withers to where the last rib is attached.
- The **withers** is the prominent ridge where the neck and the back join. At the withers, powerful muscles of the neck and shoulders attach to the elongated spines of the second to sixth thoracic vertebrae. The height of a horse is measured vertically from the withers to the ground, because the withers is the horse's highest constant point.
- The neck should be fine at the throat latch to allow the horse ease of flexing.
- The neck should blend smoothly into the withers and the shoulders and not appear to emerge between the front legs. Lightweight horses should have reasonably long necks for good appearance and proper balance.
- Shoulders should be overlain with lean, flat muscle and blend well into the withers.
- The **barrel** should be narrower at the shoulders and widen at the point of coupling (loins).
- The **girth** is the point that a horse should be measured to determine the heart girth, which can be used to determine the horse's weight.

- The **elbow** is a bony prominence lying against the chest at the beginning of the forearm.
- The hindquarters give power to the horse. They should be well muscled when viewed from the side and rear.

SELECTING A HORSE

Horses require time to care for them, facilities, knowledge, and money to pay for all the maintenance of the animal. Other alternatives to owning a horse include taking lessons, renting a horse at camps or parks, and leasing a horse and boarding it elsewhere.

If, after considering the realities of owning a horse, the decision is still to buy, then several factors must be considered. If the primary user is inexperienced, then disposition, soundness, and training become the most important factors. If the owner is investing in breeding **stock** or performance prospects, then the **pedigree** and **performance records** are crucial (Figure 8–2).

INVESTMENT OR PLEASURE

Why is the horse being purchased? This is the first question to consider. If the horse is an investment, then the buyer's personal experience may not be as critical as the advisor's knowledge and experience. If the horse is a young race or show prospect, or a breeding animal, it will be managed by a professional horseman. Investing in horses is risky business. Although there are some shining success stories, the odds of making enough money to pay the bills and get any return on the investment are poor.

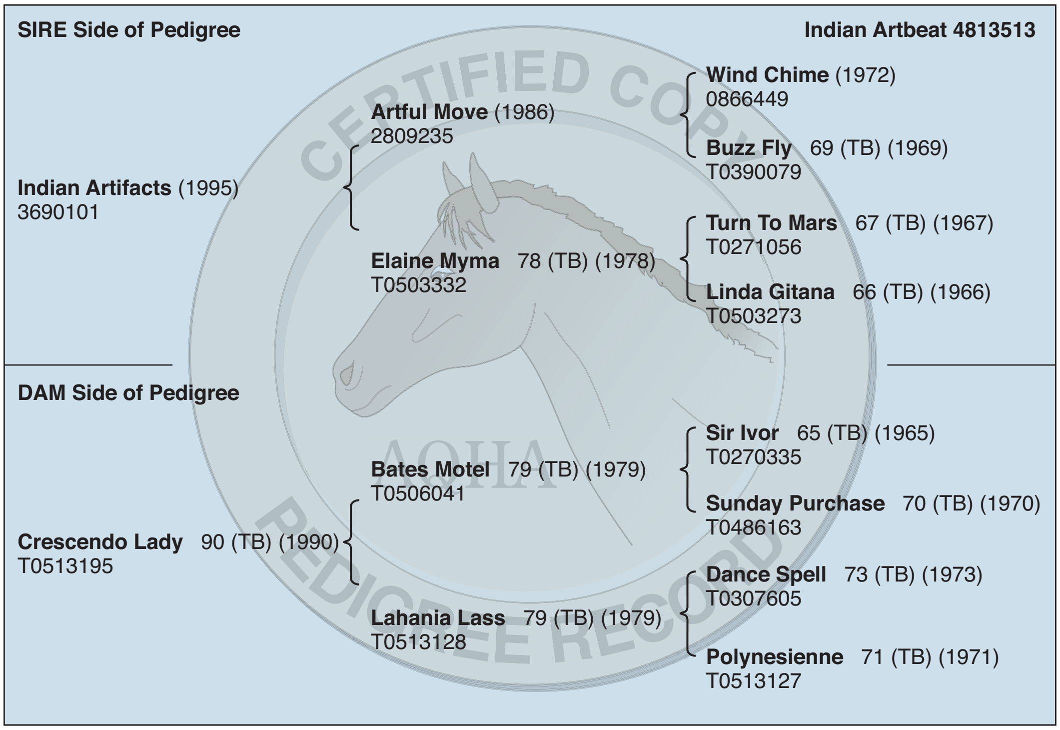


FIGURE 8–2 **Sample pedigree from the American Quarter Horse Association (AQHA).**

A person should be cautious with the first investments. Be sure that the advisor, breeder, or trainer involved has respected credentials and is someone to be trusted.

If the horse is intended for personal recreation for yourself or the family, then the horse's ability to cooperatively perform for all members of the family is essential. Owners eventually want to care for the horse themselves, so disposition, training, and soundness are important. Also, the recreation animal should be considered in the same manner as any other form of recreation—money is spent for enjoyment and the owner is not expected to make a profit. The animal requires daily upkeep, and the investment in terms of money and time is different from buying a boat or a set of golf clubs. Selecting the right horse that owners can enjoy working with daily is the key to finding continued recreation from the horse.

Selection of a horse should also consider:

- Owner's experience with horses
- Expected use
- Soundness
- Grade or registered status
- Breed
- Color
- Size of rider(s) and horse
- Age of rider(s) and horse
- Training
- Sex of horse
- Disposition and vices
- Facilities
- Price
- Conformation
- Pedigree

Experience with Horses

Very experienced owners may purchase a young horse successfully if they have the skills and knowledge needed to train the horse. Inexperienced owners and young horses are a dangerous combination. The best horse for a novice owner is a mature animal that is well trained and accustomed to a variety of situations.

If the owner intends to pay someone else to board or train the horse, then the owner's expertise is not as critical. But this may lessen the owner's enjoyment of the horse. Considering who will ride the horse most is important. Just because an adult can make the horse obey, it does not mean that a 6-year-old child can enjoy the horse safely.

Expected Use

The type of horse purchased determines how easily it can perform an intended use. Any type of quiet horse will work for a trail and pleasure horse as long as it is physically capable of performing. A relaxed, mannerly horse that has a prompt, flat-footed walk will be best for trail riding.

If a horse is being purchased for show purposes, then the quality and type become more important. Western horses tend to be lower-headed, quiet, and more heavily muscled than English horses. Hunters have longer, flatter strides and move forward with more impulsion and a higher head carriage than Western horses do. English or saddle-type horses tend to be much higher-headed, with their necks coming higher out of their withers. They move with more hock and knee elevation. Success in the show ring results directly from the horse's breed type and ability to perform. The type of horse selected should be based on the type of show situation.

Performance horses such as polo, dressage, reining, cutting, and roping horses need more specialized training and qualities. These skills increase the price of horses because of the extra cost invested in training. Success in these activities depends on athletic ability and training rather than on characteristics of a specific breed of horse.

Breeding should be reserved for those horses of a quality that can improve the breed or type. If the primary purpose of the horse is to breed it, then the success of the ancestors in the horse's pedigree and the horse's own performance record are important. Purchasing quality breeding stock is expensive, and the outcome of breeding horses is unpredictable, so it is important to spend as much as possible to obtain truly superior mares and breed to quality stallions.

Purchasing a breeding stallion should be done solely for income purposes, and only about the top 5 percent of the horses should stand as sires. Therefore, most individuals pay breeding fees, and many breeders will guarantee a foal.

Soundness

Horses must be sound enough to perform their expected activities. Horses that are lame may have permanent problems that will limit their performance or make using them inhumane. Horses with blemishes—scars or marks that do not interfere with their movement—should be less valuable as show horses, but blemishes should not be a consideration with breeding or pleasure horses.

Horses should also be sound in their breathing, vision, and reproductive capacity if they are purchased for breeding. A soundness examination should be done if much money is being spent or if a doubt exists. The more athletic the horse has to be, the more sound it must be. A race or competitive show or event horse must be very strong and sound. Pleasure trail horses and backyard horses must be sound enough to perform the expected activity, even if not perfectly. Soundness should always be measured in light of the expected performance of the horse.

Grade or Registered Status

Should a **grade** or **registered** horse be purchased? Grade, or nonregistered, horses and ponies can be successfully used as trail, pleasure, and performance horses (Figure 8–3). But one can often buy a registered horse as cheaply as a grade horse and the resale value is much higher. If disposition and comfort of a recreational horse are the most important criteria, valuable grade horses are available. If the purpose is to produce foals, then only registered horses should be used. Many performance competitions such as dressage, reining, competitive trail riding, and combined training events do not require registered horses. Open and 4-H shows provide excellent areas for the nonregistered horses to compete. When the owner anticipates participating in breed shows, races, or other activities, owning a horse of that breed should be a priority.

Breed of Horse

The breed will dictate to some extent the horse's activities and performance abilities. Usually saddle-type English horses are saddlebred, Morgan, Arabian, and pintos. These horses lend themselves to the conformation and action to do well in English competition. Tennessee walking horses, Missouri fox trotters, Paso Finos, Peruvian Pasos, and racking horses do not trot. They are very comfortable for trail riding and showing in breed events, but they will not be competitive in English, Western, or hunter classes requiring a walk, trot, and canter.

FIGURE 8–3 Colorado trail ride.

Most hunters are of the Thoroughbred, quarter horse, or European warmblood breeds, as well as ponies such as the Welsh and Connemara. Western event horses most often are the stock-type breeds, including the Appaloosa, buckskin, paint, palomino, stock-type pinto, and quarter horse. Western ponies include the Pony of the Americas (POA) and Welsh.

Racehorses are bred to trot, pace, or gallop. All harness racehorses either trot or pace and are Standardbreds. In the United States, horses that are ridden and gallop are most frequently Thoroughbreds.

All breeds of horses have calm, quiet horses as well as anxious, dangerous horses. Training and handling styles affect manners more than does the breed.

Color

The color of the horse has nothing to do with disposition, performance ability, or soundness. Color is, however, a significant determining factor in many people's purchase decision. Many breed registries such as buckskin, pinto, Appaloosa, palomino, Pony of the Americas, and Dominant Grey are based primarily on color. For individuals involved in breeding or using these breeds, color is high on the priority list. Otherwise, the training, disposition, and soundness of the horse are more critical.

Size of Rider and Horse

The horse is capable of carrying a tremendous amount of weight. The only time the relative size of the rider and the horse is important is when showing. Then the suitability of horse to rider becomes an issue. Small children are better off on large horses with quiet dispositions than on small ponies that are wild. Likewise, a small, quiet pony may be ideal for some; however, the child will likely outgrow this mount

Courtesy USDA

FIGURE 8–4 4-H girl showing horse at the Anne Arundel County Fair.

A rider's leg ought to fit down the sides of the horse in order to give **leg cues** (signals to the horse), but not be so long that the leg from the knee down does not touch the ribs. A horse that is over 58 inches at the top of the withers is best for most adults. As long as the mount is quiet enough for a child to work around and mount, the size of the animal should be considered secondary (Figure 8–4).

Age of Rider and Horse

A good guideline is the younger the rider, the older the horse. This is more a function of training, calmness, and experience that comes with an older horse than of age itself. Rarely will a horse under 5 years old be trained and quiet enough for a novice rider. Horses live to be 25 to 30 years of age, so the purchase of a 6- to 12-year-old is wise for amateurs and novices. Riders with more expertise and experience can buy, handle, and train yearlings or 2-year-olds, but these young horses do not make predictable mounts for beginners.

Training

A horse's willingness to respond to the handler's cues is a result of training. Horses that have "been around some" increase in value for the beginner. As more intricate maneuvers are desired for higher levels of competition, more training is needed. Sometimes, highly tuned horses are so responsive to the rider's cues that a novice confuses the horse and gets no response. A horse may be trained to the point that a person gets more response than is desirable. For example, the horse may make too fast a spin, too quick a start, or too hard a stop, and hurt the rider. Adequate training for the intended use combined with an experienced disposition is important.

Each horse has a unique personality. While personality traits can be similar, no two horses act or behave exactly alike. Being able to recognize and understand a horse's reactions to situations will be beneficial during horse training and the day-to-day handling of a horse.

SEX

Mares and geldings are a better choice for riders with limited experience. Mares often look more refined and attractive. Still, mares can have dramatic behavior changes when in heat (estrus). Geldings are often quieter and more consistent. The only reason to own a stallion is either to breed mares or performance-test a potential breeding stallion. **Sires** in the horse industry should be of superior quality and have successful performance records. Only those able to improve the breed should be bred. Nonregistered males should be gelded within the first 10 months of life to minimize stress on the horse and handlers.

DISPOSITION AND VICES

The horse's manners may be changed with training and handling, but the natural disposition is genetic and/or acquired from the **dam**. Bad habits such as kicking, biting, wood chewing, and leaning on the handler can be corrected with firm, consistent, humane handling. Vices such as stall weaving, cribbing, digging, and being afraid of its own water bucket are likely part of the horse and not fixable. Horses that have been exposed to trailering, clipping, shoeing, and trail riding are usually quieter and have better manners. Less-experienced owners should try to select horses with minimal vices. A good disposition should be near the top of the priority list.

FACILITIES

Housing for horses must be safe and adequate to contain the type of horse selected. Build or select housing that is suitable to the horse, rather than selecting an animal that can be housed conveniently (Figure 8–5). If the proper facilities are not available, then boarding will need to be found. Facilities should not be a priority when selecting a horse. However, they should be decided on before purchasing a horse.

Courtesy of Rick Parker

FIGURE 8–5 **Good horse facilities should be clean, well-ventilated, and safe.**

Price

The buyer determines the price that will be paid for a horse. Performance record, breed type and conformation, pedigree, and degree of advertising will influence the price. Regardless of how much is spent to purchase the horse, monthly costs are associated with keeping the horse. Table 8–1 can be created in an electronic spreadsheet program, such as Excel, and used to help calculate the cost of owning a horse for one year. The value of horses can be increased with training and subsequent race or show success. Generally, horses do not increase in value with age; rather, they depreciate. Most owners should not purchase a horse as a financial investment.

New owners need to put priority on the criteria that are important to the expected use of the horse. They should not pay for "showy" if this is not the most important criteria for the horse's use.

Most horse owners keep their first horse less than 3 years. Either they gain interest and expertise and want to get a nicer horse, or they lose interest and get out of the horse business. The nicer and more appropriate the horse purchased, the better its resale value.

Conformation

The conformation or shape of the horse will dictate its athletic ability and ability to stay sound. Straight legs, especially through the knees and hocks, suggest that the horse will not break down as soon as a horse with crooked legs. Body conformation and the

TABLE 8-1 Calculating the Annual Costs for Owning a Horse[1]

OPERATING INPUTS	UNITS	PRICE/UNIT[2]	QUANTITY[2]	TOTAL COST[3]
Grain mix	hundredweight		19.8	
Grass hay	ton		2.8	
Salt and minerals	pounds		10.0	
Farrier	head		6.0	
Veterinary medicine	head			
Veterinary services	head			
Utilities	dollar			
Tack, misc. supplies	dollar			
Bedding	head			
Entry fees	dollar			
Travel expenses	dollar			
Horse training	dollar			
Rider training	dollar			
Labor	dollar			
Interest	dollar			

Total cost of owning a horse for 1 year:

[1]Assumes one mature light (1,100 pound) horse in a confined system.

[2]Use actual figures.

[3]Calculated as the number of units (quantity) times the price per unit.

angle at which the neck ties into the shoulder determine whether the horse is capable of being a saddle-type English horse or is more suited to be a lower-headed Western-type horse. Short, strong-backed horses, horses with good angle to the shoulder, and horses with long hips and strong hindquarters are desired. A bright, alert head and eye, a long neck, and a deep heart girth make horses more athletic and, consequently, attractive.

Some unsoundnesses in the feet, legs, and eyesight are serious and permanent. Horses with sight in only one eye are more easily frightened and are of less value. Horses with splay (turned out) or pigeon-toed (turned in) feet are more prone to unsoundness than are horses with straight legs. A horse's pasterns should be set at about a 45- to 52-degree angle with the ground and the toe at the same angle as the pastern. The steeper the pastern, the more concussion on the foot and the rougher the gait for the rider. The lower the angle, the more comfortable the ride, but the pastern will be weaker and more prone to tendon damage when worked hard. As with anything else, the importance of conformation depends on intended use of the horse. Less than ideal conformation can be tolerated if the animal is sound and will not be shown in halter classes at shows.

Chapter 7 discusses many of the points to consider in evaluating conformation and soundness.

Conformation is different for the different breeds. For example, the quarter horse and the Thoroughbred are more muscled in the forearm and gaskin and through the stifle region than the American saddle horse is.

Muscling, especially through the rear quarters, is important in all breeds. Muscles in this area give horses their power. Viewed from behind, all horses should have as much width (muscle) through the center and lower part of the quarter as on top.

Figure 8–6 shows a horse with many faults. Too often, this type is difficult to keep in good condition, and it certainly lacks eye appeal.

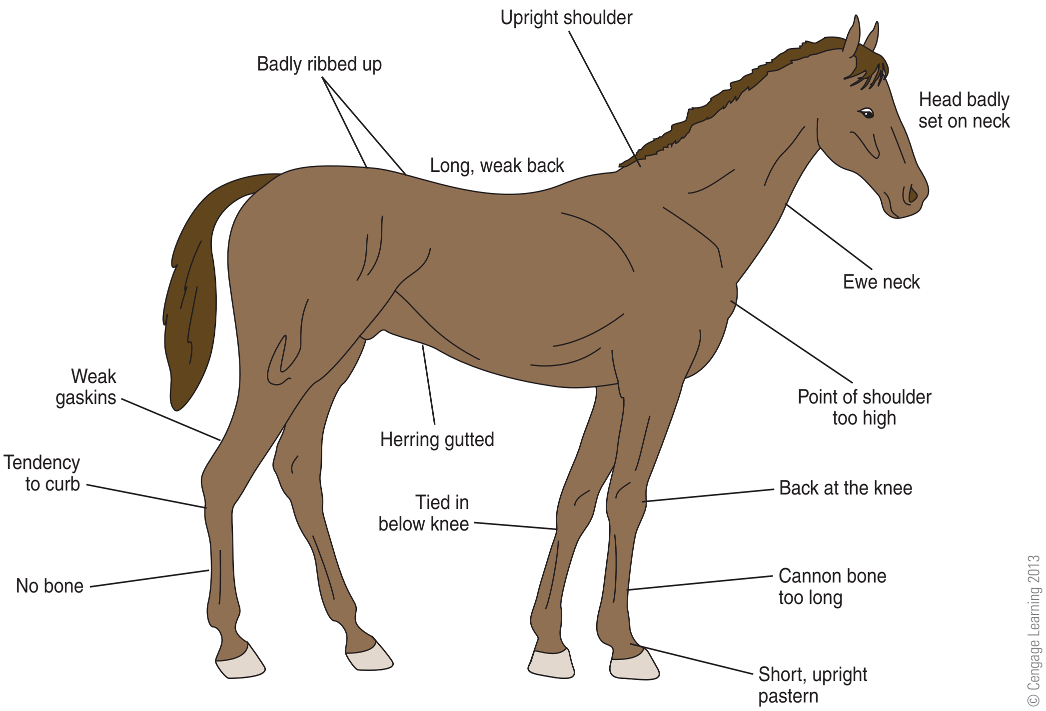


FIGURE 8–6 **A horse with many faults.**

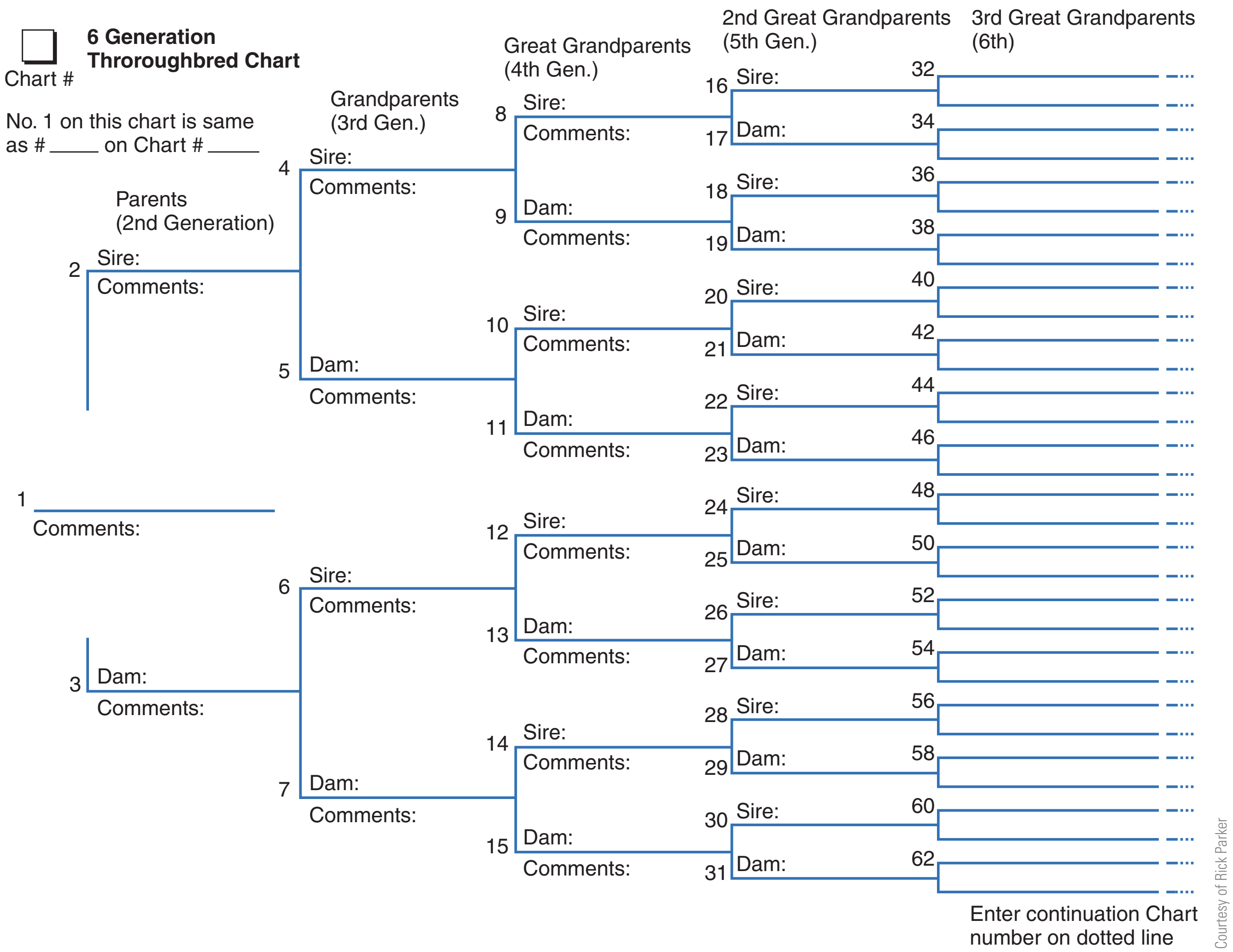


FIGURE 8-7 **Empty Thoroughbred pedigree chart showing relationships; lines are completed with names and comments that include dates.**

Pedigree

A pedigree is a record of a horse's ancestry. If the primary purpose of the horse is to breed, then the success of the ancestors in the horse's pedigree and the horse's own performance record is important. Intelligence or ability to learn is an asset in any horse. These abilities can be identified in horses trained or in training, and they may be predicted in part by pedigree or family relationships. Figure 8–7 illustrates the relationships in a six-generation pedigree chart for Thoroughbred horses.

Internet Help for Purchasing a Horse

The Internet provides some valuable guidelines for first-time horse buyers, such as:

- Buy a Horse 101: http://www.buyahorse101.com/
- wikiHow: Buy a Horse: http://www.wikihow.com/Buy-a-Horse
- eHow: How to Buy a Horse: http://www.ehow.com/how_11484_buy-horse.html
- Some videos on YouTube also provide guidelines for first-time horse buyers.

ADOPTING WILD HORSES

Because it seems like a worthy cause, some people will consider adopting a wild horse. Seldom does this prove to be a good plan for first-time horse owners. At first glance it may seem like buying a piece of the old American West, but the natural "wild" instincts of these horses and burros are very strong. Only yearlings and occasionally 2-year-olds should be considered, because they are not as set in their ways as older horses. Adopting a younger wild animal means that the new owner will have to work with the horse or burro for 1 to 2 years before it can be ridden. Most of these animals were underfed, and their health management was nonexistent before the Bureau of Land Management captured them. They have been kept in large groups and have had very little exposure to humans. They are often underdeveloped for their age and take a lot of extra care, patience, discipline, and training to be useful. For more information about adopting wild horses check out these websites:

- BLM Colorado's Wild Horse and Burro Program: http://www.blm.gov/co/st/en/BLM_Programs/wild_horse_and_burro.html
- The Wild Horse Sanctuary: http://www.wildhorsesanctuary.org/help-adopt.html
- National Wild Horse Adoption/Awareness: http://www.nationalwild-horseadoptionday.org/

Experienced owners could consider adopting horses if they have the expertise and energy to invest in a project horse. The horses are of very mixed breeding. Refined, quality horses are hard to find in the group available for adoption. Even when properly trained, the horses are seldom suitable for show purposes.

While it is commendable to want to adopt these wild horses, the low adoption and transporting expenses should be balanced with the likelihood of a successful experience. For the money, purchasing domestically raised horses represents less risk—though it does not include the emotional benefit of adopting a wild horse or burro from the public rangelands of the American West.

JUDGING

To properly appraise or judge horses, the judge should view them from at least three positions—front, side, and rear (Figures 8–8 and 8–9).

Stance

How a horse stands indicates how it will move. A long forearm contributes to a long stride. Sloping shoulders and pasterns are associated with a springy stride. If a horse stands straight, it is likely to move straight and true. If the legs are set properly, it is better able to move with collected action. The effect of conformation on a horse's movement was discussed in detail in Chapters 6 and 7.

Judging a horse requires close scrutiny of unsoundness. The pasterns, cannon bones, knees, and especially the hocks should be examined for any unusual swelling or protuberance. Nervous and continuous movement of the ears may mean impaired vision; protruding or bulging eyes, called pop eyes, usually indicate nearsightedness.

Courtesy of Rick Parker

FIGURE 8–8 **Students learning how to judge horses at the Denver Livestock Show.**

Courtesy of Rick Parker

FIGURE 8–9 **Judges making final evaluations.**

VIEW FROM THE FRONT

Figure 8–10 shows a front view of the forelimbs. A perpendicular line drawn downward from the point of the shoulder should fall on the center of the knee, cannon, pastern, and foot. View A represents the correct alignment, while views B through G represent common defects.

Vertical line from point of shoulder should fall in center of knee, cannon, pastem, and foot.

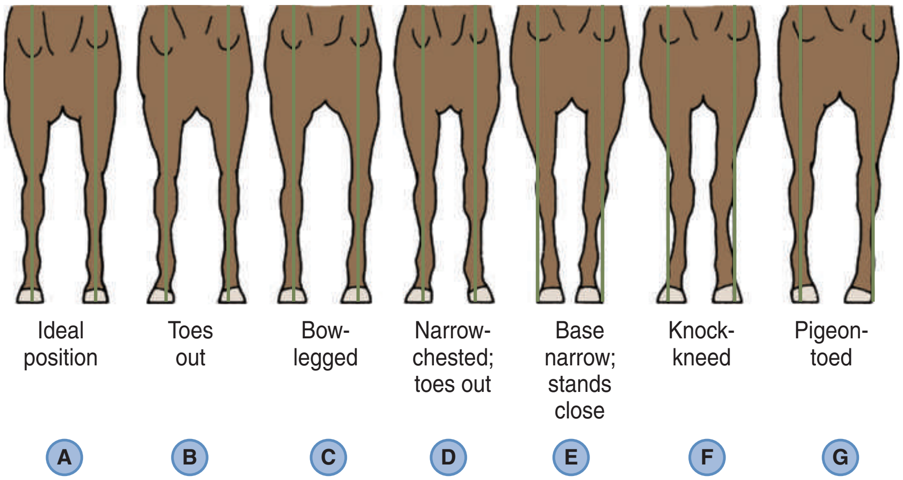


FIGURE 8–10 **Correct and incorrect positions of front legs, as shown from the front.**

VIEW FROM THE SIDE

Figure 8–11 illustrates the different conformations of the hind legs seen from the side. A perpendicular line drawn from the point of the buttock should just touch the upper rear point of the hock and fall barely behind the rear line of the cannon and fetlock.

Correct position of the leg as viewed from the side is most important in a horse. Figure 8–12 shows a side view of the forelimbs. A perpendicular line drawn downward from the center of the elbow point should fall upon the center of the knee and pastern and back of the foot. A perpendicular line downward from the middle of the

Vertical line from point of buttock should touch the rear edge of cannon from hock to fetlock and meet the ground behind the heel.

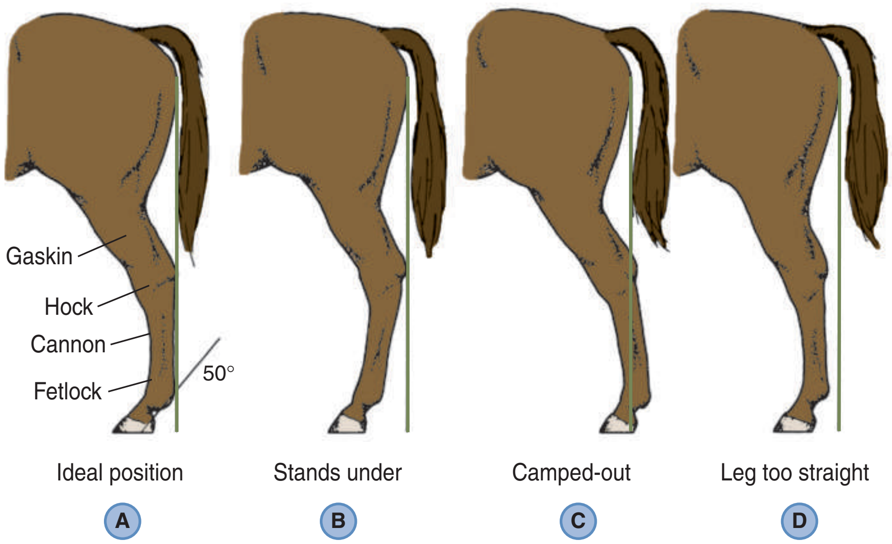


FIGURE 8–11 **Correct and incorrect positions of the rear legs, as shown from the side.**

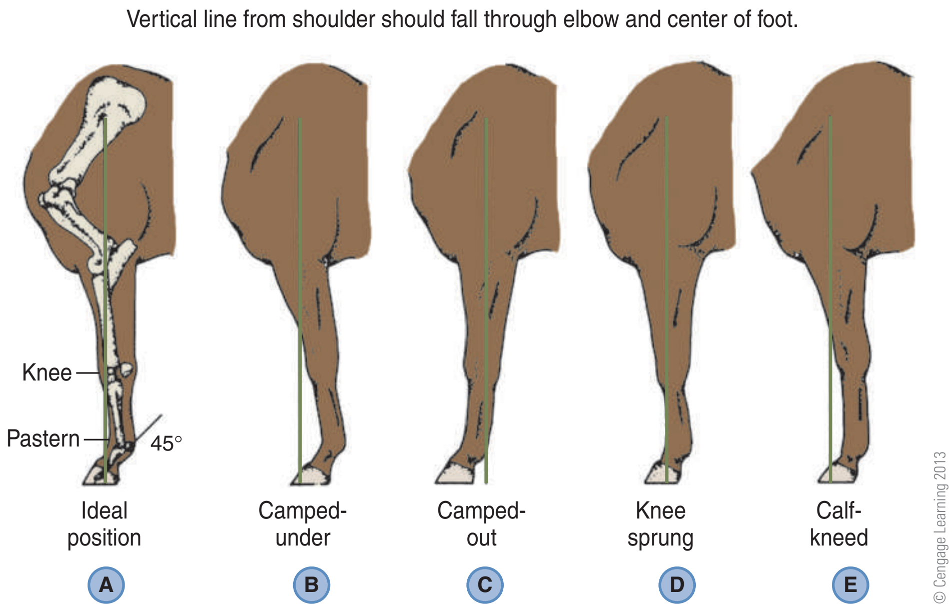


FIGURE 8–12 **Correct and incorrect positions of the front legs, as shown from the side.**

arm should fall upon the center of the foot. View A in Figure 8–12 represents the ideal conformation.

VIEW FROM THE BACK

Figure 8–13 illustrates the conformation of the hind legs viewed from the rear of the animal. A perpendicular line drawn downward from the point of the buttocks should fall in line with the center of the hock, cannon, pastern, and foot. View A in Figure 8–13 represents the correct conformation.

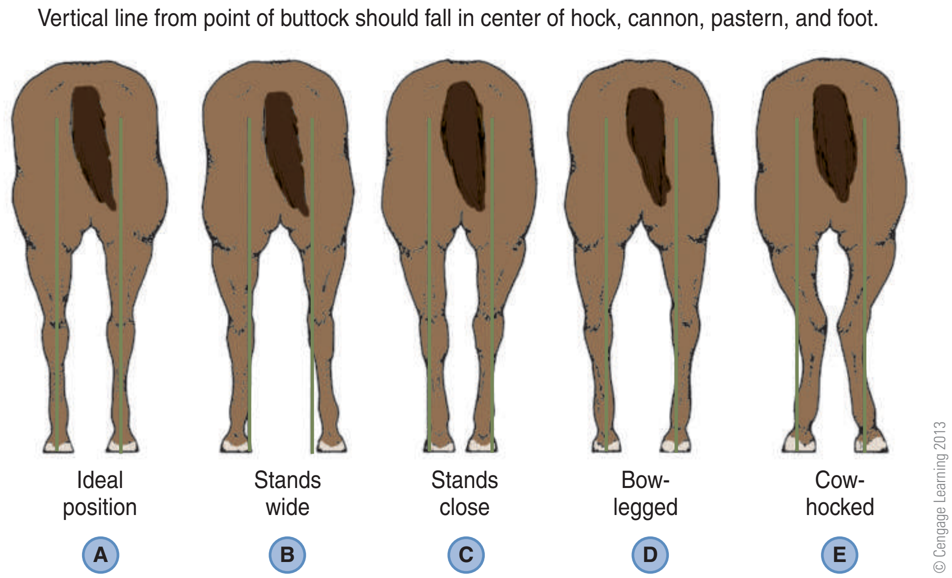


FIGURE 8–13 **Correct and incorrect positions of the rear legs, as shown from the rear.**

Body Dimensions and Performance

Major contributions to a good-bodied horse include long, sloping shoulders; short, strong back; long underline; and long, rather level croup. These attributes increase the probability that the horse is or can become a good "athlete."

If the shoulders are long and sloping, they extend the stride in running, absorb shock, reduce stumbling, move the elbows away from the girth, and raise the head slightly. The shoulders should be surmounted by clean, high withers that extend well backward to afford maximum security of the saddle.

Short backs and long underlines move the fore and rear legs farther apart, tend to raise the croup and head, contribute to style and action, and increase height and length of stride. Also, short backs are stronger, reduce the length of coupling (hipbone to last rib), and are usually more muscular than others. Finally, well-sprung ribs that blend into hips and shoulders with minimum roughness tend to accompany short backs.

Long, rather level croups accommodate more muscling, increase style and balance, and are less often associated with crooked hind legs.

Because all of the power used in motion comes from the hindquarters, muscular development should be extensive, commensurate with breed requirements. Breeching, thighs, and gaskins should be especially muscular. Long, smooth muscles are preferred to those that are short and bunchy.

Leverage is gained with maximum length from hip to hock and minimum length of cannon. These dimensions are developed to a high degree in breeds that race. Smoothness, balance, and symmetry are a result of all parts blending together, being of proportionate size, and each contributing equally to the whole of a symmetrical individual. These, combined with refinement, alertness, and a proud carriage, contribute to style.

Leg Set

Proper leg set is essential to durability and good action. A leg should be properly positioned under each corner of the body, knees, and hocks should not deviate inward or outward, and feet should point straight forward as viewed from the front, side, and back.

If a horse stands on crooked legs, it must move likewise. Crooked movement detracts from appearance, wastes energy, and predisposes a horse to unsoundnesses.

Pasterns should be medium in length, sloped at approximately 45 degrees, and flexible but strong. Hoofs should have the same angle as pasterns, and be deep and wide at the heels, moderate in size, dense of horn, and free of rings. White hoofs are softer (wear faster) than others. Slope of shoulders and pasterns and expansion of heels account for shock absorption when the horse is in motion.

Bone should be adequate in size, show definition of joints, and should appear flat when viewed from the side, as compared to a front view.

Bone spavins, bogs, thoroughpins, and weakness are common to sickle hocks. Jarring from short, straight pasterns and shoulders predisposes to side bones, stiffness, bogs, and lameness. Pigeon toes tend to wing, whereas splayed feet tend to swing inward in motion.

Effect of Quality on Wearability

Quality is indicated by refinement of head, bone, joints, and hair coat. It is reflected in thin skin, prominent veins, and absence of coarseness, especially in the legs. Good circulation in the legs is important to durability. Coarse, "meaty" legs with reduced

Courtesy of Rick Parker

FIGURE 8–14 **Past Grandma Rodeo Queen Myrtle Bean making her horse flex its neck for a sugar cube.**

circulation tend to stock, **puff**, bog, and become unsound. A horse of quality is more attractive and more appealing to the buyer.

Effect of Head and Neck on Flexibility

The length and shape of a horse's neck and the size of its head affect action. The neck should be long, slightly arched, and fine and clean at the throatlatch for maximum balance, style, and maneuverability. Fine throats enhance ease of breathing and allow maximum flexion of the chin without binding the jaws on the neck (Figure 8–14). Short-necked, thick-throated horses "steer" hard and may be "head slingers" from jaw pressure when pulled up short. Size of head should be in accord with breed requirements. Ears should not be oversized and should be carried alertly. Eyes should be wide-spaced, large, and clear. Nostrils should be large but refined, and lips firm instead of pendulous.

What Does It Take to Be a Good Horse-Show Judge?

Being a good horse-show judge requires knowledge and skill. Here is a checklist:

- An exact knowledge of the rules of the division or breed
- A knowledge of correct conformation and movement
- A knowledge of standards of perfection for each breed or division in both halter and performance classes
- An organized mind to sort out top and bottom
- Good note-taking skills and a good method of remembering
- Physical stamina and good health
- Impartiality, ethics, and fairness
- Courtesy and good manners
- Control of the show ring: keeping track of entries, lineups, workouts, and time constraints
- Ability to live with a decision

Judges serve as their own conscience. The best show-ring decision is the one a judge makes when he or she has the correct knowledge and is ethical and fair.

Effect of Disposition on Usefulness

If riding is to be a joy and safety a requirement, good dispositions become a must. They may be both "born" and "made." Some breeds are more docile than others, and wide differences exist among individuals within breeds. Any horse appropriately trained will have a satisfactory disposition for normal riding. Conversely, horses of excellent disposition can be spoiled by improper handling.

The horse's ears and eyes show nervousness and resistance. Handling the feet can indicate the disposition of the horse.

Courage or "heart" is necessary for horses used for racing and sporting events. Intelligence or ability to learn is an asset in any horse. These can be identified in horses trained or in training and may be predicted in part by pedigree or family relationships.

A horse with the proper conformation and disposition is physically able to be an effective performer. To do so, it needs to be fed correctly and kept healthy.

COLORS AND MARKINGS

Being a good judge requires familiarity with the colors and markings of horses. Some of these are unique to a breed, and others are purely descriptive. Colors and markings are also used for identification.

Body Colors

Body colors range from black to white. A good judge uses the proper color description when judging horses.

- Bay—Body color ranging from tan through red to reddish brown; mane and tail black; usually black legs
- Black—Body color true black without light areas; mane and tail black
- Blue roan—More or less uniform mixture of white with black hairs on the body, but usually darker on head and lower legs; can have a few red hairs in mixture
- Brown—Body color brown or black with light areas at muzzle, eyes, flank, and inside legs; mane and tail black
- Buckskin—Body color yellowish or gold; mane and tail black; usually black on lower legs. Buckskins usually do not have dorsal stripes.
- Chestnut—Body color dark red or brownish red; mane and tail usually dark red or brownish red, but may be flaxen
- Dun—Body color yellowish or gold; mane and tail may be black, brown, red, yellow, white, or mixed; usually has dorsal stripe, zebra stripes on legs, and transverse stripes over withers
- Gray—Mixture of white with any colored hairs; often born solid-colored or almost solid-colored and get lighter with age, or more white hairs appear
- Grullo—Body color smoky or mouse-colored; not a mixture of black and white hairs, but each hair mouse-colored; mane and tail black; usually black on lower legs. Usually has dorsal stripe.
- Paint—The two most common paint color patterns are **tobiano** and **overo**. The tobiano horse will usually have head markings like a solid-colored horse; legs may be white, and body markings are often regular and distinct, being

FIGURE 8–15 **Paint horse with foal.**

oval or round patterns. The overo horse will often have a **bald face**, at least one dark-colored leg, and body markings that are usually irregular, scattered, or splashy white. These markings do not cross the back between the withers and tail (Figure 8–15).

- Palomino—Body color golden yellow; mane and tail white. Palominos do not have a dorsal stripe.
- Red dun—A form of dun with body color yellowish or beige; mane, tail, and dorsal stripe are red
- Red roan—More or less uniform mixture of white with red hairs on the body, but usually darker on head and lower legs; can have red, black, or flaxen mane and/or tail
- White—A true white horse is born white and remains white throughout its life. A white horse has snow-white hair, pink skin, and brown, hazel, or blue eyes.

HEAD MARKS

Head markings include the **star**, **strip** or **stripe**, **snip**, **blaze**, and bald face. These are illustrated in Figure 8–16.

A star is a solid white mark on the forehead. The shape may range from oval to diamond to a narrow vertical, diagonal, or horizontal star. A strip or stripe is a white mark starting at eye level or below and ending on or above the upper lip. The size and shape of a stripe may vary widely and must be described in detail as to its width, length, and relationship (whether it is connected or unconnected) to a star.

A snip is a white or beige mark over the muzzle between the nostrils, while a blaze is a wide patch of white extending down the face and covering the full width of the nasal bones. A bald face is a wide white marking that extends beyond both eyes and nostrils.

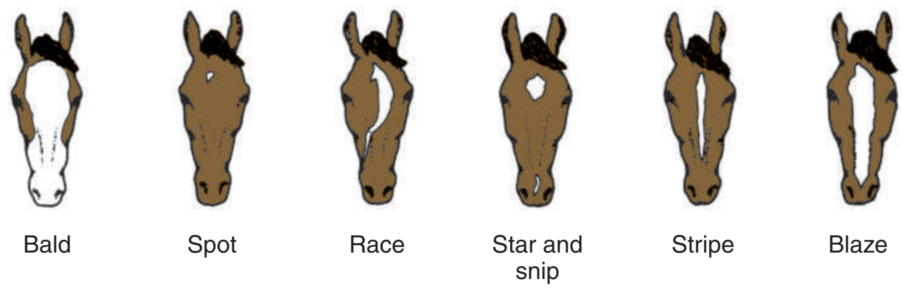


FIGURE 8–16 **Typical head and face markings.**

Leg Marks

Descriptive words for leg markings include **coronet**, pastern, **ankle**, **half-stocking**, **stocking**, **stocking plus**, white on knee or hock, **white spots**, and **distal spots**.

A coronet is a white marking covering the coronet band. A pastern is a white marking from the coronet to the pastern, and an ankle a white marking from the coronet to the fetlock. A half-stocking is a white marking from the coronet to the middle of the cannon, a stocking is a white marking from the coronet to the knee, and a stocking plus is a white marking like the stocking, but one in which the white extends onto the knee or hock (Figure 8–17).

The designation *white* on knee or hock indicates a separate white mark on the knee or hock. *White spots* means white spots on the front of the coronet band or on the heel; *distal spots* indicates dark spots on a white coronet band. Figure 8–18 shows the markings on the leg.

FIGURE 8–17 **Horse with stockings being judged.**

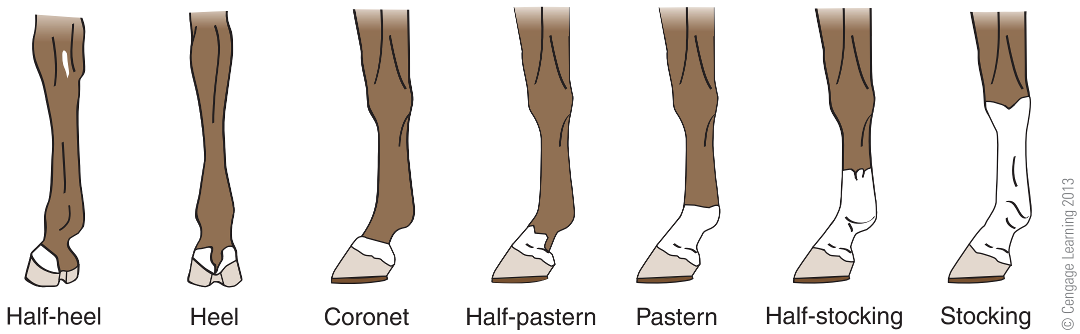


FIGURE 8–18 **Typical leg markings.**

HORSE SCORECARD

Table 8–2 can be used as a scorecard when judging light horses. It helps the judge remember what to look for in each view and in specific areas.

QUALITIES OF A JUDGE

To be a successful judge either at a show on an individual basis or in a judging contest competing on a team, judges need the following attributes:

1. A desire to know thoroughly what is being judged
2. A clear knowledge of the ideal or standard type and the ability to recognize desirable and undesirable points of conformation
3. Quick and accurate powers of observation
4. Ability to form a mental image of many individual animals and to rank them by making comparisons
5. Reasoning power that takes into account practical considerations
6. Ability to reach a definite decision based on sound judgment
7. Extreme honesty and sincerity to avoid bias or prejudice
8. Decisions based on personal knowledge and judgment
9. Steady nerves and confidence in ability to make close independent decisions based entirely on the animals' merits
10. Ability to do the best work possible at the time and have no regrets about the results or accomplishments
11. Ability to evaluate and rank the individual animal according to its appearance on the day of judging, regardless of its rank at previous shows
12. Sound knowledge acquired through practice and experience to give effective reasons for decisions
13. A pleasant and even temperament without fraternizing with exhibitors or friends along the ringside
14. Firmness to stand by and defend placings without offending or in any way implying decisions are infallible

TABLE 8–2 Scorecard for Judging or Selecting Light Horses

VIEW OR ITEM	WHAT TO LOOK FOR	IDEAL TYPE	POINTS ASSIGNED	POINTS GIVEN
Front	Head	Well-proportioned, refined, clean-cut, with chiseled appearance; broad, full forehead with great width between eyes; jaw broad and strongly muscled; ears medium size, well carried and attractive	15	
	Femininity or masculinity	Refinement and femininity in brood mares; boldness and masculinity in stallions		
	Chest capacity	Deep, wide chest		
	Set of front legs	Straight, true, and squarely set		
Rear	Width of croup, and width through rear quarters	Wide and muscular over croup and through rear quarters	15	
	Set of hind legs	Straight, true, and squarely set		
Side	Style and beauty	High carriage of head, active ears, alert disposition, and beauty of conformation	35	
	Balance and symmetry	All parts well developed and nicely blended together		
	Neck	Fairly long; carried high; clean-cut about throat latch		
	Shoulders	Sloping at about 45 degrees		
	Topline	Short, strong back and loin with long, nicely turned and heavily muscled croup; high well-set tail; withers clearly defined and of same height as high point over croup		
	Coupling	Short, as denoted by last rib being close to hip		
	Rear flank	Deep		
	Arm, forearm, and gaskin	Well-muscled		
	Legs, feet, and pasterns	Straight, true, and squarely set legs; pasterns sloping about 45 degrees		
	Quality	Abundant, denoted by clean, flat bone, well-defined joints, tendons, refined head and ears; fine skin and hair		
	Breed type	Enough characteristics of specific breed to meet breed specifications		
Soundness	Soundness and freedom from any defects in conformation that may predispose to unsoundness	Sound and free from blemishes	15	
Action	At walk	Easy, prompt, balanced; a long step, with each foot carried forward in a straight line; feet lifted off the ground	20	
	At trot	Rapid, straight, and elastic with joints well flexed		
	At canter	Slow and collected; readily executed on either lead		
Total points:			100	

HOW TO BECOME A HORSE JUDGE

Like any skill, becoming a horse judge requires practice, practice, and more practice. Individuals can begin to learn the skill of judging by participating in judging events as a contestant in 4-H or other contests and eventually participating in judging competitions in high school and college as a member of a judging team. For example, Horse Evaluation is one of the Career Development Events (CDE) for the National FFA Organization. Preparing for this event requires practice sessions that the FFA advisor arranges.

Other organizations that host organized equine evaluation events include the National Postsecondary Agricultural Students (PAS) Organization (www.nationalpas.org) and the North American Colleges and Teachers of Agriculture (NACTA) Judging Conference (www.NACTAteachers.org).

According to the CDE Handbook, participants in this event should practice judging four halter classes represented by the following breeds and types: Quarter Horse, Conformation Hunter, Appaloosa, Arabian, Paint, American Saddlebred, and Morgan. All halter classes in the CDE are judged as sound. This means the judging teams can assume the horses have no unsoundnesses, so the teams must look for the other traits in order to place the animals—balance, muscling, structure, quality, and traveling.

Future judges also need practice in performance classes. In the CDE, teams judge four performance classes. These classes judge the horse and rider in performances such as Western Pleasure, Western Riding (Pattern One), Reining, English Pleasure (Saddle Seat), Hunter Under Saddle (Hunt Seat), and Hunter Hack. Performance classes are judged as presented, which means that unsoundness can be penalized. The American Quarter Horse Association reining pattern is provided to the teams before the event. All horses run the same pattern, and they are given the pattern in advance.

Some helpful resources for developing judging skills include:

- AQHA Handbook of Rules and Regulations—(updated annually) <http://www.aqha.com/en/Showing/Content-Pages/Resources/Exhibitors/Handbook.aspx>
- National FFA—Horse Evaluation CDE <https://www.ffa.org/Programs/Awards/CDE/HorseEvaluation/Pages/default.aspx>
- Oklahoma State University—Horse Breeds <http://www.ansi.okstate.edu/breeds/horses>
- University of Kentucky Agripedia—Horse Judging <http://www.ca.uky.edu/agripedia/agmania/horse/>
- ASC118 Horse Judging Manual from the University of Kentucky http://www.uky.edu/Ag/AnimalSciences/pubs/asc118.pdf>

Also helpful for the aspiring judge is the official judging guide and breed specifications from each of the various breed associations. Finally, people who are serious about becoming a horse judge should find a mentor who is willing to work with them as they develop their individual skills.

SUMMARY

Horse ownership can be a rewarding experience if the appropriate horse is selected. Criteria for selecting a horse include experience with horses, expected use, soundness, grade or registered, breed, color, size, age, training, sex, disposition and vices, facilities, price, and conformation. The importance of each of these factors will depend on individual needs. As experience is gained and interest grows (or changes), different types of horses will be needed. Sometimes expert help is needed when deciding what type of horse is right. Regardless of the horse selected, consistent and firm discipline and proper management are vital to maintain the animal. Horse ownership is a big responsibility. Continually gaining more knowledge can make horse ownership a more rewarding experience.

Judging horses requires extensive knowledge about horses in order to make fair comparisons and reach a sound conclusion. Judges need to be able to describe horse colors, markings, and conformation. When judging conformation, emphasis is placed on the set of feet and legs. A good judge must recognize when a horse has a fault in the way it is set on its legs, since this determines how it will move. A horse with crooked legs cannot move true. Regardless of a horse's excellent head, neck, shoulder, top, and general balance and conformation, if it is crooked on its legs, it is not a top horse.

Besides a thorough knowledge of horses, good judges should have personality traits that make them accurate and fair.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Buying a horse represents a sound investment that will increase in value.
2. Young horses are best for the first-time rider/owner.
3. Potential horse owners should consider only a registered horse.
4. Adopting a wild horse is the best risk for a first-time horse owner.
5. A horse with a bald face lacks hair on its nose.

Short Answer

6. List eight costs associated with owning a horse after the initial purchase.
7. Identify 10 terms used to describe the body color of horses.
8. List 10 factors to consider when selecting a horse.
9. Which is the best choice for riding: a mare, a gelding, or a stallion?
10. What is a good guideline for selecting the first horse for a young rider?

Critical Thinking/Discussion

11. When is breed an important consideration in selection?
12. Why is the proper selection of a horse so important?

13. When is the purchase of a horse considered an investment with the possibility of making money?
14. Why are age and sex important considerations when selecting a horse?
15. Describe five typical face markings found on horses.
16. Describe five typical leg markings.
17. Why is conformation a more important consideration than breed when selecting a horse for personal enjoyment?
18. Briefly describe how a horse should be judged.
19. What makes a person a good judge of horses?
20. Differentiate between selecting a horse for an investment and selecting a horse for personal recreation.

STUDENT ACTIVITIES

1. Collect color photographs of horses representing the following body colors: bay, blue roan, brown, buckskin, dun, grullo, tobiano, overo, red roan, palomino, and white. The breed registries in Table A–16 in the appendix may be helpful.
2. Select one of the breed registries in Table A–16. Contact the registry and ask them to send any guidelines they have for judging horses representative of their breed.
3. Attend a horse-judging event such as a horse show, county fair, 4-H, or FFA event. Take notes and photographs. Report on the event.
4. Using the Internet, newspaper want ads, or other sources, develop a table of horse prices. Include as much information about each horse as possible. For example, include the breed, age, sex, and any special training. Find this information on at least 15 horses for sale.
5. Make a photocopy of Table 8–1 or create it in an electronic spreadsheet program such as Excel. Using actual values from your area, complete the table and calculate the cost of owning a horse for one year.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). *Horse industry handbook: A guide to equine care and management.* Lexington, KY: Author.

Avila, B., and Copeland, S. (2007). *Be a Smart Horse Buyer: A Guide to Avoiding Common Mistakes and Finding the Right Horse for You*. Gaithersburg, MD: Horse & Rider Magazine.

Barton, F. T. (2010). *Our friend the horse: A complete practical guide to all that is known about every breed of horse in the world.* Chestnut Hill, MA: Adamant Media Corporation.

Draper, J. (2003). *The complete book of horses, horse breeds & horse care.* London, UK: Lorenz Books/Anness Publishing.

Draper, J. (2008). *The illustrated guide to horse breeds: A comprehensive visual guide to the horses and ponies of the worlds, with over 300 colour photographs.* London, UK: Lorenz Books, Arness Publishing, Ltd.

Silver, C. (1993). *The illustrated guide to horses of the world.* Stamford, CT: Longmeadow Press.

Ward, L (2004). *The horse illustrated guide to buying a horse*, Irvine, CA: BowTie Press.

Wood, C. H., & Jackson, S. G., and Janicki, K. M. (2004). *Horse judging manual.* Lexington: University of Kentucky, College of Agriculture, Cooperative Extension Service (http://www.uky.edu/Ag/AnimalSciences/pubs/asc118.pdf).

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as, Google or Bing, find more information by searching for these words or phrases:

adopting horses	horse markings	registered horses
grade horses	horse pedigree	selecting a horse
horse breeds	horse-show judge	
horse coloring	judging a horse	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 9

Determining Age, Height, and Weight of Horses

Horses, like people, vary considerably in vigor and longevity. In general, horses have passed their physical peak when they reach 9 to 10 years of age. At this age, the chance of an unsoundness being present has increased. Age and height are important considerations when selecting a horse for competition or for personal use.

OBJECTIVES

After completing this chapter, you should be able to:

- List the names used for different age groups of horses from birth to 3 years
- Discuss the importance of knowing the age of a horse
- Name four changes in teeth that are indicators of different ages
- Diagram a tooth to show the parts that change during the aging process
- Describe the changes horses' teeth exhibit during their lifetime
- List the temporary and permanent teeth of the horse and their approximate time of eruption
- List four abnormal tooth conditions
- Give four reasons that knowing the height and weight of a horse is important
- Tell how to determine the height of a horse in hands and inches
- Calculate the weight of a horse from the measurements of the heart girth and body length

KEY TERMS

angle of incidence
baby teeth
birth date
bishoping
canines
centrals (centers)
colt
corners
cups
deciduous
dental stars
dentition
filly
floating
foal
Galvayne's groove
girth
heart girth
incisors
infundibulum
intermediates
mare
milk teeth
molars
monkey mouth
neck
nippers
parrot mouth
pincers
premolar
smooth mouth
stallion
2-year-olds
weanling
wolf tooth
yearlings

IMPORTANCE OF AGE

Young horses are referred to by their age. The young horse is called a **foal** until it is weaned. A male horse is referred to as a **colt** until it is 3 years old, and then it is called a **stallion**. A young female horse is called a **filly** until it reaches the age of 3, when it is referred to as a **mare**. Sometimes the term **weanling** is used for horses that are 6 months to 1 year of age. Horses 1 to 2 years old may be called **yearlings**, and horses 2 years of age may be called **2-year-olds**.

A horse's condition and training are more important than its age. Prime age for a horse is about 7 to 9 years, but this is not necessarily the ideal age. Horses frequently are active into their late 20s if they get proper care.

Buyers can often purchase top-quality older horses at the same price or less than they would pay for younger horses of lesser quality. Although most older horses cannot perform as actively as they did when younger, they may have many years of useful service left.

Buyers should be ready to decide whether they prefer a younger horse or if an older one would do as well. This decision cannot be made until the buyer evaluates the individual horse. Finally, the age of the horse purchased depends on what the buyer can afford and what horses the buyer finds available.

Age is also important for competitive events. For racing or showing events, the foal's **birth date** is considered to be January 1, regardless of the actual month of birth during the year. So a foal born April 1, 2001, will be 10 years old on January 1, 2011. Individuals who race or show try to have foals born as near to January 1 as possible. This gives the horse the advantage of more growth than those born later in the year.

USING TEETH TO DETERMINE AGE

Of course, the best way to determine the age of a horse is from good records. A record of a horse's birth is required by breed registries. When a record of age does not exist, the teeth furnish the best estimation of the age of a horse.

The art of determining the age of horses by inspection of the teeth is an old one. It can be used with a considerable degree of accuracy in determining the age of young horses. The probability of error increases as age advances and becomes a guess after the horse reaches 10 to 14 years of age. Stabled animals tend to appear younger than they are, whereas those grazing sandy areas, such as range horses, appear relatively older because of wear on the teeth.

Age determination is made by a study of the 12 front teeth, called **incisors**. The two central pairs both above and below are called **centrals (centers)**, **pincers**, or **nippers**. The four teeth adjacent to these two pairs are called **intermediates**, and the outer four teeth are designated as **corners**.

Canine teeth or "tusks" may appear midway between the incisors and **molars** at 4 or 5 years of age in the case of geldings or stallions, but seldom appear in mares. Adult horses have 24 molar teeth (Figure 9–1).

Four key changes in the teeth can be used to estimate the age of horses:

1. Occurrence of permanent teeth
2. Disappearance of cups
3. Angle of incidence
4. Shape of the surface of the teeth

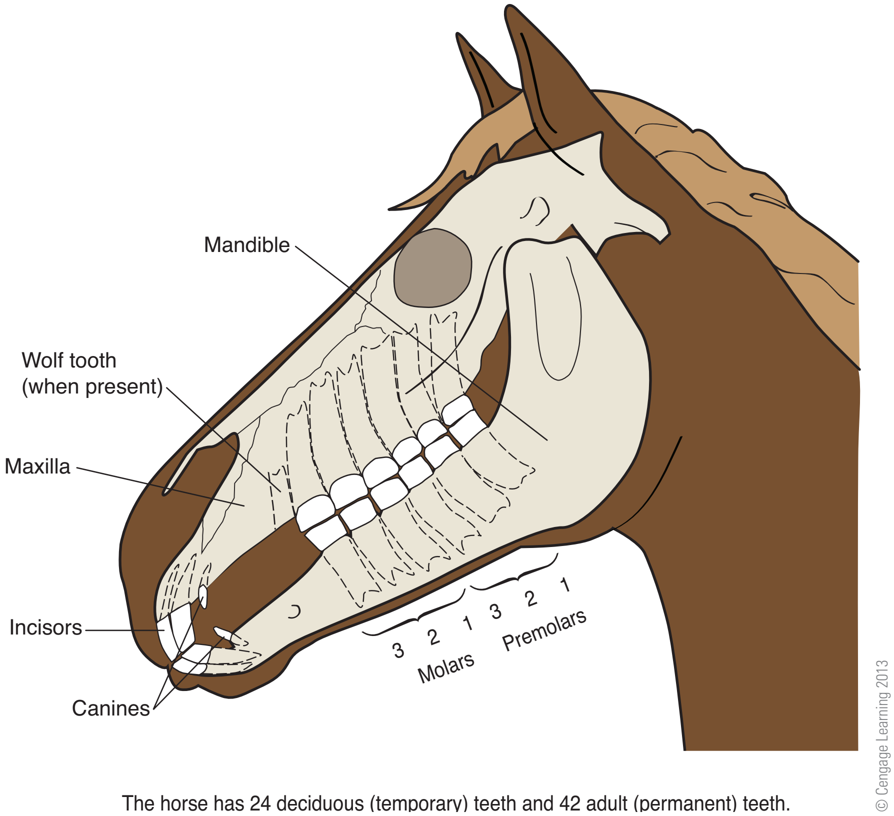


FIGURE 9–1 **The position of the teeth in the horse skull.**

Occurrence of Permanent Teeth

Horses have two sets of teeth, one temporary and one permanent. Temporary teeth may also be called **baby** or **milk teeth**. Temporary incisors tend to erupt in pairs at 8 days, 8 weeks, and 8 months of age.

A well-grown 2-year-old may be mistaken for an older horse unless permanent teeth can be accurately identified. Permanent teeth are larger, longer, darker in color, and do not have the well-defined **neck** joining root and gum that temporary teeth do.

The four center permanent teeth appear (two above and two below) as the animal approaches 3 years of age, the intermediates at 4, and the corners at 5. This constitutes a full mouth.

Disappearance of Cups

In the center of their surfaces, young permanent teeth have deep indentures referred to as **cups**. Cups are commonly used as reference points in determining age. Those in the upper teeth are deeper than the ones below, so they do not wear evenly with the surface or become smooth at the same rate. In general, the cups become smooth in the lower centers, intermediates, corners, upper centers, intermediates, and corners at 6, 7, 8, 9, 10, and 11 years of age, respectively. A **smooth mouth** theoretically appears at 11. A few horse owners ignore cups in the upper teeth and consider a 9-year-old horse smooth-mouthed. Although complete accuracy cannot be ensured from studying cups, this method is second in accuracy only to the appearance of permanent teeth in determining age.

As cups disappear, **dental stars** appear—first as narrow, yellow lines in front of the central enamel ring, then as dark circles near the center of the tooth in advanced age.

ANGLE OF INCIDENCE

The angle formed by the meeting of the upper and lower incisor teeth (profile view) affords an indication of age. This **angle of incidence** or "contact" changes from approximately 160 to 180 degrees in young horses, to less than a right angle as the incisors appear to slant forward and outward with aging. As the slant increases, the surfaces of the lower corner teeth do not wear clear to the back margin of the uppers, so that a dovetail, notch, or hook is formed on the upper corners at 7 years of age. It may disappear in a year or two, reappear around 12 to 15 years, and disappear again. The condition varies considerably between individuals, but most horses have a well-developed notch at 7.

SHAPE OF THE SURFACE OF THE TEETH

The teeth change substantially in shape during wear and aging. They appear broad and flat in young horses. They may be twice as wide (side to side) as they are deep (front to rear). This condition reverses itself in horses that reach or pass 20 years. From about 8 to 12 years, the back (inside) surfaces become oval, then triangular at about 15 years. Twenty-year-old teeth may be twice as deep from front to rear as they are wide (Figure 9–2).

STRUCTURE OF THE TOOTH

Being able to estimate the age of a horse by its teeth also requires an understanding of the structure of the tooth and different stages of wear. Figure 9–2 shows the structure

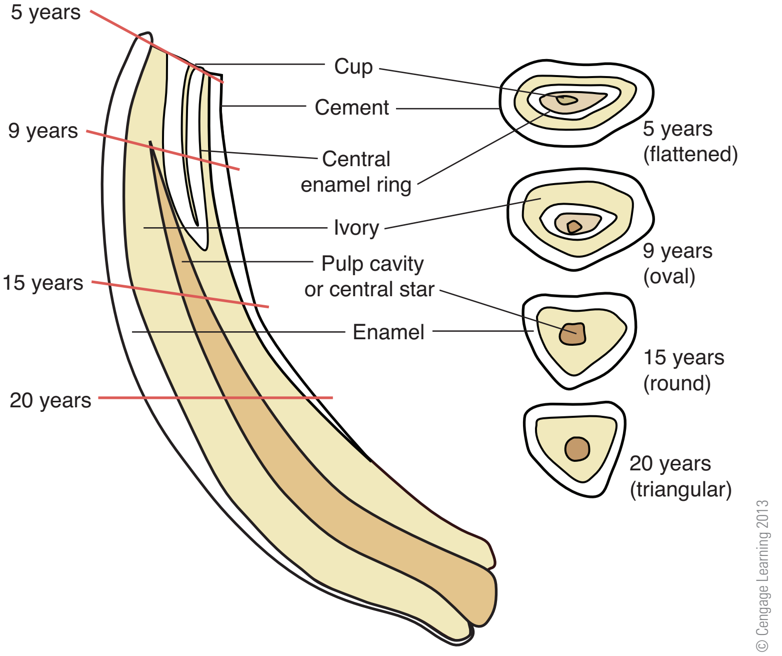


FIGURE 9–2 **How a horse's tooth wears helps determine age.**

of a tooth as viewed longitudinally and in cross section. As the horse ages and the tooth wears, different portions of the tooth become visible.

NUMBER AND TYPE OF TEETH

Table 9–1 summarizes the numbers, types, and appearance of teeth in horses.

Less than Two Weeks

Between birth and 2 weeks of age, the newborn has its first pair of incisors erupt. These are the central incisors. In profile, the mucous membrane of the gums will be a thin cover over the intermediate incisors. The temporary first, second, and third **premolar** should be present.

Four to Six Weeks

Between 4 and 6 weeks of age, eruption of the second set of incisors, the intermediates, occurs. The central incisors are in contact and coming into wear. The intermediates are not in contact, have no wear, and the cups are deep.

Six to Ten Months

The final set of temporary incisors, the corners, erupts between 6 and 10 months of age. The permanent first premolar (or **wolf tooth**) erupts. Not all horses have this wolf

TABLE 9-1 Horse Teeth and the Approximate Age at Eruption

TYPE: Temporary (Milk or Deciduous)		**TYPE:** Permanent	
TOOTH	**AGE**	**TOOTH**	**AGE**
1st incisors (or centrals)	Birth or first week	1st incisors (or centrals)	2.5 years
2nd incisors (or intermediates)	4 to 6 weeks	2nd incisors (or intermediates)	3.5 years
3rd incisors (or corners)	6 to 10 months	3rd incisors (or corners)	4.5 years
Canine (or Bridle)	Birth to first 2 weeks for all premolars	Canine (or bridle)	4 to 5 years
1st premolar		1st premolar (or wolf tooth)	5 to 6 months
2nd premolar		2nd premolar	2.5 years
3rd premolar		3rd premolar	3 years
		4th premolar	4 years
		1st molar	9 to 12 months
		2nd molar	2 years
		3rd molar	3.5 to 4 years

How Old Is Your Horse?

This poem helped old-timers remember how to use the teeth to tell the age of a horse.

To tell the age of any horse
Inspect the lower jaw of course.

Two middle nippers you'll behold
Before the colt is two weeks old.

Before six weeks two more will come;
Twelve months the corners cut the gum.

At two the middle nippers drop;
At three the second pair can't stop.

At four years old the side pair shows;
At five a full new mouth he grows.
Black spots will pass from view.
At six years from the middle two.

The side two pairs at seven years,
And eight will find the corners clear.

The middle nipper, upper jaw,
At nine the black spots will withdraw.

At ten years old the sides are light;
Eleven finds the corners white.

As time goes on the horsemen know
The oval teeth three-sided grow.

They longer get, project before,
'Til twenty when we know no more!

—Anonymous

tooth. The dental surfaces of the centrals and intermediates start to show wear. The cup is shallower in the centrals than the intermediates because they have been in wear longer. The corners are not in contact with each other.

One Year

All the temporary incisors are visible from the front. In profile, the upper and lower corner incisors are not in contact. The dental surfaces of the centrals show considerable wear. The dental star is seen usually in the centrals and intermediates as a dark or yellowish-brown transverse line in the dentin on the labial (the surface of the tooth closest to the gums) side of the **infundibulum** (the funnel-shaped inside of the tooth). The first molar should be present by 1 year.

Two Years

The central and intermediate incisors are now quite free from the gum, especially the upper incisors. All pairs of the incisors should be in wear. The dental surface of the lower central incisors is smooth; the intermediates show decided wear; the corners show considerable wear. The dental star is clearly visible in the lower incisors. Eruption of the second molar occurs.

Two and One-Half Years

The first pair of permanent incisors erupt. The upper central incisors have not reached the level of the **deciduous** intermediates. The lower permanent central incisors have erupted through the gum, but most of the labial surface of the lower incisors is covered by mucous membrane. In profile, the intermediate and corner incisors show distinct necks. The dental surface shows the intermediates worn smooth and the corners with noticeable wear. The second permanent premolar erupts as well.

THREE YEARS

The first set of permanent incisors, the centrals, are now in wear. They are more solid in appearance, are larger and broader than the temporary teeth, and have vertical ridges and grooves. The dental table of the central incisors has a deep cup, and the borders are sharp. Eruption of the third premolar takes place.

THREE AND ONE-HALF YEARS

The second pair of permanent incisors, the intermediates, erupt. The central incisors are well in wear. The intermediates are nearing contact. In profile, the gap between the upper and lower intermediates is visible. The dental surfaces show wear on the centrals. The intermediates are sharp, since they have not made contact yet. The temporary corners are nearly smooth.

FOUR YEARS

The first two sets of permanent incisors are now in wear. The jaws have acquired so much width that from the front, the corner temporary incisors are barely visible. **Canines** start to erupt. These may erupt as early as 3.5 years or as late as 5 years. The dental surfaces of the central incisors show wear, but the cups are deep. The intermediates are in wear, but sharp. The fourth premolar erupts as well as the third molar.

FOUR AND ONE-HALF YEARS

The last pair of incisors, the corners, erupt. Head on, the central and intermediate incisors are in contact. The permanent corners are visible, but they are not in contact. In profile, the upper and lower canines are erupting and are sharp. The dental surfaces have distinct cups in the centrals and intermediates, while the corners are sharp.

FIVE YEARS

The permanent **dentition** is complete. All the incisors are in wear. The canines have erupted completely. The dental surfaces of the centrals and intermediates are wide transversely and show wear, but their cups are readily visible and completely encircled by the central enamel.

SIX YEARS

Dental surfaces of the lower centrals are usually smooth, and the shape is more oval. The central enamel is not as wide as it was at 5 years, and it is closer to the surface of the tooth closest to the tongue surface. The intermediates have distinct cups but otherwise resemble the centrals. The corners show wear. The canines have reached their full length and are in wear.

SEVEN YEARS

In profile, the dental surface of the lower corner incisor is narrower than that of the upper. This leads to a notch on the caudal corner of the upper incisor—the 7-year notch or hook. Dental surfaces of the lower central and intermediate incisors are smooth. Cups are no longer present. The lower corners retain their cups.

Eight Years

Lower dental surfaces are smooth, and all cups are gone in lower corners. The dental star appears in the lower central incisors, first as a dark yellow or yellow-brown transverse line in the dentin on the cheek side of the infundibulum of the permanent central incisor. The central and intermediate incisors are oval.

Nine Years

The 7-year hook has usually disappeared by 9 years. The distal end of **Galvayne's groove** may be visible at the margin of the gum on the upper corner incisors (Figure 9–3). The central incisors are round, while their central enamel is triangular. Their dental star is more distinct and narrower and near the center of the dental surfaces. The intermediate incisors are becoming round, while the corners are oval.

Ten Years

The angle of the teeth is more oblique. The distal end of Galvayne's groove should be visible on the upper corner of the upper incisor. Dental surfaces of the lower central and intermediate incisors are round, while the corner incisors are oval to round. The central enamel is triangular in the central incisors and close to the lingual border. The dental star is more distinct and near the center of the teeth. Galvayne's groove appears at the gum margin of the upper corner incisor at about 10 years of age, extends halfway down the tooth at 15 years, and reaches the table margin at 20. It then recedes and disappears at 30 years of age.

Eleven Years

The hook on the upper corner incisor returns (it may not appear until 12 years, and it usually persists to 15 years). The angle of the jaw increases in obliquity. The central enamel of each lower incisor forms a small ring close to the lingual border. Dental stars are narrower transversely and near the center of the dental table.

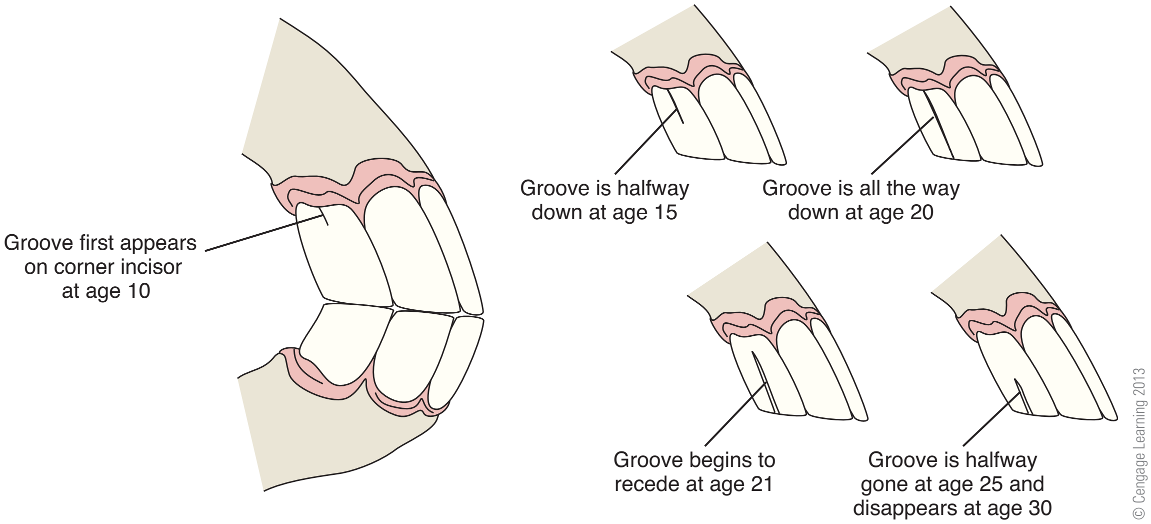


FIGURE 9–3 **Galvayne's groove.**

Twelve Years

Dental surfaces of all the lower incisors should be round. The central enamel is small and round, and it is disappearing from the centrals. The dental star is seen as a small yellow spot near the center of the dental surfaces.

Thirteen Years

Dental surfaces of the lower centrals may appear round or triangular. The central enamel in the lower incisors is small and round and, in many instances, disappearing. Dental stars are near the middle of the dental surfaces. The length of the teeth and the shape of the dental surfaces are the important markers for this age.

Fifteen Years

Galvayne's groove extends halfway down the labial (the surface of the tooth closest to the gums) surface of the upper corner incisors. The dental surfaces of the lower central incisors appear triangular. The intermediates are round to triangular and all lower incisors show a dark, distinct dental star.

Seventeen Years

Dental surfaces of the lower incisors are triangular. Dental stars are round and near the center of their respective teeth. Head on, the corner incisors are inclining slightly to the inside. In profile, the angle of the incisors is increasing.

Twenty Years

Galvayne's groove extends down the entire length of the labial surface (the surface of the tooth closest to the gums) of the upper corner incisors. The upper corner incisors deviate distinctly toward the median plane. Deviation of the intermediates is not as marked. The dental table of the lower incisors may be compressed transversely and may be worn almost to the gum (Figure 9–4).

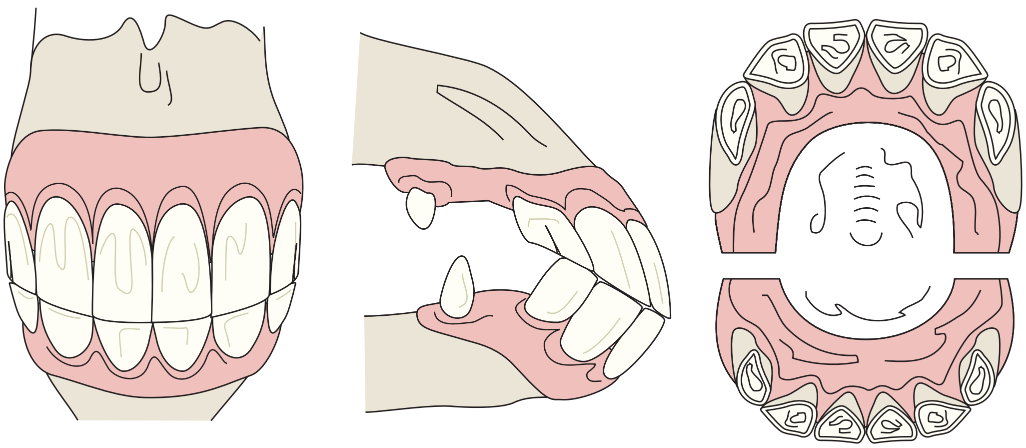


FIGURE 9–4 The teeth of an older horse.

In summary, the younger a horse is, the better chances are of accurately determining its age by its teeth. The older a horse, the more lifestyle has affected the wear and shape of the horse's teeth and the more difficult it is to determine its age.

External factors such as feed choice, grazing on sandy soil and vices, such as cribbing, can cause the surface of the incisors to wear quicker than normal. Breed can also play a small roll in teeth development. Some breeds, especially pony breeds, mature slower and eruption of their permanent teeth is delayed accordingly

Abnormal Tooth Conditions

Several factors influence the wear and appearance of teeth: bite, cribbing, **bishoping**, and **floating**.

- **Parrot mouth** is a result of the upper and lower incisors not meeting because the lower jaw is too short. If it also affects the molars, then sharp points and hooks may form during wear. This condition is rather common and may seriously interfere with grazing (Figure 9–5).
- **Monkey mouth** is the opposite of parrot mouth and is seldom seen in horses.
- Cribbing is a habit common to stabled horses that damages incisors by chipping or breaking them.
- Floating, sometimes called dental reduction or dental equilibration, means to file or smooth points, hooks, or ramps on teeth to facilitate chewing. Points are sharp tooth projections, on the inside of the lower jaw near the tongue and on the outside of the upper jaw near the cheek, from normal dental wear. Hooks are sharp projections on the front of the upper row of jaw "grinding teeth" or on the back of the bottom row of jaw "grinding teeth." A ramp is a sloping surface that can have sharp edges on the premolar/molars of the jaw. Points, hooks, and ramps can all cause tongue or cheek injury.

FIGURE 9–5 Parrot mouth.

FIGURE 9–6 **Good horse owners check their horse's teeth on a regular basis.**

Molars should be checked regularly by veterinarians as the horse approaches midlife and should be kept floated as needed (Figure 9–6). Since the molars can become razor sharp, one should avoid placing fingers in the horse's mouth.

OTHER INDICATORS OF AGE

The features of older horses are a little like those of older people. The sides of the face become more depressed, the poll more prominent, and the hollows above the eyes deeper. The backbone becomes more prominent and starts to sag, and the joints appear more angular. Around the temples, eyes, nostrils, and elsewhere, white hair appears.

MEASURING HORSES

Typical measurements such as height, weight, and **girth** are influenced by age. These measurements are also affected by breed, type, sex, and nutrition.

Height

Height can influence price. Ponies are often cheaper because their use is limited. Horses are measured in hands. A hand is equal to 4 inches. With the horse on level ground, the point of measurement is the distance from the highest point of the withers to the ground. So, a horse measuring 60 inches is a 15-hand horse.

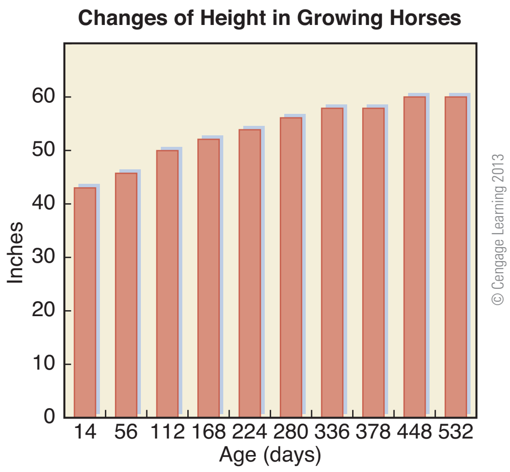


FIGURE 9–7 **Height chart.**

FIGURE 9–8 **Thoroughbred mother and growing foal.**

Height changes as a foal grows. Figure 9–7 shows how the height of Thoroughbred foals changes as they age (Figure 9–8).

Weight

Breed, type, and age determine the weight of a horse. Figure 9–9 graphically demonstrates how rapidly a horse increases in body weight as it matures. Knowing the weight of a horse is important for determining:

- Amount of feed needed
- Adequacy of a feeding program
- Potential health problems
- Optimal training and competing (Figure 9–10)
- Maximal breeding efficiency
- Proper amount of medication

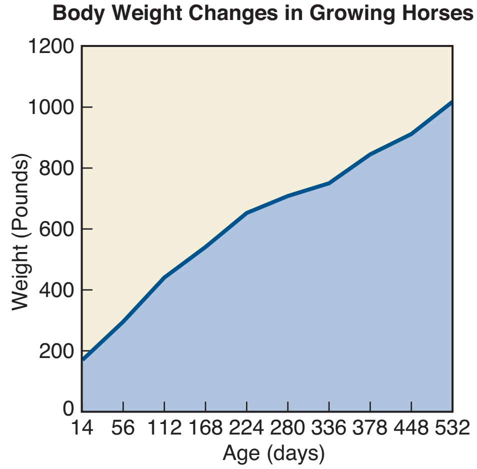


FIGURE 9–9 **Weight chart.**

FIGURE 9–10 **Thoroughbred mother and growing foal in action.**

Using Length and Girth

A University of Florida study found 88 percent of visual guesses on horses' weight resulted in underestimates. The best way is to use a truck scale: Weigh the trailer and horse together and then weigh the trailer unloaded. Weight tapes give only rough estimates. For those who cannot use the truck scale method, researchers developed the following formula, using **heart girth** and body length.

Measure the heart girth just behind the elbow, taking the reading right after the horse exhales. Measure body length from the point of the shoulder to the point of the buttocks in a straight line (see Figure 9–11). Avoid using a cloth measuring tape because it may stretch. A metal carpenter's tape is accurate, but it is noisy and can

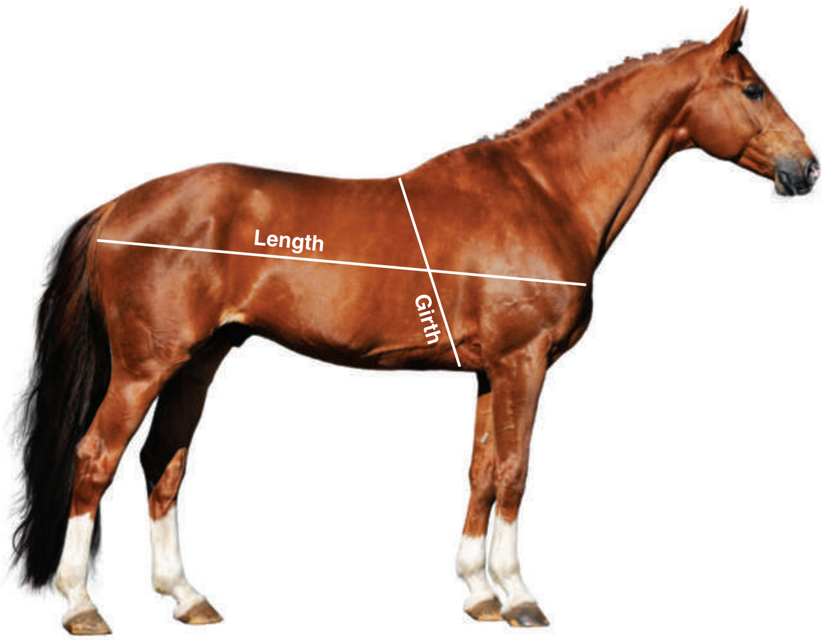


FIGURE 9–11 **Measuring length and heart girth to calculate weight.**

spook a horse. A plastic-coated tape works best. If one is not available, use cord or string that has no stretch, and mark the spot with a pen. Then measure the cord with a carpenter's tape or yardstick.

Take the two measurements and multiply the heart girth (in inches) times itself. Then multiply that number by the body length in inches. Divide the total by 330 for the approximate weight in pounds.

For example, if the horse measures 75 inches around the heart girth, and body length is 64 inches:

$$\frac{\text{heart girth} \times \text{heart girth} \times \text{body length}}{330} = \text{body weight}$$

$$\frac{75 \times 75 \times 64}{330} = 1{,}091 \text{ pounds}$$

For light horse foals from 1 to 6 weeks of age, a more accurate weight can be calculated using the following formula:

$$\frac{\text{heart girth in inches} - 25.1}{0.07} = \text{body weight}$$

A heart girth measurement is the circumference of the chest just behind the elbow. Heart girth gives some idea as to the space available for the heart and lungs.

Heart girth also can be used alone to estimate body weight. Some tapes are sold that give a direct reading of girth to weight. If this type of tape is not available, an ordinary measuring tape can be used and the girth converted to body weight using Table 9–2.

TABLE 9-2 Estimating a Horse's Weight from the Girth Measurement

GIRTH (INCHES)	WEIGHT (POUNDS)[1]	GIRTH (INCHES)	WEIGHT (POUNDS)[1]
32	100	66	860
40	200	68	930
45	275	70	1,000
50	375	72	1,070
55	500	74	1,140
60	650	76	1,210
62	720	78	1,290
64	790	80	1,370

[1] For pregnant mares, multiply the value by 1.02, 1.06, 1.11, or 1.17 for their weight at 8, 9, 10, and 11 months of pregnancy, respectively.

SUMMARY

Age, height, and weight are important when considering a horse for competition or for personal use. For horses of a known age, the terms *colt*, *filly*, *weanling*, *yearling*, and *2-year-old* can be used until maturity. When accurate records are not available, age-related, specific changes in the teeth provide an accurate estimate of age.

The height of a horse relates to its use and value. Height can easily be measured. When scales are not available, the weight of a horse can be estimated from the girth measurement and a standardized table or from the girth and body length measurements and a standardized formula. Body weight is used for several management decisions.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. A young female horse less than 3 years old is called a colt.
2. Horses have two sets of teeth.
3. The 12 front teeth of a horse are all called incisors.
4. Dental stars are the same as premolars.
5. A horse's girth can be used to estimate its weight.

Short Answer

6. List four reasons for needing to know the weight of a horse.
7. If the girth of a horse is 64 inches, about how much does it weigh?
8. If the girth of a horse is 70 inches and its body length is 62 inches, how much does it weigh?

9. If a horse is 64 inches from the highest point of its withers to the ground, how many hands tall is it?
10. What term is used to describe tampering with the tooth cups to make the horse appear younger?
11. What is the opposite of monkey mouth?
12. _______ is filing off or smoothing the high spots in molars to improve chewing.
13. When do horses get their temporary and permanent centrals?
14. When do horses get their third permanent molar?

Critical Thinking/Discussion

15. Discuss four key changes in teeth that are used to estimate the age of a horse.
16. Define these terms: foal, colt, stallion, mare, filly, weanling, and yearling.
17. Describe the importance of knowing the age of a horse.
18. What creates the dental star, and when does it first appear?
19. Where is Galvayne's groove, and when does it first appear?
20. Describe the changes in height and body weight as a foal grows.

STUDENT ACTIVITIES

1. Diagram the upper and lower jaw of a horse with a full complement of permanent teeth.
2. Compare the estimated body weight of a group of horses using the girth measurement method and the girth–body length formula.
3. Obtain an animal tooth and cut it in half lengthwise. Identify the parts of the tooth.
4. Sometimes the body weight of horses is given in kilograms and the height is given in centimeters. Develop a table of converted values for the following body weights given in kilograms: 80, 150, 220, 450, 500, and 550. Do the same for the following heights given in centimeters: 108, 126, 132, 139, 146, and 151. In this table, convert the weight to pounds and the height to inches and hands.
5. Using different colors of modeling clay, make a model of a tooth that shows what happens as the surface of the tooth wears away.
6. Using the information in Table 9–2, create your own tape for measuring girth that gives a direct reading of a horse's weight.
7. Obtain a horse skull and describe how the teeth can be used to estimate age.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). *Horse industry handbook: A guide to equine care and management*. Lexington, KY: Author.

Edwards, E. H. (2008). *The encyclopedia of the horse.* New York: DK Publishing, Inc.

Evans, J. W. (2000). *Horses: A guide to selection, care, and enjoyment* (3rd ed.). New York: Owl Books.

Gore, T., Gore, P., & Griffin, J. M. (2008). *Horse owner's veterinary handbook.* Hoboken, NY: Wiley Publishing, Inc.

McCracken, T. O., & Kainer, R. A. (1998). *The coloring atlas of horse anatomy.* Loveland, CO: Alpine Publications.

Lewis, L. D. (1996). *Feeding and care of the horse* (2nd ed.). Media, PA: Williams & Wilkins.

Pavia, A., & Posnikoff, J. (2005). *Horses for dummies, 2nd Edition.* Hoboken, NJ: Wiley Publishing, Inc.

Peplow, E. (2005). *Encyclopedia of the horse, 2nd Ed.* New York: Barnes & Noble Books.

Vogel, C. (2011). *Complete horse care manual.* New York: DK Publishing, Inc.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

aging horses	growing horses	measuring horses
colt	heart girth	stallion
equine dentistry	horse birth date	weanling
fillies	horse teeth	yearlings
foal	mares	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 10

Genetics

Genetics is a science that studies heredity and variation. Heredity is defined as the resemblance among individuals related by descent; variation is the occurrence of differences among individuals of the same species. Genetic material is contained on the chromosomes of all cells, and the chromosomes are found in the nucleus of cells. Reproduction is the process of getting genetic material from the male in the form of sperm to the female egg.

Before reading this chapter, you should review Chapter 4. In Chapter 4, the function of the cell is discussed.

OBJECTIVES

After completing this chapter, you should be able to:

- Define a gene, an allele, a chromosome, and DNA
- Discuss genome sequencing and its value
- Explain the difference between phenotypic and genotypic expression
- Explain how mules are produced
- Discuss basic inheritance
- Distinguish between single- and multiple-gene inheritance
- Distinguish among recessive dominance, codominance, and partial dominance
- Describe how DNA codes for proteins that make up the body and function in the body
- Compare qualitative traits to quantitative traits
- Discuss the relationship between genetics and environment
- Explain how genetics determines coat color
- Name five genetic diseases or abnormalities

KEY TERMS

additive genes
albino
alleles
chromosomes
deoxyribonucleic acid (DNA)
dominant allele
gametes
genes
genome
genomics
genotype
heterozygous
homozygous
jack
karyotype
messenger ribonucleic acid (mRNA)
nonadditive gene
nucleotides
nutrigenomics
phenotypes
proteomics
Punnett Square
qualitative traits
quantitative traits
recessive allele
sexed semen

BASIC GENETICS

Genes are the basic unit of inheritance. They are carried on the **chromosomes** of all body cells. In the **gametes**—eggs or sperm—genes pass inherited traits to the next generation. Different forms of the same gene—at the same location on the chromosome—are called **alleles**. Genes contain the "blueprint" or code that determines how an animal will look and interact with its environment.

Genes are made of **deoxyribonucleic acid (DNA)**. Resemblances and differences among related individuals are primarily due to genes. Genes cause the production of enzymes that control chemical reactions throughout the body, thus affecting body development and function. For normal body development and function, genes must occur in pairs. Genes are a part of the chromosomes that reside in the nucleus of all body cells (Chapter 4). Chromosomes in the nucleus of a particular cell contain the same genetic information as the chromosomes in every cell of the body. So, the chromosomes in the cells of a horse's ear are the same as the chromosomes in its heart. The genes on the chromosomes, however, have specific functions in specific body tissues.

The number of chromosomes an animal possesses varies from species to species, but is consistent for a species—horses have 64 chromosomes, while humans have 46. In the normal cell of a horse or any mammal, chromosomes occur in distinct pairs. Horses have 32 chromosome pairs, for a total of 64 chromosomes.

GENOMES

The complete set of "instructions" for making an organism is called its **genome**. The genome contains the master blueprint for all cellular structures and activities for the lifetime of the cell or organism. Found in every nucleus of the many trillions of cells in an animal, the genome consists of tightly coiled threads of DNA and associated protein molecules, organized into distinct, physically separate microscopic structures called chromosomes.

The horse genome is organized into 64 chromosomes in 32 pairs. All genes are arranged linearly along the chromosomes. The nucleus of most horse cells contains two sets of chromosomes, one set from each of its parents. Each set has 31 single chromosomes, or autosomes, and an X or Y sex chromosome. A normal female will have a pair of X chromosomes; a male will have an X and Y pair. Chromosomes contain roughly equal parts of protein and DNA. DNA molecules are among the largest molecules now known.

During mitosis (cell division), chromosome pairs condense and are visible with a light microscope. A **karyotype** analysis involves blocking cells in mitosis and staining the condensed chromosomes with dye. The dye-stained regions of the chromosomes are rich in adenine and thymine, producing a dark band. A karyotype is a photograph of the entire set of chromosomes, cut up and arranged in pairs. Thus the normal karyotype for a mare is 64, XX; for a stallion it is 64, XY. Figure 10–1 shows a karyotype for horses.

If unwound and tied together, the strands of DNA would stretch more than 5 feet long but would be only 50 trillionths of an inch wide. For every organism—from simple bacteria to remarkably complex horses—the components of these slender threads encode all the information necessary for building and maintaining life.

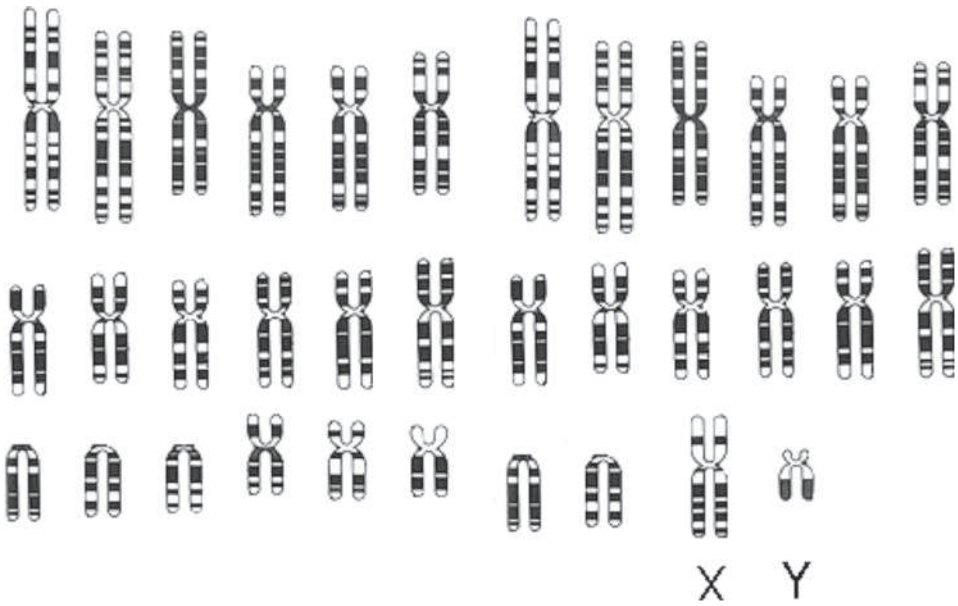


FIGURE 10–1 A diagram illustrating a horse's karyotype.

Understanding how DNA performs this function requires some knowledge of its structure and organization.

STRUCTURE OF DNA

In animals and humans, a DNA molecule consists of two strands wrapped around each other to resemble a twisted ladder whose sides, made of sugar and phosphate molecules, are connected by rungs of nitrogen-containing chemicals called bases. Each strand is a linear arrangement of repeating similar units called **nucleotides**, each composed of one sugar, one phosphate, and a nitrogenous base (Figure 10–2).

Four different bases are present in DNA: adenine (A), thymine (T), cytosine (C), and guanine (G). Chromosomal DNA contains an average of 150 million bases. The particular order of the bases arranged along the sugar-phosphate backbone is called the DNA sequence. This sequence specifies the exact genetic instructions required to create a particular organism with its own unique traits.

The two DNA strands are held together by weak bonds between the bases on each strand, forming base pairs. Genome size is usually stated as the total number of base pairs. The horse genome contains over 3 billion base pairs.

Each time a cell divides into two daughter cells, its full genome is duplicated; for horses and other complex organisms, this duplication occurs in the nucleus. During cell division, the DNA molecule unwinds and the weak bonds between the base pairs break, allowing the strands to separate. Each strand directs the synthesis of a complementary new strand, with free nucleotides matching up with their complementary bases on each of the separated strands. Strict base-pairing rules are adhered to—adenine will pair only with thymine (an A-T pair) and cytosine only with guanine (a C-G pair). Each daughter cell receives one old and one new DNA strand. The cell's adherence to these base-pairing rules ensures that the new strand is an exact copy of the old one. This minimizes the incidence of errors (mutations) that may greatly affect the resulting organism or its offspring.

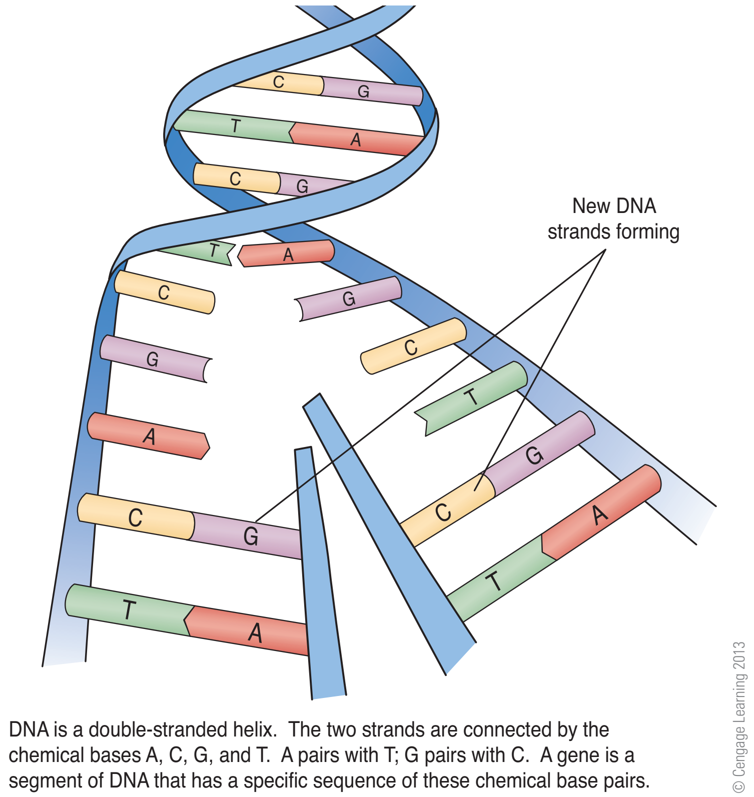


FIGURE 10–2 **The strands of DNA are similar to a twisted ladder with chromosomes contributed by each parent.**

How the Code Works

Each DNA molecule contains many genes. A gene is a specific sequence of nucleotide bases, whose sequences carry the information required for constructing the proteins that provide the structural components of cells and tissues as well as the enzymes for essential biochemical reactions.

Within the gene, each specific sequence of three DNA bases (a codon) directs the cell's protein-synthesizing machinery to add specific amino acids. For example, the base sequence ATG codes for the amino acid methionine. Since three bases code for one amino acid, the protein coded by an average-sized gene (3,000 base pairs) will contain 1,000 amino acids. The genetic code is thus a series of codons that specify which amino acids are required to make up specific proteins.

The protein-coding instructions from the genes are transmitted indirectly through **messenger ribonucleic acid (mRNA)**. This mRNA is moved from the nucleus to the cellular cytoplasm, where it serves as the template for protein synthesis. The cell's protein-synthesizing machinery then translates the code into a string of amino acids that will constitute a specific protein molecule (Figure 10–3).

Genome Sequenced

The horse genome was sequenced in 2007 with the final report published in late 2009. An international team of researchers reported decoding the genome of the domestic horse, *Equus caballus*, revealing a genome structure with remarkable similarities to

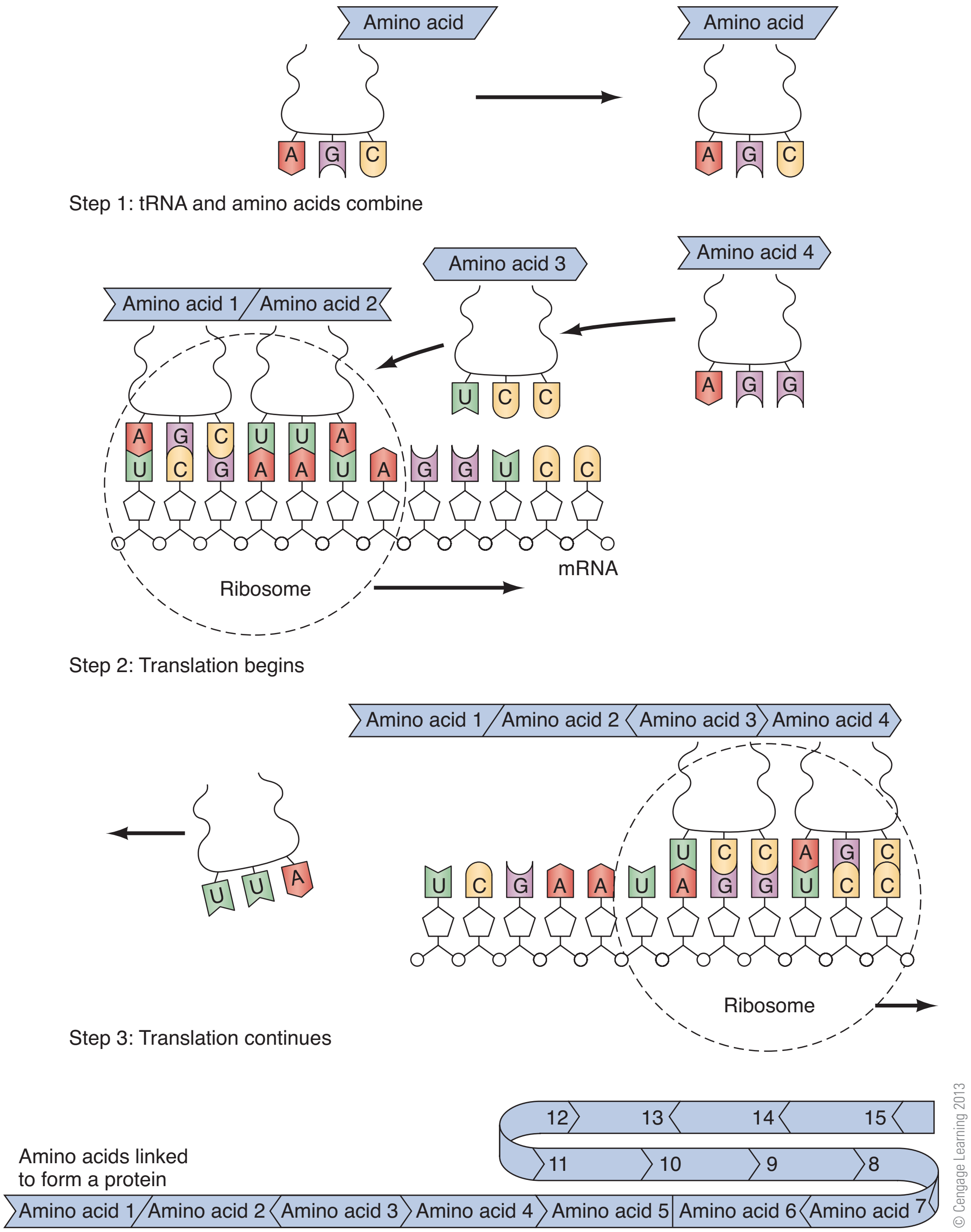


FIGURE 10–3 **How DNA directs the formation of protein.**

humans. The genome showed more than 1 million genetic differences across a variety of horse breeds.

The researchers used the DNA from a Thoroughbred mare named Twilight. A Thoroughbred was chosen since Thoroughbreds have a very narrow bloodline—81 percent of an individual's genes can be traced back to its foundation ancestors. Twilight was chosen to have her genes mapped, because she had the least genetic diversity out of a group of 10 horses originally selected. The horse's DNA sequence revealed a genome that is roughly 2.7 billion letters, or nucleotides, in size—slightly larger than the genome of the domestic dog, and smaller than both the human and cow genomes. Sequencing the horse genome sheds light on a key part of the mammalian branch of the evolutionary tree, and the work also provides a critical starting point for mapping disease genes in horses.

The Horse Genome project is based at the University of Kentucky, but is a collaboration of over 100 scientists from 20 countries (http://www.uky.edu/Ag/Horsemap/welcome.html). Researchers allow free access to the data by publishing their work on-line and making the genome sequence data available on public databases. Researchers can access the horse genome sequence data through the following public databases: GenBank (http://www.ncbi.nih.gov/Genbank) at NIH's National Center for Biotechnology Information, NCBI's Map Viewer (http://www.ncbi.nlm.nih.gov), UCSC genome browser (http://www.genome.ucsc.edu/) at the University of California at Santa Cruz, and the Ensembl genome browser (http://www.ensembl.org) at the Wellcome Trust Sanger Institute in Cambridge, England.

Ultimately the aim of the project will be to have a "gene chip" for the horse, as is available for humans and other animal species. Gene chips allow the measurement of a gene expression in a particular tissue using messenger RNA labeled on the surface. Thousands of genes can be analyzed at once in a single experiment, making them a powerful tool for finding new therapies and treatments for diseases. The Horse Genome project will benefit the health and welfare of horses. The information gained can he used by horse owners, vets, researchers, and nutritionists to improve the health and performance of the animals.

With all the new research around the genetics and gene sequencing a new vocabulary developed—a group of words that could be called "omics." Some of the frequently used words are described in the following sections.

Genomics

Genomics is the study of genes and their function. Genomics aims to understand the structure of the genome, including the mapping genes and sequencing the DNA. Genomics examines the molecular mechanisms and the interaction of genetic and environmental factors in disease.

Nutrigenomics

Nutrigenomics is the study of how different feeds may interact with specific genes to increase the risk of common chronic diseases. Nutrigenomics also seeks to provide a molecular understanding of how common chemicals in the diet affect health by altering the expression of genes and the structure of an animal's genome. The idea underlying nutrigenomics is that the influence of diet on health depends on an animal's genetic makeup.

Proteomics

Proteomics is the study of the complete set of proteins (directed by DNA) produced by a species, using the technologies of large-scale protein separation and identification. The study includes how proteins are modified, when and where proteins are expressed, how they are involved in metabolic pathways and how they interact with one another.

With the research tools of today, genetic research is advancing steadily, often rapidly, on many fronts, providing new solutions answering questions about heredity.

FUNDAMENTALS OF INHERITANCE

Chromosomes and gene numbers change during gamete (sex cell) formation (Figure 10–4). Gametes are the eggs produced by sexually mature mares and the sperm cells produced by sexually mature stallions. During gamete formation in a horse, the 32 chromosome pairs of a cell duplicate. Then, one of the four members associated with each of the duplicated chromosome pairs is randomly transferred to one of four forming gametes. The newly formed gamete now contains only one member of each original chromosome pair. This splitting of chromosome pairs causes a random transfer of each member into a forming gamete.

When an egg and sperm unite at fertilization, each carries only one member of each of its original chromosome pairs. The joining of a particular egg and sperm cell occurs at random. At fertilization, the chromosome number is restored to its original value. The new cell, the zygote that develops into a fetus, has one member of each

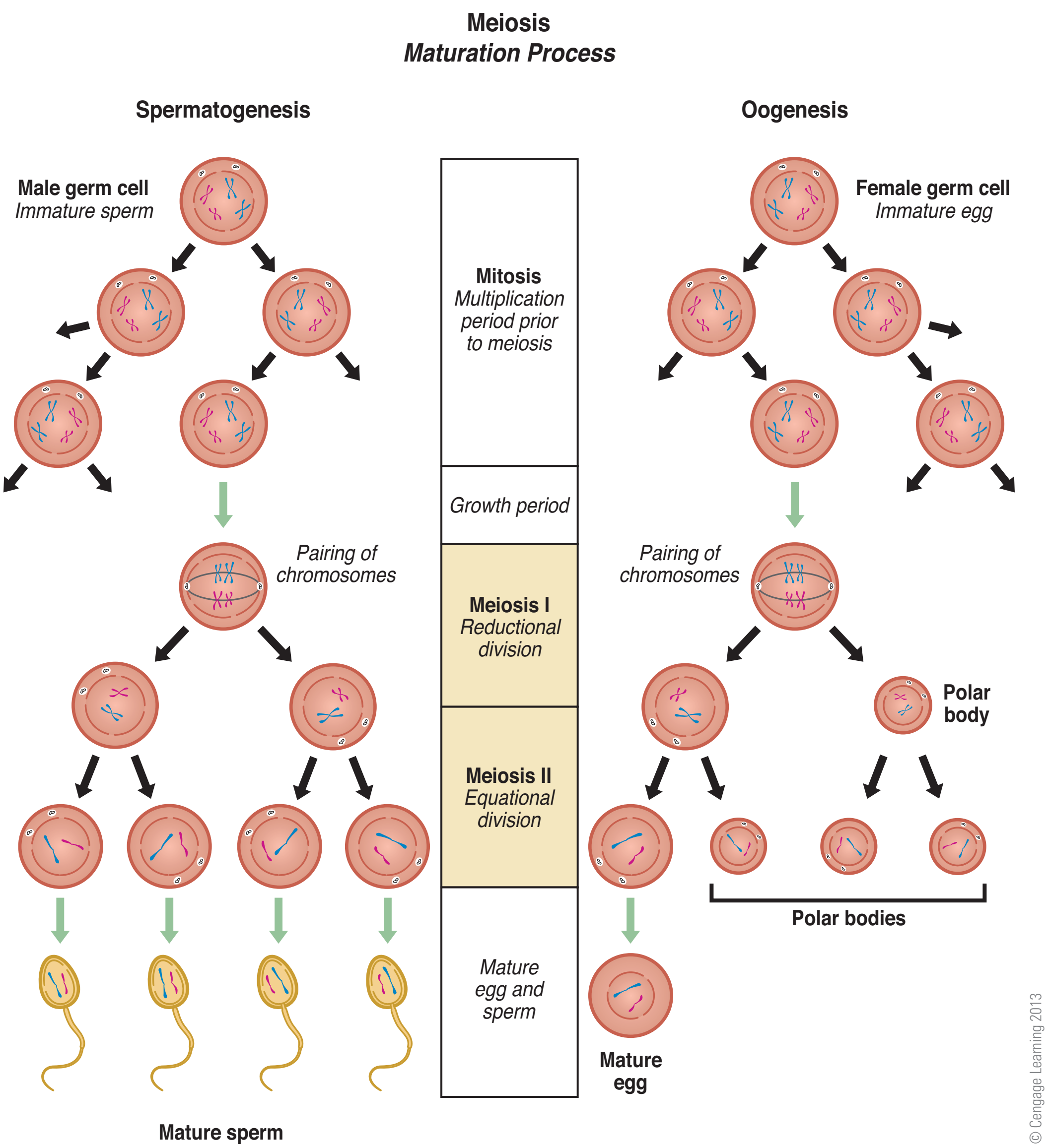


FIGURE 10–4 How the process of meiosis occurs in horses.

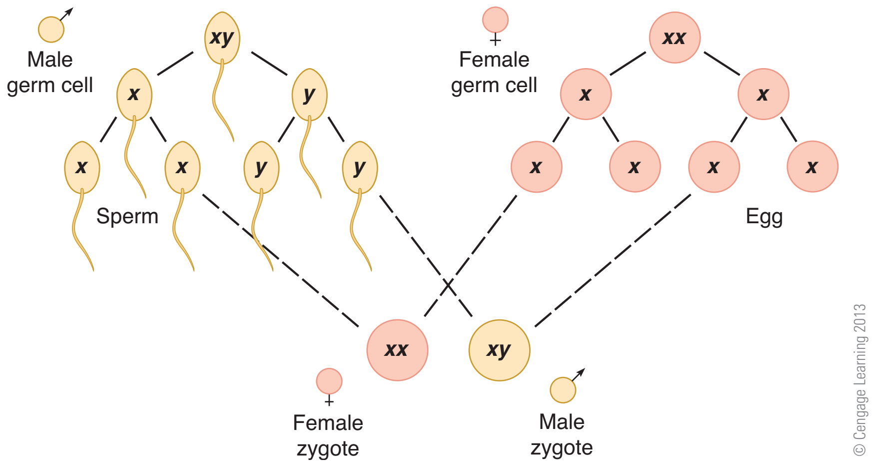


FIGURE 10–5 **How sex is determined with the X and Y chromosomes.**

chromosome pair from its sire and the other member from its dam. The resulting offspring will be genetically different from either parent due to the union of randomly matched gametes. Since horses have 64 chromosome pairs, the possible number of distinct assortments of genes in forming gametes is infinite. The possible number of genetically different horses is much larger than the total number of horses being raised on the nation's farms.

How Sex Is Determined

Chromosomes also determine the sex of a horse. The most common system of sex determination is the XY system of mammals. In this system, females carry XX chromosomes and males carry XY chromosomes. When females produce eggs, every egg possesses one X chromosome. When males produce sperm, half the sperm carry the X chromosome and half the Y chromosome. When the eggs and sperm unite, half the zygotes will be XX (female) and the other half will be XY (male). On average, in a normal population, half of the offspring are males and half are females. Figure 10–5 illustrates how sex is determined with the XY system.

Sexed Semen

In all livestock species the ability to produce all males or all females could provide great economic returns. As shown, the ratio of males to females for livestock species is about 50/50. For many years scientists worked to separate the X-bearing sperm cells from the Y-bearing sperm cells. In recent years scientists have had success with a process using a flow cytometer. The sperm cells are treated with a fluorescent dye that glows as they are run through the machine. Because the "X" chromosome has just that one leg of DNA compared to the "Y" chromosome, it glows slightly brighter. The flow cytometer sorts the cells into "X" cells, "Y" cells or "undetermined," which are discarded. When only X-bearing or Y-bearing sperm cells are present the semen is referred to as **sexed semen**. The process is expensive and greatly reduces the number of sperm cells available for fertilization. At the time is not a practical method for most horse owners.

CHROMOSOMES AND GENES

The random transfer of chromosomes and their genes to form gametes is called random segregation. Random segregation is the major cause of genetic differences among related individuals. These differences in genetic makeup are often referred to as genetic variation. Traits showing a great deal of genetic variation have a better chance of responding to selective breeding. If a large amount of genetic variation is present in a population, some animals will carry many favorable genes while others will have more undesirable genes for a given trait. If individuals with favorable genes can be identified and bred, the likelihood that their offspring will possess those favorable genetic traits increases. The specific genes that reside in the gene pairs which control a trait comprise the animal's **genotype**.

Alleles

Every cell contains a duplicate set of genes. Each set is derived from the single gene sets contributed at conception by both the mother and the father. The gene sets contain similar, but not necessarily identical, information. For example, both sets contain a gene determining hair structure, but one set may contain the instructions for straight hair and the other for curly hair. The alternative forms of each gene are called alleles.

If both alleles are identical, the animal is said to be **homozygous** at that gene; if the alleles are dissimilar, the animal is said to be **heterozygous** at that gene. Information about homozygosity or heterozygosity for various genes can be inferred from information about parents and/or progeny and can be used for predicting the outcome of matings. For most alleles of horse coat colors, one cannot tell by looking at an animal whether it is homozygous at each coat color gene, so zygosity information is not critical for purposes of identification. Sometimes, however, information about coat colors of parents may be used as an indication of incorrect parentage or erroneous identification, so some familiarity with genetic relationships may be useful.

Dominance

Both sets of genes function simultaneously in the cell. Often when the gene pair is heterozygous, one allele is visibly expressed but the other is not. The expressed allele in a heterozygous pair is known as the **dominant allele**; the unexpressed one is the **recessive allele**. The term *dominant* is given an allele only to describe its relationship to related alleles and does not indicate any kind of physical or temperamental strength of the allele or the animal possessing it. Likewise, possession of a recessive allele does not connote weakness.

For simplicity in constructing models, geneticists symbolize genes by letters such as A, B, and so on. The dominant allele of a gene is symbolized by a capital letter, for example R, and the recessive by a lowercase letter—r.

For a given gene pair, the two genes can be alike or different. A homozygous gene pair has two identical genes, while a heterozygous gene pair has different genes. Gene action can be grouped into two categories: nonadditive and additive.

Nonadditive gene action: When **nonadditive gene** pairs control a trait, members of the gene pairs will not be equally expressed.

Additive gene action: **Additive genes** are those in which members of a gene pair have equal ability to be expressed. Expression of the gene pair is the sum of the individual effects of the genes in the pair.

Example of Dominant and Recessive Gene. Assuming horse color in some cases is a simple matter of dominant and recessive alleles (Refer to Table 10–2 later in this chapter), a black horse may be either homozygous dominant (EE) or heterozygous (Ee). Either way the dominant gene will be expressed. A sorrel horse is homozygous recessive (ee). What colors of horses would be expected if a heterozygous black stallion (Ee) mated with sorrel (ee) mares?

Possible gene combinations that could occur from the matings can be predicted using a tool called the Punnett Square. To use the Punnett Square for a single pair of genes, a rectangle of three columns and three rows is created. Across the top, each one of the genes contributed by the stallion are placed into a separate column. Down the left side, each one of the possible genes contributed by the mare into are entered in a separate row. Next the possible combinations of genes at mating are entered into the table where rows and columns intersect as shown below:

		Stallion	
		E	e
Mare	e	Ee	ee
	e	Ee	ee

Over a number of matings about one-half (50 percent) of the horses will be black (Ee) and half will be sorrel (ee). Punnett Squares are often used to make predictions when the number of gene pairs involved is one to three. After that the Punnett Square grows too large.

Heredity versus Environment

All traits of horses are not controlled by just one gene pair. In fact, very few economically important traits are controlled by a single or even just a few gene pairs. Traits are controlled by possibly hundreds of gene pairs. Consequently, traits are generally grouped into two categories: qualitative and quantitative.

Qualitative Traits

Qualitative traits have four distinguishing characteristics:

1. Qualitative traits are controlled by a single or a few gene pairs.
2. **Phenotypes** (the trait characteristics we can see like color) of qualitative traits can be broken into distinct categories in which every member in that category looks the same.
3. The environment has little effect on the expression of the gene pair(s) controlling a qualitative trait. For example, coat color stays the same regardless of the environment.
4. The genotype of an individual for a qualitative trait can be determined (identifying the genes that occupy the gene pair[s]) with reasonable accuracy.

Qualitative traits show three types of gene action:

1. Dominance
2. Codominance
3. Partial dominance

An example of dominant inheritance is combined immunodeficiency. Blood type is an example of codominance, and coat color is an example of partial dominance.

Quantitative Traits

Quantitative traits are dissimilar in their attributes when compared to qualitative traits. Characteristics of quantitative traits include:

1. Quantitative traits are controlled by possibly hundreds or thousands of gene pairs located on several different chromosome pairs. Some gene pairs will contain additive genes, others will contain nonadditive genes. Most economically important traits are quantitative traits.
2. The environment does affect expression of the gene pairs controlling quantitative traits.
3. Phenotypes of quantitative traits cannot be classified into distinct categories, since they range from one extreme to another. It is impossible to accurately determine how many gene pairs are controlling a quantitative trait, so an exact gene type can never be determined.

These factors make it difficult to identify individuals that have superior genotypes for quantitative traits.

Table 10–1 shows how much of some important traits in horses are due to genetics and how much are due to environment.

TABLE 10-1 Influence of Genetics and Environment on Some Traits in Horses

TRAIT	DUE TO GENETICS (PERCENT)	DUE TO ENVIRONMENT (PERCENT)
Height at withers	45 to 50	50 to 55
Body weight	25 to 30	70 to 75
Body length	35 to 40	60 to 65
Heart girth circumference	20 to 25	75 to 80
Cannon bone circumference	20 to 25	75 to 80
Pulling power	20 to 30	70 to 80
Running speed	35 to 40	60 to 65
Walking speed	40 to 45	55 to 60
Trotting speed	35 to 45	55 to 65
Movement	40 to 50	50 to 60
Temperament	25 to 30	70 to 75
Reproductive traits	10 to 15	85 to 90

Genotypic Expression

With all traits, the individual's phenotype is the sum of effects of the genotypic and environmental effects (phenotype = genotype + environmental effects). Since qualitative traits are usually not affected by the environment, the phenotype of a qualitative trait is a good indicator of the genotype. Environmental effects do influence the phenotypic expression of a quantitative trait. An individual with an inferior genotype can rank higher phenotypically than individuals with superior genotypes because of favorable environmental effects. To reduce environmental effects, all animals must be treated the same. Usually an individual's phenotype, compared to an average for a similar group, is a good indicator or estimate of his or her genotype, or genotypic value.

Genetic evaluation programs often estimate the transmitting ability of an individual. Estimated transmitting ability is equal to one-half of an individual's estimated breeding value. The estimate of transmitting ability is the contribution a stallion or mare is expected to make to the genotypic value of their offspring.

Horse Improvement Programs

Most genetic progress for quantitative traits in livestock, including horses, has been made by selection based on phenotypes or on estimates of breeding values derived from phenotype, with no knowledge of the number of genes affecting the trait or the effects of individual genes. The basic principle of a horse improvement program is to identify superior animals within each breed. The major criterion for selecting superior animals is form (conformation) as related to function (performance), with the primary emphasis on the athletic ability of the horse. Horse improvement programs are designed to help improve the quality of bred horses, identify superior horses, and establish markets.

The process can vary, but typically three evaluators assess the yearling and 2-year-old classes. A consensus evaluation score is given to each horse. Horses in performance classes receive an evaluation score based on a combination of performance and conformation as outlined in their breed-specific class guidelines. Horses are scored up to 20 points in each of five categories:

1. Front limbs
2. Hind limbs
3. Head, neck, body, and balance
4. Athletic movement
5. Type

Standardized scorecards or forms are used to keep scoring consistent.

Objectives of the performance evaluation in an improvement program include the evaluation of athletic ability, temperament, and trainability of young horses. The evaluation covers simple maneuvers consistent with basic training of young horses in each breed, including such maneuvers as walking, trotting, cantering, changing leads, changing direction, moving off the leg, halting, and backing. A horse should excel if it remains under control; moves in a light, relaxed, rhythmic style; and executes transitions correctly and quietly. The horse should appear to be a willing participant, enjoying the activity.

A horse improvement program tries to identify horses with potential to excel in a wide range of performances. Training potential for specialized activities such as pleasure, trail, reining, pack horse, dressage, or jumping is not part of the evaluation.

Until all genes have been sequenced and identified, and scientists have learned to manipulate individual genes, genetic improvement will continue to rely on record keeping, observation, judgment, and selection.

COAT COLOR

A system for classifying horse coat colors and markings is important in any horse identification program. To have accurate and uniform application of the terminology for color classes, the system should stress recognition of basic, definable characteristics and should minimize the importance of subtleties that cannot be clearly defined. A scheme of coat-color classification based on recognition of the effects of the alleles of seven genes provides the tools necessary to define most of the common colors seen in horses.

Though an animal may show the dominant allele of a gene, it is not possible to determine by looking at the animal whether the second allele is dominant or recessive. A recessive allele may be masked by a dominant allele, which leads to the expression "hidden recessive." Dominant alleles are never hidden by their related recessive alleles. Table 10–2 lists the seven genes and their action in the coat color of horses.

THE W AND G GENES

The W (white) gene and the G (gray) gene represent alleles whose actions can obscure the actions of the other coat-color genes. If either the W allele of the W gene or the G allele of the G gene is present, the other coat-color genes cannot be determined by superficial examination.

A horse with the dominant allele W typically lacks pigment in its skin and hair at birth. The skin is pink, the eyes brown (sometimes blue), and the hair white. Such a horse is termed white, or sometimes called **albino**. The W allele is only rarely encountered. All nonwhite horses are ww.

In horses, gray is controlled by the dominant G allele. A horse with a G allele will be born any color but gray and will gradually become white, or white with red or black flecks, as it ages. Earliest indications of change to gray can be seen by careful scrutiny of the head of a young foal. Often the first evidence of the gray hairs is seen around the eyes. In intermediate stages of the graying process, the horse will have a mixture of white and dark hairs. In contrast to white (W) horses, gray horses are born pigmented and go through lightening stages, but always contain pigment in their skin and eyes at all stages of coloration change.

A gray horse will be either GG or Gg. It is not possible to tell by looking at the horse whether it is homozygous for G. All nongray horses will be gg. For homozygous recessive colors, both alleles are written in the notation for color assignment, since a horse showing a color or pattern produced by recessives is by definition homozygous for the recessive alleles; for example, aa allows black hair to be uniformly distributed over the body.

Because gray is produced by a dominant gene, at least one parent of a gray horse must be gray. If a gray horse does not have a gray parent, then the purported parentage should be considered incorrect and seriously reevaluated.

TABLE 10-2 Action of Horse Coat-Color Genes

GENE	ALLELES[1]	OBSERVED COAT COLOR
W	W w	WW: Lethal. Ww: Horse is typically pigmented in skin, hair, and eyes and appears to be white. ww: Horse is fully pigmented.
G	G g	GG: Horse shows progressive silvering with age to white or flea-bitten but is born any nongray color. Pigment is always present in skin and eyes at all stages of silvering. Gg: Same as GG. gg: Horse does not show progressive silvering with age.
E	E e	EE: Horse has ability to form black pigment in skin and hair. Black pigment in hair may be either in a points pattern or distributed overall. Ee: Same as EE. ee: Horse has black pigment in skin, but hair pigment appears red.
A	A a	AA: If horse has black hair (E), then that black hair is in a points pattern. Gene A has no effect on red (ee) pigment. Aa: Same as AA. aa: If horse has black hair (E), then that black hair is uniformly distributed over body and joints. Gene A has no effect on red (ee) pigment.
C	C Ccr[2]	CC: Horse is fully pigmented. CCcr: Red pigment is diluted to yellow; black pigment is unaffected. CcrCcr: Both red and black pigments are diluted to pale cream. Skin and eye color are also diluted.
D	D d	DD: Horse shows a diluted body color to a pinkish-red, yellow-red, yellow, or mouse-gray color and has dark points including dorsal stripe, shoulder stripe, and leg barring. Dd: Same as DD. dd: Horse has undiluted coat color.
TO	TO to	TOTO: Horse is characterized by white spotting pattern known as tobiano. Legs are usually white. Toto: Same as TOTO. toto: No tobiano pattern is present.

[1] Different forms of the same gene.
[2] In this table, cr codes for a dilution factor.

The E Gene

The first step for defining the coat color of a horse that is neither gray nor white is to decide if the animal has any black pigmented hairs. These hairs may be found in a distinctive pattern on the points (such as legs, mane, and tail), or black hair may be the only hair color (except for white markings) over the entire body. If a horse has black hair in either of these patterns, then the animal has an allele of the E gene, which contains the instructions for placing black pigment in hair. The alternative allele to

E is e. The e allele allows black pigment in the skin but not in the hair. The pigment conditioned by the e allele makes the hair appear red.

If an animal has no black-pigmented hair, it has the genetic formula ee. Basically, an ee animal will be some shade of red ranging from liver chestnut, to dark chestnut, to chestnut, or sorrel. Manes and tails may be lighter (flaxen), darker (not black), or the same color as the body. These pigment variations of red cannot yet be explained by simple genetic schemes. Shades of red are not consistently defined by breeds or regions of the country, so use of specific terms for the shades of red can be confusing.

Since the red animal is not gray and not white, its genetic formula is ww, gg, ee. When two red horses are bred (ww, gg, ee × ww, gg, ee), the offspring should also be red (ww, gg, ee). If the offspring has black pigment (E) or is gray (G) or white (W), the assumed parentage is incorrect.

The A Gene

The gene that controls the distribution pattern of black hair is known as A. The A allele in combination with E will confine the black hair to the points to produce a bay. Various shades of bay, from dark bay or brown through mahogany bay, blood bay, copper bay, and light bay, exist. The genetics of these variations has not been defined. Any bay horse will include A and E in its genetic formula as well as ww and gg.

The alternative a allele does not restrict the distribution of black hair. Thus, in the presence of the E allele of the E gene, a uniformly black horse is produced. In most breeds the a allele is rare, so black horses are infrequently seen. In many black horses, the hair fades in the sun, especially around the muzzle and flanks; such animals may be called brown. The term *brown* can be used for several genetic combinations—various reds, bays and dark bays, as well as some blacks.

Neither A nor a affects either the pigment or its distribution in red (ee) horses. So, an examination of coat color cannot determine which alleles of the A gene a red horse has.

The C Gene

An allele of the C gene, known as C, causes pigment dilution. Fully pigmented horses are CC. Heterozygous horses (CC) have red pigment diluted to yellow, but black pigment is not affected. A bay (E, A) becomes a buckskin by dilution of the red color body to yellow without affecting the black color of the mane and tail. The genetic formula for a buckskin is ww, gg, A, E, CC. A red horse (ee) becomes a palomino (Figure 10–6) by dilution of the red pigment in the body to yellow, with mane and tail further diluted to flaxen. The genetic formula for a palomino is ww, gg, ee, CC.

A genetically black horse (E, aa) can carry the dilution allele without expressing it, because CC affects only red pigment.

In the homozygous condition, C completely dilutes any coat color to a very pale cream with pink skin and blue eyes. Such horses are often called cremello (also perlino or albino). Typically, such horses are the product of the mating of two dilute-colored animals such as palominos or buckskins. Cremello may be difficult to distinguish from white.

The D Gene

The D gene determines a second kind of dilution of coat color. Its effects can be confused with those of C, but several important differences in the effects of D and C on color exist. First, D dilutes both black and red pigment on the body but does

FIGURE 10–6 **A palomino horse.**

not dilute either pigment in the points. Red body color is diluted to a pinkish-red, yellowish-red or yellow; black body color is diluted to a mouse-gray. Second, in addition to pigment dilution, a predominant characteristic of the D allele is the presence of a particular pattern that includes dark points, dorsal stripe, shoulder stripe, and l eg barring. Third, homozygosity for D does not produce extreme dilution to cream, as does C.

This pigment dilution pattern is called dun. In an otherwise red horse, the D allele produces a pinkish-red horse with darkened points known as a red dun or claybank dun (ww, gg, ee, CC, D). In an otherwise bay animal, the D allele produces a yellow or yellow-red animal with black points known as a buckskin dun (ww, gg, E, A, CC, D). An otherwise black animal with the D dilution allele is a mouse-gray color with black points known as a mouse dun or grulla. (ww, gg, E, aa, CC, D).

The effect of D and C can be easily confused in A, E horses, so care must be taken in identification. An animal can have both the C and D dilutions, a situation that may be difficult to distinguish except by breeding tests. D is found in only a few breeds of horse, and probably in the United States would be seen only in stock horse breeds, as well as in some ponies.

The TO Gene

Several different white spotting patterns exist in horses, but so far only that of the tobiano has been clearly shown to be conditioned by a single gene. Tobiano spotting, symbolized by TO, is a variable restricted pattern of white hair with underlying pink skin that can occur with any coat color. The pattern is present at birth and stable throughout life. Generally, white extends across the back in an apparent top-to-bottom distribution on the body. The white areas may merge to form an extensive white pattern of generally smooth outline. The legs are white, but the head is usually dark except for a facial marking pattern. Tobianos can now be screened for their potential to be true breeders for the tobiano pattern.

ASSIGNMENT OF COAT COLOR BY GENETIC FORMULA

Defining the coat color of a horse is a stepwise process. The first step is to determine if either G or W is present. If yes, then the animal is gray or white, and this is the end of the identification task.

If the horse is neither gray nor white, then assignment of alleles of the other genes can be made to define the color. First, one must decide if the horse has E. If E, then it must be decided whether the horse has A. If the animal does not have E, then a decision about A cannot be made. If none of the colors is diluted and if no spotting pattern is present, these decisions about E and A will define the colors bay, black, and red.

If dilution of the basic colors to yellow, light red, mouse gray, or cream is present, then further definition can be made with addition of the C and D alleles to the basic formula containing W, G, E, and A. In the absence of white spotting, these decisions will define the colors palomino, buckskin, cremello, red dun, buckskin dun, and mouse dun.

If a white spotting pattern that meets the definition of tobiano is present, TO can be assigned to the genetic formula.

The outcome of decisions about the genes W, G, E, A, C, D, and TO results in the assignment of alleles for each gene. Each assignment should be carefully reviewed to consider if the chosen alleles are likely to be found in the breed of horse being identified.

Some of the genetic formulas and the color definitions that can be assigned by this process are shown in Table 10–3.

TABLE 10-3 Genetic Formulas and Resulting Coat Colors

GENETIC FORMULAS[1]	COLOR
W	White
G	Gray
E, A, CC, dd, gg, ww, toto	Bay
E, aa, CC, dd, gg, ww, toto	Black
ee, aa, CC, dd, gg, ww, toto	Red
E, A, CCcr, dd, gg, ww, toto	Buckskin
ee, CCcr, dd, gg, ww, toto	Palomino
CcrCcr	Cremello
E, A, CC, D, gg, ww, toto	Buckskin dun
E, aa, CC, D, gg, ww, toto	Mouse dun
ee, CC, D, gg, ww, toto	Red dun
E, A, CC, dd, gg, ww, TO	Bay tobiano
ee, CC, D, gg, ww, TO	Red dun tobiano

[1]Refer to Table 10–2 for a description of the action of each gene.

GENETIC ABNORMALITIES

Defects in DNA can result in the failure to form essential proteins or in the formation of abnormal proteins, which may in turn cause death or disease in the horse. These defects may be caused by abnormalities in a single gene, the cumulative effect of a group of abnormal genes, or some chromosomal abnormality. Table 10–4 lists and describes some of the genetic abnormalities or diseases in horses.

TABLE 10-4 Some Genetic Diseases of Horses Caused by a Single or a Few Genes

GENETIC DISEASE	DESCRIPTION	COMMENTS
Combined immunodeficiency (CID)	Failure of immune system to form; animals die of infections.	Disease of Arabian and part-Arabian horses; transmitted as autosomal recessive; mutation of a single gene.
Hyperkalemic periodic paralysis (HyPP)	Defect in the movement of sodium and potassium in and out of muscle; animals intermittently have attacks of muscle weakness and/or tremors and collapse.	Disease of quarter horses; transmitted as autosomal dominant; involves one gene.
Myotonic dystrophy	Spasms occur in various muscles.	Signs lessen with age in mildly affected animals
Hemophilia A	Failure to produce blood-clotting factor; bleeding into joints, development of hematomas.	Disease of Thoroughbreds, quarter horses, Arabians, and Standardbreds; transmitted as X-linked.
Hereditary multiple exostosis	Bony lumps develop on various bones throughout the body.	Seems to be the result of a single dominant gene.
Parrot mouth	Lower jaw is shorter than upper jaw; incisor teeth improperly aligned.	Not life-threatening and can be managed with proper dental care and feeding management.
Lethal white foal syndrome	Failure to form certain types of nerves in the intestinal tract; foals die of colic several days after birth.	Affects some offspring produced by mating two overo paint horses; several genes involved.
Laryngeal hemiplegia (roaring)	Paralysis of the muscles that move the cartilages in the larynx; causes noise in the throat with exercise.	Seems progressive becoming worse with age.
Cerebellar ataxia	Degeneration of specific cells in the cerebellum of the brain; causes incoordination.	Found almost exclusively in Arabian horses.
Gonadal dysgenesis	Animals tend to be small and weak at birth; show disorders of the reproductive system; mares are sterile.	Presence of a single X chromosome in a female; caused by failure of the X chromosome to separate after duplication.
Hydrocephalus (waterhead or water on the brain)	Accumulation of fluid within compartments of the brain; results in crushing of brain.	Congenitally affected animal born alive often die within 48 hours.

(*continues*)

TABLE 10-4 *(continued)*

Neonatal isoerythrolysis (NI)	Hemolytic disease of the newborn; foal's red blood cells destroyed by antibody in mare's colostrum; results in anemia and sometimes death.	Genetic makeup of animal predisposes to disease; underlying basis is incompatibility in blood type between the mare, the foal, and the foal's sire.
Umbilical hernias	Opening in the body wall at the navel does not close normally; intestines may drop through opening.	Surgical and nonsurgical repair possible.
Inguinal hernias	Openings through which testicles descend allow intestines to escape into the scrotum; may cause colic.	Surgical repair recommended; more common in Standardbreds, Saddlebreds, and Tennessee Walking Horses.
Hereditary equine regional dermal asthenia (connective tissue disease)	Skin is hyperelastic—easily stretched fragile with impaired healing	Due to homozygous recessive mutation; no cure; reduced incidence by managed breeding.
Epitheliogenesis imperfecta	Skin fails to form over parts of the body or in the mouth.	Foals die due to overwhelming infections.
Cataracts	Cloudiness of the lens in the eye; result in blindness.	Surgical removal possible.

MULES

No discussion of genetics and horses would be complete without a mention of the mule. In a way, mules are themselves a genetic abnormality—they have an uneven number of chromosomes. A mule is the offspring of a male donkey (jack) and a female horse (mare). A mule is much like the horse in size and body shape but has the shorter, thicker head, long ears, and the braying voice of the donkey. It also lacks, as does the donkey, the horse's calluses, or "chestnuts," on the hind legs. The reverse cross—between a stallion and a female donkey (called a jennet or jenny)—is a hinny, sometimes also called a jennet. A hinny is similar to the mule in appearance but is smaller and more horselike, with shorter ears and a longer head. It has the stripe or other color patterns of the donkey. Hinnies are more difficult to produce than mules. Although they may display normal sex drives, mules are generally considered infertile. Rarely, a female mule or hinny may come into heat and produce a foal. Horses have 64 chromosomes (32 pairs); donkeys have 62 (31 pairs). Mules and hinnies have 63 chromosomes.

Mules are not the only hybrids of horses. Horses and Grant's zebras (*Equus burchelli*) have been successfully crossed, producing a zorse. These show the coat color and markings of the horse and the zebra. Like mules, zorses are infertile. Horses have 64 chromosomes, and zebras have 66 chromosomes.

First Cloning of Mules

Dr. Gordon Woods, a University of Idaho (Moscow) professor of animal and veterinary science, began working on an equine cloning project in 1998. Eventually the research team working on the project also included Dr. Kenneth L. White, Utah State University professor of animal science, and Dr. Dirk Vanderwall, a University of Idaho assistant professor of animal and veterinary science.

Courtesy University of Idaho, Paul Schofield.

Idaho Gem, the first cloned mule, with his surrogate mother, Syringa.

For three years, from 1998 to 2000, the team worked without apparent success, after transferring the nuclei from the mule cells into 134 horse eggs and implanting them into mares. In 2001, the team began to focus on the calcium levels in the fluid surrounding the eggs during the cloning procedure. The researchers continued to adjust the calcium levels in the fluid surrounding the egg during the cloning procedure, resulting in more success and eventually leading to the birth of the first clone of a hybrid animal and the first cloned equine species. The baby mule, Idaho Gem, was born May 4, 2003, to a surrogate mare, Syringa. The foal's DNA comes from a fetal cell culture first established in 1998 at the University of Idaho, making it a full sibling of a champion racing mule owned by Idaho businessman and mule enthusiast Don Jacklin of Post Falls, Idaho. In 2003 two more healthy mule clones, Utah Pioneer and Idaho Star, were born—one on June 9 and the other July 27.

In 2005, Idaho Gem and Idaho Star were transported to trainers to prepare them for racing in 2006. On June 4, 2006, Idaho Gem finished third in the Winnemucca Mule Race. This was the first showdown between cloned and natural-born mules. After his first six races, Idaho Gem had collected two firsts, two seconds, a third, and a fourth.

Scientists in Cremona, Italy, created the world's first cloned horse in May of 2003. The cloned horse was a Halflinger named Promotea—after Prometheus in Greek mythology who stole fire from the gods and gave it to humans.

Summary

Genes are the basic unit of inheritance. They are composed of DNA and arranged along the length of the chromosomes. Foals receive one-half of their genetic material from the stallion and one-half from the mare. The genetic makeup of a horse is called its genotype. How the genetic information is expressed in terms of the physical appearance of the horse is called the phenotype. Most traits of a horse are controlled by many genes. The genetic makeup of a horse and the environment interact. The sequencing of the horse genome will aid in the study of how genetics and environment interact. Harmful genetic material passed to a foal may produce disease or death.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. The complete set of instructions for making an organism is called its genome.
2. The possible number of distinct assortments of genes in forming gametes is not over 100.
3. Differences in genetic makeup are often referred to as genetic variation.
4. The environment has little effect on the expression of the gene pair(s) controlling a qualitative trait.
5. Alanine is one of the four bases in DNA.
6. Some genes actually dilute the coat color of horses.

Short Answer

7. How many pairs of chromosomes do a horse and mule have?
8. In horses, which sex carries the XY chromosomes and which sex carries the XX chromosomes?
9. What is the difference between a homozygous gene pair and a heterozygous gene pair?
10. List the three types of gene action that qualitative traits show.
11. Name five economically important traits.
12. Every cell contains a duplicate set of genes. What is the alternative form of each gene called?
13. What do the W and G genes express in horse coat color?
14. List five genetic diseases or abnormalities.
15. How is a dominant and recessive allele of a gene indicated when making models?

Critical Thinking/Discussion

16. Briefly describe the structure of DNA.
17. What is a gamete?
18. Explain an animal's genotype.
19. Discuss the genetic control of coat color in horses.
20. Discuss the role of genetics and environment in the expression of economically important traits in the horse.
21. Compare qualitative to quantitative traits.
22. Discuss the role genome sequencing can play to improve horse disease prevention and the management of horses.

STUDENT ACTIVITIES

1. In a report or presentation, use color photographs, videos, or real horses to describe the genetics of the coat color.
2. Obtain prepared microscope slides and view the chromosomes in the nucleus of some animal cells.
3. Draw or make a three-dimensional representation of DNA.
4. Using the Internet and/or other research methods, develop a report or presentation about any work that is being done to map the genome of horses.

5. To understand the randomness of the genetic process, have five people roll a pair of dice 12 times. Make a table that tracks how many times each person rolls two 1s, two 2s, two 3s, two 4s, two 5s, and two 6s. Report your results and compare with others
6. Develop a report on the chromosome numbers of horses, donkeys, and mules. Which chromosome is missing in the mule when compared to the chromosomes of a horse? Why are mules generally sterile?
7. Report on the use of sexed semen in horses.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). Horse industry handbook: A guide to equine care and management. Lexington, KY: Author.

Asimov, I. (1962). *The genetic code.* New York: New American Library.

Asimov, I. (1954). *The chemicals of life.* New York: New American Library.

Bowling, A. T., & Ruvinsky, A. (2000). *The genetics of the horse.* Oxon, UK: CAB International.

Dutson, J. (2005). *Storey's illustrated guide to 96 horse breeds of North America*. North Adams, MA: Storey Publishing.

Frandson, R. D., Wilke, W. L., & Fails, A. D. (2009). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.

Grandin, T. (Ed) (1997) *Genetics and the behavior of domestic animals*. New York: Academic Press.

Kahn, C. M. (Ed.), & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

Knight, L. W. (2009). *The breeding and rearing of jacks, jennets and mules-1902.* Ithaca, NY: Cornell University Library.

McKinnon, A. O., Squires, E. L. Vaala, W. E., & Varner, D. D. (2010). *Equine reproduction.* Ames, IA: Wiley-Blackwell.

Morris, T. & Binns, T. (2010). *Thoroughbred breeding: Pedigree theories and the science of genetics*. London: J. A. Allen.

Smith, D. C. (2009). *The book of mules: Selecting, breeding and caring for equine hybrids*. Guilford, CT: The Lyons Press

Sponenberg, D. P. (2009). *Equine color genetics*. Ames: IA: Wiley-Blackwell.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

chromosomes	heredity	phenotype
dominance	horse coat color	qualitative traits
environment	horse genetics	quantitative traits
genes	horse improvement program	selection
genome sequencing	karyotype	sexed semen
genotype		

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 11

Reproduction and Breeding

Reproduction is the process of getting genetic material from the male to genetic material from the female through the union of sperm and egg cells. To produce offspring with regularity, maximize reproductive efficiency, and protect the future reproductive capabilities of the mare requires a sound, practical understanding of the mare's reproductive process and the development of breeding practices that coincide with her physiology.

OBJECTIVES

After completing this chapter, you should be able to:

- Discuss breeding periods
- List and discuss the major parts of the female reproduction tract
- List and discuss the major parts of the male reproduction tract
- Describe reproductive hormones during the estrous cycle
- Recognize fertility problems
- Explain gestation and parturition in horses
- Discuss and demonstrate methods of artificial insemination and heat detection
- Explain embryo transfer
- Describe the management of the mare and stallion before, during, and after the breeding season
- Describe the management of the mare, including care at parturition, nursing to weaning, and growing to maturity

KEY TERMS

abortion
artificial insemination (AI)
bag up
barren
caslick
colostrum
dystocia
ejaculation
embryo transfer
flushing
foal heat
follicle
gestation
hand mating
heat (estrus)
hippomane
involution
lactation
libido
lochia
maiden
metritis
open
ovulation
parturition
photoperiods
placenta
polyestrous
postpartum
prostaglandins
relaxin
semen
settle
short cycle
silent heat
stillbirth
teased
waxed teats
wet
winking

PHYSIOLOGY OF REPRODUCTION

When it comes to breeding practices and the reproductive process, the mare's reproductive control mechanisms are quite efficient when the animal is left to function in the wild. Manipulation and confinement have reduced the efficiency of reproduction. Several factors contributing to poor reproductive performance include:

- Reproductive anatomy
- Long time period before an embryo can safely implant in the uterus
- Variable hormonal system synchronizing the whole process

Reproductive organs of the stallion and mare, as well as the horse's endocrine system, were introduced in Chapter 5. Figures 11–1 and 11–4 review the reproductive organs of the stallion and mare.

STALLION

The reproductive organs of the stallion consist of two testes, each suspended by a spermatic cord and external cremaster muscle; two epididymides; two deferent ducts; the penis; and the associated muscles. Accessory sex glands are paired vesicular glands, one prostate gland, and paired bulbourethral glands. The outside of the reproductive tract includes the scrotum, prepuce, and penis (Figure 11–1).

The scrotum is an outpouching of the skin, divided into two scrotal sacs by a septum. The two sacs each contain one testis, located on either side of the penis. The testes should descend from the abdominal cavity through the inguinal canal into the scrotum between the last 3 weeks of gestation and the first 2 weeks after birth. If this does not happen before closure of the inguinal ring, the cryptorchid testis (usually the left one) stays in the abdominal cavity.

The testes produce hormones (testosterone) and sperm cells. Sperm cells, or spermatozoa, are the male sex cells. The normal adult stallion has two testes located in the scrotum. Each testicle is suspended from the abdomen by the spermatic cord, which also contains nerves and blood vessels. Blood vessels in the spermatic cord are arranged so that the blood is cooled before it reaches the testes, since heat inhibits sperm production. Also, the muscles in the spermatic cord and scrotum control testicular temperature by positioning the testes close to the body in cold weather and farther away when they are warm. Muscles within the spermatic cord are called the cremaster muscles and muscles within the scrotum are called the tunica dartos muscles. Each testicle is surrounded by a fibrous capsule called the tunica albuginea. Within the lobuli (lobules) of the testes are the seminiferous tubules, which contain the primary germ cells. Through the process of spermatogenesis (sperm production) primary germ cells become spermatozoa.

The epididymis is a long, U-shaped structure attached to the top of each testicle. While in the epididymis, sperm are nourished by the fluid around them, and chemicals prevent them from moving their flagellum while they mature, thus forcing energy conservation.

The vas deferens is the duct which carries mature sperm from the epididymus to the urethra.

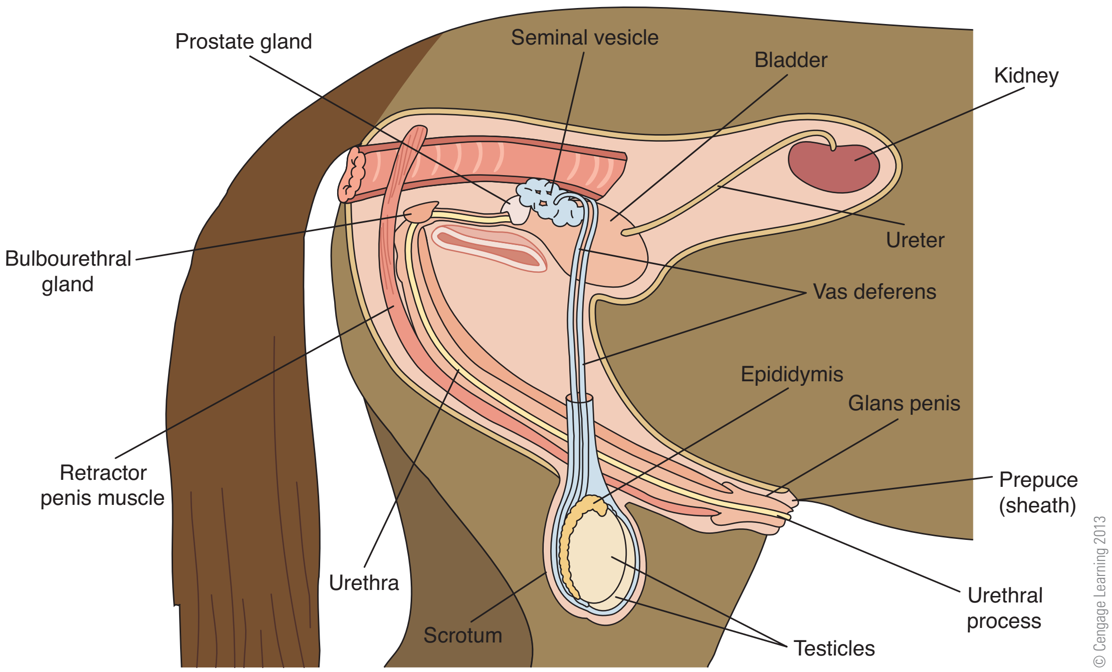


FIGURE 11–1 **Stallion's reproductive organs.**

The accessory sex glands (seminal vesicles, ampulla, bulbourethral glands and prostate gland) secrete seminal fluid into the vas deferens, forming semen. The seminal vesicles, or vesicular glands, secrete a large portion of acidic seminal fluid, which contains high levels of protein and potassium. The ampulla is the enlarged glandular portion of the vas deferens, and secretes a large amount of fluid very similar to that of the seminal vesicles. The prostate gland produces alkaline (basic) fluid that contains proteins, compounds that break up proteins, citric acid, and zinc. Finally, the bulbourethral glands produce a clear fluid that flushes the urethra of urine and bacteria before **ejaculation**.

Mating Process

The process of ejaculation consists of three parts: erection, emission, and ejaculation.

Erection is stimulated by teasing the stallion. During erection, the penis lengthens and stiffens through engorgement with blood. Emission occurs in strong pulsatile contractions.

During emission, **semen**, which contains spermatozoa and fluid from the ampulla plus fluids from the accessory glands, arrive in the pelvic urethra.

During ejaculation, the semen is expelled through the urethra (Figure 11–2).

Reproduction in the stallion is also under hormonal control. The hormones directly involved include releasing hormones (from the hypothalamus), FSH, LH, and testosterone. Actions of these hormones are described in Chapter 5 and Table 5–1.

Sperm Production

Spermatogenesis or sperm production occurs in the testes at the microscopic level through the process of meiosis (Figure 11–3). No spermatozoa production occurs until a stallion is well over a year old, and full reproductive capacity is not reached

FIGURE 11–2 **Mare being bred.**

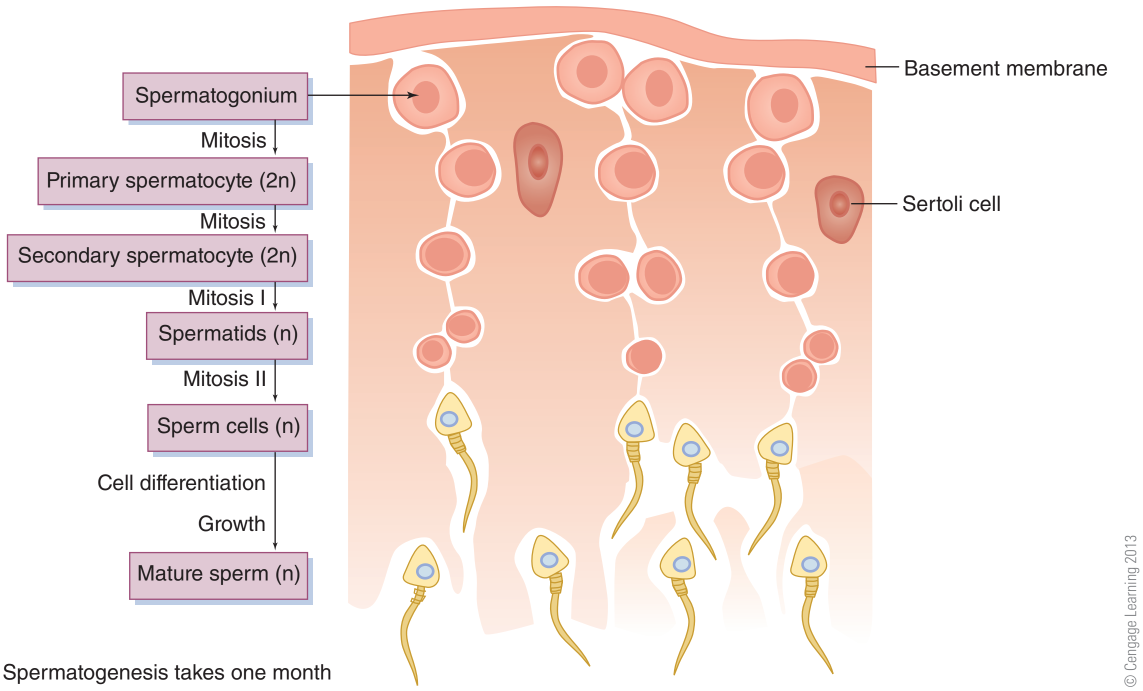


FIGURE 11–3 **Diagrammatic presentation of sperm production in the testes. This occurs at the microscopic level.**

until the age of 4. The stallion's reproductive capacity will then remain constant until he is about 20 years old. The tendency is to overuse a young stallion and underuse an old stallion.

TABLE 11–1 Quantitative Data on Stallion Semen and Spermatozoa

VOLUME PER EJACULATE IN MILLILITERS	SPERM PER CUBIC MILLIMETER	TOTAL SPERM IN EJACULATE
60 to 100	150 to 300 million	5 to 15 billion

Sperm output and sperm production is influenced by:

- Season
- Testicular size
- Age
- Frequency of ejaculation

Although stallions produce spermatozoa throughout the year, they are seasonal breeders. In the Northern Hemisphere, the three best months for testicular size, development, and function are May, June, and July, while from September through February the testes are regressed, especially in November and December. In December and January, the sperm count is 50 percent of that during June and July. Normal semen characteristics are given in Table 11–1.

If the majority of mares have to be bred early in the season, between February and June, an artificial lighting program may be useful. Starting in mid- to late December, the stallion should be exposed to 16 hours of light and to 8 hours of darkness per day; this should be continued until there are 16 hours of natural daylight. However, the stallion has to be normally exposed to the decreasing daylight in the fall to eliminate a photorefractory (not sensitive to light change) condition that would prevent his being sensitive to increasing light. Artificial **photoperiods** do lead to early burnout and a decline in performance at the end of the breeding season.

Mare

The mare's reproductive organs are supported by the broad ligament. The main organs of the female reproductive system are the ovaries, oviducts, and uterus. The ovaries are the gonads of the female animal, and there are two of them in each mare. Two functions of the ovary are the production of eggs (ova) and hormones (estrogen and progesterone). Each ovary is kidney shaped, with a length about of 2 inches and a width of about 1.5 inches.

Developing ovum on the ovary are surrounded by follicles. When the follicle bursts, ovulation occurs. Ovulation refers to the release of the egg by the ovary. Oviducts carry the egg from the ovary to the uterus, and are the sight of fertilization if it is to occur. Each oviduct is 8 to 12 inches long. Sometime the oviducts may also be called the Fallopian tubes.

The uterus, or womb, is where the unborn fetus grows. It may be divided into the uterine body, the right horn, and the left horn. The three layers of the uterine wall are the serous membrane, the myometrium, and the endometrium. The uterus and birth canal (vagina) join at the cervix (Figure 11–4).

The closure of the cervix maintains pregnancy by retaining the embryo and its membranes within the uterus and preventing entry of bacteria. Maintenance of the cervical seal is vital for embryo survival by preventing infection. The closure of the cervix is controlled by hormonal levels and can be unstable. The placenta attaches

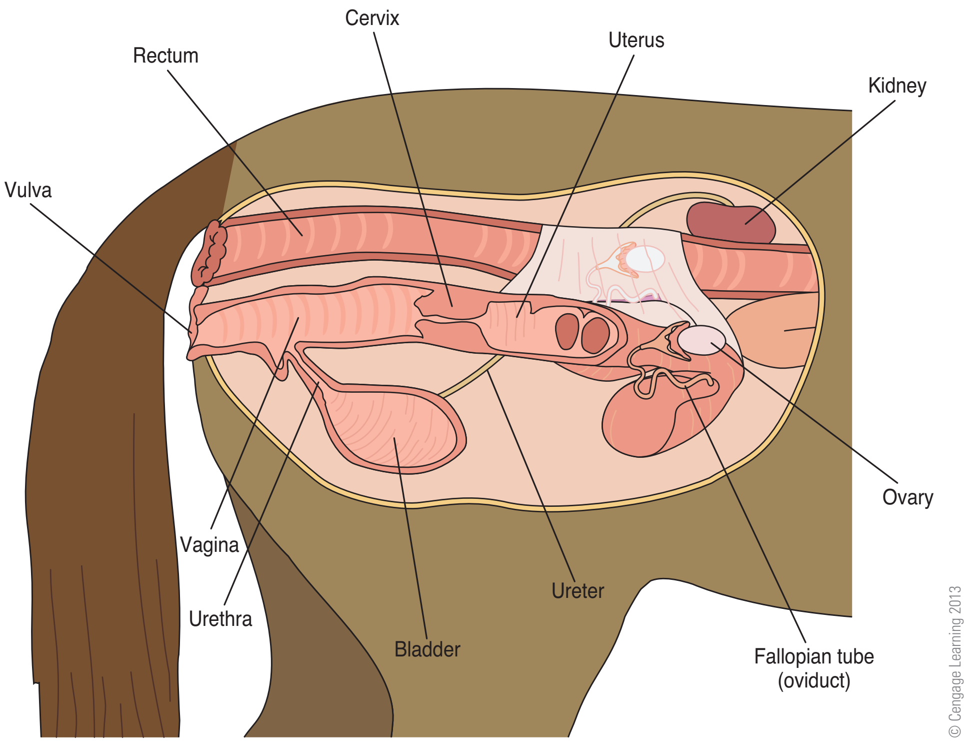


FIGURE 11–4 **Mare's reproductive tract.**

to the endometrial lining of the uterus by innumerable tiny villi that project into the lining, forming a shallow one-cell-thick fusion through which the placenta transfers the embryo's blood, oxygen, and nutritional needs. This type of placenta does not allow immunoglobulins to pass to the fetus. This attachment is responsible for maintaining embryonic life, and early shedding or detachment of the placenta drastically endangers the pregnancy.

Hormones of Reproduction

All reproductive functions in the mare are controlled by hormones produced in the glands of her endocrine system; hormonal balance controls all phases of reproductive tract stimulation and inhibition. When hormonal balance is not achieved, either because of a natural imbalance or a disturbance, a mare will have problems cycling, conceiving, maintaining pregnancy, delivering a foal, and providing an adequate milk supply. Table 5–1 describes the actions of the hormones involved in reproduction.

Hormonal Cycles

The mare has a strong **follicle**-stimulating phase of her estrous cycle when the ovary produces estrogen, which causes her to come into **heat (estrus)** and ovulate. The luteal phase occurs after she ovulates and is responsible for production of the corpus luteum and its production of progesterone.

If conception does not take place, **prostaglandins** are released that destroy the corpus luteum, reduce progesterone, and allow the mare to cycle again. If there is conception, no prostaglandins are released, and the corpus luteum remains dominant. The high level of progesterone during the luteal phase maintains pregnancy by keeping follicle-stimulating hormone (FSH) and estrogen in check, thereby preventing the mare from coming back into estrus and disrupting the newly established pregnancy. Progesterone also relaxes the uterus to allow the embryo to implant and the new pregnancy to be established.

The mare is a seasonally **polyestrous** species, which means that she comes into estrus several times a year but does not cycle all year round. In the Northern Hemisphere, the mare begins cycling somewhat irregularly in January and February as the days get longer. She continues having more regular cycles until her breeding season peaks in June. In September or October, as the days shorten, the mare ceases to cycle regularly. By late November she stops cycling altogether and remains inactive through winter. The times of the year with irregular and subfertile cycles in February and March, and in September and October, are called breeding transition months.

The current tendency of some breeders to mate mares earlier and earlier in hopes of producing foals earlier in the year is a reproductive problem for the mare. While this practice is perhaps economically advantageous when a larger and more developed foal is presented in the sale or show ring, it is incongruent with the mare's natural timing. The result is that reproductive efficiency is sacrificed for the chance to attain greater weanling and yearling sizes. An arbitrary January 1 birth date entices breeders to try to breed their mares before they are ready to accept and maintain a pregnancy or even to conceive.

When mares begin cycling in the spring, their estrus (heat) lasts 6 to 8 days. The length of estrus progressively shortens until it is only 3 to 4 days in most mares at the peak of the season in May or June. These durations are only guidelines. Variation is more the rule.

During estrus, or heat, follicles develop in the ovaries. The follicles produce the hormone estrogen, which causes the signs of sexual receptivity. Although several follicles develop simultaneously, usually only one follicle will emerge as dominant. **Ovulation**, the time when a primary follicle is ready to shed an egg mature enough for fertilization from the ovary, occurs late in the estrous, no more than 2 days before the mare goes out of heat (Figure 11-5). The exact time of ovulation varies for individual mares. In fact, early in the season, a mare may exhibit signs of estrus and not ovulate at all, just as some mares may ovulate on schedule but not show outward signs of estrus (heat). The incidence of ovulation within the estrous period increases as daylight increases, peaking in late June.

After ovulation, the now eggless cavity in the follicle fills up with a blood clot and is now called the corpus hemorrhagicum. This becomes the corpus luteum that produces the hormone progesterone, which corresponds with the diestrus (no sexual activity).

During estrus, the cervix relaxes and is soft and rose pink. Secretions in the vagina during estrus (heat) are clear and slimy, and the vagina is red and vascular. In diestrus, the cervix protrudes into the vagina; it is pale pink and tightly constricted; and secretions are scant, viscous, and sticky.

At the time of ovulation, the follicle in large mares may be as large as 65mm in diameter (ranging from 35 to 65mm). By day 20, the follicle may be detected by rectal palpation and by ultrasound. Ultrasound can estimate follicular size and can also differentiate between a young corpus luteum and a soft follicle, even though these structures feel similar during rectal palpation.

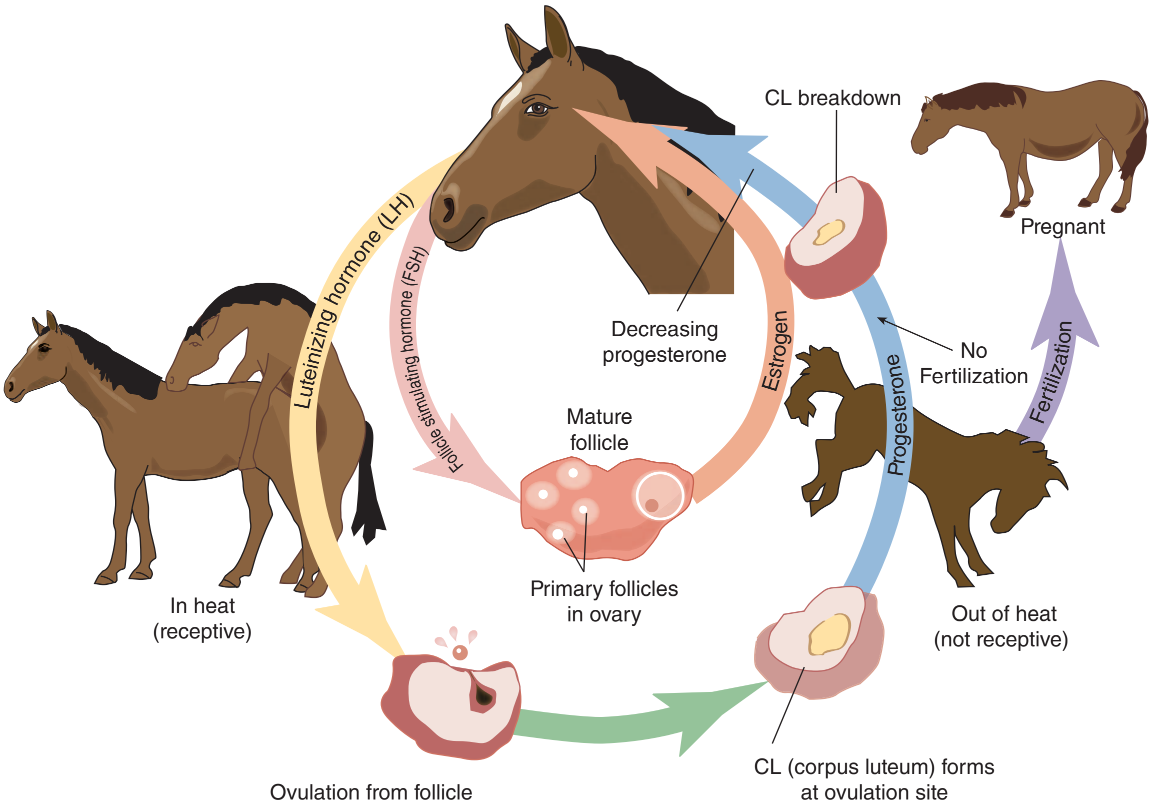


FIGURE 11–5 **Estrous cycle in the mare.**

Usually only one follicle will ovulate. Occasionally two follicles will ovulate at the end of the estrous phase. This is undesirable because twin fetuses have a high risk of **abortion** and cause complications such as **dystocia** (long or difficult labor) and retained placenta.

If the fetus is aborted before day 45, the mare continues to show signs of being pregnant, due to special tissue secreting the hormone that maintains pregnancy, until day 120. Therefore, another ultrasound should be performed after day 45 (Table 11–2).

TABLE 11–2 Breeding Characteristics of Mares

Range in age when heat period begins	15 to 24 months
Recommended minimum age to breed	24 to 36 months
Duration of estrus (heat)	3 to 7 days
Best time to breed	Every other day beginning second day of heat
If not bred, estrus recurs in	10 to 35 days

Breeding Habits

Estrous cycles will start in a mare at puberty, which is usually between the age of 15 to 24 months, but can be as early as 1 year of age and as late as 4 years of age. The mare usually goes into winter anestrus between November and February or March. The mare has a normal estrous cycle of 21 to 22 days. The first 5 to 7 days, when the mare displays behavioral signs of sexual receptivity to the stallion, are called the estrous. When **teased** with a stallion, the mare will raise her tail and urinate, and the labia will open to expose the clitoris (homologous to the male penis) while she assumes a mating position. Exposing the clitoris is called "winking."

During the second, or luteal phase, the behavioral pattern is that of sexual rejection of the stallion. This is called diestrus and lasts 14 to 15 days. During diestrus, the mare will switch her tail, pin her ears back, kick, and move away from the stallion when she is teased.

Fertilization

The ovum leaves the ovary and enters the oviduct, where fertilization will take place. The ovum is viable for 8 to 12 hours, while the spermatozoa coming up the oviduct can live for 24 to 48 hours (sometimes for several days) inside the mare's reproductive tract. The time involved for the spermatozoa to travel through the oviduct and reach the ovum is 4 to 6 hours. Based on these time constraints, breeding is recommended within 1 or 2 days before ovulation. After the egg is fertilized, it travels down the oviduct and enters the uterus in 5 to 6 days. Once in the uterine horn, the embryo is very mobile; it bounces around and may move from one uterine horn to the other. By day 16 to 18, the embryo settles in one part of the uterus, where it implants.

From ovulation to **parturition**, the average length of **gestation** is 335 days, plus or minus 2 to 4 weeks. This depends on the season, nutritional status of the mare, and sex of the fetus.

Sterility

Abortion is the premature termination of pregnancy before 300 days of gestation, while termination after that time (when a foal may be born alive) is considered **stillbirth**. Abortion can be caused by both bacteria and viruses. If a mare aborts, a veterinarian should be consulted.

Checking the Mare for Breeding

Considerations for breeding include:

- Appearance
- Pedigree
- Hereditary disorders
- Disposition
- Conformation
- Performance

Factors that relate to the mare's reproductive potential are:

- Age
- Breed
- Status
- Past breeding records
- Previous athletic use
- General health
- Nutrition

Age

From puberty to old age, a mare can conceive and carry a foal to term. The 2- to 3-year-old may have some abnormal cycling patterns. After multiple foals, mares may have anatomical changes in the vulva and vagina, predisposing for pneumovagina (air in the vagina) and urine pooling.

Breed

Breed organizations differ in policy on natural versus artificial insemination, semen transport, and preservation of semen, as well as on embryo transfer. Miniature breeds and the very large draft breeds show a greater tendency to reproductive failure.

Status

A **maiden** mare is one that has never been bred. A **barren** or **open** mare is one that was either not bred the previous season or did not conceive in the previous season. Unless she was not bred, this implies failure of conception or failure to maintain pregnancy. A **wet** mare has foaled during the current breeding season and is nursing the foal.

Past Breeding Records

Previous foaling data, such as gestation length, any complications, cycling patterns from previous years, previous reproductive surgery, previous uterine infection and treatment, as well as evidence of early embryonic death in previous seasons are all helpful information in reproductive evaluation.

Previous Athletic Use or Performance

After an athletic career, reproductive performance may be compromised because of injuries, diseases, or treatment with anabolic steroids.

General Health

Previous medical events such as chronic obstructive pulmonary disease (heaves) leading to coughing and difficulty breathing, cardiac disease, or pain from laminitis or tendinitis will all influence reproductive potential.

Nutrition

Mares in poor condition may not cycle or breed. Improving the nutrition of a mare before breeding can increase the chances of a successful mating. More information on this topic can be found in Chapter 13.

Pregnancy Diagnosis

Ultrasound has been used for pregnancy diagnosis since the early 1980s and is used in addition to rectal palpation. Ultrasound may also provide diagnosis of conditions that cannot be felt by rectal palpation.

The ultrasound probe is inserted into the rectum and moved across the reproductive tract. Ultrasonography is useful in studying the normal reproductive cycle, diagnosing diseases of the ovaries and uterus, early detection of pregnancy, diagnosing twins, diagnosing embryonic death, and determining length of gestation.

No Absolutes in a Biological System

As a rule, most mares are seasonally polyestrous. This means that during a specific season of the year, mares experience several reproductive cycles. In the Northern Hemisphere, as the days get longer, mares show behavioral estrus or heat beginning in February and extending through July. The same trends occur in mares in the Southern Hemisphere for the corresponding seasons. Mares kept on grass normally go into anestrus—no cycles—in the winter. Near the equator, where the amount of daylight remains fairly constant, the length of the estrous cycle shows little variation.

But as a whole population, mares can be classified into three major categories:

- **Defined breeding season.** Wild horses breed during the time of year that corresponds to the longest days of the year. So, the foals are born during the spring of the year when feed is apt to be the best.
- **Transitory breeding season.** Some domestic breeds and some individual mares show estrous cycles throughout the year. These mares breed, but matings in the winter months are not fertile since ovulation does not occur during the cycle. Actual ovulation occurs with estrus (heat) only during a breeding season defined by the increasing amount of light. Again foals are born during a limited foaling season.
- **Year-round breeding.** Some domestic breeds and some individual mares have estrous cycles accompanied by ovulation all year. Foals are born any time of year.

Of all the domestic animals, the reproductive cycle of the mare shows the greatest variation—there are no absolutes in biology.

In nonpregnant mares, ultrasound study of the ovaries can distinguish between follicles, corpus hemorrhagica, corpus lutea, ovarian cysts, and tumors. In the uterus, cysts or an infection can be diagnosed.

With ultrasonography, the diagnosis of pregnancy is possible as early as day 10 to 15 of gestation. The fetal heartbeat can be detected as early as day 22 of gestation, and should be routinely looked for from day 25 on. Between day 60 and 70, it is possible to determine the sex of the foal.

The persistent absence of estrus in response to teasing is a fairly reliable indicator of pregnancy, especially two to three weeks after breeding when the mare would be expected to return to estrus if she were not pregnant.

CARE AND MANAGEMENT OF THE STALLION

Yearlings should not be depended on for breeding. Two-year-olds may **settle** 10 mares; 3-year-olds, 30; and mature stallions, 50 mares when hand mated. About half of this number can be pasture mated. A short breeding season will reduce the number, and sexual individuality of the stallion will greatly affect his siring ability.

The breeding stallion should be fed like a horse at hard work. An estimate is 1½ pounds of grain and 1 pound of hay per 100 pounds body weight. If he is worked under saddle, more feed will be required. Because of diverted interests, a ration high in palatability may be necessary for some stallions to get adequate intake. Grazing of good grass, even for short periods of time, is recommended.

Regular exercise usually results in increased sexual vigor (**libido**) and fertility.

For safety, fences should be strong and tall when stallions are grazed loose; and mares should not be in adjoining pastures unless extremely tall fences are used.

Methods of Mating

Two methods of mating are used when breeding horses: pasture mating and **hand mating**.

Pasture mating reduces labor, affords convenience to the owner, "catches" shy breeding mares, and creates an opportunity for a high settling percentage. It has the disadvantage of reducing the number of mares a stallion can serve, and it obscures breeding dates. Some risk to the stallion exists.

Stallions should be hand mated a few times as 2-year-olds, then turned loose in a large pasture with a few older mares when they are to be used in a pasture breeding program. Even so, stallions are likely to carry some scars from their experience. For this reason, pasture mating is seldom used with breeds whose owners discriminate against blemishes. It is extensively practiced with stock horses in the range country.

A combination of hand mating followed by pasture mating will extend the number of mares bred and increase settling percentage (Table 11–3).

Hand mating is practiced under a wide variety of conditions, ranging from rather casual selection of mares and sanitation conditions to operations that are highly supervised with a veterinarian in attendance.

Stallions used with hand mating should be adept at teasing mares. This may be done at a teasing pole or over a stall door or any other sturdy fixture that does not injure the horses or attendants. A teasing stall and breeding stall are shown in Figures 11–6 and 11–7.

TABLE 11–3 Mating Capacity of Sires

	NUMBER OF FEMALES TO MATE IN A BREEDING SEASON	
AGE OF SIRE	HAND MATING	PASTURE MATING
2-year-old stallion	10	5
3-year-old stallion	30	15
4-year-old stallion	35 to 40	20
5-year-old stallion	40 to 75	20 to 25

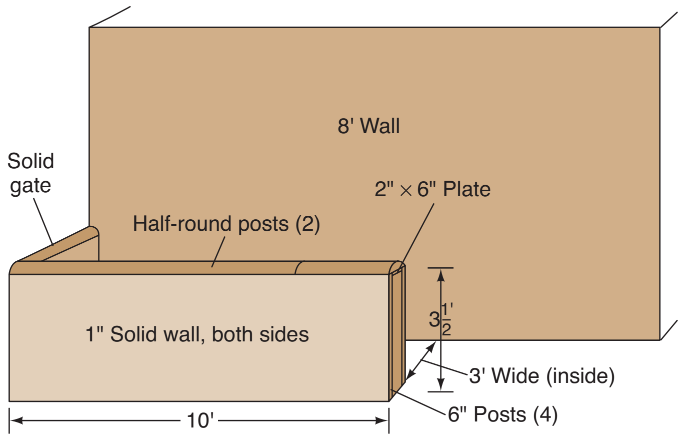


FIGURE 11–6 **Teasing stall.**

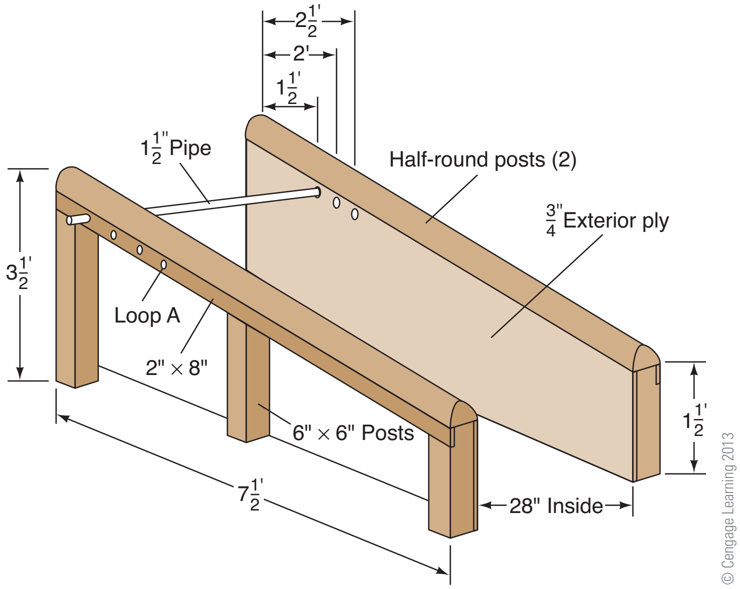


FIGURE 11–7 **Breeding stall.**

CARE OF THE PREGNANT MARE

For the pregnant mare, aside from nutritional requirements, attention should be paid to regular dental and hoof care. Broodmares usually do not need shoes, but if they are shod, the shoes should be removed a few weeks before foaling to protect the foal at birth. A good exercise program is recommended.

Parasite control to protect both mare and foal can be effected by deworming and helped along with general measures, such as sanitation and cleanliness. More details on parasite control are given in Chapter 15.

A vaccination program should include vaccinations against rhinopneumonitis (3rd, 5th, 7th, and 9th months of pregnancy), tetanus, equine encephalomyelitis, and influenza 4 weeks prior to foaling. In endemic areas, and under guidance from a veterinarian, additional vaccinations may be given for strangles, rabies, anthrax, and Potomac horse fever. In general, deworming and vaccination programs should be administered under the guidance of a veterinarian.

Since the placenta does not allow transfer of maternal antibodies to the fetus, the foal has to obtain antibodies against infection from the **colostrum**. The foal's intestine will absorb the antibodies only during the first 24 hours after birth, with the greatest absorption during the first few hours. If the mare loses colostrum in the last weeks of pregnancy when she starts to "**bag up**," this colostrum should be collected and saved for the foal.

Care at Foaling Time

Proper preparation of the mare for foaling is necessary if an owner is to realize the results of the time, effort, and money invested. The owner must prepare the mare, the environment, and her handlers for foaling.

During the final two months of pregnancy—the 10th and 11th months of gestation—the mare's abdomen takes on the pendulous, enlarged characteristics of pregnancy. Mares that have had several foals tend to take on this appearance sooner. The mare develops a wider stride to compensate for the increased weight she is carrying, and her ribs may appear more "sprung." This is also when the mammary glands begin to develop.

The pituitary hormone, prolactin, stimulates the udder to produce milk. If no mammary gland development is noted prior to foaling, the owner should be suspicious of hormonal inadequacies. This is a common occurrence if the mare is consuming fescue grass. An endophyte in some contaminated fescue seed heads blocks the action of prolactin. Normally, however, the udder slowly enlarges over the final 2 months of pregnancy. It becomes turgid and the teats fill out. Any leakage from the teats prior to foaling should be collected to avoid any loss of the antibody-rich colostrum.

The mare's tail head, croup, and perineal area (between rectum and genitals) become relaxed several days prior to parturition. This is due to the hormone **relaxin**, which loosens the ligaments of the pelvis. The amount of relaxation varies with the age of the mare and the number of previous pregnancies. Relaxation can be very slight and difficult to observe in a maiden mare, and quite pronounced, even to the novice owner, in an older mare.

Signs of Impending Parturition

The following checklist will help owners identify many of the signs present prior to foaling:

- Large, pendulous abdomen, or sudden change in position of the foal. Change in gait; occurs 1 to 2 months before giving birth.
- Udder enlargement. Change in its shape, texture, or temperature. A change in milk color from clear, or amber, to cloudy, or chalky white, means that delivery is very near. Calcium concentration in the mammary secretion increases immediately prior to foaling. If the milk calcium concentration is measured, by either the owner or a veterinarian, it can be used to predict the foal's arrival time.
- **Waxed teats**. Drops of sticky, clear, or amber-colored fluid excreted prior to parturition become dried and hard, coating the ends of the teats, giving them a waxy appearance; occurs 2 weeks to just hours before foaling.
- Relaxation of the tail head, croup, and perineal (around the urinary, genital, and anal) area; occurs 1 month to 2 weeks before foaling.
- Enlarged abdominal milk veins; occurs 2 months to 2 weeks before foaling.
- Loss of appetite. Does not occur in all mares, but if present, depressed appetite usually occurs during the last month of gestation.
- Change in personality. May separate from the herd if pastured with other mares. May push hindquarters up against a wall. Usually, if present, this behavior will change in the last 4 to 2 weeks before foaling.

Mares vary widely in the degree and length of time they exhibit these signs. The best predictor of foaling time is knowledge of the mare's gestation length and behavior during previous pregnancies.

Equipment Helpful for Foaling

Before foaling, the owner or manager should assemble the following equipment or supplies that will be needed during and/or after foaling:

- Four to five ounces of an iodine solution in a sterile jar
- Tail bandages or 3-inch gauze bandages
- Roll of sterile cotton
- Package of gauze squares (3 or 4 inches square)
- Adhesive tape (1 inch wide)
- One pint povidone-iodine compound
- Six to eight clean towels
- Enema tube, soap, and lubricant
- Seamless pail
- Large animal thermometer

Labor and Parturition

The mare's labor is intense and rapid. Usually it is over within an hour. Because of this rate, an owner does not have time to develop a wait-and-see attitude. Because all of the foal's oxygen is obtained through the umbilical cord blood supply, a prolonged delivery can quickly endanger the foal. If the mare or the foal appears to be having difficulties, help must be summoned at once. Labor is commonly divided into three stages.

Stage 1

The uterus begins to contract, the foal moves into position to be born, and the cervix relaxes in stage 1. Stage 1 usually is imperceptible and can go unnoticed, even by the watchful observer. Signs of late stage 1 labor, which may be observed in some mares, include restlessness, tail switching, pacing, and sweating over the neck, chest, and flanks. Because some of the symptoms are similar, stage 1 may be confused with colic. The mare may urinate and defecate frequently and carry her tail in an elevated position. The mare's respiration and heart rate may be increased, and her body temperature may be decreased. Stage 1 may be as short as several minutes or last longer than 24 hours. Recognizing this stage is important in order to prepare for the upcoming period of intense labor.

To prepare a mare in stage 1 labor for foaling, thoroughly clean the mare's perineal area with a povidone-iodine solution, and bandage the tail out of the way. Clean and disinfect the foaling stall. If the mare has a **caslick** in place (a suture closing her vulva to prevent infection), remove it now. After completing the preparations, observe discreetly from a distance. Horses do not like to give birth in noisy surroundings, and the mare can shut down the foaling process if she does not feel completely safe.

Stage 1 ends when the allantois, or fetal membranes, are pushed through the cervix by the advancing fetus and rupture, releasing amniotic fluid (breaking water).

Stage 2

This is the time of intense labor contractions that push the foal through the birth canal. Stage 2 usually lasts no more than 30 minutes. Little can be done to slow the labor or

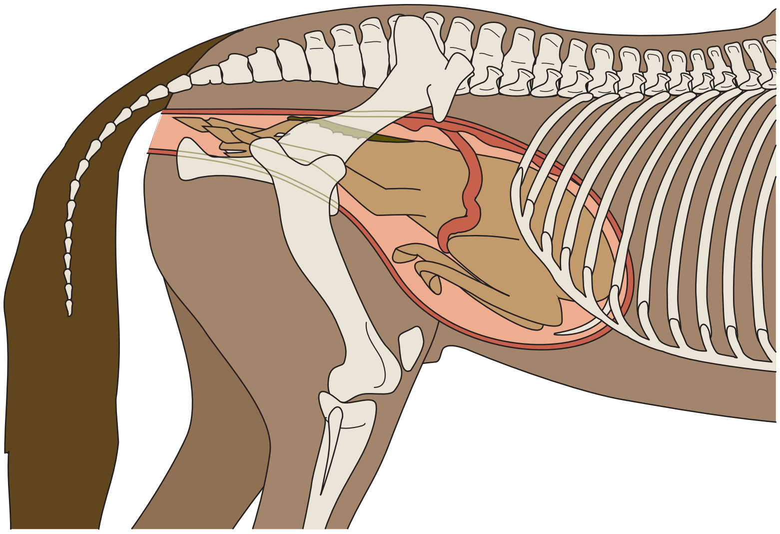


FIGURE 11–8 **Normal presentation of a foal.**

a white, filmy membrane known as the amniotic membrane. The **placenta**, a thicker pink membrane, is attached to the uterine wall and should not be visible at this time.

The foal normally is lying on its stomach, positioned upright in the birth canal with its forefeet slightly displaced, one before the other, and with the muzzle resting on top of the knees. The bottom of the feet should be facing toward the mare's hocks; the curving of the foal toward the hocks helps move the shoulders and hip through the mare's pelvis (Figure 11–8).

The mare usually lies down as stage 2 commences. If the mare is startled, she may jump up and give birth standing. This results in quite a fall for the foal and premature rupture of the umbilical cord.

The foal's feet should appear within 15 minutes of the appearance of fetal fluid and membranes. If both feet are not visible, the attendant should insert a gentle hand into the vulva to find the missing foot and guide it gently to the proper spot. This may prevent a sharp hoof from tearing the vaginal roof and perineal area.

Once the shoulders, the widest portion of the foal's body, are born, the rest of the foal usually follows shortly. Occasionally the hips may lock in the mare's pelvis; gentle, downward tension on the foal's front legs will help. This assistance should be very quiet and calm and timed with the mare's contractions.

If the mare has been pushing for 45 minutes and no sign of a foal is seen, intervention is needed quickly if the foal is to survive. Should the mare require assistance, the attendant must first make sure that the foal's front legs and head are properly positioned. If they are, traction may be used to gently pull the front legs.

Stage 2 is complete when the foal has been born.

Dystocia. Many situations cause dystocia, or difficult birth, in the mare. A mare may become exhausted in the middle of labor and be unable to push the foal out, especially if she is older or in a debilitated condition. A foal will not fit through the birth canal unless it is in the proper position. Any deviation from the front-legs-first, head-facing-down-between-the-knees posture may result in dystocia. The presence of twins is a possibility when labor becomes extended. Usually, however, a leg or the head becomes turned back or tucked in such a way to be pointing against the direction of the foal's movement. The entire foal may also be completely backward, or breech, with

Signs of dystocia require immediate veterinary attention. Until the veterinarian arrives, the attendant may try to place the foal in the correct position by turning, locating, and extricating lodged limbs. If repositioning is attempted, care must be taken to ensure that the attendant's arm is sterile and well-lubricated. Inserting a length of rubber tubing into the mare's trachea and walking may prevent her from bearing down too hard on the foal or your arm. Whether the foal has been born or not, the placenta detaches from the uterine wall within an hour of the start of stage 2. If the placenta detaches before the foal is born, the foal will lose its oxygen supply and die. Time is critical.

Foal. The newborn foal may have a blue tongue and bluish-white nasal mucus. As soon as it is born, the fetal membranes should be cleared away from the foal's head so that breathing can start. The umbilical cord should be allowed to break on its own. Once this has happened, the foal's navel should be immediately treated with an iodine solution to prevent entrance of pathogens through the opening. In some instances, the navel will bleed after the umbilical cord has broken. The cord should be tied shut with a length of sterile umbilical tape, gauze, or string (Figure 11–9a through d).

FIGURE 11–9A A foal birth—the presentation of the front hooves.

FIGURE 11–9B A foal birth—the amniotic membrane still encasing the foal.

FIGURE 11–9C The completed foal birth.

FIGURE 11–9D The mare and foal bonding with each other.

Stage 3

Stage 3 is complete when the placenta and fetal membranes are expelled. Prior to being passed, the placenta hangs from the vulva. It should be tied up so that the mare does not tear it or become afraid of it. The membranes usually are passed 5 to 45 minutes after the foal's birth. If they have not been passed in 2 hours, the membranes are considered retained, and a veterinarian should be called (see Figure 11–10).

The placenta must be naturally released from the uterus. Pulling may tear the placenta and leave small pieces in the uterus. These small pieces of placenta in the uterus can cause **metritis**, an inflammation of the uterus. Metritis is an infection that


Courtesy of Rick Parker

FIGURE 11–10 **Stage 3 of parturition, placenta and fetal membranes being expelled.**

may result in laminitis or death. A mare with this condition may appear normal 48 hours after birth and then develop symptoms. Once serious symptoms develop, it may be too late to prevent permanent damage.

The placenta should be inspected after it has been passed to ensure it is complete and there are no tears or pieces missing. It is normal for a soft, dark-brown body of tissue called the **hippomane** to be floating among the membranes.

Immediately Postpartum

After the membranes have been properly expelled, the mare's uterus will undergo **involution**, during which the uterus returns to its nonpregnant size. Without infection or trauma, the uterus will involute within 10 days. However, if a uterine infection is present, the process is delayed. Older mares who have had many foals involute more slowly than younger mares. Involution may cause abdominal pain and some colic-like symptoms. Some mares become extremely agitated, and the attendant should watch carefully to make sure the mare does not endanger the foal by rolling or getting up and down frequently.

The first 24 hours are most critical for both the mare and the foal (Figure 11–11). For this reason, they should be kept in a clean, quiet environment where they can be observed frequently. Many horse owners leave the pair stalled for the first day. After that, weather conditions and temperature should dictate whether the mare and foal are turned out or housed indoors. Damp or wet environments should be avoided the first few weeks. Some mares and foals will actually fare better, and some foals show slightly greater resistance to adverse environmental conditions if they are kept outdoors.

Courtesy of Rick Parker

FIGURE 11–11 **A newborn foal and mare kept in a clean, quiet environment.**

Postpartum Mare Care

A mare needs special attention during the first week after delivery. The perineal region will be bruised and sore. Defecation may be painful. Bran, beet pulp, more salt, or other laxative-type feeds may loosen the stool and make defecation less painful. Because decreased appetite and water intake will result in decreased milk production, every effort should be made to keep the mare comfortable. The mare should have free-choice access to water and mineralized salt. During the first 3 months of **lactation**, the mare's energy requirements are double normal maintenance levels, and she needs larger amounts of concentrates and high-quality hay.

A broodmare's stall is normally very dirty because she is eating and drinking larger amount of feeds. Because the foal is very susceptible to disease at this time, every effort should be made to keep the stall as fresh and clean as possible. This problem is easily prevented by housing outdoors.

Normal and Abnormal Postpartum Occurrences

The mare's uterus continues to involute through the first 2 weeks after delivery. During this time a dark-brown fluid may be seen on the vulva. This odorless discharge, called **lochia**, is normal. However, a foul-smelling discharge signals a uterine infection and requires medical attention. About the seventh or eighth day **postpartum**, the mare's reproductive tract needs to be examined by a veterinarian if she is to be rebred.

Colic is relatively common during the first week postpartum. A more serious condition occurring immediately postpartum is internal bleeding caused by rupture of the middle uterine artery. This condition, occasionally seen in mares over 15 years of age, is usually fatal. Symptoms associated with a middle uterine artery rupture are colic, pawing, anxiousness, and profuse sweating. The gums may also look pale or white. A veterinarian should be called at once if this condition is suspected. Often a mare with a middle uterine artery rupture is unaware of her surroundings and of her foal. To prevent injury, remove the foal from the stall.

Rebreeding

At 6 to 12 days postpartum, most mares will come into heat. This first estrus, called **foal heat** is part of the uterine involution process. Unless uterine involution is practically complete, conception is unlikely in a mare bred during foal heat.

Any uterine or vaginal bruising, damage, or swelling slows down the involution process, and the uterus will be unable to support embryo life. The conception rate for mares bred during their foal heat is only 40 percent. These mares run a greater chance of developing uterine infections and scarring since the uterus is most susceptible to infection during the first 30 days after foaling. Semen is not sterile; thus, every time a mare is bred, bacteria are introduced into her uterus. Excessive or improperly timed breeding attempts increase the chances of uterine infections.

The fertile egg is released from a follicle on the ovary during the mare's estrus. This usually occurs on about the seventh and again on the thirtieth day after delivery. A mare usually goes out of estrus within 1 day after ovulation, although there is variation between mares. Some remain in standing estrus for longer periods after ovulation, and some ovulate without showing any external signs of estrus. These mares are said to go through a **silent heat**. A common cause of silent heat in mares who have just foaled is their concern for their foals. Their maternal instinct is stronger than the instinct to display estrous. If the mare is allowed to see her foal at all times while she is being teased, she may relax and show some evidence of estrus. Older mares who have had many foals may not be completely involuted and ready to conceive, even on the second heat after foaling.

Prolactin, the hormone that stimulates milk production (lactation), may inhibit estrogen and the hormones necessary for ovarian activity. In some mares, no ovulation takes place during lactation. Lactational inhibition of ovarian activity (the estrous cycle) is more common if the mare is on a substandard diet and in a negative energy balance. If this is the case, the mare's plane of nutrition needs to be improved, the foal weaned early, or hormonal treatments used under a veterinarian's supervision.

Transporting the Mare and Foal

Many consider the second heat cycle after delivery to be the most desirable time to breed. If the mare is to be transported to the stallion, she should arrive well before the onset of her second heat. Arriving at the breeding farm 18 days postpartum should leave sufficient time for the mare to adapt to her new surroundings before estrous begins. Loading and unloading should become routine for the mare before the foal arrives. Many less-experienced owners prefer to have the mare foal at the breeding farm if the distance from home is great.

Body Condition of the Mare

A mare's body condition affects her reproductive efficiency and ability to reproduce. She should have an ideal body condition score of 5 (see Table 14–1) before her second heat occurs.

Condition score is a method of quantifying the amount of subcutaneous fat cover. If a mare is not in acceptable condition, her diet must be changed to move her in the direction of a 5 score. Thin mares must gain weight because poor nutrition causes mares not to cycle normally. A score of 4 is termed moderately thin and is characterized by a negative crease down the back, with the vertebrae slightly protruding. A faint outline of the ribs is discernible, some fat can be felt about the tailhead, and neither the withers, shoulders, or neck are obviously thin.

A mare in ideal 5, or moderate condition score, would have a level back with ribs that cannot be visually distinguished but can be easily felt. The fat around the tailhead is beginning to feel spongy, and the withers appear rounded over the backbone. The shoulders and neck blend smoothly into the body.

Condition score 6 is moderate to fleshy. A horse with a score of 6 has a slight crease down the back and spongy fat over the ribs. Fat around the tailhead feels soft, and deposits of fat form along the sides of the withers as well as behind the shoulders and along the sides of the neck.

ARTIFICIAL INSEMINATION

Artificial insemination (AI) is the process of collecting semen from a stallion and depositing that semen into the mare, without conventional breeding. Advantages are the decreased risk of injury and infection. Also, because the semen can be evaluated and divided in samples, many more mares can be bred to the same stallion.

Some horse breed registries, such as the Jockey Club, do not permit AI. Others, such as those for quarter horses and Standardbreds, will allow AI, but only with fresh semen collected on the premises of the mare. They will not allow transportation or freezing of the sperm. Before deciding on AI, an owner should contact the breed registry.

Once collected, the semen should be immediately poured into a warmed graduated cylinder to be measured. To evaluate the percentage of progressively motile spermatozoa, an extender should be added to the raw semen before it is examined under the microscope. A sperm is called progressively motile only if it moves rapidly across the microscopic field.

When spermatozoa are to be stored or shipped, they have to be cooled. However, this cooling process stresses the cells and can injure them. To preserve the spermatozoa, they should be mixed with an extender, cooled slowly, and preferably kept at a low temperature for less than 36 hours.

Frozen sperm has both advantages and disadvantages. Although some breed registries impose restrictions on this practice, shipping liquid nitrogen containers anywhere in the world is cheaper than shipping a mare. A stallion's breeding season can continue while he is at shows, and his semen can be preserved many years after his death. The disadvantages are lower pregnancy rates and possible inbreeding.

The practice of artificial insemination requires identification of the stallion with photographs, blood type, and possibly DNA fingerprinting to avoid errors in identity and pedigrees. Horse owners should contact the breed registry for regulations.

Videos showing the AI of a mare can be found on YouTube; for example: http://www.youtube.com/watch?v=-EKWcxRdpn4.

EMBRYO TRANSFER

An embryo can be nonsurgically removed from the uterus of one mare, transferred, and inserted into the uterus of another mare. **Embryo transfer** allows reproduction by older, less fertile mares; reproduction by 2-year-old mares; and increased production of foals from genetically superior mares; but this method is very expensive and the yield is not high.

The basic embryo transfer procedure has changed little over the years. Success rates have improved due to improved quality control and precise timing of different aspects of the procedure. Embryo transfer is more costly in horses than in cattle and other animal species due to the lack of medications to cause horses to regularly produce many embryos to transfer per procedure.

Embryo transfer consists of three phases:

1. Synchronization of the estrous cycles of the donor and the recipient mare(s)
2. Embryo **flushing**
3. Embryo transfer procedure

Synchronization of the Donor and the Recipient Mare

The donor is usually a valuable sport or subfertile mare, while the recipient is an inexpensive but healthy mare. Synchronization requires the use of hormones such as progesterone, prostaglandin, and HCG (human chorionic gonadotropin) or eFSH (equine follicle stimulating hormone). To ensure good synchronization, as the process is not perfect, two recipients are usually synchronized for each donating mare. The donor must be carefully palpated, cultured, and bred. Ovulation of the donor and the recipients must be timed to within 12 hours for best results, requiring twice-daily ultrasounds.

Embryo Flushing

Flushing is performed 7 or 8 days after insemination or breeding and involves lavaging (washing) the microscopic embryo out of the uterus using a special sterile solution. The embryo is then developmentally sized and graded from 1 (excellent) through 4 (poor quality).

Embryo Transfer Procedure

Embryo transfer is performed nonsurgically by loading the embryo into a uterine transfer catheter in a special nurturing solution and transferring the embryo into the uterus of the most synchronized recipient.

The odds of retrieving an embryo are very good (70 to 80 percent) from a healthy and reproductively sound donor mare. If the mare has a heavy show schedule or is subfertile, the success rate diminishes somewhat. Once recovered, embryos graded "good" or better will have a 60 to 70 percent chance of resulting in a pregnancy. Overall chances per cycle for a successful transfer with a young healthy donor are 50 to 60 percent and 30 to 40 percent with older, problem donors. Breeding and flushing difficult mares on multiple cycles is the best way to ensure at least one pregnancy.

Recipient mares in no way contribute to the foal's genetics. The characteristics of the foal are already programmed at conception with genetic material only from the donor mare and the stallion. The stallion is of great importance in the equation for success. Fresh sperm and the good timing of breeding are imperative.

Videos showing embryo transfer can be found on YouTube; for example: http://www.youtube.com/watch?v=41-f7ZgC4Uw

ARTIFICIAL CONTROL OF BREEDING

Management of equine reproduction involves the use of photoperiods and hormones. The designated birth date of foals of many performance breeds in the Northern Hemisphere is January 1. This creates an economic pressure to start the breeding season in February so foals will be born in January. Since the mare is usually in winter anestrus (no heat), artificial lighting is used to induce follicular activity.

A mare requires approximately 60 days of artificial lighting before ovulation occurs. To induce ovulation in early February, the artificial lighting has to start in late November or early December. Mares must be confined to the area where the light (either one 200-watt incandescent or two 40-watt fluorescent bulbs per stall) is located. Also, they should be within 7 to 8 feet of the light source. Automatic timers can be used to provide artificial light, beginning at sunset. Sixteen hours of total daylight, natural plus artificial, and 8 hours of darkness is the correct ratio.

Hormones can be used to make a mare **short cycle**, or come in season early. Another use of hormones is to ensure that a mare will ovulate within 24 to 48 hours after being bred.

Special lighting techniques to simulate longer days and the hormone injections that are employed to bring mares into heat earlier in the winter require intensive management and often result in improperly timed breedings that are not successful. Mares becoming pregnant early in the year are more likely to lose their fetuses because of extreme fluctuations in hormone levels.

SUMMARY

Reproductive organs of the mare, under hormonal control, produce an egg (ovum) during the breeding season. Reproductive organs of the stallion, under hormonal control, produce sperm cells. Successful breeding during estrous—the heat period of the mare—allows a sperm cell to unite with the egg. This brings together the genetic material of the mare and stallion to produce a new, unique horse. At first this new horse is a mass of cells called an embryo. The embryo implants into the uterus of the mare. As the embryo takes on the form of a new horse, it is called a fetus. After about 11 months of developing the fetus in her uterus, the mare goes through the process of labor and parturition, or birth. While the mare's reproductive tract goes through a process of involution in preparation for the next pregnancy she feeds and cares for the new foal.

The reproductive process can be artificially controlled by lighting or hormones. Breeding can also be controlled by artificial insemination and embryo transfer.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Photoperiod is when a mare is receptive to photographers.
2. Dystocia means difficult birth.
3. The practice of artificial insemination is accepted by all breed registries.
4. Winking is a sign of estrous in mares.
5. Waxed teats are a sign of impending birth.
6. Artificial insemination is 100 percent successful.

Short Answer

7. List three parts of the mare's reproductive tract.
8. List three parts of the stallion's reproductive organs.
9. What are four signs of estrous or heat?
10. Name the four factors that influence sperm output and production.
11. How soon after parturition can a mare be bred?
12. What hormone stimulates milk production?

Critical Thinking/Discussion

13. What is the role of the hormone progesterone in the mare?
14. What are the advantages and disadvantages of both pasture and hand mating?
15. Discuss the meaning of polyestrus in the mare.
16. Explain the difference between abortion and stillbirth.
17. Describe stage 1 and stage 2 of parturition.
18. What is the meaning of condition scoring of the mare?

STUDENT ACTIVITIES

1. Invite a local veterinarian to visit your class to discuss reproductive problems in horses.
2. Visit a veterinarian's clinic or a horse farm when horses are being diagnosed for pregnancy.
3. Obtain prepared microscope slides of semen, and compare the sperm cells of two different species.
4. Research and diagram the changes in a horse embryo through the fetal stages to the point of parturition.
5. Using Table A–16 in the appendix, contact five breed registries and inquire about their policy for embryo transfer and artificial insemination.
6. Create a collection of videos from YouTube that demonstrate various reproduction management techniques.

ADDITIONAL RESOURCES

Books

Frandson, R. D., Wilke, W. L., & Fails, A. D., . (2007). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.Hafez, E. S. E. (2000). *Reproduction in farm animals* (7th ed.). Philadelphia: Lippincott Williams & Wilkins.

Hartman, D. (2010). *Manual of equine reproduction,* 3rd ed. Maryland Heights, MO: Mosby Elsevier.

Kahn, C. M. (Ed.), & Line, S. (Ed). (2010). *The Merck veterinary manual* (9th ed.). Whitehouse Station, NJ: Merck & Co.

McCracken, T. O., & Kainer, R. A. (1998). *The coloring atlas of horse anatomy.* Loveland, CO: Alpine Publications

McKinnon, A. O., Squires, E. L. Vaala, W. E., & Varner, D. D. (2010). *Equine reproduction.* Ames, IA: Wiley-Blackwell.

Morel, M. D. (2008). *Equine reproductive physiology, breeding and stud management, 3rd Ed.* Oxfordshire, UK: CABI Publishing.

Raynor, M. (2005). *The Horse Anatomy Workbook*. London, UK: J.A. Allen.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases:

artificial insemination
care of pregnant mare
dystocia
embryo transfer
fertilization
horse mating (pasture or hand)
horse reproduction
mare reproductive system
parturition
pregnancy diagnosis
reproductive hormones
sperm production
stallion reproductive system
sterility

Table A–18 in the Appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 12

Digestion and Nutrition

Digestion—the process that releases nutrients from feeds for use by the horse's body—begins in the mouth, where food is ground and mixed with saliva. Feed then moves to the stomach, where the chemical breakdown starts releasing the nutrients.

The science of nutrition draws heavily on findings of chemistry, biochemistry, physics, microbiology, physiology, medicine, genetics, mathematics, endocrinology, cellular biology, and animal behavior. To the individual involved with horses, nutrition represents more than just feeding. Nutrition becomes the science of the interaction of a nutrient with some part of a living organism, including the composition of the feed, ingestion, liberation of energy, elimination of wastes, and all the syntheses for maintenance, growth, and reproduction.

OBJECTIVES

After completing this chapter, you should be able to:

- List six categories of nutrients
- Define terms associated with energy
- List the sources of energy nutrients
- Describe the functions of energy nutrients
- Describe the symptoms of energy nutrient deficiencies
- Describe the energy needs of horses for milk production, pregnancy, and work
- List the most important compound sugars
- Describe the digestion of fiber
- Explain the function of protein
- Describe digestible protein
- Explain essential amino acids
- Identify at what stages of the horse's life protein requirements are the greatest
- Describe the functions of minerals in horse nutrition
- Describe the deficiency symptoms caused by the lack of minerals in the ration
- List the macrominerals needed by horses

OBJECTIVES *(continued)*

- Identify the microminerals needed by horses
- List the vitamins that are essential in horse nutrition
- Describe the functions of vitamins
- Describe deficiency symptoms caused by the lack of three vitamins in a ration
- List and discuss factors affecting the amount of water a horse will consume
- Describe the ways by which horses lose water from the body

KEY TERMS

absorption
amino acids
as-fed basis
bomb calorimeter
concentrates
crude protein (CP)
dehydration
digestible energy (DE)
digestion
dry-matter basis
essential amino acids
fat-soluble vitamins
fermentation
gross energy (GE)
heat increment (HI)
hyperparathyroidism
hypochloremia
impaction
lactose
macrominerals
metabolic alkalosis
metabolizable energy (ME)
microminerals
National Research Council (NRC)
net energy (NE)

EVOLUTION OF HORSE NUTRITION

Much credit has been attributed to oats and timothy hay for the nutrition of horses. But researchers have been unable to substantiate a need for either, when substitutions of other grains and hays were made. The Arabian horse, progenitor of most domestic breeds, reached its excellence in a country that produced no oats or timothy hay. As early as 1911, the animal nutrition scientist E. A. Trowbridge, completed 365-day tests with hardworking mules that showed less weight loss and 28 percent less feed cost with corn compared to oats fed with mixed hay. Respiration counts showed no difference in heat tolerance. However, over the yearlong test, mules seemed to tire of corn more than oats.

Horses relish oats. This fact, combined with the knowledge that less care is needed to avoid digestive problems with oats than with corn because of the higher fiber content of oats, has always made oats popular.

Timothy hay and good oats fed together make a satisfactory ration for adult horses. But they are too low in protein, calcium, and vitamins for broodmares and growing horses.

The Committee on Nutrient Requirements of Horses, Board on Agriculture and Natural Resources, Division on Earth and Life Studies of the **National Research Council (NRC)** of the National Academies (http://www.national-academies.org) examined the literature and current practices in the nutrition and feeding of horses and published recommendations on horse nutrition. The latest NRC publication on horse nutrition was issued in 2007. Many of the recommendations in this chapter and Chapter 13 are based on this NRC publication.

DIGESTIVE SYSTEM—ANATOMY AND FUNCTION

The anatomy of the horse's digestive system was discussed in Chapter 5. Figure 12–1 serves as a review of the general anatomy.

The small intestine is a major site of **digestion** and **absorption** of many nutrients. Good parasite control is necessary for optimum function of the small intestine. Parasites not only reduce feed utilization, but can cause colic.

KEY TERMS

nonruminant
nutrients
osteomalacia
rations
rickets
roughage
total digestible nutrients (TDN)
water-soluble vitamins

The large intestine consists of the cecum and colon. It has a large population of microorganisms (bacteria and protozoa) that ferment the fiber in plant materials. If feed changes are made rapidly, the microorganisms do not have time to adapt. Fiber digestion is dependent on the efficiency of microbial **fermentation** in the cecum and colon. Horses do not digest low-quality forages (cellulose) as well as cattle do, so they need to eat immature, high-quality hay or pasture. Besides supplying energy, dietary fiber helps regulate the flow of nutrients in the digestive tract and guards against behavioral problems related to boredom. The only nutritional problem to feeding high-quality forage as the sole source of feed is that some classes of horses need more energy than an all-forage diet can supply.

To a degree, the cecum and colon serve the same purpose for the horse that the rumen does for the cow. However, the cecum's location toward the end of the digestive tract probably reduces its contribution to the horse's overall digestive efficiency. Feed passes through the horse's gastrointestinal (GI) tract much faster than through the GI tract of ruminants. This faster rate of food passage is largely responsible for lower digestion efficiency in horses than in ruminants.

NEEDS FOR FEED

Horses need the same feed ingredients as other livestock. These ingredients are carbohydrates, fats, protein, minerals, vitamins, and water. The first three of these can be converted to yield energy. Major sources of energy and protein are grains and roughages, including pasture.

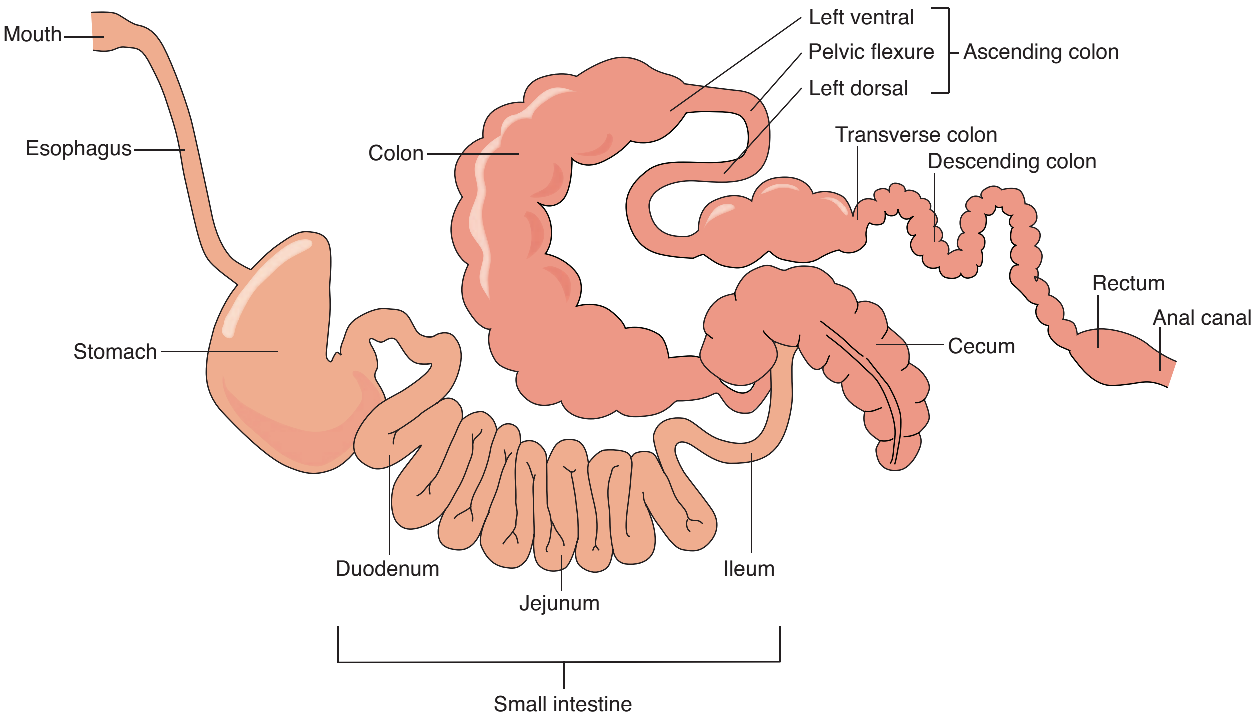


FIGURE 12–1 **The horse's digestive system.**

Feeding horses is both an art and a science. There is considerable variation in individual horses' nutrient requirements, but a table of these requirements forms a useful basis for formulating **rations**. Feeding practices are discussed in Chapter 13.

All horses require **nutrients** to maintain body weight and to support digestive and metabolic functions. They need additional nutrients for growth, work, reproduction, and lactation.

Often tables of nutrient requirements for horses are expressed in two ways: (1) daily nutrient requirements and (2) nutrient concentration in the feed. This may be expressed on an **as-fed basis** or a **dry-matter basis**.

Most horses receive their daily ration in two parts: **roughage** (hay or pasture) and **concentrates**. The concentrate portion contains grain and may include a protein supplement, minerals, and vitamins. It may also include bran, cane molasses, and/or dehydrated alfalfa.

NUTRIENT NEEDS

Feeds and feedstuffs contain the energy and nutrients essential for the growth, reproduction, and health of horses. Deficiencies or excesses can reduce growth and/or lead to disease. Dietary requirements set the necessary levels for energy, protein, **amino acids**, lipids (fat), minerals, and vitamins.

Table 12–1 indicates how the major nutrients are measured on a daily basis or in terms of their concentration in the feed.

ENERGY/CARBOHYDRATES

Horses are **nonruminant** herbivores who use carbohydrates for their main energy supply. Carbohydrates eaten by the horse first pass through the stomach and intestine, where nonstructural carbohydrates—starch, maltose, and sucrose—are removed and enter the portal vein (Figure 12–2). These carbohydrates are used for energy or

TABLE 12-1 Requirements for the Major Nutrients Expressed and Their Units

NUTRIENT	UNIT OF MEASURE (AMOUNT/DAY)	UNIT OF MEASURE (CONCENTRATION)
Digestible energy	megacalories (mcal)/day	mcal/kg
Crude protein	kilograms (kg)/day	percent (%)
Calcium	grams/day	%
Phosphorus	grams/day	%
Sodium, potassium	grams/day	%
Copper, zinc, iron, other trace minerals	milligrams (mg)/day	parts per million (ppm) or mg/kg
Vitamins A, D, and E	international unit (IU)/day	IU/kg
Thiamine, other B vitamins	mg/day	mg/kg

Note: 1 kg (kilogram) = 2.2 lbs.

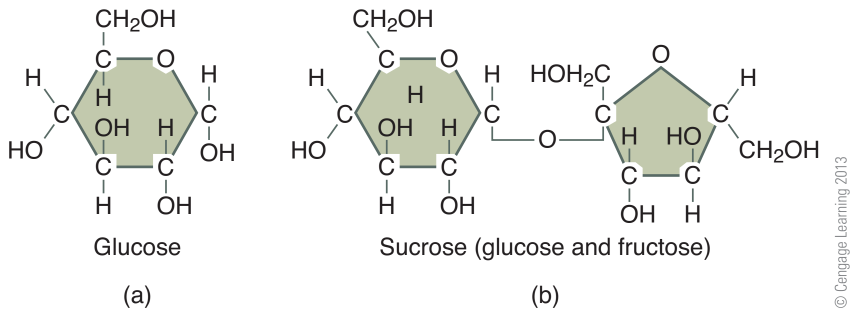


FIGURE 12–2 **Diagram of two types of carbohydrates: (a) —a monosaccharide (1 sugar molecule), and (b) sucrose— a disaccharide (2 sugar molecules).**

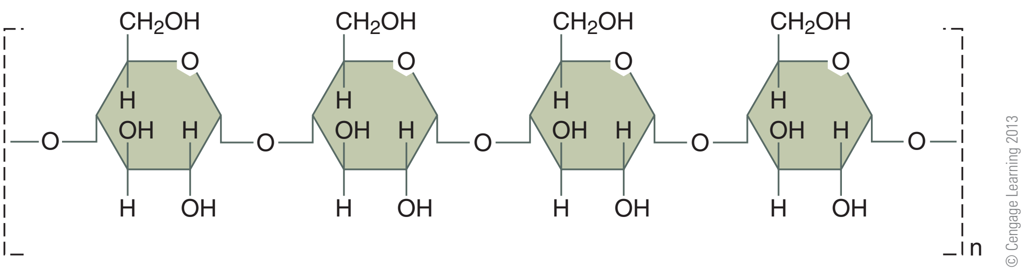


FIGURE 12–3 **Diagram of starch—a long chain of glucose molecules. The "n" on the lower right of the diagram means that starch is any large number of glucose molecules connected.**

converted to other biochemicals needed for life. The liver stores carbohydrates in the form of glycogen (Figures 12–2 and 12–3).

The remaining nonstructural carbohydrates, as well as the structural carbohydrates—cellulose and hemicellulose—then reach the areas of the digestive tract that carry out fermentation. Fermentation results in the production of volatile fatty acids—acetic, propionic, isobutyric, isovaleric, and valeric acid. These volatile fatty acids are easily absorbed and converted into energy.

As a side note, **lactose**—the sugar found in milk—is tolerable to horses up to 3 years of age. After that, the addition of milk or its by-products to the feed may disturb the gastrointestinal tract, causing diarrhea.

Fat/Lipid

Fat is a concentrated source of energy that can be readily utilized by the horse. Fat contains 2.25 times more energy per unit of weight than do carbohydrates or proteins. During exercise, especially strenuous activity such as galloping, body fat will be mobilized and converted to energy.

Fat in the diet seems to spare the glycogen storage; increasing the fat in the diet increases performance and maintains body condition. Horses accept fat addition to the diet as long as the fat is not rancid. Often, performance horses are fed a percentage of their digestible energy concentration in the form of corn oil. The proportion of energy generated from fat and carbohydrate can be altered in exercising horses by dietary manipulation, but the ideal proportion is not yet known.

ENERGY REQUIREMENTS

Energy is measured in terms of calories. Horses need calories in the form of digestible energy. A calorie is a measure of the heat energy in feed. Digested food is actually burned in the body, so the number of calories in a feed determines how much heat energy will be released when the food is burned in the body.

To directly measure calories in a feedstuff, a sample of feed is completely burned in a controlled environment—a **bomb calorimeter**. If one gram of a feedstuff contains one calorie, it has enough heat energy to raise the temperature of water exactly 1 degree Celsius from 14.5°C to 15.5°C.

For nutrition, one calorie is out of the realm of discussion. The energy in feedstuffs is expressed as thousands of calories or kilocalories (kcal), or it is expressed as millions of calories or megacalories (mcal). The fires of life burn the feeds at a slow, controlled burn, releasing the calories for energy to maintain life, reproduction, growth, and work (See Chapter 4).

Energy can be measured as **gross energy (GE)**, **digestible energy (DE)**, **metabolizable energy (ME)**, or **net energy (NE)**. Figure 12-4 shows how gross energy flows through the body.

To estimate the DE of a feedstuff, a digestion trial is performed and the total or gross energy of the feed consumed and the feces excreted are measured with the use of a bomb calorimeter. The feed energy is abbreviated GE. The fecal energy is abbreviated FE. Fecal energy is the single greatest energy loss for any given feedstuff. The apparent DE is estimated by the following equation: DE = GE − FE. The actual DE values are available for a number of the domestic species and a broad range of feedstuffs. In comparison to DE, metabolizable energy (ME) is a more accurate estimate of the energy value of a feedstuff. To determine ME, the total or gross energy of a feed consumed, the feces excreted, the urine excreted, and the gases excreted are measured. The urinary and gaseous energy are abbreviated UE and GE*, respectively. The primary gas produced by microbial metabolism in the GI tract is methane. The ME is estimated using the following equation: ME = GE − (FE + UE + GE*).

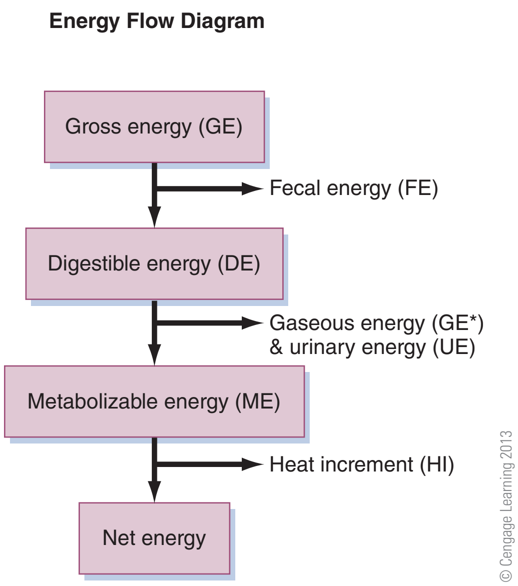


FIGURE 12–4 **Energy flow during digestion. Digestible energy (DE) undergoes some losses as it is used in the body.**

The most accurate term to describe the energy value of a feedstuff is net energy (NE). Net energy estimates the energy available for maintenance and productive functions in the animal. As the efficiency of energy utilization varies by function, the NE values vary by function. The three NE values are net energy of maintenance growth and lactation. The first step to estimate NE is to estimate ME via a balance trial. The second step is to estimate the **heat increment (HI)** by calorimetry. The heat increment is the energy loss associated with the consumption, digestion, absorption, and metabolism of the nutrients for maintenance and productive functions. The energy is in the form of heat. The NE is estimated using the following equation: NE = ME – HI. Rather than by direct determination, the majority of NE values are estimated with the use of equations.

Most nutrient requirement tables for horses now use DE. Digestible energy is expressed in calories, usually megacalories (million) or kilocalories (thousand). Energy requirements are needed for or altered by:

- Maintenance
- Reproduction
- Gestation
- Lactation
- Growth
- Work
- Old age
- Stalling

Maintenance

The maintenance requirement of the horse is described as the energy needed to keep the animal from gaining or losing weight.

Reproduction

Energy is an important factor in the success of reproduction in mares. A mare that is in poor condition but gaining weight is twice as likely to conceive as a mare that is in poor condition while maintaining weight. Mares that are in the range of good condition to fat condition have higher conception rates, whether they maintain or even lose body weight.

Gestation

During the last 3 months of pregnancy, the fetus experiences the greatest amount of growth. The 9th, 10th, and 11th months of gestation require an increase in DE.

Lactation

Milk production and composition varies between breeds, as well as individual horses. The conversion of milk to DE requires more DE per pound of milk produced. This means lactating mares must be provided daily with more DE. Table 12–2 shows the required increase in DE for mares of different weights and stages of lactation.

Growth

The tendency in the past has been to push the growth of foals to try to produce the biggest horse possible, as quickly as possible. This is not always in the best interest of the animal. Requirements for energy during growth are based on the age of the animal and the amount of weight being gained each day.

TABLE 12–2 Increase of Daily Digestible Energy for Mature 1100-pound Mares during Last Months of Pregnancy and First Months of of Lactation[1]

MONTH OF PREGNANCY OR LACTATION	ENERGY (DE)
10th	20.2
11th	21.4
1st	31.7
2nd	31.7
3rd	30.6

[1]From *Nutrient Requirements of Horses*, by the National Research Council, 2007. (Using the information from this publication, nutrient requirements for various, sizes and conditions can be calculated at this website: http://nrc88.nas.edu/nrh/.)

What is TDN?

Total digestible nutrients (TDN) is another method that estimates the energy value of a feedstuff. Some say the TDN system is not the most accurate system available. However, as the TDN system is relatively easy to understand and has been available for a long period of time, the TDN system remains the most common system used on farms. To estimate TDN, the total individual digestibilities of protein, carbohydrates, and lipids in the feedstuff are determined using digestion trials in combination with proximate analysis. Then, to estimate TDN, the individual digestibilities are plugged into to the following equation: TDN = (digestible crude protein) + (digestible crude fiber) + (digestible nitrogen-free extract) + (digestible ether extract × 2.25). The multiplier of 2.25 is used to adjust for the greater energy density in a unit of ether extract compared to a unit of carbohydrate or protein. TDN is expressed in units of concentration or mass. TDN values account for fecal and urinary energy losses, therefore TDN is intermediate between DE and ME values. The primary advantage of the TDN system is its simplicity. The primary disadvantage of the TDN system is it tends to overestimate the energy value of fibrous feedstuffs in comparison to nonfibrous feedstuffs.

Work

A working horse naturally needs more energy than a horse at rest does. Many studies have been done to calculate the exact requirements of exercising horses. The huge variety in the types of work or exercise that horses do, as well as the ability of a given breed, or individual, to perform those tasks prevents us from having one formula that fits every animal. Ponies, light horses and draft horses need more daily energy for light, moderate, or heavy work/exercise.

Old Age

The older horse can be treated as a maintenance animal. However, the decrease in activity and use may lead to obesity and related health problems. It is wise to monitor the geriatric horse for weight gain and adjust its diet to include more forage.

Stalling

A stalled horse has a lower requirement for energy but is more likely to develop bad habits and vices. The stalled animal is better off with larger quantities of a lower-energy roughage. This keeps the feed present for a greater portion of the day and gives the stalled horse an activity similar to normal behavior—grazing.

Underfeeding and Excess of Energy

Energy and protein are the major factors in evaluating a horse's ration. Underfeeding of either nutrient will cause a reduction in health and performance. Overfeeding can result in excessive fat deposition. Overfeeding of protein can be wasteful and sometimes causes stress. A depressed appetite can be an indication of a protein deficiency and then cause an energy deficiency.

Protein

The protein requirement of the horse is related to the quality and digestibility of the protein and the requirements of the individual. Young animals undergo stages of rapid growth and require proteins to provide building blocks for their bodies.

Proteins are composed of amino acids. These amino acids are used by the horse to build the proteins in its body. As a nonruminant, horses are presumed to require these 10 **essential amino acids**: arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. These amino acids are essential because they cannot be synthesized by the body in sufficient quantities to meet the demand for them.

Various studies compared the growth of horses in different stages of life to the compositions of the proteins that the animals were eating. These studies indicated that the greatest growth was achieved when the horses were fed proteins high in lysine (an essential amino acid). Daily nutrient requirements of horses provided in the Nutrient Requirements of Horses, by the National Research Council, (2007), lists the lysine requirement. (Using the information from this publication, nutrient requirements for various, sizes and conditions can be calculated at this website: http://nrc88.nas.edu/nrh/.) Figure 12–5 shows diagrams of several amino acids. High-quality proteins contain more of the essential amino acids. Mature horses do not need protein of as high a quality as younger animals do.

Protein in the diet is expressed as **crude protein (CP)**. Digestible protein (DP) is a more accurate estimate of how much protein the animal is actually able to use. The DP of individual feeds has not been calculated for horses. Instead, DP values are estimated from CP values.

Deficiency

Insufficient dietary protein decreases production of protein in foals. This results in smaller, less-healthy foals, sometimes called "poor doers."

In an adult animal, a dietary deficiency of protein increases problems in areas of high protein turnover. The hair coat and hoof wall may be adversely affected, and tissue wasting may occur.

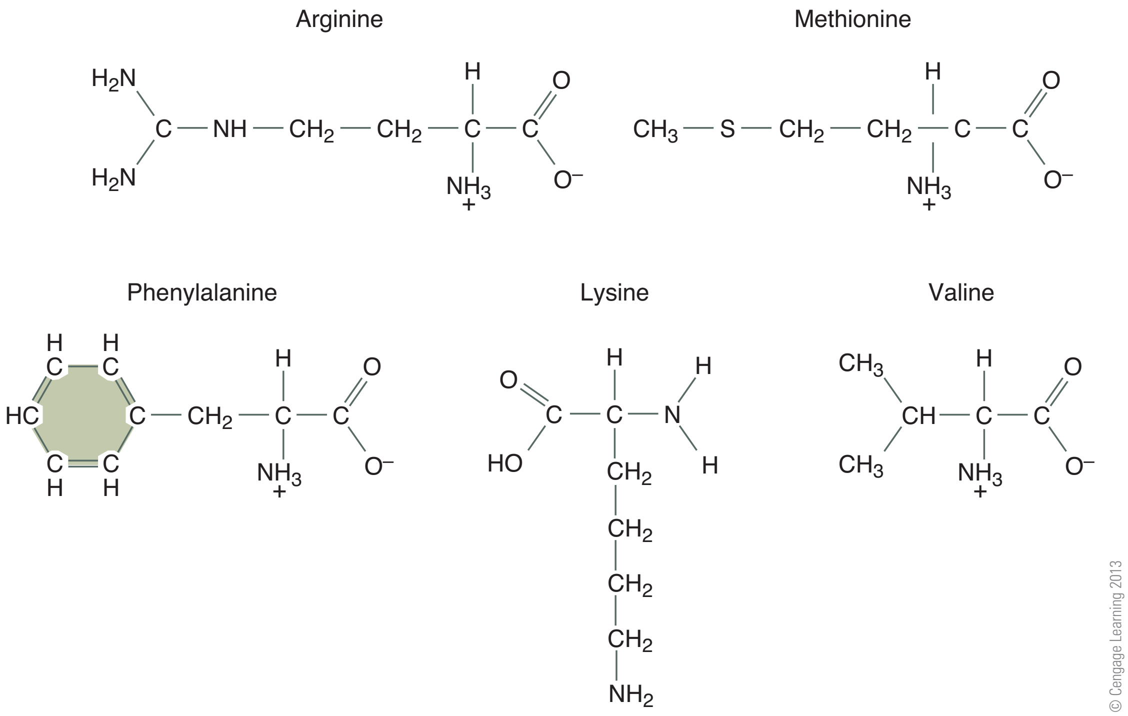


FIGURE 12–5 **Diagram of five amino acids—the "building blocks" of protein. Note lysine requirements are listed in the 6th Edition of the Nutrient Requirements of Horses.**

Excess

Excess protein has not been found to cause adverse effects on horses when fed in moderation. For adult horses, especially for hardworking horses, there is some debate about the value of excess protein.

MINERALS

Minerals are important for energy transfer and as an integral part of vitamins, hormones, and amino acids. The horse obtains most of its necessary minerals from pasture, roughage, and grain. Depending on the amount required by the body, minerals in the diet are classified as **macrominerals** or **microminerals** (sometimes called trace minerals). The seven macrominerals include:

1. Calcium (Ca)
2. Phosphorus (P)
3. Potassium (K)
4. Sodium (Na)
5. Chloride (Cl)
6. Magnesium (Mg)
7. Sulfur (S)

Eight microminerals important in equine nutrition include:

1. Copper (Cu)
2. Iodine (I)
3. Iron (Fe)
4. Selenium (Se)
5. Cobalt (Co)
6. Manganese (Mn)
7. Fluorine (F)
8. Zinc (Zn)

Table 12–3 summarizes some of the mineral requirements and the signs of their deficiency in horses.

TABLE 12–3 Horses: Requirements, Functions, and Deficiency Signs of Minerals

MINERAL (REQUIREMENT)	FUNCTIONS	DEFICIENCY SIGNS
Calcium[1]	Bone mineral; blood clotting; nerve, muscle, and gland function	Rickets, osteomalacia, Nutritional Secondary Hyperparathyroidism (NSH), osteoporosis; bones may be soft and easily deformed or broken
Phosphorus[1]	Bone mineral, part of many proteins involved in metabolism	Bone disease; decreased growth; reproductive problems; low blood phosphorus
Iron (50 mg/kg)[2]	Part of hemoglobin and some enzymes; oxygen transport	Anemia: lack of stamina, poor growth
Copper (9 mg/kg)	Iron absorption; hemoglobin synthesis; skin pigments; collagen metabolism	Anemia; hair pigment loss; bone disease: swollen joints, deformed thin bones
Magnesium (.1%)	Bone mineral, enzyme activator: energy metabolism	Nervousness; muscle tremors; ataxia; convulsions; mineralization of blood vessels; low serum magnesium
Sodium, potassium, and chloride	Tissue fluid pressure and acid-base balance; passage of nutrients and water into cells; nerve and muscle function	Craving for salt; hyperexcitability, decreased growth rate; loss of appetite
Zinc (36 mg/kg)	Activator of many enzymes	Hair loss, scaly skin, poor wound healing; reproductive, behavioral, and skeletal abnormalities
Iodine (.1 mg/kg)	Thyroid function	Goiter; poor growth; low body temperature; impaired development of hair and skin; foals weak at birth
Manganese (36 mg/kg)	Synthesis of bone and cartilage components; cholesterol metabolism	Reproductive problems: delayed estrus, reduced fertility, spontaneous abortion, skeletal deformities in the newborn
Selenium (.2 mg/kg)	Removal of peroxides from tissues; enzyme activation	White muscle disease; low serum selenium and serum glutathione peroxidase concentration

[1] See Table 12–1.

[2] Units per kg of air-dried feed.

Calcium

Calcium (Ca) is involved in homeostasis—the functions that maintain life—blood-clotting mechanisms, and muscle contractions. Calcium also makes up 35 percent of the horse's bone structure.

Calcium deficiency in developing foals may lead to **rickets**, which shows up as poor mineralization of bone tissue, enlarged joints, and crooked long bones. Calcium excess does not seem to be detrimental, as long as the level of phosphorus is adequate.

Phosphorus

This mineral makes up 14 to 17 percent of the horse's skeleton. Phosphorus (P) is required for many energy-transfer reactions and for the synthesis of some lipids and proteins. Phosphorus requirements increase during late gestation and lactation. In the horse's diet, calcium and phosphorus are considered together in the calcium-to-phosphorus ratio.

Calcium-to-Phosphorus Ratio

Calcium and phosphorus are considered together because they work together and affect one another's availability. The ratio and level of calcium and phosphorus must both be considered. Adequate vitamin D must be available for proper calcium and phosphorus use. Bone growth problems are a symptom of problems with the calcium, phosphorus, and vitamin D complex.

A calcium-to-phosphorus (Ca:P) ratio of less than 1:1 may be detrimental to calcium absorption. Even if the calcium intake is sufficient, excessive phosphorus intake will cause malformations of the skeleton. On the other hand, very high ratios of calcium to phosphorus (as high as 6:4) in growing horses will not be detrimental as long as the phosphorus intake is adequate. Phosphorus deficiency will produce rickets in the developing horse and weakening of the bones (**osteomalacia**) in the mature horse, similar to what is found in deficiencies of calcium and vitamin D. Excessive phosphorus intake will lead to reduction of calcium absorption, chronic calcium deficiency, and nutritional secondary **hyperparathyroidism**. Hyperparathyroidism is an increase in the function of the parathyroid glands, which lie next to the thyroid gland in the neck.

Table 12–4 gives the proper ratios of calcium to phosphorus for various classes of horses.

Potassium

This mineral maintains the acid-base balance and osmotic pressure inside the cells. Forages and oilseed meals generally contain 1 to 2 percent potassium in the dry matter. Cereal grains (corn, oats, wheat) contain 0.3 to 0.4 percent potassium. Required potassium concentration in a diet for growing foals is 1 percent. A mature horse requires 0.4 percent in the diet.

Because forages usually constitute a significant portion of the diet, the horse should get its potassium requirement from the diet. If only cereal grains are fed, potassium chloride and potassium carbonate can be used as supplements.

Potassium deficiency in foals causes loss of appetite and weight loss. These symptoms promptly reverse when potassium carbonate is given. Excess potassium in the diet is readily excreted, provided water intake is normal.

TABLE 12–4 Calcium-to-Phosphorus Ratios

STATUS	MINIMUM CA:P	MAXIMUM CA:P	OPTIMUM CA:P
Nursing foal	1:1	1.5:1	1.2:1
Weaning	1:1	3:1	1.5:1
Yearling	1:1	3:1	2:1
Mature	1:1	5:1	2:1

Sodium

Sodium maintains the acid-base balance outside the cells and regulates the osmosis of body fluids. Sodium is also involved in nerve and muscle function. Since the sodium concentration of natural feedstuffs for horses is often lower than 0.1 percent, salt is often added to concentrates at rates of 0.5 to 1.0 percent or fed free-choice as plain, iodized salt.

Chronic sodium deficiency in horses results in decreased elasticity of the skin, a tendency to lick sweat-covered tool handles, decreased appetite, and decreased water intake. Eventually, the horse will stop eating. If the deficiency is acute, the horse will have uncoordinated muscle contractions, impaired chewing, and an unsteady gait. In the blood, the sodium and chloride will be low and the potassium high. Horses are tolerant of high levels of salt in their diets as long as there is free access to fresh drinking water.

Chloride

In the diet, chloride normally accompanies sodium as NaCl or salt. This is an important extracellular anion (negative charge) involved in acid-base balance and osmotic regulation. Chloride is an essential component of bile, hydrochloric acid, and gastric secretions. The chloride requirement is assumed adequate when the sodium requirement is met.

Magnesium

More than half of the magnesium found in a horse's body exists in the skeleton. Magnesium is an activator of many enzymes. Magnesium concentrations in common feedstuffs range from 0.1 to 0.3 percent.

Sulfur

Sulfur is a component of many biochemicals in a horse's body, including amino acids, biotin, thiamine, insulin, and chondroitin sulfate. Requirements for the horse have not been established, and a deficiency has not been described.

Copper

This mineral is essential for several copper-dependent enzymes. Deficiency of copper may cause bone disease and bone malformation. A deficiency may also cause a dullness of the coat color. Horses are tolerant of excess copper.

Iodine

Iodine is essential for the production of the thyroid hormones. These hormones regulate basal metabolism. If iodine has to be supplemented, iodized or trace mineralized salt containing 70 mg of iodine per kilogram can be used.

Iodine deficiency in pregnant horses, which may show no symptoms themselves, may lead to foals that are either stillborn or born too weak to stand and suckle. These foals have an enlargement on the front side of the neck due to enlargement of the thyroid gland—a condition called goiter.

An excess of dietary iodine may result from using feedstuffs high in iodine, such as kelp (a seaweed), or from adding excessive supplemental iodine. This may lead to baldness in horses.

If a pregnant mare has had too much iodine in the feed, the foal will be born with an iodine-induced goiter. The milk of the mare will contain excess iodine. The foal needs to recover from the excess of iodine received before birth. An alternate source of milk, low in iodine, has to be found.

Before giving iodine supplementation to the pregnant mare or the foal with a goiter, the owner must determine whether the horse was fed too little or too much iodine.

Iron

In the body of a horse, 60 percent of the iron is in the red blood cells and 20 percent is in the muscles. Common feedstuffs should meet the horse's iron requirements.

Iron deficiency causes anemia when too little iron is available for the formation of red blood cells. Because milk is low in iron, young, milk-fed foals are most likely to have deficient iron. Iron supplements have not proven effective in improving the oxygen-carrying capacity of red blood cells.

Excess iron is very toxic to young animals, and death can result in a foal that has been given supplemental iron by mouth. Before death, the foal shows diarrhea, jaundice, dehydration, and coma.

Selenium

This mineral is essential for detoxification of certain peroxides that are toxic to cell membranes. Selenium is closely connected with vitamin E in that the two work together to scavenge free radicals.

Selenium deficiency is linked to the status of vitamin E. Selenium–vitamin E deficiency causes white muscle disease that involves both the skeletal muscles and the heart muscle. The symptoms are weakness, difficulty in suckling and swallowing, troubled breathing, and heart dysfunction.

Excess selenium can be acute or chronic. The acute form (blind staggers) exhibits itself in blindness, head pressing, perspiration, colic, diarrhea, and lethargy. This acute form is seen if selenium is ingested from some toxic plants. Chronic selenium toxicity results in hair loss about the mane and tail and cracking of the hoofs around the coronary band.

Cobalt

Cobalt is a part of vitamin B_{12}. Microflora in the cecum and colon use dietary cobalt to make vitamin B_{12}. Specific dietary cobalt requirements have not been studied in the horse.

Manganese

Manganese is necessary for metabolizing carbohydrate and fat and for synthesizing cartilage. Manganese requirements in horses are not established, but some recommendations are made based on information from other species.

Fluorine

Fluorine is involved in bone and tooth development in other species. The dietary necessity is not established in horses. Excesses of fluorine in the diet can cause colored teeth, bone lesions, lameness, and unthriftiness (loss of condition).

Zinc

Zinc is a component of many enzymes. Experimentally, a zinc deficiency can be produced in foals. Signs of the deficiency include loss of appetite, reduced growth rate, and rough, scaly skin.

Common equine feedstuffs contain 15 to 40 mg of zinc per kilogram. If a supplement is needed, zinc sulfate, zinc oxide, zinc chloride, zinc carbonate, and various zinc chelates can be used.

VITAMINS

Vitamin requirements, like other nutrient requirements, are affected by age, stage of production, gastrointestinal infections, and muscular activity (Figure 12–6). Type and quality of the diet and extent of vitamin absorption determine the need for vitamin supplements. Bacteria in the gut produce vitamins while breaking down feedstuff. These vitamins are also available for absorption. Forages contain mostly fat- and **water-soluble vitamins** so that horses grazing high-quality pastures should not need vitamin supplementation. Vitamins are classified as fat-soluble or water-soluble.

The **fat-soluble vitamins** are vitamins A, D, E, and K. Conditions interfering with fat absorption also adversely influence absorption of these vitamins. Vitamin K is synthesized in the intestines. Vitamin D requires exposure to ultraviolet light. The other fat-soluble vitamins must be present in the diet. Table 12–5 summarizes some of the vitamins, their functions, and signs of a deficiency.

Courtesy USDA

FIGURE 12–6 **Draft horses use nutrients derived from feed for work. Belgian draft horses on a farm in New York.**

TABLE 12–5 Horses: Requirements, Functions, and Deficiency Signs of Vitamins

VITAMINS	FUNCTIONS	DEFICIENCY SIGNS
Vitamin A (2,000 IU/kg)[1]	Growth and development of bone and epithelial cells, vision	Night blindness, poor conception rate, abortion, loss of libido, testicular degeneration, convulsions, elevated cerebrospinal fluid pressure
Vitamin D (250 IU/kg)	Absorption of dietary calcium and phosphorus	Poor mineralization of bone, bone deformities
Vitamin E (15 IU/kg)	Antioxidant in tissues	Decreased serum tocopherol, increased red blood cell fragility; muscular dystrophy
Thiamine (3 mg/kg)	Coenzyme in energy metabolism	Loss of appetite and weight; incoordination, muscular weakness and twitching
Riboflavin (2 mg/kg)	Coenzyme in many enzyme systems	Conjunctivitis, lacrimation, aversion to bright light

[1] Units per kg of air-dried feed.

Vitamin A

Vitamin A is important for vision. Metabolites of vitamin A are found in visual pigments within the retina. This vitamin also plays a basic role in cell differentiation and, in the growing animal, in bone remodeling. Green plants and hays contain carotene, which the body normally converts to vitamin A.

Deficiency of vitamin A causes night blindness, excessive tearing of the eye, thickening of the horn layer of the skin and the cornea, lack of appetite, poor growth, respiratory infections, abscesses under the tongue, convulsive seizures, and progressive weakness.

Excess vitamin A, given over a long time, may cause fragile or thick bones, flaking skin, and tumors. In some animals, hair and skin are lost. These horses are severely depressed and lie down on their sides.

Vitamin D

Dietary vitamin D seems to be sufficiently present, especially if the horse is exposed to sunlight. Deficiency of vitamin D in the diet, while the horse is deprived of sunlight, seldom produces rickets; but it does produce loss of appetite and slower growth. Supplementary vitamin D in the diet promotes absorption of calcium and phosphorus.

Excess vitamin D in the diet leads to calcification of blood vessels, the heart, and other soft tissues, and to bone abnormalities. Besides accidental addition of excess vitamin D to the diet, an excess may be caused by ingestion of certain toxic plants, such as day jasmine.

Vitamin E

An interrelationship exists between vitamin E and selenium. They both function as a part of a multicomponent antioxidant defense system.

Vitamin E activity in feedstuffs is reduced by moisture, mold growth, and grinding of the feedstuff during processing. Deficiencies of vitamin E and of selenium are difficult to distinguish separately. A deficiency of both nutrients in the foal will show pale areas in degenerating skeletal and cardiac muscles, as well as swelling of the tongue. If the deficiency is not corrected, pulmonary congestion occurs.

Claims that vitamin E is beneficial in restoring fertility in horses have not been verified by research. No symptoms of excess vitamin E in the horse are known.

Vitamin K

Vitamin K plays an important role in blood clotting. Deficiency of vitamin K results in decreased production of thrombin, which in turn interferes with the formation of fibrin clots. This leads to excessive bleeding with blood that will not clot. Too much vitamin K does not seem to cause problems in the horse.

Water-soluble Vitamins

Water-soluble vitamins include thiamine, riboflavin, niacin, pantothenic acid, biotin, folacin, ascorbic acid (vitamin C), choline, and vitamin B_{12}. Some of the water-soluble vitamins are often grouped as the B vitamins. This includes thiamine, riboflavin, niacin, pantothenic acid, biotin, and folacin. The water-soluble vitamins are available in feedstuffs or synthesized by microorganisms in the intestine. Only a couple of the water-soluble vitamins have a required level in the diet.

A need for thiamine in the diet has been demonstrated. Deficiency of riboflavin contributes to periodic ophthalmia (moon blindness). Common sources of B vitamins are green plants, dried legumes, and soybean meal.

Less is known about vitamins than minerals, but supplementation is easy and inexpensive.

Horses with access to good pasture, if only for a brief time, and those receiving good-quality hay, especially if it is half legume, will probably need no vitamin supplementation (Figure 12–7). Deficiencies are more likely to appear with horses confined for long periods of time on poor-quality roughage.

FIGURE 12–7 **Green forages are a good source of vitamins such as vitamin K, thiamine, and riboflavin for these horses.**

Establishments with horses confined for long periods should consider an economical commercial source of vitamins as insurance against deficiencies when the roughages are not of top quality. On the other hand, "stuffing" an animal with vitamins many times beyond the known requirement increases expenses and contributes nothing to its health.

WATER

A source of fresh, clean drinking water is essential for horses at all times. Daily consumption can average 10 to 12 gallons, with much higher amounts consumed during hard work/exercise and/or hot weather conditions. When water is not available by free choice, idle animals should be taken to it at least twice daily at regular intervals. **Impaction** is a common and rather serious problem resulting from infrequent drinking. Hot horses should be cooled out or permitted small amounts of water before drinking their fill. To refresh the animal and reduce heat exhaustion, those at work should be watered frequently whenever possible.

Dehydration and Electrolyte Balance

Dehydration from sweating results in the loss of both water and electrolytes—sodium, chloride, and some potassium. During extended workouts in hot, dry weather, the losses can be significant. In heavy sweating, the loss of chloride can result in **hypochloremia**, a condition in which there are low levels of chloride in the blood, and **metabolic alkalosis**, which is when pH increases above normal.

An adequate water supply, a balanced diet, and free-choice mineralized salt should provide all the necessary fluid and electrolytes for racing or extended work.

REQUIREMENTS AND ALLOWANCES

The Committee on Nutrient Requirements of Horses, Board on Agriculture and Natural Resources, Division on Earth and Life Studies of the National Research Council (NRC) of the National Academies (http://www.national-academies.org), examined the literature and current practices in the nutrition and feeding of horses and published recommendations on horse nutrition. The latest NRC publication on horse nutrition was issued in 2007. Many of the recommendations in this chapter and Chapter 13 are based on this NRC publication.

Tables 12–6, 12–7, and 12–8 are adapted from the NRC information. Table 12–6 provides daily requirements for digestible energy, crude protein, calcium, phosphorus, and vitamin A for different conditions and weight. Table 12–7 presents the same daily requirements for growing horses with different mature weights, with or without exercise. Finally, Table 12–8 lists the mineral and vitamin requirements for maintenance, pregnancy, and exercise. Using the information from this publication, nutrient requirements for various, sizes and conditions can be calculated at the 2007 Nutrient Requirements of Horses website (http://nrc88.nas.edu/nrh/). Figure 12-8 shows an example of requirements that can be generated at this website.

The next task is to put all of this information about digestion and nutrition into action and feed horses. The feeding of horses is covered in Chapter 13.

TABLE 12–6 Daily Nutrient Requirements for Mature Horses[1]

CONDITION	MATURE BODY WEIGHT (LB)	DIGESTIBLE ENERGY (MEGACALORIES)	CRUDE PROTEIN (GRAMS)[2]	CALCIUM (GRAMS)	PHOSPHORUS (GRAMS)	VITAMIN A (1,000 IU)
Mature horse (average)	440	6.7	252	8.0	5.6	6.0
	880	13.3	504	16.0	11.2	12.0
	1100	16.7	630	20.0	14.0	15.0
	1980	30.0	1134	36.0	25.2	27.0
Mature horse at moderate exercise	440	9.3	307	16.0	11.6	9.0
	880	18.6	614	28.0	16.8	18.0
	1100	23.3	768	35.0	21.0	22.5
	1980	42.0	1382	63.0	37.8	40.5
Mares, last 30 days of pregnancy	440	8.1	336	14.4	10.5	12.0
	880	16.2	673	28.8	21.0	24.0
	1100	20.2	841	36.0	26.3	30.0
	1980	36.4	1514	64.8	47.3	54.0
Mares, first month of lactation	440	12.7	614	23.6	15.3	12.0
	880	25.4	1228	47.3	30.6	24.0
	1100	31.7	1535	59.1	38.3	30.0
	1980	54.5	2763	106.4	68.9	54.0

[1]From Nutrient Requirements of Horses, by the National Research Council, 2007. (Using the information from this publication, nutrient requirements for various, sizes and conditions can be calculated at this website: http://nrc88.nas.edu/nrh/)

[2]One pound is equal to 453.6 grams.

TABLE 12–7 Daily Nutrient Requirements for Growing Horses[1]

CURRENT AGE AND CONDITION (MONTHS)	CURRENT BODY WEIGHT (LB)	ADG- (LB/DAY)[2]	DIGESTIBLE ENERGY (MEGACALORIES)	CRUDE PROTEIN (GRAMS)[2]	CALCIUM (GRAMS)	PHOSPHORUS (GRAMS)	VITAMIN A (1,000 IU)
Growing horses[3] 440 lb mature weight							
4	148	0.75	5.3	268	15.6	8.7	3.0
12	282	0.40	7.5	338	15.1	8.4	5.8
18 (moderate exercise)	342	0.24	10.0	362	14.8	8.2	7.0
24 (heavy exercise)	379	0.15	11.2	387	14.7	8.1	7.7
Growing horses 880 lb mature weight							
4	298	1.48	10.6	535	31.3	17.4	6.1
12	567	0.79	15.0	677	30.1	16.7	11.6
18 (moderate exercise)	684	0.51	20.0	725	29.6	16.5	13.9
24 (heavy exercise)	756	1.31	22.3	775	29.3	16.3	15.5
Growing horses 1100 lb mature weight							
4	370	1.85	13.3	669	39.1	21.7	7.6
12	708	0.99	18.8	846	37.7	20.9	14.5
18 (moderate exercise)	853	0.64	25.0	906	37.0	20.6	17.4
24 (heavy exercise)	946	0.40	27.9	969	36.7	20.4	19.3

[1]From *Nutrient Requirements of Horses*, by the National Research Council, 2007. (Using the information from this publication, nutrient requirements for various, sizes and conditions can be calculated at this website: http://nrc88.nas.edu/nrh/)

[2]One pound is equal to 453.6 grams.

[3]Moderate rate of gain

TABLE 12–8 Daily Mineral and Vitamin Requirements for a Mature 1100 Pound Horse[1]

NUTRIENT	MAINTENANCE (AVERAGE)	PREGNANCY	MODERATE EXERCISE
Sodium, g	10.0	10.0	17.8
Chloride, g	40.0	40.0	53.3
Magnesium, g	7.5	7.6	15.0
Potassium, g	25.0	25.0	32.0
Sulfur, g	15.0	15.0	16.9
Iron, mg[2]	400.0	400.0	450.0
Zinc, mg	400.0	400.0	450.0
Manganese, mg	400.0	400.0	450.0
Copper, mg	100	100	112.5
Iodine, mg	3.5	3.5	4.0
Cobalt, mg	0.5	0.5	0.6
Selenium, mg	1.0	1.0	1.13
Vitamin A, 1000 IU	15.0	30.0	22.5
Vitamin D, IU	3300.0	3300.0	3300.0
Vitamin E, IU	500.0	800.0	900.0
Thiamin, mg	30.0	30.0	56.5
Riboflavin, mg	20.0	20.0	22.5

[1]From *Nutrient Requirements of Horses*, by the National Research Council, 2007. (Using the information from this publication, nutrient requirements for various sizes and conditions can be calculated at this website: http://nrc88.nas.edu/nrh/)

[2]Parts per million (ppm)) = mg/kg = mg/2.2 lb.

2007 Nutrient Requirements of Horses

Title Page | Animal Specification | Dietary Supply | Other Nutrients | Program Info | Program Operation

Animal Specification

500 mature weight, kg

2.50% intake level, % BW

534 estimated actual weight, kg

0.41 estimated weight change, kg/d

- Adult at maintenance
- Stallion
- Growing
- Pregnant — 9 months of gestation
- Lactating
- Working/training

	Amt	DE	CP	Lys	Ca	P	Na	Cl	K
	kg	Mcal	g	g	g	g	g	g	g
Animal requirements		19.25	797	34	36	26	11.0	41.0	25.9
Dietary supply	0.00	0.00	0	0	0	0	0.0	0.0	0.0
Balance	–12.50	–19.25	–797	–34	–36	–26	–11	–41	–25.9
Densities (per kg DM) (12.50 kg intake)		1.54	6.4	0.27	0.29	0.21	0.09	0.33	0.21

FIGURE 12–8 **Example of nutrient requirements and dietary supply for balancing feeds for horses using the website of the National Research Council on Nutrient Requirements of Horses, http://nrc88.nas.edu/nrh/. Note: The top box allows the users to specify the type of horse being fed. The bottom box are the results.**

SUMMARY

The purpose of digestion and nutrition is to supply the horse with the proper amounts and kinds of nutrients for maintenance, growth, reproduction, lactation, and work. These nutrients include carbohydrates, fats, protein, minerals, and vitamins. Water is also an important part of proper nutrition. Carbohydrates, fats, and protein provide energy, which is measured in calories. Protein in the diet also provides amino acids, which are the building blocks for protein in the body of the horse. Depending on the quantity in the body, minerals are classified as macrominerals or microminerals. Minerals become a part of the skeleton, function in energy production, and become a part of enzymes. Vitamins are either fat-soluble or water-soluble. Forages contain vitamins, and some vitamins are produced by microoganisms in the digestive tract. Vitamins serve in biochemical reactions that influence how the other nutrients are used in the body. Deficient, out-of-balance, or excess nutrients can reduce production and/or lead to health problems.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Carbohydrates are made up of amino acids.
2. Macrominerals supply most of the energy in the diet.
3. Vitamin A is a fat-soluble vitamin.
4. Fats contain more energy than proteins or carbohydrates do.
5. A lactating mare needs more energy than a pregnant mare in the early stages of gestation does.

Short Answer

6. Name four fat-soluble vitamins and six water-soluble vitamins.
7. List five macrominerals and five microminerals.
8. Name five conditions that alter the energy requirements of a horse.
9. Give two terms used to express energy in a feed and two terms used to express protein in a feed.
10. What other element is always associated with sodium in the diet?

Critical Thinking/Discussion

11. Compare the energy needs of a mature mare that is being maintained to those of a mare that is lactating and a mare that is working out each day.
12. What is a calorie?
13. Describe two functions of protein in the diet.
14. Explain the importance of the calcium-to-phosphorus ratio.
15. Describe the symptoms of three vitamin deficiencies.

STUDENT ACTIVITIES

1. Obtain five samples of high-protein feeds common to your area. Take these samples to a laboratory for protein analysis.
2. Fecal material is a reality of any livestock production operation. Research the differences or similarities in the composition of horse, sheep, beef, and dairy fecal waste.
3. Compare the nutrition information contained on a cereal box for humans to the information contained on a feed tag for horses. What did you learn about human nutrition?
4. Obtain feed labels from horse, dairy, pig, and chicken feed. Compare the contents of each and compare the price.
5. Collect samples of horse feed and develop a display using small bottles or plastic bags. Label the type of feed and its protein, energy, and mineral content. Use a feed composition table to find this information.
6. Develop a report or presentation on the digestion of protein, carbohydrates, fats, or fiber in horses.
7. Use the nutrient calculator at The National Academies website (http://nrc88.nas.edu/nrh/) and report on your findings.

ADDITIONAL RESOURCES

Books

Asimov, I. (1954). The chemicals of life. New York: New American Library.

Briggs, K. (2007). *Understanding equine nutrition: Your guide to horse health care and management*. Lexington, KY: Blood-Horse Publications.

Cheek, P. R. (2004). *Applied animal nutrition: Feeds and feeding* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Committee on Nutrient Requirements of Horses, National Research Council. (2007). *Nutrient requirements of horses* (6th ed.). Washington, D.C.: The National Academies Press.

Frandson, R. D., Wilke, W. L., & Fails, A. D. (2009). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.

Kahn, C. M. (Ed.), & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

Kahn, C.M., & Line, S. (2007). *The Merck/Merial manual for pet health: The complete pet health resource for your dog, cat, horse or other pets - in everyday language*. Whitehouse Station, NJ: Merck & Co.

Pavia, A., & Gentry-Running, K. (2008). *Horse health and nutrition for dummies.* Hoboken, NJ: Wiley, Publishing, Inc.

Vogel, C. (2011). *Complete horse care manual.* New York, NY: DK Publishing, Inc.

Worth, M. (2004). *Storey's guide to feeding horses: Lifelong nutrition, feed storage, feeding tips, pasture management.* North Adams, MA: Storey Publishing.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

amino acids	energy requirements of horses	nutrition of horses
colic	fat-soluble vitamins	trace minerals
digestion of fiber	microminerals	vitamins
digestion of horses	minerals	
digestive system		

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for

CHAPTER 13

Feeds and Feeding Horses

The greatest expense of owning a horse is the feed. This can be lessened by keeping a healthy horse, feeding a balanced ration according to need, and purchasing feeds that meet the needs of the animal.

OBJECTIVES

After completing this chapter, you should be able to:

- Identify and describe sources of hay
- List and describe sources of concentrates
- Describe how to feed roughages and concentrates
- Name and describe sources of proteins
- Explain how horses are fed according to their activity level
- Make feeding recommendations or management suggestions
- Describe some typical rations for horses at different stages and activity levels
- Calculate the nutrient level of a mixed feed using a feed composition table
- Discuss how to feed minerals
- Describe the addition of vitamins to a ration

KEY TERMS

azoturia
bloom
bolt
bulk
dry matter
creep feeding
forage
heaves
legume
Monday morning disease
palatable
pasturing
rotational grazing
roughage
silage
stocking rate
supplement
trace-mineralized salt

DETERMINING WHAT TO FEED

In balancing rations, the goals of a horse owner are to:

- Furnish horses with a daily supply of nutrients in the correct amounts
- Supply palatable, easily obtained feedstuffs
- Provide feedstuffs economical for the conditions

By nature, horses consume **forage**. Under natural conditions, they spend several hours a day grazing. Basing rations on adequate amounts of good-quality roughage minimizes digestive disturbances such as colic. Supplementing hay or pasture with the correct amount of the right concentrates will meet all requirements for energy, protein, minerals, and vitamins.

Since individual horses vary considerably in their nutrient requirements, feeding horses is both an art and a science. But tables such as Tables 12–6, 12–7, and 12–8 in Chapter 12 provide a useful basis for formulating rations. Horse owners need to be able to read and understand these tables.

All horses require nutrients to maintain body weight and to support digestive and metabolic functions. In some cases they need additional nutrients for growth, work, reproduction, or lactation.

Tables of nutrient requirements for horses are expressed in two ways:

1. Daily nutrient requirements
2. Nutrient concentration in the feed (This may be expressed on an as-fed basis or on a **dry-matter** basis.)

Most horses receive their daily ration in two parts: **roughage** (hay, silage, and/or pasture) and concentrates. The concentrate portion contains grain and may include a protein **supplement**, minerals, and vitamins. It may also include bran, cane molasses, and/or dehydrated alfalfa.

The horse owner must decide:

- How much and what kind of roughage to feed
- The correct concentrate mixture and the amount of it needed to supply the nutrients not present in adequate amounts in the roughage

FEEDS FOR HORSES

Feeds for horses are discussed in five groups:

1. Roughages
2. Concentrates
3. Protein supplements
4. Minerals
5. Vitamins

Most grains and hays contain 88 to 90 percent dry matter. If a horse receives insufficient dry matter, it may become bored and chew on its stall or eat its bedding. If the feed has too much **bulk** (excessive amounts of fiber or water), the horse might not be able to eat enough to satisfy all its nutritional requirements for carbohydrates, protein, minerals, and vitamins.

Table 13–1 provides the composition of some common feeds for horses. Dry matter, digestible energy (DE), crude protein (CP), calcium (Ca), and phosphorus (P) content are listed for hays, concentrates and protein supplements, and mineral supplements.

TABLE 13–1 Nutrient Content of Selected Feeds for Horses (As-fed Basis)

FEEDSTUFF (INTERNATIONAL FEED NO.)	DRY MATTER (%)	DE. (MCAL/ LB)	TDN (%)	CRUDE PROTEIN (%)	LYSINE (%)	CA (%)	P (%)
Alfalfa, dehy, meal, 17% (1-00-23)	92	.89	47.2	17.4	.8	1.38	.23
Alfalfa, hay, s-c, early bim (1-00-059)	90	.90	48.1	18.0	.8	1.48	.19
Alfalfa, hay, s-c, full bim (1-00-068)	91	.87	43.6	15.5	.8	1.08	.22
Alfalfa, grazed (2-00-196)	26	.26	14.1	5.3	.2	.40	.07
Alfalfa-brome, smooth, grazed (2-00-262)	21	.21	10.7	3.9	–	.32	.08
Bahiagrass, hay, s-c (1-00-462)	90	.81	42.3	8.5	–	.45	.20
Barley, grain (4-00-549)	89	1.45	72.6	11.5	.4	.05	.34
Barley, hay, s-c (1-00-495)	88	.80	42.3	7.8	–	.21	.25
Barley, straw (1-00-498)	91	.57	28.1	4.0	–	.27	.06
Beet pulp, dried (4-00-669)	91	1.18	59.2	8.9	.5	.62	.09
Bermuda grass, hay, s-c (1-00-703)	91	.77	39.8	9.4	–	.43	.16
Bluegrass, Kentucky, grazed, early (2-00-777)	31	.29	15.4	5.4	–	.15	.14
Bluestem, big, grazed, early (2-00-821)	27	.26	13.4	3.6	–	.17	.05
Brewer's grains, dried (5-02-141)	92	.98	47.9	27.1	.9	.29	.51
Brome, smooth, hay, s-c (1-00-947)	90	.87	47.0	12.4	–	.34	.24
Brome, smooth, grazed, early (2-00-963)	27	.25	12.7	4.1	–	.20	.18
Canary grass, reed, hay (1-01-104)	89	.82	42.8	9.1	–	.32	.21
Clover, ladino, hay, s-c (1-01-378)	89	1.05	56.8	20.0	–	1.30	.30
Clover, red, hay, s-c (1-01-415)	88	.81	42.3	13.0	–	1.22	.22
Clover, red, grazed, early (2-01-428)	20	.19	9.4	4.1	–	.44	.07

(*continues*)

TABLE 13-1 (*continued*)

FEEDSTUFF (INTERNATIONAL FEED NO.)	DRY MATTER (%)	DE. (MCAL/ LB)	TDN (%)	CRUDE PROTEIN (%)	LYSINE (%)	CA (%)	P (%)
Corn, cobs, ground (1-01-782)	90	.57	27.8	2.8	–	.11	.04
Corn, grain (4-02-931)	87	1.54	77.4	8.8	.3	.02	.29
Corn, stover, w/o ears, s-c, mature (1-02-776)	85	.77	36.1	5.4	–	.49	.08
Corn, ensiled (3-20-506)	37	.55	27.6	3.1	–	.08	.09
Corn-and-cob meal, ground (4-02-849)	87	1.29	64.4	7.8	.2	.06	.24
Corn, distiller's grains, dehy (5-02-842)	93	1.29	64.4	27.8	.8	.09	.39
Cottonseed, meal, solv-extd (5-01-621)	91	1.23	61.6	41.3	1.7	.17	1.11
Fescue, meadow, hay, s-c (1-01-912)	88	.72	37.1	8.2	–	.33	.25
Lespedeza, hay, s-c (1-02-607)	90	.84	43.9	10.7	–	.93	.22
Linseed, meal, mech-extd (5-02-045)	91	1.26	62.8	34.5	1.2	.41	.87
Milk, skimmed, dried (5-01-175)	94	1.73	86.5	33.4	2.5	1.28	1.02
Molasses, sugar cane, liquid (4-04-696)	74	1.11	55.5	4.3	–	.74	.08
Oat, grain (4-03-309)	89	1.35	67.6	11.8	.4	.08	.34
Oat, hay, s-c (1-03-280)	91	.74	38.0	8.6	–	.29	.23
Oat, straw (1-03-283)	92	.84	44.2	4.1	–	.22	.06
Orchardgrass, grazed (2-03-442)	24	.18	9.3	3.0	–	.06	.09
Orchardgrass, hay, s-c (1-03-438)	90	.77	40.0	10.5	–	.37	.23
Prairie, midwest, hay (1-07-956)	94	.71	35.7	5.6	–	.37	.14
Rye, grain (4-04-047)	88	1.41	70.4	12.0	.4	.06	.32
Sorghum, grain (milo) (4-04-444)	89	1.44	72.0	10.0	.2	.04	.30
Soybean, meal, beans, solv-extd (5-04-604)	90	1.47	73.8	45.7	2.8	.30	.69
Soybean, seeds, heat-processed (5-04-597)	93	1.60	80.0	36.6	2.2	.26	.61
Soybean, oil (4-07-983)	100	3.30	170.0	–	–	–	–
Soybean, hay, s-c (1-04-558)	89	.79	41.4	14.1	–	1 13	.22
Soybean, straw (1-04-567)	88	0.58	28.5	4.6	–	1.39	.05

(*continues*)

TABLE 13-1 *(continued)*

FEEDSTUFF (INTERNATIONAL FEED NO.)	DRY MATTER (%)	DE. (MCAL/ LB)	TDN (%)	CRUDE PROTEIN (%)	LYSINE (%)	CA (%)	P (%)
Sunflower, seed, w/o hulls, meal, solv-extd (5-04-739)	92	1.30	65.3	45.2	1.7	.42	.94
Timothy, grazed, midbloom (2-04-905)	29	0.23	11.6	2.7	–	.11	.09
Timothy, hay, s-c, head (1-04-883)	89	.94	50.6	8.6	–	.32	.20
Trefoil, birdsfoot, hay, s-c (1-05-044)	91	.87	45.8	13.9	–	1.54	.21
Wheat, bran (4-05-190)	89	1.00	49.5	15.4	.6	.13	1.13
Wheat, grain (4-05-211)	89	1.55	77.4	13.0	.4	.05	.45
Wheat, hay, s-c (1-05-172)	89	.76	39.8	7.7	–	.13	.18
Wheat, straw (1-05-175)	91	.72	36.8	3.3	–	.16	.04
Whey, dried (4-01-182)	93	1.56	78.0	13.1	.9	.85	.76
Yeast, brewer's, dried (7-05-527)	93	1.40	69.8	43.4	3.0	.14	1.36
Bone meal, steamed (6-00-400)	96	–	–	–	–	27.7	12.9
Dicalcium phosphate (6-01-080)	98	–	–	_	–	21.8	18.5
Diammonium phosphate (6-00-370)	98	–	–	(17%N)	–	–	20.0
Limestone, ground (6-02-632)	100	–	–	–	–	37.1	–
Monosodium phosphate (6-04-288)	94	–	–	–	–	–	24.2
Rock phosphate, raw (6-03-945)	100	–	–	–	–	35.0	13.0
Rock phosphate, defluorinated (6-01-780)	100	–	–	–	–	32.0	16.9

ROUGHAGES

Adequate amounts of roughage in the ration decrease the risk of colic and laminitis. Roughage also helps maintain the correct calcium-to-phosphorus ratio, because roughages—especially legume hays—are high in calcium and because grain is low in calcium. Rations should always contain more calcium than phosphorus. Calcium-to-phosphorus ratios between 1.1:1 and 2:1 are within an acceptable range. Even higher calcium levels can be tolerated. However, when phosphorus levels are higher than calcium levels, severe skeletal abnormalities may result.

Adequate hay in the ration of horses kept in stalls also is beneficial because they eat it over a longer time span than they do grain. This helps prevent vices such as wood chewing.

A good rule of thumb is to feed at least 1 pound of hay per day for every 100 pounds body weight of the horse. A 1,000-pound horse would be fed about 10 pounds of hay per day. Mature, idle horses in good condition, fed excellent hay in increased quantities (about 2 pounds per 100 pounds of body weight), may do well without grain added to their ration. Growing or working horses, mares during late pregnancy, and mares during lactation need grain and other concentrates in addition to the roughage.

Hays

The most important consideration in selecting a dry roughage is that it be free of dust and mold. Otherwise, **heaves** and colic may result. Early-cut hays, properly cured, are preferred. They can be identified by color, head development on grass hays, leaf-to-stem ratio, and size of stems in legumes. Bales should be broken to check for dust and moldy odor.

Idle adult horses that are confined will eat about 15 to 20 pounds of good-quality mixed hay daily when no grain is fed. Feeding just what the horse will eat takes some experience and observation. Table 13–2 provides guidelines for feeding hay to a mare in a dry lot or stall.

Legume Hays. **Legume** hays are higher in protein and minerals and are more palatable than grass hays. They make excellent horse feed and should be included in the rations of young growing animals, breeding animals, and many adult working horses.

Alfalfa. When properly cured, alfalfa is nutritionally the best of the legumes. Its high protein, calcium, and vitamin content make it especially useful in balancing rations for broodmares and young, growing horses. Some halter-show people make extensive use of top-quality alfalfa in show rations, especially with horses that are finicky about eating.

Some alfalfa hay may contain blister beetles, so hay should be carefully examined. If the beetles are eaten by a horse, severe illness or even death can result.

Clovers. Many varieties of clover are used alone or in combination with grass hays for horses. Red clover is similar to alfalfa and can be substituted for it, usually with slightly less-beneficial results. It is lower in protein and usually has a higher ratio of stems to leaves than alfalfa. Properly cured Alsike clover is a good hay for horses.

TABLE 13-2 Average Amounts of Good-Quality Hay to Feed to a Mare in Dry Lot or Stall

BODY WEIGHT (LBS)	DAILY AMOUNT OF HAY (LBS)
800	12 to 16
900	14 to 18
1,000	15 to 20
1,100	17 to 22
1,200	18 to 24
1,300	20 to 26

Lespedeza. When cut early, lespedeza makes an excellent hay. It is higher in protein than red clover. The calcium content is about half that of alfalfa. When lespedeza is cut late, many leaves are lost from shattering, and the stems become wiry and low in digestibility.

Grass Hays. Grass hays yield less per acre and are lower in protein, calcium, and vitamins, but they are less likely to be moldy and dusty than legume hays. They are usually cut too late to yield quality hay and often are priced higher than their feeding value justifies.

Grass hays (Figure 13-1) often are grown and harvested in mixtures with legumes to produce an excellent combination suitable for almost any kind of horse feeding program.

Timothy. No other hay has had the lasting popularity of timothy. Its wide range of climatic adaptability, ease of curing, bright color, and freedom from dust and mold make it the horse owner's favorite. Since it is low in protein, it is a better feed for mature work horses than for stallions, mares, or young, growing stock. If it is fed as the only roughage, it should be supplemented with protein or fed with a high-protein grain such as oats instead of corn. Special effort need not be made to obtain timothy; it can be satisfactorily substituted for in all horse rations. Mature, late-cut timothy is a poor feed for any class of livestock.

FIGURE 13–1 **Horses in a corral feasting on hay.**

Prairie grass. Some horse owners substitute prairie hay satisfactorily for timothy. However, it is lower in protein, less bright in color, and usually less palatable than timothy.

Bromegrass. Bromegrass makes good horse hay. It is palatable when harvested in the bloom stage.

Orchard grass. Orchard grass is much like bromegrass but not quite as satisfactory.

Cereal grasses. Cereals make good hays when cut early. They should be cut in the soft to stiff dough stage. They are seldom cut early enough. Oats, barley, wheat, and rye hays are preferred, in that order. Extensive use is made of these in the Pacific Coast region.

Fescue. Fescue hay infected with endophyte fungus causes reproductive problems in mares if fed during late pregnancy. It is also low in energy, and horses don't like it very much. If harvested before it gets too mature, however, it usually works for mature geldings or open mares, providing they have adequate supplementation.

Silage

Various types of **silage** can be used to replace half of the hay ration. It must be of good quality, free of decay or mold, and chopped fine. Good corn silage is preferred, but grain sorghum and grass silage can be used. It should be worked slowly into the rations of mature idle horses, growing horses, broodmares, and stallions. It is too bulky for hardworking animals and foals. Legume haylage can replace silage with equal or superior results. The cost for haylage for most horse owners is too high unless they combine it with a cattle-feeding program.

Pastures

Grass is the natural feed for horses (Figure 13–2). No one feedstuff is as complete in nutrients as green pasture grown on fertile soil, and few feeds are fed in a more healthful environment. Grass reduces costs, provides succulence in the ration, and furnishes minerals and vitamins that are sometimes lacking in other feeds. However, hardworking horses need supplemental energy feeds because of the high water content of grass. Dry grass is usually low in protein and vitamins, and heavy stocking rates pose a parasite problem.

Pasturing can reduce stable vices caused by boredom or mineral deficiencies. Pasture rotation reduces the problem of parasites. **Rotational grazing** will also reduce patch grazing; placing minerals away from the water source encourages more evenly distributed grazing (Figure 13–2). A horse requires 2 to 5 acres of pasture for maintenance. Table 13–3 can be used to determine the **stocking rate** for horses on pastures, that is, the number of horses per unit of land area.

Animal units in Table 13–3 describe a pasture based on a horse's needs. For example, a 10-acre pasture may have a carrying capacity of 3 animal units. This means it can provide feed for three 1,100-pound horses in a maintenance condition, but it can provide feed for less than two lactating mares (3/1.8). Lactating mares represent 1.8 animal units because of their increased nutritional needs.

FIGURE 13–2 **Pasturing and rotational grazing are good feeding practices.**

TABLE 13-3 Pasture Stocking Rate for 1,100-Pound Mare

CONDITION	ANIMAL UNITS[1]
Maintenance	1.0
Light work (2 hours/day)	1.4
Medium work (2 hours/day)	1.8
Last 90 days of pregnancy	1.1
Peak lactation	1.8

[1] Animal units describe the carrying capacity of a pasture.

Factors such as forage species, season, environmental moisture, fertilization, and length of time that horses have access to the pasture affect proper stocking rates. Denser stocking rates reduce the average daily gain. Yearlings on properly stocked, high-quality, well-managed Bermuda grass can be expected to gain 1 to 1.2 pounds of body weight per day, which is equal to moderate growth rate recommendations for yearlings. Expected gains on small grains are less for yearlings (0.8 to 1 pound per day), possibly due to the intake of large amounts of water.

Stocking rate recommendations based on unit amounts of available forage per unit amount of animal can be difficult to understand. Usually, requests are made for stocking rates based on the number of horses per land area. However, differences in horse weight and use make it difficult to give recommendations for specific situations. Under controlled circumstances, stocking rates as intense as one mature, non-producing horse to 1 to 1.5 acres of thick, productive Bermuda grass at 4 to 6 inches of growth can be used. The same stocking rates on small grains would require 6 to 7 inches of plant growth. Pastures that have less-dense or shorter forage or those that are not as intensively managed will require more acreage per horse. If horses are kept in unimproved, native grass pastures, they commonly need 5 to 10 acres per horse.

Recommendations for managing grazing of horses include the following:

1. Forage must be of high quality for optimal nutrient utilization.
2. Do not overestimate the amount of forage available when determining stocking rate. Trees, sacrifice areas (trampled areas), overgrazed areas, and brush must be considered.
3. Available forage will change due to season of the year and amounts of rainfall received.
4. Allow forage to grow to an acceptable height before providing access to grazing (Bermuda grass, 3 to 6 inches; cool season annuals, 6 to 8 inches).
5. Rotate pastures by removing horses periodically.
6. Decrease sacrifice areas (all forage killed) by frequently relocating feed troughs in pastures of adequate size.
7. Horses accustomed to a hay-grain diet should be gradually introduced to an all-forage diet. If a horse's digestive tract is not given a chance to adapt to this dietary change, colic or founder may result.
8. Use proper pasture management and grazing management practices to economically produce and maintain horses.

Proper grazing and forage management practices allow pastures to be used to their full potential for horses.

Concentrates

Concentrates are high-energy feeds. Grains are concentrates used with hay to regulate energy intake and ensure that nutrients are sufficient to meet the work, growth, or reproductive performance required of the animal. Medium-sized, hardworking horses may need as much as 12 pounds or more of grain and an equal amount of hay daily to maintain body weight, whereas idle adult horses may get fat on grass alone.

Horses like grain. Some even **bolt** it to the point of choking. Most grains are improved by grinding or rolling, but none should be ground fine. Frequent feedings in small amounts are preferred, with at least a half-hour's rest for tired horses before grain is fed. Continued heavy grain feeding during a day off can cause a serious disease called **azoturia (Monday morning disease)**. In general, grain rations should be cut in half and hay increased on days that working horses are idled. Substituting one or more grains for others needs to be a gradual process. Grains for horses include oats, corn, grain sorghum, barley, wheat, wheat bran, and cane molasses. Table 13–4 provides some guidelines for feeding grain with hay or pasture.

Oats

Oats are the grain of choice for most horse owners and horses (Figure 13-3). The bulky nature of oats permits horse owners maximum liberty in their use with minimum danger of digestive disorders. Even the pickiest horses find oats to their liking. Oats are higher in protein (around 12 percent crude protein) than most grains, which makes them useful with low-protein grass hays. However, half-legume hay ensures a more complete ration when oats are fed as the only grain. Some disadvantages are

TABLE 13-4 Amount of Hay and Grain to Be Fed to a 1,100-Pound Mare during Late Gestation

	ALFALFA		GRAZING OR GRASS HAY	
	HAY	GRAIN MIX (10% CP)[1]	HAY	GRAIN MIX (14% CP)
STATUS	POUNDS	POUNDS	POUNDS	POUNDS
Open or early to mid-pregnancy	17 to 22	–	17 to 22	–
Pregnant (9 months to term)	14 to 15	5 to 6	14 to 15	6 to 7
Early lactation (0 to 3 months)	14 to 15	10 to 12	14 to 15	12 to 14
Late lactation (>3 months)	14 to 15	6 to 7	14 to 15	7 to 8

[1] CP = Crude protein.

FIGURE 13–3 Working horse taking a break to enjoy a bucket of oats.

expense on a digestible energy basis and variability in quality. Federal grades are No. 1, No. 2, No. 3, No. 4, and Sample. Grades 1 and 2 are the best buy. Although oats are an excellent horse feed, when cost and/or convenience dictate, most rations can be formulated satisfactorily without them.

Corn

Corn is a good feed that is used extensively in the Midwest. About 15 percent less corn would equal a given weight of oats in energy value. For this reason, corn is especially useful for improving the condition of thin horses and maintaining condition of those at hard work. It is often a good buy on an energy basis, even exceeding hay on occasion.

Because of its high energy content and low fiber, corn must be fed with more care than oats to avoid colic. Corn and oats, in equal parts, make an excellent grain ration. Corn can supply all of the grain when fed according to the work that horses are performing and when large amounts are not given at one time.

Some people call corn a "heating" feed in warm weather. This theory is not easy to explain, because "heat" produced by digestion is greater for fibrous feeds, such as hays and oats, than for corn. Probably a major reason is that horses eating corn tend to stay fatter than others, especially if they are not regularly exercised.

Grain Sorghum

Grain sorghum can be substituted for corn in most rations. It varies in protein content from 6 to 12 percent, it has little vitamin A, and some varieties are unpalatable. Grain sorghum is best when used in a grain mixture. In some areas, grain sorghum is often a better buy than corn. It should be cracked or rolled.

Barley

Barley is a very satisfactory feed when ground and fed as described for corn. Fifteen percent wheat bran or 25 percent oats fed with barley almost eliminates the risk of colic.

Wheat

Wheat is seldom fed to horses except in the Pacific Northwest. It can be fed as a part of the grain ration—about one-third—when fed with a bulky feed. Wheat should be rolled or coarsely ground. Wheat tends to be doughy when moist and produces palatability problems (Figure 13-4).

FIGURE 13–4 **Concentrate feeds–wheat, corn and soybeans. Note: oil is extracted from soybeans leaving soybean meal.**

Wheat Bran

Wheat bran is highly **palatable**, slightly laxative, and very bulky. Horse owners have long preferred "bran mashes" for animals stressed by extreme fatigue, foaling, or sickness. Bran is reasonably high in protein, high in phosphorus, and, like other grains, low in calcium. Because of its high energy cost, it is generally used at levels of 5 to 15 percent of the ration.

Cane Molasses

The addition of 5 to 10 percent molasses reduces dust and increases palatability of a ration. Greater amounts will have too great a laxative effect. It is very low in protein and usually expensive on an energy basis. Dried molasses is often added to the grain ration to increase consumption.

Protein Supplements

The horse's need for protein is relatively low and easy to meet with practical rations. Except for milking mares, most 600- to 1,200-pound horses need from .75 to 1 pound of digestible protein (DP) daily. If the roughage is half-legume hay fed in adequate amounts, the protein need will be met. However, supplementing rations of young growing horses is insurance against a deficiency and stimulates appetite. The hair coat of horses being fitted for show will **bloom** to a higher degree when about 1 pound of an oil meal is supplied daily. However, large amounts will cause a laxative effect (Figure 13–5).

Protein supplementation is needed when poor-quality, late-cut grass hays are fed. Some of the protein supplements used for horses are linseed meal, soybean meal, and cottonseed meal.

FIGURE 13–5 **Good nutrition produces a healthy, active horse with a good hair coat.**

Feedstuff Rules of Thumb

Nutrition is a complex topic. For the novice, remembering everything can be difficult. Specific information can be learned from books, tables, and people. General rules of thumb are helpful and easy to remember.

Here are some rules of thumb about the nutrient content of feedstuffs for horses.

- **Rule #1 for Energy:** Total digestible nutrients (TDN), or calories, for hay is about 50 percent; for grains it is about 75 percent.
- **Rule #2 for Protein:** The protein content for alfalfa and clovers (legumes) is about 14 to 16 percent; for grasses it is 7 to 10 percent.
- **Rule #3 for Minerals:** Legumes are rich in calcium; grasses are fair. All forages are low in phosphorus. Grains are high in phosphorus, but low in calcium.
- **Rule #4 for Vitamins:** Forages are high in vitamins; grains are low.

Four rules are easier to remember than entire feed tables. Of course, when accurate information is needed, feed tables and laboratory tests should be consulted.

Linseed Meal (30 to 32 percent protein)

"Old process" or "expeller-type" linseed meal was considered by horse owners to be effective in blooming the hair coat. It contained a fatty acid (linoleic) that may be deficient in standard horse rations. "New process" or "solvent" processing removes this fatty acid from linseed meal. Because linseed meal is not well balanced in amino acids, use of solvent process is hard to justify. Fitters of show horses who use legume hay may find the laxative effect of linseed meal too intense for their programs.

Soybean Meal (42 to 50 percent protein)

Soybean meal is a preferred supplement for horses. It is higher in protein, has a better balance of amino acids, and in the Midwest it is cheaper than other supplements.

Cottonseed Meal (40 to 45 percent protein)

Cottonseed meal is used extensively for horses in the Southwest. It seldom costs less than soybean meal in the Midwest and is not as palatable, so the extent of its use is limited.

Commercial Protein Supplements

These vary in composition, protein level, and price. They often contain needed minerals and vitamins and are convenient for those who do not wish to formulate their own horse rations. Some may be expensive. Commercial supplements are usually formulated for a specific feeding program. They should be fed according to directions.

Other Protein Supplements

Alfalfa meal, corn gluten meal, meat meals, and others can be used as protein supplements for horses.

Minerals

Trace-mineralized salt contains no calcium, and phosphorus and dicalcium phosphorus are not a source of selenium, manganese, or other trace minerals. A horse has a natural craving for salt, but has neither an appetite for nor an instinct to

FIGURE 13–6 **Dapple grey horse enjoying a trace mineralized salt lick.**

seek out sources of calcium or phosphorus. Limestone and dicalcium phosphate are rich but unpalatable sources. Therefore, the way to supplement horses with calcium or phosphorus is to mix them with trace-mineralized salt, limestone or dicalcium phosphate. Trace mineralized salt licks (blocks) can also be used for horses (Figure 13–6).

Vitamins

Most, if not all the vitamin needs of horses are supplied by levels naturally occurring in grains and forages. Green forages are good sources of vitamins A and E. While most if not all of the horse's maintenance requirement for vitamin A is met by forages. Vitamin A needs increase during production and growth such that supplementation may be necessary. Needs for vitamin A are the largest, followed by Vitamins D and E. Given access to sunshine and exercise, most horses will not need Vitamin D supplementation unless they are rapidly growing or preparing for heavy exercise at young ages. The B vitamins are thought to be produced in sufficient amounts to supply the needs of most horses. Rations for heavily worked horses might need to be supplemented.

Commercially prepared horse feeds routinely supplement fat soluble and water soluble vitamins at levels above suggested requirements, so the need for on-site supplementation is not necessary. Excess intake of fat-soluble vitamins A and D is detrimental since fats, and the substances soluble in them, are poorly excreted from the body. Excessive intake of water-soluble vitamins is rarely detrimental as water-soluble substances are readily excreted from the body. Vitamin premixes must be fed only at levels recommended on the label. Also, before adding a premix the amount of vitamins in the feed must be accounted for.

WATER

Water is not often thought of as a nutrient, although lack of water intake causes illness and death much more quickly than feed nutrients. Water requirements vary with losses, so horses housed in hot environments or those losing large amounts through sweat, respiration, or milk will need more water than nonproducing or sedentary horses. Intake is more in hot environments, with larger feed intake or larger horses.

With the possible exception of the extremely hot horse immediately following hard exercise, water should be offered free choice. Extra intake of water is easily expelled through urine. Voluntary water intake varies considerably between horses and by the same horse on different days. Water consumption should be monitored whenever possible so normal intake levels can be assured and observed. Sources must supply fresh, clean water supply, as contaminants may decrease voluntary intake or contain products harmful to the health of the horse.

COMMERCIAL FEEDS

Commercially prepared feeds may actually provide nutrients such as trace minerals, vitamins, and protein supplements in a less-expensive form than the individual horse owner can provide.

But a word of warning: Aside from providing adequate nutrition, no nutrient or supplement will (a) make the hoof grow faster and stronger; (b) cure a curb, spavin, ringbone, etc.; (c) increase conception in mares or libido in stallions; (d) increase intelligence; (e) prevent colic; or (f) cure heaves, sleeping sickness, and equine infectious anemia (EIA). In short, horse owners should not be fooled into buying magic from a bottle or a can.

SAMPLE RATIONS

Based on the information in this chapter, the following sample rations can be modified to fit the needs of individual horses and horse owners. Tables 13–5 through 13–8 provide sample rations for a foal, a weanling, a 2-year-old, a pregnant or lactating mare, and an adult horse. Information for each ration provides the amount of each ingredient needed to make a half-ton or a ton of feed. The amounts can be adjusted mathematically to make smaller or larger amounts of feed.

Table 13–5 provides a sample ration for a **creep-feeding** foal. This ration should not be used after weaning because it is too high in protein and calcium unless it is fed with a nonlegume hay (Figure 13–7).

Table 13–6 is an example of a ration for a weanling horse. This ration is lower in protein and calcium but higher in energy than the ration in Table 13–5.

The example ration shown in Table 13–7 is lower still in protein and calcium than the rations in either Table 13–5 or 13–6. If a mare is obese in late pregnancy, she does not need grain and can be maintained on a good-quality hay.

The ration example in Table 13–8 is too low in protein, calcium, and phosphorus for weanlings and lactating mares. It is marginal for mares in late pregnancy.

TABLE 13–5 Foal Creep Ration

INGREDIENTS	POUNDS TO MAKE ½ TON	POUNDS TO MAKE 1 TON
Oats (crimped or crushed)	440	880
Corn (coarsely cracked)	220	440
Soybean meal (44 percent)	240	480
Molasses (liquid)	70	140
Dicalcium phosphate	15	30
Limestone	10	20
Salt (trace mineral)	5	10
Vitamins A, D, E to supply 4,000 IU/lb	–	–
Total pounds	1,000	2,000

Notes: Crude protein in the diet is 18 percent.

Calcium in the diet is 0.88 percent.

Phosphorus in the diet is 0.60 percent.

Feed this grain ration free-choice with good legume hay to foals from 2 weeks old to weaning or to early weaned foals from 3 to 8 months old.

FIGURE 13–7 **Clydesdale foal and mare. Care must be taken when planning the care and feeding of foals.**

TABLE 13–6 Weanling Horse Ration

INGREDIENTS	POUNDS TO MAKE ½ TON	POUNDS TO MAKE 1 TON
Oats (crimped or crushed)	440	880
Corn (coarsely cracked)	270	540
Soybean meal (44 percent)	190	380
Molasses (liquid)	75	150
Dicalcium phosphate	10	20
Limestone	10	20
Salt (trace mineral)	5	10
Vitamins A, D, E to supply 4,000 IU/lb	–	–
Total pounds	1,000	2,000

Notes: Crude protein in the diet is 16.31 percent.

Calcium in the diet is 0.75 percent.

Phosphorus in the diet is 0.55 percent.

Feed this grain ration to weanlings. Add good legume or at least half-legume hay at the rate of 1 to 1½ pounds of grain per 100 pounds of body weight. Feed hay free-choice.

TABLE 13–7 Yearling, Two-year-old, Late Pregnancy, and Lactating Mare Ration

INGREDIENTS	POUNDS TO MAKE ½ TON	POUNDS TO MAKE 1 TON
Oats (crimped or crushed)	440	880
Corn (coarsely cracked)	340	680
Soybean meal (44 percent)	130	260
Molasses (liquid)	70	140
Dicalcium phosphate	5	10
Limestone	10	20
Salt (trace mineral)	5	10
Vitamins A, D, E to supply 4,000 IU/lb	–	–
Total pounds	1,000	2,000

Notes: Crude protein in the diet is 14.3 percent.

Calcium in the diet is 0.61 percent.

Phosphorus in the diet is 0.43 percent.

Feed this ration at the beginning of the yearling year with good legume or at least half-legume hay or good pasture. Regulate intake to control the desired degree of condition. Four to 8 pounds daily should be adequate.

As growing horses approach 18 months of age, nonlegume hay is adequate with enough grain to maintain condition.

TABLE 13–8 Adult Horse, Early Pregnancy, and Late Two-year-old Ration

INGREDIENTS	POUNDS TO MAKE ½ TON	POUNDS TO MAKE 1 TON
Oats (crimped or crushed)	500	1,000
Corn (coarsely cracked)	390	780
Soybean meal (44 percent)	30	60
Molasses (liquid)	65	130
Dicalcium phosphate	3	6
Limestone	7	14
Salt (trace mineral)	5	10
Vitamins A, D, E to supply 4,000 IU/lb	–	–
Total pounds	1,000	2,000

Notes: Crude protein in the diet is 11.0 percent.

Calcium in the diet is 0.43 percent.

Phosphorus in the diet is 0.36 percent.

This ration is designed for adult and 2-year-old idle and working horses and for mares until the last 3 months of pregnancy. It may be fed with either legume or nonlegume hay, but nonlegume hay will result in fewer digestive upsets with hardworking horses eating large amounts of grain.

CALCULATING NUTRIENTS

Formulating an adequate ration for a horse is simple if these steps are followed:

1. Know what the horse requires (see Tables 12–6 and 12–7).
2. Know what kind of feed will fill those requirements economically (Table 13–1).
3. Know what feeds are palatable.
4. Know how much of a given feed the horse can eat.
5. Know how to calculate the amount of a nutrient in a feed.

The most common feeding problem confronting horse people is figuring what percentage of a given nutrient is in a mixed ration. Referring to tables will show how much protein, digestible energy, or calcium is in corn or oats but will not be specific for a mixed feed of unequal parts of corn, oats, and soybean meal. To figure the nutrient content of a mixed grain ration, simply multiply the pounds of each of the feedstuffs in the mixture (corn, oats, soybean meal, etc.) by the percentage of the nutrient (digestible energy, protein, calcium, etc.) that each feed contains. Total the amounts obtained and divide by the number of pounds of feed in the mixture. This procedure provides a weighted average.

A Sample Calculation

For example, what is the protein content of a feed that contains 500 pounds of oats, 400 pounds of corn, and 30 pounds of soybean meal? To find the protein content of a mixed feed:

1. Find the protein content of each of the feedstuffs in Table 13–1.
2. Multiply this value by the number of pounds of that feedstuff in the mixture.

3. Next find the total pounds of protein in the feed mixture.
4. Finally, divide the total amount of protein in the feed mixture by the total weight of the feed mixture and convert this to a percentage.

The following example shows how.

Feedstuff	Protein in Feedstuff		Pounds Feedstuff in Mix		Protein in Mix
Oats	11.8%	×	500	=	59 lbs
Corn	8.8%	×	400	=	35.2 lbs
Soybean meal	45.7%	×	30	=	13.7 lbs
Total			930		108.2 lbs

$$\frac{\text{108 lbs of protein in mix}}{\text{930 lbs of feed mix}} \times 100 = \text{11.6 percent protein in the mixture}$$

This process will work with the digestible energy, calcium, and phosphorus of the feed mix.

The common error is to add up the protein content of the corn, oats, and soybean meal and divide by 3. But if corn and oats constitute 90 percent of the mixture, they naturally have a greater effect on the average composition than soybean meal, which makes up only 10 percent of the mixture.

FEEDING MANAGEMENT RECOMMENDATIONS

Because feeding horses is as much an art as it is a science, the following guidelines will help horse owners successfully feed their horses.

1. Feed only quality feeds.
2. Feed balanced rations.
3. Feed half the weight of the ration as quality hay.
4. Feed higher protein and mineral rations to growing horses and lactating mares.
5. Feed legume hay to young, growing horses; lactating mares; and out-of-condition horses.
6. Use nonlegume hays for adult horses.
7. Regulate the hay-to-grain ratio to control condition in adult horses.
8. Feed salt separately, free-choice.
9. Feed calcium and phosphorus free-choice.
10. Keep teeth functional. Horses 5 years and older should be checked annually by a veterinarian to see if their teeth need floating (filing).
11. See that stabled horses get exercise—they will eat better, digest food better, and be less prone to colic.
12. Feed according to the individuality of horse. Some horses are hard keepers and need more feed per unit of body weight.
13. Feed by weight, not volume. A gallon of two different grains may vary in nutrient content.

14. Minimize the use of finely ground feedstuffs in a prepared ration. If a ration is ground fine, horses will be reluctant to eat it and the chances of colic will increase.
15. Offer plenty of good water, no colder than 45 F. Free-choice water is best. Horses should be watered at least twice daily.
16. Change feeds gradually. When changing from a low-density (low-grain), high-fiber ration to one of increased density, change gradually over a period of a week or more.
17. Start horses on feed slowly. Horses on pasture should be started on dry feed gradually. Start this on pasture if practical, and gradually increase the feed to the desired amount in a week to 10 days.
18. Do not feed grain to tired or hot horses until they have cooled and rested, preferably for 1 or 2 hours. Instead, feed hay while they rest in their blankets or out of drafts.
19. Feed before work. Hungry horses should finish eating at least an hour before hard work.
20. Feed all confined horses at least twice daily. If horses are working hard and consuming a lot of grain, three times is mandatory.
21. When feeding hay, give half the hay allowance at night, when horses have more time to eat and digest it.

SUMMARY

Feeding horses is part art and part science. High-quality roughages form the basis for feeding horses. The nutritional needs of the horse change depending on its condition, activity level, age, gestational stage, or lactation. Additional nutritional needs can be met by feeding concentrates and protein supplements. The ration of a horse may also need mineral supplementation to cover its calcium, phosphorus, and other mineral requirements. Some vitamins may be added from a premix. Horse owners can make their own rations or buy commercially prepared feeds.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Founder in horses can occur on lush pasture.
2. Legume hays are low in protein.
3. Oats are the horse’s favorite grain.
4. Feed changes for horses should occur slowly.
5. Commercial feeds can cure all ills of the horse.

Short Answer

6. How many acres of pasture does a horse require for maintenance?
7. List the five groupings of feeds for horses.
8. List five types of hay for horses.
9. Identify five horse feeding/management recommendations.
10. If a horse is working hard, how many times a day should it be fed?

Critical Thinking/Discussion

11. What is the role of roughage in the horse's diet?
12. How does the horse owner supplement horse rations with minerals?
13. Explain the five guidelines or steps for formulating a ration for a horse.
14. What is an advantage of stable feeding? Of pasture feeding?
15. Using Table 13–1, calculate the digestible energy, protein, and calcium content of a feed that contains 600 lb of oats, 200 lb of corn, and 30 lb of soybean meal.
16. Define the term *dry matter.*

STUDENT ACTIVITIES

1. Identify in a diagram the external and internal structures associated with the digestive system of the horse. (Use Chapter 5 as a guide.)
2. Obtain samples of protein feeds, for example, soybean meal, cottonseed meal, and commercial protein supplements. Use published composition tables (such as Table 13–1) and compare each feed. Observe differences in the smell, texture, etc. Compare the costs. Share this information in a presentation.
3. Use a computer program to balance the diet of a racehorse or a pregnant mare. Figure the cost of the diet.
4. Contact suppliers of horse equipment to obtain information on feeders and compare the different types.
5. Collect fresh samples of some typical horse feedstuffs and determine their dry-matter content. Weigh the samples at collection time. Dry (do not cook) these samples in an oven and weigh them again. Use the data generated to calculate the percentage of dry matter.
6. Collect and display various feed samples. Use these samples to develop a feed identification test.

ADDITIONAL RESOURCES

Books

Briggs, K. (2007). *Understanding equine nutrition: Your guide to horse health care and management.* Lexington, KY: Blood-Horse Publications.

Cheek, P. R. (2004). *Applied animal nutrition: Feeds and feeding* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Committee on Nutrient Requirements of Horses, National Research Council. (2007). *Nutrient requirements of horses* (6th ed.). Washington, D.C.: The National Academies Press.

Lewis, L. D. (1996). *Feeding and care of the horse* (2nd ed.). Media, PA: Williams & Wilkins.

Pavia, A. & Gentry-Running, K. (2008). *Horse health and nutrition for dummies.* Hoboken, NJ: Wiley, Publishing, Inc.

Pilliner, S. (2009). Horse nutrition and feeding. Ames, IA: Wiley Blackwell.

Vogel, C. (2011). *Complete horse care manual.* New York: DK Publishing, Inc.

Worth, M. (2010). *The horse nutrition handbook.* North Adams, MA: Storey Publishing.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

concentrates	grass hays	protein supplements
feeding horses	horse rations	roughage
feeding management of horses	legume hays	silage
forage for horses	pastures for horses	supplements
	poisonous plants	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 14

HEALTH MANAGEMENT

All horse owners want their horses to be healthy, to look good, and to be physically fit. Most have a sense that these three things are connected. But in what ways? How can an owner or trainer tell whether a horse is healthy just by looking at it? What does a healthy horse look like? And, once the state of a horse's health is determined, what can be done to improve and maintain it? These are good questions. The problem is that almost every horse owner would answer them differently.

OBJECTIVES

After completing this chapter, you should be able to:

- Define terms associated with disease conditions
- Discuss disease resistance and immunity
- Define terms associated with the severity of a disease or condition
- Describe immunization
- Discuss how a vaccination program relates to immunity
- List signs of disease
- Discuss common diseases caused by viruses
- Discuss common diseases caused by bacteria
- List five noninfectious diseases
- Identify three zoonotic diseases of horses
- Describe the signs of good health in a horse
- List the objectives for first aid for horses
- List four digestive diseases
- List five respiratory diseases
- Discuss laminitis and colic
- Relate body condition to health

KEY TERMS

active immunity
agglutination
antibiotics
antibodies
antigen
capillary refill
condition score
disease
humoral immunity
hydration
immunocompromised
immunoglobulins
infectious
lesions
morbidity
mutagens
noninfectious
passive immunity
passive transfer
rotavirus
titer
toxins
vaccines
zoonosis

SIGNS OF HEALTH

For the horse owner or anyone working with horses, the first step in health management is learning to recognize a healthy horse. Disease can then be recognized and treated early.

Healthy horses show good body condition. Other ways to quickly assess the health of a horse include evaluating its general appearance and behavior, examining specific parts of the body (such as hoofs and eyes), observing its manure and urine, and measuring vital signs such as heart rate, respiratory rate, and temperature.

Normal Body Condition

Body condition refers to the amount of fat cover on horses. A scoring system that assesses fat cover has been designed to gauge reproductive efficiency in mares. An evaluation—or **condition score**—based on this system can also serve as a guide to judging the nutritional status of all horses. This system is presented in Table 14–1.

Most horses should score between 4 and 6. Scores lower than 4 or higher than 6 on this scale could indicate metabolic and other health problems.

When using the scoring system, the following factors need to be considered:

1. Accuracy will increase if the areas of fat accumulation can be palpated.
2. Long hair may mask the appearance of fat.
3. Different body conformations affect the ability to visually determine body condition.
4. Taller, larger-framed horses with prominent withers may appear to be leaner than shorter, smaller-framed horses with similar body conditions.
5. Mares in late gestation may have less fat cover over the ribs due to the influence of the weight of the fetus and associated tissues. More emphasis should be placed on other locations of fat accumulation.
6. Horses on high-percentage forage diets will typically have larger bellies with lower, distended abdomens than will horses being managed on grain or in exercise programs. These “hay bellies” can give the appearance of fat, causing overestimation of body condition.
7. Periodic reevaluations of individual horses will help to decrease the influence of conformational differences in body condition assessment.

Body condition cannot be altered significantly in short periods of time. Gains in body weight must be made with gradual increases in the ration. The horse’s body requires time to assimilate increases of energy into fat. Also, the incidence of colic and founder will increase when making dramatic adjustments in the amount of the daily ration. Increasing a mature horse’s body condition from a score of 3 to a score of 6 may take up to 4 months when consuming about 1.75 percent of body weight in grain per day and unlimited hay.

TABLE 14–1 Horse Condition Scoring System

SCORE	CONDITION DESCRIPTION
1	**Poor.** Animal extremely emaciated. Spinous processes, ribs, tailhead, and point of hip and point of buttocks project prominently; bone structure of withers, shoulders, and neck easily noticeable; no fatty tissue can be felt.
2	**Very thin.** Animal emaciated. Slight fat covering over the base of spinous processes; transverse processes of the lumbar vertebrae feel rounded; spinous processes, ribs, tailhead, and point of hip and point of buttocks prominent; withers, shoulders, and neck structures faintly discernible.
3	**Thin.** Fat built up about halfway on the spinous processes; transverse processes cannot be felt; slight fat cover over the ribs; spinous processes and ribs easily discernible; tailhead prominent, but individual vertebrae cannot be identified visually; point of buttocks appear rounded but easily discernible; point of hip not distinguishable; withers, shoulders, and neck accentuated.
4	**Moderately thin.** Slight ridge along back; faint outline of ribs discernible; tailhead prominence depends on conformation, but fat can be felt around it; point of hip not discernible; withers, shoulders, and neck not obviously thin.
5	**Moderate.** Back is flat (no crease or ridge); ribs not visually distinguishable but easily felt; fat around tailhead beginning to feel spongy; withers appear rounded over spinous processes; shoulders and neck blend smoothly into body.
6	**Moderate to fleshy.** May be slight crease down back; fat over ribs spongy; fat around tailhead soft; fat beginning to be deposited along the side of withers, behind shoulders, and along the sides of neck.
7	**Fleshy.** May have crease down back; individual ribs can be felt, but there is noticeable fat between ribs; fat around tailhead soft; fat deposited along withers, behind shoulders, and along neck.
8	**Fat.** Crease down back; difficult to feel ribs; fat around tailhead very soft; area along withers filled with fat; area behind shoulder filled with fat; noticeable thickening of neck; fat deposited along inner thighs.
9	**Extremely fat.** Obvious crease down back; patchy fat appearing over ribs; bulging fat around tailhead, along withers, behind shoulders, and along neck; fat along inner thighs may cause them to rub together; flank filled with fat.

Other Signs of Good Health

Observing horses at horse events like shows, races, and other competitions is another good way to establish a standard for what is normal.

A bright, actively interested horse can be recognized at a glance (Figure 14–1). It will be alert, inquisitive, and attentive. It will not have the dull, lethargic look that can indicate overtraining, overuse, or ill health.

When in pastures, lots, and paddocks, horses normally will try to stay in a group, so one off by itself may be hurt or ill. Normal, healthy horses also chew evenly with both sides of their mouth and show predictable enthusiasm for eating.

Hair Coat

A shiny, glossy hair coat is one of the best indicators of a healthy horse. Hair coat reflects good nutrition and health and certainly can be improved by regular grooming.

Courtesy USDA

FIGURE 14–1 **Thoroughbred racehorses coming down the home stretch at the Maryland State Fair.**

Hoof Growth

Normal, healthy horses have healthy hoof-wall tissue. The wall should grow at a rate of 1⁄4 to 1⁄2 inch per month. The hoof should be smooth and uncracked, forming a straight line with the front of the pastern when viewed from the side.

Eyes

The eyes should be bright, fully open, and clear, without discharge or a glazed, dull appearance.

Hydration

The water balance of a horse is vital to its health. A skin-fold test can be done by pinching a fold of skin on the neck, pulling it out, and recording the number of seconds the skin takes to return to its normal position. One-half to 1 second is normal; longer means the horse is dehydrated.

Feces/Urine

Horses normally have firm fecal balls that are not loose and watery and do not show undigested grains and other feedstuffs. Urine is normally wheat-straw colored and not cloudy or dark red.

Mucous Membranes

The membranes of the horse's gums and lips should be a healthy pink. Pale, white, yellow, or deep purple colors are all cause for concern.

TABLE 14–2 Signs of Health in the Horse

SIGN	NORMAL
Temperature	99.5°F to 101.5°F
Heart rate	32 to 48 beats per minute
Respiratory rate	8 to 16 breaths per minute
Mucous membranes	Pink color
Capillary refill time	1 to 2 seconds

Capillary Refill

A horse's circulation can be assessed by gently pressing a thumb against the gums of the horse and counting the number of seconds it takes for the color to return to the area once the thumb is removed. One to 2 seconds is normal.

Heart Rate

The normal heart rate of an adult, resting horse is 32 to 48 beats per minute. This will vary with the age of the horse, ambient temperature and humidity, exercise, and excitement levels.

Respiratory Rate

The normal respiratory rate of an adult, resting horse is 8 to 16 breaths per minute. Exercise, ambient temperature, humidity, fever, distress, pain, and anxiety will increase the respiratory rate.

Temperature

The normal body temperature of a horse is 99.5°F to 101.5°F. High environmental temperature, exercise, or dehydration can increase this by 2 to 3 degrees (Table 14–2).

Body Weight

Regardless of body type and breed, the nutritional requirements, medical dosages, and management practices vital to maintaining healthy horses are based on body weight.

This is one area where observation, no matter how close, is not sufficient. The only way to get an accurate, reliable weight for a horse is to weigh it. A horse's weight can vary by as much as 60 pounds, depending on how recently it has eaten, drunk, urinated, and defecated.

Overweight horses are more common than malnourished ones, but the health of the horse is compromised in either case. Health management begins with proper feeding to meet the horse's nutritional needs and keep it in top physical condition.

MANAGING HEALTH THROUGH PROPER NUTRITION

The nutritional requirements of horses depend on their exercise level, reproductive state, age and growth rate, and mature body weight. These must be determined in order to feed horses properly. Determinations must be based on the actual use and

Photo courtesy Cathy Esperti

FIGURE 14–2 **Mare rescued from a negligent owner. At the time of her rescue she had lost a tremendous amount of weight and muscle tone, and her health suffered. The spots on her back were caused by rain rot. After being well cared for she regained her normal weight and good health. Providing the mare with basic necessities of food, water, and shelter would have kept her healthy.**

condition of each horse, not on good intentions or wishful thinking by the owner. Each horse is different and needs to be fed according to its individual temperament, metabolic rate, and genetic makeup (Figure 14–2).

Feeding Classification

Nutritional requirements and proper feeding of horses were covered in Chapters 12 and 13. The basic feeding classifications to ensure good health include maintenance, pregnancy, lactation, growth, and work.

Maintenance

The horse in this feeding classification is mature, maintaining its body weight. It is not pregnant, lactating, breeding, or being exercised. The nutritional requirements are very low relative to other classifications.

Pregnancy

Nutritional requirements during the first 8 months of pregnancy are the same as for a mare being maintained. However, during the 9th, 10th, and 11th months of pregnancy, the mare's requirements increase 11 percent, 13 percent, and 20 percent, respectively.

Lactation

During the first 3 months after foaling, mares can produce milk equivalent to 3 percent of their body weight every day and 2 percent per day during months 4 to 6. Feeding requirements are above maintenance during lactation.

FIGURE 14–3 **Welsh pony mare and foal. Growing foals require plenty of free exercise and high-quality feed.**

Growth

Growing foals require feeds of higher quality than those for maintenance. Growth rate and age of the foal determine the requirements. Horses are considered to be growing for up to 30 months, and for longer in the slower-maturing breeds. Optimum growth rates for various breeds have not been well defined; but overfeeding can cause developmental orthopedic diseases, and underfeeding can cause permanent stunting (Figure 14–3).

Work

Horses being exercised or worked require more nutrients, especially energy, than do horses being maintained. As the intensity or duration of the work increases from light to moderate to intense, energy requirements increase 25 percent, 50 percent, and 100 percent above maintenance, respectively.

Essential Nutrients

Horses need the same basic nutrients that humans do: water, energy, protein, minerals, and vitamins. In horses, as in humans, too much or too little of any of these essentials can lead to serious health problems.

Water

Horses need a good supply of clean water daily. Water is essential for all body functions, including temperature regulation and feed digestion. The amount of water needed depends on exercise level, ambient temperature, quality of the feeds in the ration, and proportion of the diet that is forage. A minimum of 1 gallon of water per 100 pounds of body weight per day should be provided, but free access to cool, clean water is best in most situations.

Energy

The nutrients in a horse's rations primarily determine its weight and condition. Energy is derived primarily from carbohydrates, fats, and any protein excesses. Energy is needed for body functions, including maintenance, temperature regulation, digestion, and work.

All energy provided beyond what the body needs goes toward the formation of fat. A deficiency of energy will reduce the body condition score (fat) before the biological needs will be sacrificed. Prolonged deficiencies will result in unthriftiness and starvation. Excesses of energy can cause obesity, which can in turn cause many metabolic diseases such as laminitis (founder), osteochondrosis, epiphysitis, tying-up syndrome, and colic.

Protein

The body needs proteins for muscle and bone growth, milk production, fetal growth, and normal metabolism. Protein requirements of many horses, especially those in the maintenance, early pregnancy, and exercise classifications, can be met with good-quality hay or pasture forage.

Minerals

The development of bone and many essential reactions within the body require adequate levels of calcium, phosphorus, sodium, chloride, selenium, and other minerals. Many of these minerals can be adequately supplied with good-quality mixed hays or a mineral supplement in the concentrate mixture. Trace-mineralized salt with selenium should always be available.

Vitamins

Fat-soluble vitamins (A, D, E, and K) as well as water-soluble vitamins (B complex and possibly C) are required as coenzymes throughout the body for normal metabolism. Because forages are rich sources of vitamins, very few horses grazing good pastures or fed predominantly good hay are likely to need supplementation. High-stress situations may require vitamin B complex supplementation.

HORSE HEALTH PROGRAM

Keeping a horse healthy requires diligent attention to details. But prevention is always better than treatment.

General Program

Following are a few minimum guidelines essential for normal horse care. Horses vary widely in their metabolism and must be managed as individuals in regard to maintaining health. For more specific guidance and when questions arise or problems develop, owners should seek help from a veterinarian, extension agent, farrier, feed store operator, or some other equine professional.

1. Shelter from wind and weather with trees and a shed or barn is adequate in most climates. Much of the tradition about horse housing is for the owner's comfort, not the horse's.

2. To reduce chance of injury, a safe environment that is free of hazards such as nails, barbed wire, broken fences, glass windows, and unsecured pesticides should be provided.
3. Adequate clean water should be provided at least two times a day; free access to water is best.
4. A routine schedule of feeding and exercise should be maintained. Sudden changes in feeds, feeding schedule, or work/activity can cause lameness, colic, and muscle problems. Regular exercise, either free-choice or regulated, is important in maintaining athletic horses.
5. Horses are natural nibblers. They can be fed once a day but will be more efficient (digest more of their feed) if fed two or three times daily.
6. Horses should be fed at least 1.5 to 2.5 percent of their body weight per day in hay or pasture. Hay (forage) helps prevent intestinal problems and abnormal behavior (vices) caused by lack of fiber and boredom.
7. Commercial concentrate feed mixtures should be used if necessary to supply the nutrients needed. The concentrate should be selected to complement the hay or pasture composition. Feed should be fed based on weight, not volume.
8. Hays and feeds should be free of dust and mold.
9. When necessary, feeds should be changed gradually over a 10- to 14-day period.
10. Floating (filing) a horse's molars to decrease the sharp points that interfere with normal chewing is often needed. Regular dental checkups and floating will prevent mouth problems (Figure 14–4). Table A–14 outlines an equine dental program.
11. Horses should be dewormed regularly, and parasite load should be assessed with occasional fecal floatation tests and treated accordingly (see Chapter 15).
12. All horses should be on a regular vaccination schedule that includes tetanus.
13. Regular hoof care is important. Feet may need to be trimmed periodically if hoof growth exceeds wear, but it is not usually necessary to keep shoes on horses that are not in training or being ridden or driven on rough terrains (see Chapter 17).

FIGURE 14–4 Regular dental checkups prevent mouth problems.

American Association of Equine Veterinary Technicians and Assistants

The American Association of Equine Veterinary Technicians and Assistants (AAEVT; http://www.aaevt.org/) is a sister organization to the American Association of Equine Practitioners (AAEP; http://www.aaep.org/) and is a separate professional nonprofit organization. Membership in the AAEVT is open to all veterinary technicians, assistants, and support staff with an equine interest and those employed in the veterinary health care industry worldwide. Student membership is available for those currently enrolled in an American Veterinary Medical (AVMA)/Canadian Veterinary Medical Association (CVMA) accredited program of veterinary technology. The AAEVT offers equine oriented continuing education (CE) courses focusing on all aspects of equine practice geared toward the needs, experience level and interests all members. This association is a professional association and is not for the general horse owning public.

AAEVT offers an online Equine Certification Program through Animal Care Technologies (ACT; www.aaevt.4act.com).

AAEVT provides scholarships for those members interested in pursuing additional education through an AVMA/CVMA accredited veterinary technology program, or for those seeking to attend one of the AAVET Regional Symposiums, or for those enrolled in the AAEVT on line Equine Certificate Program.

AAEVT Mission: To promote the health and welfare of the horse through the education and professional enrichment of the equine veterinary technician and assistant.

The goals and objectives of the AAEVT include:

- To promote and provide continuing educational opportunities that are relevant and accessible to equine technicians and assistants
- To encourage and improve communications between equine technicians and assistants by creating a network so we can share ideas, find others with similar interest and areas of expertise, and post job opportunities.
- To be more informed on legislative matters that affect the equine veterinary community
- To educate the public and the veterinary profession as to the value and benefits gained by employing and supporting trained para-professionals
- To promote and maintain professionalism and ethical behavior for all equine technicians and assistants and to improve the development of the vocation
- To promote and maintain the professional relationship between the AAEP and members of the AAEVT
- To assist in providing the best medical attention and practices to improve the health and welfare of the horse
- To provide resource and leadership for the benefit of the equine industry and the veterinary community that serves it.

The online CE program with ACT is to provide basic to advanced training to those employed by the equine practitioner and those with an interest in the equine veterinary profession. AVMA accredited programs do not focus on the academics, skills, resources, and training required for proficiency as an equine veterinary assistant or technician; and since these skills are needed by the equine practitioner, the AAEVT will provide a certification program for the equine veterinary community outside of the accredited AVMA programs. Those who complete the program will be recognized as AAEVT Certified Equine Veterinary Technicians/Assistants.

IMMUNITY

The immune system forms the body's defense against a foreign substance, whether microorganisms (bacteria, fungi, viruses, protozoa, and parasites), a potentially toxic material (foreign protein, carbohydrate, or nucleic acid), or an abnormal cell (one invaded by a virus or that has become malignant). It attacks the foreign substance and maintains a memory of the invader so that a second exposure will provoke a greater, faster response.

Immunity refers to the ability of an animal that has recovered from a disease to remain well after a second exposure to the same disease. Immunology is the branch of medicine concerned with the body's response to foreign substances and abnormal cells; immunization is the ability to create a response to fight an illness without exposing the body to that illness.

Under normal circumstances the immune system responds to foreign organisms by producing **antibodies** and stimulating specialized cells that destroy the organisms or neutralize their toxic products. The immune system monitors the body's cells constantly to ensure that they are not abnormal. Cells infected with viruses or cells from another animal (even the same species) have protein markers on their outer membranes that signal the immune system to destroy them. The immune system also can recognize and eliminate malignant or abnormal cells within the body. These mutant, or cancer, cells may occur spontaneously, or they may be induced by certain viruses or chemicals (**mutagens**).

Cells and Tissues in the Immune Response

The immune system has two general responses: it activates cells to destroy a harmful cell with cell-to-cell interaction, or it activates other cells to produce large protein molecules called antibodies that bind to bacteria, yeast, some viruses, and even **toxins** (poison) and make them harmless. In many cases, both responses occur. To activate the immune cells, large cells called macrophages eat and partially digest the invading material and place pieces of it, called the **antigen**, on its surface (Figure 14–5). This attracts and activates T cells from the thymus.

Since the T cell and the antigen must fit together in order to bind, there are many different T cells to match the many antigens. If the T cells are what are called

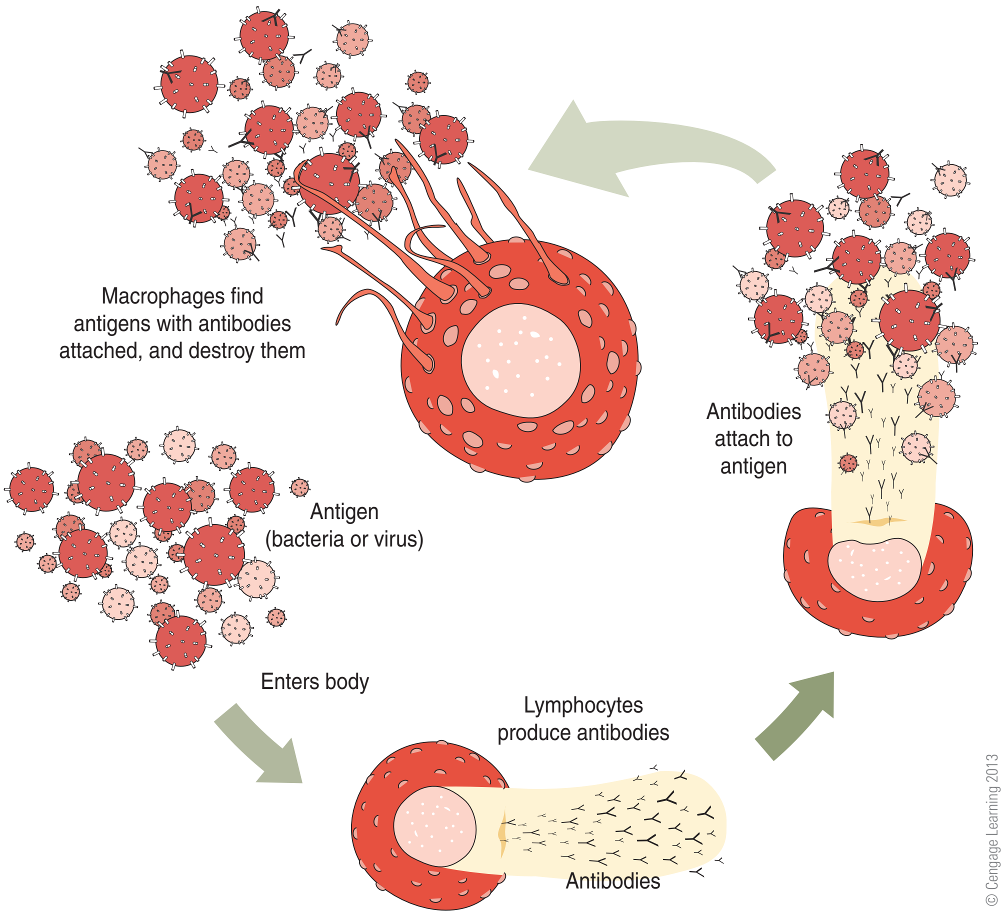


FIGURE 14–5 **The formation of antibodies—the immune response.**

the helper type, they will attract B cells, formed in the bone marrow, whose receptors must also match the antigen. The combination of antigen prepared by the macrophage and helper T cell will activate the B cell specific for that antigen, which multiplies to form a clone. The clone then begins to make antibodies. Other clonal cells form the immune memory for this antigen by remaining indefinitely in an alert state, ready to multiply again should the antigen appear in the future.

Antibodies control not only bacteria but also viruses, fungi, yeast, parasites, protozoa, and many toxic chemicals. In addition to helper T cells, there are killer T cells that can recognize a body cell that has been invaded by a virus and kill that cell so the virus cannot multiply.

Macrophages found throughout the tissues of the body and in the form of monocytes make up about 3 percent of white blood cells. Lymphocytes, two-thirds of which are T cells and one-third B cells, constitute 30 to 40 percent of white cells of the blood. T cells are also found in the thymus gland and in lymph nodes. B cells make up the cells of the outer portion of lymph nodes.

Antigens

An antigen is a substance that, when introduced into an organism, induces an immune response consisting of the production of a circulating antibody. This type of immunity is known as **humoral immunity**. Protein molecules are potent antigens. Within a few days after injection, an antigen summons large amounts of the antibody capable of interacting with it. The interaction of an antigen with its specific antibody does not involve the entire antigen but only small areas on its surface.

Antibodies

The molecules responsible for recognizing antigens on foreign molecules on cell surfaces are called antibodies. Antibodies are members of a related group of gamma globulin molecules known as **immunoglobulins** (Ig). A typical immunoglobulin is made of four protein chains joined together in two pairs.

Five classes of immunoglobulins exist, based on structural differences. These differences are identified by the Greek letters gamma, mu, alpha, delta, and epsilon, and the immunoglobulins that contain them are called IgG, IgM, IgA, IgD, and IgE, respectively. Each class has different biological and structural properties and is distributed throughout the body.

IgG, the most abundant immunoglobulin, occurs primarily in blood serum as well as throughout the internal body fluids. Produced in response to bacteria, viruses, and fungi that have gained access to the body, IgG is a major line of defense against such organisms.

Antibodies in Defense

The simplest and most prevalent means by which the immune system defends the body against bacteria and viruses is by the combination of a specific antibody with the antigens located on the surface of invading organisms. An aggregate of cells, called an agglutination, is formed by antibodies bound by one of their two combining sites to one cell, and to another cell by their other site. These aggregates are then engulfed and digested by the body's wandering scavenger cells, the macrophages. Antibodies also bind to toxic molecules (toxins) given off by microorganisms, forming large, insoluble aggregates (precipitates) that are also removed by macrophages. Antibodies also cover up the attachment sites of viruses, preventing their ability to infect cells. Precipitin and **agglutination** reactions are used as diagnostic tools for identifying and quantifying the antibodies of infectious organisms in blood samples and other body fluids.

The Newborn Foal

Because protective antibodies are too large to pass through the mare's thick placenta and into the foal's bloodstream, antibodies are not provided to the foal by the mare during gestation. Immunity for the foal is available only through the antibodies in the mare's first milk, the colostrum. The colostrum, however, is available for only 48 hours, after which it is replaced by normal milk, which has no immunity value. Ingestion of colostrum is the most critical factor influencing the foal's survival, growth, and future health.

The foal's ability to absorb antibodies from the colostrum through the lining of the duodenum of the intestine is based on the presence of special absorption cells in the small intestine. These special cells decrease rapidly over the first 24 hours of the foal's life. After 48 hours they are replaced with normal duodenal lining; a foal can absorb antibodies only during its first 2 days and absorbs most of them within its first 12 hours of life. The foal must receive colostrum during the critical first 12 hours of life to receive the antibodies it will need for immunity in the following 3 to 4 months (Figure 14–6).

Antibodies are passed from mare to foal through **passive transfer**. Occasionally a foal exhibits a failure of passive transfer; even though the antibodies are readily available in the colostrum, the foal is unable to absorb and use them. An immunoglobulin, IgG, test

Courtesy Rick Parker

FIGURE 14–6 **Foals nurse to receive colostrum from their mother.**

can be performed to identify failure of passive transfer of blood. An immunoglobulin level of less than 600 to 800 mg/dl (milligrams per deciliter) indicates a problem. Blood IgG levels below 400 mg/dl indicate a failure of passive transfer, and a veterinarian should be consulted.

Antibodies against certain diseases will be present in the mare's colostrum if she is vaccinated with booster injections 30 days before parturition. The mare should be vaccinated against all common diseases, because the colostrum can contain antibodies against only those diseases to which she has been exposed. Tetanus is one disease to which horses are extremely susceptible. If the mare has not been given a tetanus toxoid 30 days prior to parturition, then the foal should be given 1,500 IU of tetanus antitoxin at birth to protect it from the tetanus pathogen, which is ever present in equine feces.

No antibiotics or probiotics, such as special vitamin formulations, should be administered the first day of life in an effort to bolster the foal's vigor. These tend only to increase illness and diarrhea in the newborn foal.

Occasionally a mare does not produce milk in adequate quantities, produces poor-quality colostrum, leaks her colostrum, or dies. A source of frozen colostrum taken from other mares will give the foal the immune protection it needs. Milking 6 to 8 ounces of colostrum from all mares after their foals have suckled will provide a reserve that can be frozen. This resource should be on hand even if no problems are expected. When used, this colostrum should be slowly heated, not microwaved, to body temperature. Microwaving destroys the protein molecules that make the antibodies protective. The best colostrum sources will be from mares on the same farm as the foal in order to provide the most specific immunity. Nurse mares can be used as a source of milk.

Plasma transfusions can be used to raise the IgG levels in foals that are more than 24 hours old. Generally 1 liter of plasma is administered over a 30- to 60-minute period, depending on the foal's vigor. The best plasma source is from a horse living on the same farm as the foal. Commercial plasma sources are available, but the antibodies in this plasma may not be specific enough to give the foal adequate protection against the particular disease organisms in its immediate environment. Typically, a plasma transfusion of 1 liter raises the IgG level only 200 mg/dl. More than one transfusion may be needed for foals with very low IgG levels.

Premature Foals

Foals that arrive prematurely (before 320 days of gestation) are especially susceptible to risks from the environment and disease. Since their bodies are physiologically underdeveloped, they are unprepared, even with sufficient colostrum, to adequately resist disease. The lungs of premature foals are especially underdeveloped. They tend to have low body temperatures; are especially susceptible to colds, infections, and hypothermia; and require intensive care if they are to survive.

VACCINATIONS

Horses establish an immunity to a specific disease first by being exposed and then by developing their own antibodies to fight off that specific disease. A foal is born with no immunity (antibodies of its own), and the protection it first receives must come in the form of colostrum from its dam. This is termed **passive immunity**—when an animal receives antibodies that were produced by another animal. **Active immunity** is when an animal is challenged and stimulated to produce its own antibodies. This challenge is usually a disease that is present and introduces a foreign protein or antigen into the animal. If the horse has a high level of antibodies in its blood, the antibody **titer** (level) is said to be high for that specific antibody or disease.

Vaccinations are given to do one of two things:

1. Give the animal antibodies that were produced by another animal (passive immunity)
2. Challenge the horse with just enough antigen that it will build its own antibodies (active immunity)

In both cases, the object is to protect the vaccinated animal against a specific disease.

Vaccines contain either inactivated killed organisms or modified live organisms. The ideal vaccine:

- Prevents clinical signs of the disease
- Stimulates the immune response
- Produces durable immunity with a single dose
- Is safe with no side effects
- Is incapable of producing the disease
- Is stable during movement and storage
- Is economical

The efficacy of any vaccine can be influenced by the type of vaccine, site of action, normal antigenic variation, and age of the horse when vaccinated. Various stresses also reduce an animal's ability to respond to a vaccination.

Table 14–3 gives examples of vaccination programs and schedules for some common equine diseases (also refer to Tables A–10 and A–11).

A "standard" vaccination program for all horses does not exist. Each individual situation requires evaluation based these criteria:

- Risk of disease (anticipated exposure, environmental factors, geographic factors, age, breed, use, and sex of the horse)
- Consequences of the disease (**morbidity**, mortality, zoonotic potential)
- Anticipated effectiveness of the selected product(s)
- Potential for adverse reactions to a vaccine(s)
- Cost of immunization (time, labor, and vaccine costs) versus potential cost of disease (time out of competition; impact of movement restrictions imposed in order to control an outbreak of contagious disease; labor and medication if, or when, horses develop clinical disease and require treatment; or loss of life)

Horse owners should work with a local veterinarian to develop a vaccination program. Copies of the vaccination and health maintenance records should accompany the movement of horses. Owners of equine facilities should establish health entry prerequisites, including, vaccination history. Horses should be vaccinated no later than one month prior to entering or leaving such a facility in order to produce adequate antibodies before the anticipated exposure.

TABLE 14–3 A Suggested Vaccination Program

DISEASE	INITIAL VACCINE SERIES	BOOSTER
Tetanus	2 injections, 1 month apart	Annually or at time of injury
Influenza	2 injections, 2 months apart	Annually or every 3 to 4 months for horses at risk
Rabies	2 injections at 3 and 12 months of age	Annually
Eastern, Western, Venezuelan encephalomyelitis	3 injections at 3, 4, and 6 months of age	Annually, before onset of insect season
Rhinopneumonitis (equine herpesvirus Type I and IV)	2 injections at 3 and 6 months of age	Mares in 5th, 7th, and 9th months of pregnancy; every 3 to 6 months for horses in areas of risk
Botulism	3 injections, 1 month apart	Annually for broodmares; 1 month prior to foaling
Equine viral arteritis	1 injection	Mares and stallions; 3 weeks prior to breeding; inadvisable in late gestation
Strangles	2 to 3 injections, 1 month apart	Annually or prior to exposure
Potomac horse fever	2 injections, 1 month apart	Annual booster in May/June in high-risk areas
Anthrax	2 injections, 1 month apart	Annually to horses at risk of exposure
West Nile virus	2 injections, 4 to 6 weeks a part; pregnant mares 4 to 6 weeks before foaling	Annually
Rotaviral diarrhea	Pregnant mares 3 doses at 8, 9 and 10 months of gestation	NA

Based on information from: Art and Science of Equine Production, course number ASC 410, University of Kentucky.

CAUSES OF DISEASE

Disease is any condition of a horse that impairs normal physiological functions. Disease increases costs, reduces performance, and can limit growth in the young horse.

Two broad categories of disease affect horses: **infectious** and **noninfectious** diseases. Infectious diseases are caused by pathogenic organisms present in the environment or carried by other animals. In contrast, noninfectious diseases are caused by environmental problems, nutritional deficiencies, or genetic defects. Noninfectious diseases are not contagious and usually cannot be cured by medications. Noninfectious diseases are often a management problem.

Infectious Diseases

Infectious diseases are broadly categorized as parasitic, bacterial, and viral. Both internal and external parasites can affect horses (Figure 14–7). Parasitic diseases are discussed in Chapter 15.

FIGURE 14–7 Winter tick – an external parasite.

Bacterial diseases are often internal infections and require treatment with antibiotics. Bacterial diseases can also be external, resulting in erosion of the skin and ulceration.

Viral diseases are impossible to distinguish from bacterial diseases without special laboratory tests. They are difficult to diagnose, and no specific medications are available to cure viral infections. Immunization can protect horses from some viral diseases, but vaccines do not exist for all the viruses that cause disease in horses.

Noninfectious Diseases

Noninfectious diseases can be broadly categorized as environmental, nutritional, or genetic. Many nutritional diseases are caused by the lack of or excess of a nutrient. Many of these are described in Chapter 12. Environmental diseases include natural or human-made toxins in the environment. Genetic diseases are covered in Table 10–4 in Chapter 10.

DISEASES OF HORSES

For the purpose of discussion, following are some of the more common and/or serious diseases of horses. They are categorized as respiratory diseases, digestive diseases, and other common diseases of horses.

Respiratory Diseases

The principal use for most horses depends on their athletic ability, which requires physical soundness. Any disease that affects the respiratory system may potentially interfere with the horse's soundness of wind and thus its overall athletic ability.

Some disease conditions may interfere with respiratory health. Respiratory disease can affect horses of any age, and chronic problems may seriously reduce the usefulness of horses at maturity.

Respiratory diseases can be caused by bacterial or viral agents, anatomical problems, allergic responses, or a combination of these.

Sinusitis

In this condition, the sinuses of the horse's head become inflamed. Causes include infectious agents, structural problems, and tumors.

Sinusitis is rarely contagious unless it is caused by a specific virus or bacterium. The person who cares for the horse may notice a discharge from one or both nostrils.

This may be quite thick and tinged with blood, and frequently has a strong, unpleasant odor. Occasionally, the side of the horse's face may appear swollen.

Veterinarians diagnose sinusitis by physical examination, cultures of the discharges, X-ray examination, and sometimes by surgery accompanied by biopsy or the removal of a small piece of the involved tissue.

Prevention includes periodic examinations for abnormalities, an active immunization program to prevent infectious diseases, and periodic dental exams to prevent tooth disease from affecting the sinuses.

Palate Elongation

In this structural abnormality, the soft portion of the roof of the mouth extends too far back into the upper throat or pharynx, where it may interfere with breathing during strenuous exercise. Veterinarians diagnose the condition by examining the horse's throat with an endoscope, a flexible instrument with lights, that allows them to look into body cavities or spaces.

Horses cannot breathe through their mouths, due to the physical design of the pharynx. Elongation of the soft palate reduces normal airflow to the point that a horse becomes unable to tolerate hard exercise.

This is a developmental problem of the horse's anatomy. Treatment consists of surgically removing the excess portion of the palate.

Bleeders

EIPH, or exercise-induced pulmonary hemorrhage (bleeding), is a serious condition in equine athletes. Racehorses are most frequently affected. The more strenuous the exercise, the more frequently bleeding occurs.

The hemorrhage occurs in minute vessels in the lungs. Although seldom fatal, bleeding can interfere with the horse's breathing and result in what appears to be choking or difficulty obtaining air.

Since blood does not always appear at the nostrils, owners may not be aware that bleeding is occurring. In some horses, blood flows from the nostrils when they lower their heads.

Heaves

Allergic equine respiratory disease is primarily seen clinically as a condition called *heaves* by horse owners, or pulmonary emphysema by veterinarians. It resembles asthma or emphysema in humans. Horses suffering from heaves exhibit reduced tolerance to exercise, a frequent soft cough, a distinct push with the abdominal muscles when air is being expelled, and a crackling or squeaking sound over the lung fields that can be heard with a stethoscope.

The condition frequently follows a bout of respiratory disease accompanied by severe coughing. It sometimes appears suddenly with severe respiratory distress in bronchial asthma–like an attack. The condition usually is progressive. Frequently it is associated with feeding of roughage containing a large amount of dust, pollen, or mold spores.

Aside from avoiding feeds that cause the condition, preventive steps include a vigorous vaccination program against infectious respiratory disease. Prompt treatment and adequate rest are required until the horse recovers. Treatment is a combination of several procedures. Nonallergenic, dust-free feeds and as much green pasture turnout as possible is needed. This may be combined with antihistamines, bronchial dilators, and/or regularly decreasing doses of corticosteroids. Sometimes atropine or atropine-like drugs help in acute cases. Some degree of follow-up nursing care will be needed for the rest of the horse's life.

Rhinopneumonitis

Equine herpesvirus types 1 and 4 (EHV-1 and EHV-4) cause rhinopneumonitis. In susceptible horses, especially foals, it is an acute upper respiratory infection with severe nasal discharge. Direct contact spreads the virus between horses.

After exposure, susceptible horses may develop a temperature of 102°F to 107°F for up to a week. Other signs include depression, loss of appetite, a watery nasal discharge, and a mild cough. Immunized horses usually develop a milder infection or even an infection without any signs. Occasionally, the virus enters the central nervous system and causes mild to severe lack of coordination that can progress to total paralysis.

Pregnant mares without immunity to EHV may abort. Abortions usually occur from the 8th through the 11th month of pregnancy. Occasionally, weak foals are born but die shortly after birth. Mares abort without warning and breed back without difficulty. Although some specific signs may occur in aborted foals, laboratory diagnosis is best.

Prevention by immunity from either natural exposure or vaccination is relatively short-lived. Repeated exposure or repeated immunizations enhance protection (Figure 14–8).

Vaccination programs vary, but generally include vaccinating with either a modified live virus vaccine at 2- to 3-month intervals year-round or using the killed product at the 5th, 7th, and 9th month of pregnancy. No effective treatment is now known. Vaccinating foals at 90 days of age and repeating at 120 days of age reduces the clinical signs in foals.

FIGURE 14–8 **Some diseases require repeated immunizations to enhance protection.**

Horse farms must isolate pregnant mares and foals from contact with temporary stock. Show and racehorses returning to the farm or mares visiting for breeding are sources of infection. No other animals or humans are known to be affected by this virus.

Influenza

Influenza is an acute, highly contagious disease that causes a high fever and persistent cough. Flu is caused by at least two distinct myxoviruses that are widely spread throughout the horse population. Exposure occurs at shows, sales, races, trail rides, and other events where horses come together from different areas.

Following exposure to nasal discharges containing influenza virus, the susceptible horse develops a temperature of up to 107°F within 3 to 5 days. The fever may persist for up to 3 days. A hard, persistent cough develops early and persists for up to 2 to 3 weeks.

Secondary bacterial infections sometimes develop as a complication. Muscle soreness and stiffness are occasionally seen.

Good nursing care is the best treatment. This includes providing a soft, palatable, dust-free diet and fresh, clean water, while preventing drafts. Bandaging of legs and blanketing may help.

Horses should not return to work of any kind for 10 to 14 days after complete cessation of all flu symptoms. If the horse returns to work too soon, recurring bouts or other complications usually result.

Use of **antibiotics** or fever-controlling drugs is seldom needed and should only be done following a veterinarian's advice. Serious complications occur when a horse's symptoms are masked by medication, since the horse returns to work too soon.

A vaccine containing two inactivated viruses provides some prevention. An initial vaccination followed by a booster in 4 to 6 weeks is recommended. Follow-up boosters are given at 3- to 6-month intervals. The more likely the horses are to be exposed, the more frequent the boosters are recommended (Figure 14–9).

FIGURE 14–9 **Proper vaccinations keep these Clydesdale sisters healthy.**

Pinkeye

Viral arteritis, or pinkeye, is a separate viral disease that can cause respiratory symptoms along with swelling of the legs and abortion in pregnant mares. This usually is a sporadic disease spread by contact with infective nasal discharges.

Few horses die unless complications occur. Young or very old horses are most severely affected. Up to 80 percent of infected pregnant mares may abort. Severity apparently varies greatly between outbreaks.

Symptoms occur 1 to 8 days following exposure. Swelling and redness appear around the eyes, with flowing of tears and squinting. Horses are dull and go off their feed. Eyelids, legs, and the underside of the body become swollen. Some yellowing or jaundice may be noticed. Pregnant mares abort during or shortly after the fever occurs.

Complications can include fatal lung disease due to accumulation of fluid. This is especially dangerous if the horse has already had a lung disease.

Veterinarians diagnose viral arteritis by clinical signs and differentiating it from several other viral diseases.

Treatment in general consists of very careful nursing care. The specific treatment depends on the individual case. Vaccines are currently available. Prevention is best accomplished through good sanitation and isolation.

Strangles

This is a highly contagious abscess-producing infection caused by a specific streptococcus bacterium, *Streptococcus equi*. Pus from ruptured abscesses can contaminate the environment, including mangers, fences, and water tanks. This material remains infectious to other horses for months and is a major means of prolonging an outbreak of the disease on a farm.

Young horses are most frequently affected, but susceptible horses of any age may develop the disease following exposure. Stress created by hauling, weaning, weather changes, hard work, and poor nutrition all weaken a horse's defense. Outbreaks tend to be prolonged and may follow introduction of an apparently healthy carrier.

Only horses, mules, ponies, and related equidae (zebras and others) are susceptible. Other domestic animals and humans do not develop the disease.

Three to 6 days following exposure, infected horses stop eating. They may extend their heads and drool. Swallowing is painful. A temperature of 106°F is not unusual.

Swelling between the jaws and near the base of the ear may occur. These swellings enlarge, become soft, burst, and drain a creamy, blood-tinged pus within 5 to 7 days.

Once the abscesses drain, the temperature frequently returns to normal or near normal. During the period when the temperature is high, the horse appears very depressed and may lose a considerable amount of weight.

The entire course of the disease in an uncomplicated case takes 4 to 6 weeks. Complicated cases may be prolonged for months, with failure of lesions to heal, severe weight loss, and extensive abscess formation throughout the animal's body.

If new horses are added regularly to a herd, the disease can reoccur. The infection rate is high, with over 80 percent of exposed horses showing signs of the disease. Death losses usually are low if no complications occur.

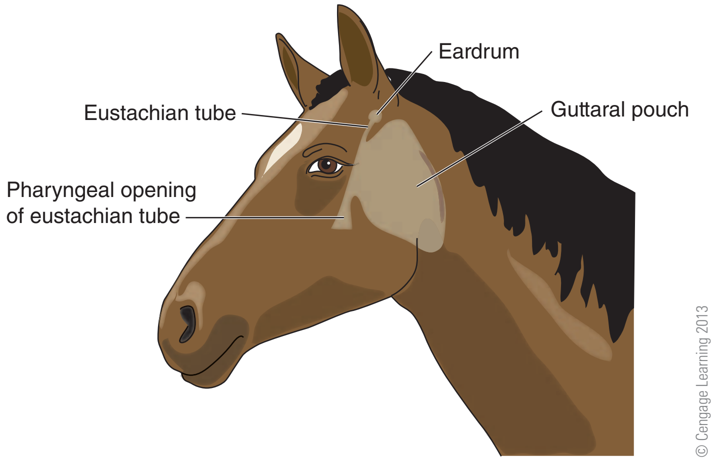


FIGURE 14–10 **Apart from the problem of long-term guttural pouch carriers, recovered horses may shed *Streptococcus equi* from their nose and in their saliva for up to 6 weeks following infection.**

Death may occur either from abscesses rupturing within internal organs or from choking due to large abscesses blocking the horse's ability to breathe or breaking into the horse's airway, resulting in suffocation.

After the apparent recovery of an affected horse, considerable rehabilitation time is necessary to avoid a flare-up of infections in the throat (guttural pouches) and development of internal abscesses; swelling of the legs, head, or abdomen; and joint infections, especially with foals and yearlings (Figure 14–10).

Veterinarians diagnose strangles by its clinical appearance plus culture and identification of the organism *Streptococcus equi.* Other streptococci can cause a similar but milder disease that resembles strangles.

Commercially available vaccines prevent strangles. Two or three injections at 1-month intervals are given deep in heavy muscles. Boosters are given annually. Vaccination of horses during an outbreak or while recovering from the disease can be disastrous. Only healthy, uninfected, unexposed horses should be vaccinated. More recently, intranasal (modified live bacteria) vaccines are also provided for use for the prevention of strangles.

Treatment is best determined by a veterinarian. Applying hot packs on forming abscesses, cleaning abscesses, and providing easily eaten feed and fresh, clean water are essential. Isolating infected animals in one spot and leaving them there until completely healed prevents widespread contamination from the contents of abscesses.

Streptococcus equi is highly sensitive to penicillin, but vigorous and prolonged treatment is necessary. Recommended doses of penicillin should be administered daily and for several days after the horse's temperature returns to normal. This usually requires treatment for a minimum of 10 to 14 days.

Discontinuing treatment too soon, reducing dosage, skipping days of treatment, or using inappropriate drugs or dosages are the most frequent causes of treatment failure.

Pleuropneumonia

This disease condition usually is the aftereffect of an earlier respiratory problem and can be caused by several different organisms. Inflammation develops in the tissues that line the chest cavity and surround the lungs. This space fills with fluid, debris, and infective bacteria.

Pleuropneumonia results from incomplete or improper treatment of a previous lung disease. In most cases, corticosteroids or other anti-inflammatory drugs were used. Occasionally, inadequate dosages of antibiotics or sulfa drugs were given, or treatment was not carried out for long enough.

Pleuropneumonia is usually considered a contagious disease. The condition is painful, and the horse is reluctant to move. Pressure over the chest area causes discomfort, and some horses act as though they have colic or abdominal pain.

The veterinarian diagnoses the disease by listening to the horse's chest with a stethoscope for abnormal lung sounds, by observing the horse's painful attitude, by noting sounds of increased density on percussion, and finally, by performing a chest tap—drawing fluid for examination.

Avoiding respiratory disease in horses is the best prevention. This includes providing a clean, healthy environment, ensuring a complete immunization and internal parasite control program, and avoiding undue stress. If respiratory disease occurs, prompt, appropriate treatment is necessary for the indicated length of time.

Treatment may consist of drainage by tubes surgically implanted in the chest, specific antibiotic treatment, and good nursing care.

Abscess Pneumonia

This is a serious disease of foals. The bacterium *Rhodococcus equi* causes heavily encapsulated abscesses to develop in the lung, where they displace lung tissue. In severe cases, extensive destruction of lung tissue occurs. The bacterium seems to be very irritating to tissue and causes severe tissue reaction.

Symptoms seldom are evident until the disease has progressed to a critical stage. In the early stages, only a dry, persistent cough is present. Veterinarians diagnose the disease in foals by the symptoms, cultures of the trachea (windpipe), and age of the foal (usually 4 to 8 weeks when the disease is first noticed).

As the disease progresses, the foal develops severe breathing difficulty. Any exercise worsens the condition. Rectal temperatures generally are in the 102°F to 104°F range.

Death is usually due to asphyxiation as lung tissue is destroyed. Foals that recover may show no aftereffects as adults, despite the severity of symptoms during the disease's course.

Abscess pneumonia appears to be increasing in frequency, and several colleges of veterinary medicine are studying the disease. No effective commercial vaccine is currently available for use in horses. Prevention is best accomplished by superior management, especially internal parasite control, dust control, avoiding overcrowding, increased use of pasture, and minimizing enclosed housing.

Treatment with antibiotics should be vigorous and prolonged. Foals that respond must be treated for extensive periods of time—twice daily for up to 6 weeks is a fairly common treatment schedule.

Hot, dry, dusty conditions tend to result in an increase in this condition. The disease is not felt to be highly contagious, since large numbers of foals in a group usually are not affected.

When respiratory disease complications occur, problems can become more serious or even fatal. These complications have various causes. For example, some drugs cause horses to appear better, but they suppress the horses' own defenses. The infection spreads and the condition worsens. Then secondary bacterial infections follow. Cultures and identification are necessary to treat these conditions specifically.

Adequate time for complete recuperation is absolutely essential. Green grass, fresh air, and being outside are all beneficial to recovery.

Digestive Diseases

Digestive diseases are a frequent problem of horses; insurance companies cite colic as the most frequent cause of death in horses insured against loss. The following is a discussion of some of the more frequently seen causes of digestive disturbance.

Problems in the mouth—the beginning of the digestive tract—can result in improper chewing of food, which can then hamper swallowing and digestion. Malformed mouth parts on newborn foals should always be evaluated. Some abnormalities may be repaired surgically, while others may be impossible to correct. Because many of these conditions are considered heritable, use of these animals as breeding stock should be discouraged.

Wry muzzle, cleft palate, and overshot or undershot jaws are all conditions affecting horses. Their importance depends on their severity. These problems not only affect eating, but can seriously interfere with the use of bits for control when the horse becomes old enough to train for riding or driving.

Since dental disease may occur at any age, horses should have their mouths examined twice yearly for dental abnormalities. Although caries, or cavities, are uncommon, abnormal or uneven wear is frequently observed and needs correction.

Young horses lose their baby teeth from 2 to 5 years of age. At times, these teeth are not shed normally, and it becomes necessary to assist in their removal. When sharp points develop along edges of the grinding or jaw teeth, they irritate the inside of the lips and edges of the tongue. These sharp points are filed down with specially designed files called floats.

Horse owners can recognize possible dental problems when horses begin chewing abnormally, twist their heads sideways, drop excessive feed from their mouths, or refuse to eat hard grains or pellets.

Foreign bodies in the mouth cause similar problems. Grass awns, pieces of wood or metal, corncobs, and other items may lodge in the mouth and interfere with eating.

Proper feeding practices, such as using only clean feed boxes and avoiding hay with foxtail or similar type awns (bristles) in it, can prevent foreign bodies in the mouth.

Choke

Choke is a condition in horses that occurs when feed becomes lodged in the esophagus. While choke seldom is life threatening, it is uncomfortable to the horse. Many horses become excited and lunge about, trying to dislodge the material causing the choke. In the process, they may injure their handler or themselves.

Choke usually occurs when horses attempt to eat too fast or are fed very finely ground or very dry feed. Grass clippings from lawns also can cause choke.

A horse with choke should be placed in a stall and allowed free movement of its head. Veterinarians usually attempt to remove a choke with a nasogastric tube and lavage, or flushing with water. Sedation may be necessary. Owners should not attempt to dislodge a choke themselves as injury to the esophagus or lungs may occur.

Horses that choke are prone to do it repeatedly. Such horses should be denied access to the type of feed or circumstances that may cause choking.

Use of large, flat-bottomed feed troughs or placing large rocks (softball size) in the grain box will slow down gluttonous eaters. Extremely dry or finely ground grain should not be fed. Adequate eating space also helps.

Colic

Colic is a broad term that describes a horse showing abdominal pain. This can be caused by a number of conditions.

When colic occurs, it is important to determine the exact cause if possible. Successful treatment often depends on a correct diagnosis. Any colic, no matter how mild, is an emergency. The potential for the condition to worsen is too great to risk delay in treatment.

A distended stomach, acute inflammation of the small intestine, parasites that cause decreased blood flow to the intestine, dry food impaction, or gas distention of the large bowel are all types of colic. The degree of severity as well as treatment required varies.

Owners first notice that a horse has colic when it stops eating and drinking. The horse may curl its upper lip, paw at the ground, and turn its head toward either side. More severe pain causes colicky horses to sweat, get up and down, and try to roll. The horse with colic indicates it is in severe discomfort.

Rapid breathing, profuse sweating, violent activity, and a cold, clammy feeling may indicate the horse has gone into shock and is in need of immediate professional attention.

Veterinarians attempt to diagnose the specific type and cause of colic. They use medication to control pain and the horse's response to help evaluate the severity of the condition. Reducing the pressure in the stomach is important; oral medication may be needed to lubricate a mass or prevent further gas distention.

Administering oral medication is dangerous and should be done only with great care. Any foreign material, including medicine, that accidentally enters the lungs can cause pneumonia.

In some cases, surgery is the treatment of choice. This means moving an extremely uncomfortable, sick horse to a veterinary hospital that has surgical facilities. The decision needs to be made as soon as possible, and necessary supportive treatment must be provided until the horse arrives at the hospital.

The most frequent causes of colic are internal parasites and sudden drastic changes in the feeding schedule, either in the amount or kind of feed. Autopsies of many horses that die from colic reveal related lesions due to internal parasites. Diarrhea, especially in young horses, can result in colic due to telescoping of the bowel. Any severe digestive upset has the potential to result in colic symptoms.

Prevention of colic includes:

- An ongoing parasite control program, especially for young animals
- Maintaining a regular feeding schedule using only quality feeds
- Avoiding sudden dietary changes in kinds or amounts of feeds
- Providing salt and clean, fresh water, free-choice at all times

Treatment of this emergency condition is best left to professional veterinary care.

Potomac Horse Fever

Acute infectious diarrhea syndrome, or Potomac horse fever, is a severe diarrhea condition of horses. Most affected animals are adults that may recently have been under stress. About 30 percent of horses with Potomac horse fever die.

Potomac horse fever seems to be caused by the bacterium *Ehrlichia risticii.* It can occur sporadically, with only one horse on a farm being affected. An arthropod carrier is suspected, but no particular species has been identified.

Most cases have occurred in Maryland, Virginia, and southeastern Pennsylvania, but similar cases have been reported in other areas of the country.

Infected horses become depressed, stop eating, and develop a profuse, watery diarrhea. Some horses will have a fever of up to 105°F before the diarrhea starts. With continued diarrhea, the affected horse becomes weaker and develops signs of shock. The disease does not seem to be contagious and does not affect humans.

Treatment to replace fluids and control the diarrhea must begin as soon as possible. Large volumes of intravenous fluids and antidiarrheals are necessary. Time required for almost constant treatment becomes extensive and fairly expensive. Antibiotics are effective against *Ehrlichia risticii.*

Rotaviral Diarrhea

Rotavirus is a major infectious cause of foal diarrhea and has been documented to cause 50 percent or more of foal diarrhea cases in some areas.

While rotavirus diarrhea morbidity (animals getting the disease) can be high (50 percent of susceptible foals), mortality (death) is low (<1 percent) with veterinary intervention.

Equine rotavirus is transmitted by the fecal-oral route and damages the small intestinal villi resulting in cellular destruction, maldigestion, malabsorption, and diarrhea.

Vaccination of mares results in a significant increase in foals' rotavirus antibody titers. Field trials of rotavirus vaccination in pregnant mares have shown a decrease in incidence and severity of foal diarrhea on farms that historically had annual rotaviral diarrhea cases.

Foal Heat Diarrhea

Most newborn foals develop diarrhea at 7 to 12 days of age. At about the same time, the mare comes into what is called foal heat.

Affected foals usually show no problems due to the diarrhea, but occasionally they become ill or the diarrhea persists. Some may even develop serious intestinal problems and colic.

The cause is felt to be related to larvae of the intestinal threadworm, *Strongyloides westeri.* The immature larvae locate in the mare's udder, and the foal becomes infected by nursing. Within 8 to 10 days, the parasites are established within the foal's intestinal tract, where they irritate the gut wall, causing diarrhea. Deworming pregnant mares during the last 30 days of pregnancy prevents the *S. westeri* larvae.

Affected foals may respond to intestinal protectants, appropriate deworming agents, and fluids, if needed. Oral antibiotics seldom are of much value.

A secondary problem is the scalding of the foal's rear quarters, with resultant burning, irritation, and hair loss. To prevent this, horse owners must clean the foal's rear parts and place some protective ointment on the area. Applying Vaseline or zinc oxide ointment to the foal's tail helps, as it becomes a natural applicator.

Seemingly harmless diarrheal conditions can rapidly become critical. Horse owners need to keep a close watch on any animal with diarrhea. Proper treatment and aftercare are essential to minimize resultant problems.

Other Diarrheas

Other causes of acute diarrheal disease in horses include colitis, salmonellosis, and other diarrheal syndromes. Most of these are related to or follow stress, such as hauling, respiratory disease, or surgery. In some cases, such as salmonellosis, the diarrhea is contagious between horses and may infect humans.

Most of these diarrheas respond to vigorous treatment, although laminitis or founder frequently occur following a severe diarrheal episode. Sometimes a horse will recover and be left with chronically soft stools.

Specific treatments or preventions are not available at this time. A vaccine is available for salmonellosis.

Strict biosecurity and disinfection during the foaling season also lessens the morbidity associated with most types of infectious foal diarrheas and other contagious diseases.

Laminitis

Laminitis is defined as an inflammation of the lamina of the inner hoof wall. Laminitis and a process called founder are often thought to be the same problem. Laminitis is due to metabolic changes that affect the lamina. Founder is the mechanical displacement of the coffin bone within the foot. Founder is associated with laminitis, but it is possible for a horse to have laminitis without founder.

Laminitis is difficult to prevent because there are many different causes, some of which may act together to cause this lameness. One cause of laminitis is colic, especially with grain overload. Eating too much grain results in a high production of lactic acid in the horse's intestinal tract. The lactic acid damages the gut wall and allows bacteria to enter the blood. This results in endotoxemia (the presence of toxins in the blood), which affects the lamina by decreasing the blood flow to the lamina. Colic can also cause laminitis by direct damage to the intestinal wall, such as with a torsion (twist of the intestine). The wall will die in that area and, again, allow bacteria to get into the blood.

Another cause is a dystocia, or retained placenta, in the mare. Stress, exhaustion, or infections that stress the horse for extended periods can also cause laminitis.

Leg problems are another major cause of laminitis. With excessive, repetitive stress and concussion put on the leg, the blood flow to the lamina can be decreased. This damages the lamina. Lameness causes a horse to shift its weight onto the good leg. This excess stress can also lead to laminitis.

The first signs of laminitis are often subtle and can be easily missed. However, the condition develops rapidly; if it is not caught immediately, the horse can quickly become quite lame. Initial signs include restlessness or agitation—the horse will pace around the stall and shift its weight back and forth between its feet. Within the first day, the horse is often reluctant to turn, and its gait will be stiff. In the first 2 days, the horse often assumes the classic laminitis stance, to shift weight onto its heels and off

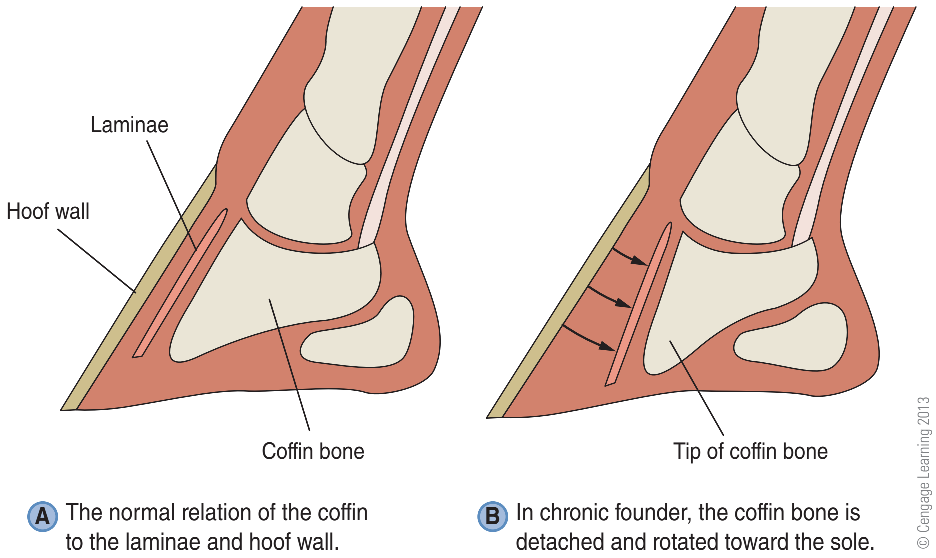


FIGURE 14–11 **A rotated coffin bone, caused by laminitis.**

its toes, which hurt. Digital pulses will often be moderate to bounding by this time, and there is usually a depression at the apex of the coronary band. By this stage, it is essential to get the horse under a veterinarian's care.

The next signs that develop include a bulging of the sole downward toward the ground so that it is not concave anymore. The coffin bone in the foot rotates (founder), which may be visible on a radiograph taken by the veterinarian. Within 4 to 5 days, a separation of the hoof wall from the skin at the level of the coronary band is possible. The coffin bone may have rotated enough by this time to have perforated the sole. This is a serious situation (Figure 14–11).

As soon as signs of laminitis are noted in a horse, a veterinarian should be called. The horse is usually treated with drugs to decrease the inflammation. Special pads are put on the sole to support it. Early in the course of laminitis, special shoes can be put on the feet to elevate the heel and take pressure off the deep flexor tendon that is responsible for the rotation of the coffin bone.

Hot- and cold-water soaks are often used to increase circulation to the lamina and cool the feet. This also helps make the horse more comfortable. The stall should be deeply bedded to help cushion the feet. If a medical reason for the laminitis exists—for example, colic—treatment of that problem needs to be initiated.

A horse that has suffered only a mild case of laminitis may recover without complication and may be able to return to its normal level of exercise. The veterinarian will have to work with the owner or trainer to determine the amount of damage and monitor the horse's recovery.

Chronic laminitis can be detected by changes in the hoof wall. Regular disturbances of the blood flow to the lamina will result in changed growth rate of the hoof wall. The heel will grow faster than the toe, and the growth rings will be farther apart at the heel. These changes should be looked for when purchasing a horse.

Blister Beetles

Blister beetles, of the insect family Meloidae, defend themselves with a toxic secretion, cantharidin, that causes severe irritation to the skin and mucous membranes of warm-blooded animals. If whole or crushed parts of blister beetles are ingested by a

FIGURE 14–12 **A blister beetle—secretion of cantharidin causes severe irritation to the skin and mucous membranes of warm-blooded animals.**

grazing animal, the cantharidin can cause irritation and hemorrhages in the stomach. The amount of cantharidin produced varies from male to female and among species of blister beetles (Figure 14–12).

Among domestic grazing animals, horses are most susceptible to this toxin. Only a few beetles, eaten with hay, can cause severe illness or even death to a horse. Affected horses exhibit signs of colic, frequently void small amounts of blood-tinged urine, and at times have muscle tremors. If blister beetle poisoning is suspected, a local veterinarian should be consulted immediately so treatment can be started.

Blister beetles commonly feed on alfalfa and the flowers of various plants that frequently grow in hay fields. The problem occurs when the hay-harvesting process crushes or grinds up blister beetles, and their toxic parts remain in hay that is fed to horses.

Some steps can be taken to reduce the possibility of incorporating blister beetles in hay. First-cutting hay seldom contains blister beetles if it is cut in early to mid-June, before the adult beetles are present in alfalfa. Blister beetle poisonings have increased since the advent of swather-conditioning equipment that runs hay between rollers or crimpers. Hay-conditioning equipment will kill many beetles as they pass through the rollers, contaminating several feet of windrow with crushed beetle parts. However, separate cutting followed by windrowing allows the beetles to find their way out of windrows while the hay is drying and prior to baling.

Other Common Diseases

Clostridial diseases as a group are caused by a family of bacteria that grow in the gut or tissue and produce gas and very powerful toxins that affect the nervous system.

Tetanus

Tetanus, a common disease of horses sometimes called lockjaw, is caused by a neurotoxin produced by *Clostridium tetani.* This nerve-tissue poison causes spasms and rigidity of the skeletal muscles. Affected horses cannot eat and have difficulty drinking. Over half of affected horses die due to suffocation, starvation, or dehydration.

Due to the large number of tetanus bacteria in the horse's digestive tract, people working around horses should consult their physicians concerning tetanus immunization for themselves.

Infected horses acquire the problem through puncture wounds or other deep wounds. Within 10 to 14 days following injury, horses become increasingly nervous, and then stiff or rigid, and they have difficulty moving. The more rapid and severe the onset of symptoms, the less chance of recovery.

Persistent treatment and much nursing care are needed. Affected horses need to be protected from light and sound that can stimulate nervousness. Horses are placed in darkened stalls and their ears plugged with cotton to reduce stimuli from sound.

Veterinarians usually administer tetanus antitoxin, antibiotics, and sedatives repeatedly for several weeks. One-third to one-half of affected horses may recover if diagnosed early and treated vigorously. Prevention is twofold. Unvaccinated animals should receive tetanus antitoxin within 24 hours following injury or surgery. This provides temporary protection for 10 to 14 days. If healing is not complete at that time, tetanus antitoxin should be repeated at 2-week intervals until healing is complete.

Vaccination with tetanus toxoid provides a very stable immunity. All horses should be vaccinated against tetanus and receive boosters once a year and following an injury.

Botulism

Botulism is caused by *Clostridium botulinum* and can occur in adults as forage poisoning or in foals as shaker foal syndrome.

With forage poisoning, adult horses become weak and stagger, have difficulty swallowing, and may go down and be partially or completely paralyzed. Silage, incompletely cured hay, and forage with spoiled areas are usually the causes. Prevention is best accomplished by careful selection of hay, silage, or other harvested forage for horses.

Shaker foal syndrome appears as a problem in young foals nursing mares that are being fed high-energy, high-protein diets. Experimental vaccination of pregnant mares prior to foaling has prevented the condition, and a vaccine may become available commercially.

Care in nutritional management of mares nursing foals may control or prevent the condition from developing in foals. Affected foals become uncoordinated, develop jerky movements, and eventually become paralyzed and die. Once symptoms are apparent, treatment has little effect.

Clostridial Myositis

Infections of muscle masses by one or more of several clostridial bacteria families can occur. These organisms usually enter through wounds, needle injections, or other muscle injury.

The bacteria grow rapidly, form gas pockets, create severe pain, and cause shock from the toxins produced. Hand pressure causes both crackling sounds and sensation due to the gas formed under the skin. Often, cattle are or have been present when a problem occurs.

Veterinarians treat this condition by promptly establishing drainage and using adequate dosages of appropriate antibiotics. Despite vigorous treatment, some cases fail to respond.

Appropriate injection techniques, avoiding the use of irritating drugs, and not injecting excessive volumes at one site are all important in preventing clostridial myositis. Prevention of injuries and prompt attention to any wound are helpful in preventing this disease. No approved vaccines are available.

Sleeping Sickness

This disease is also called equine encephalomyelitis. Three forms of this disease are caused by viruses that affect the nervous system. Wild animals and birds act as reservoirs. Mosquitoes are the principal means of virus transmission between victims. Horses at pasture are more susceptible than stabled horses. The viruses also can affect humans. In the Eastern and Western forms of the disease, horses are last hosts and the virus does not spread from them. Venezuelan encephalomyelitis, however, spreads between horses and from horses to humans.

Infected horses initially develop a fever, act as though they have problems seeing, wander aimlessly, stagger, grind their teeth, and have a drooping lip. The disease may progress until paralysis occurs. Horses with mild cases recover slowly over several weeks.

From 25 percent to 50 percent of horses infected with the Western form may die, over 90 percent infected with the Eastern form die, and 75 percent infected with the Venezuelan virus die.

No specific treatment is available, but veterinarians can provide supportive care. Mosquito control is an important preventive measure, as is annual vaccination. The Venezuelan form has not been a problem in the United States since 1971, but it could enter this country from Latin America.

Highly effective vaccines are commercially available and should be administered annually, before the mosquito season. They may be combined with other vaccines.

Swamp Fever

Equine infectious anemia (EIA), or swamp fever, is a viral disease. In the acute form, it causes severe red blood cell destruction resulting in anemia. Recovered animals are carriers. The virus is spread by bloodsucking insects and by repeated use of needles or instruments without adequate sterilization between patients.

The disease causes severe anemia, fever, weakness, weight loss, edema, and sometimes death. Inapparent infections show few, if any, symptoms. Horses, without visible signs of infections, that receive regular hard physical work or some other stress frequently begin to show clinical signs of the disease.

Clinical diagnosis of EIA is by a positive antibody level test. Titers (levels) causing a positive test occur 2 to 4 weeks after exposure to the initial disease.

No effective treatment is available. Prevention is best accomplished by maintaining horses that test negative for the antibody. Fly control and use of disposable needles among horses are also important aspects of control. Any horse with a positive antibody test should be maintained away from uninfected horses, especially during the insect season.

West Nile Virus

West Nile is a type of virus that causes encephalitis, the inflammation of the brain. The virus is most commonly spread by mosquitoes that have acquired the disease from infected birds. Because mosquitoes transmit the disease, it has the potential to affect humans, livestock, and poultry. The first documented case of the West Nile Virus in the United States was reported in September of 1999.

Symptoms of West Nile Virus typically develop between 3 to 14 days after being bitten by an affected mosquito. Symptoms include ataxia, or stumbling and lack of coordination; depression or apprehension; weakness of limbs; partial paralysis; the inability to stand; and sometimes death. Horses may be infected without showing any clinical signs.

Protecting your animals from mosquito bites is the best method of preventing the spread of the virus. Eliminating any potential mosquito breeding site is essential. Mosquitoes tend to breed in sources of still water. These can include discarded tires, bird baths, clogged roof gutters, outdoor water-holding devices, any puddle that lasts for more than 4 days, and water that may have collected on top of a swimming pool cover.

Three licensed vaccines are currently available. Horse owners should vaccinate annually in the spring, before mosquito season. Horses that recover from the disease likely develop lifelong immunity.

Rabies

Rabies (hydrophobia) is a universally fatal viral disease of the central nervous system. The virus is transmitted in saliva and infects humans, as well as other mammals. Wild animals, especially raccoons and skunks, appear to be important reservoirs of the disease.

When horses come in contact with rabid wild animals, their curiosity often results in their being bitten on the muzzle. Symptoms of rabies usually occur within 2 weeks following the bite.

A sudden change in behavior is the first indication of rabies. Drooling may or may not occur. After 1 to 3 days, horses may suddenly become vicious, attempting to bite without a reason. Some roll extensively, as if they had colic. The size and strength of horses makes them dangerous and potentially unmanageable. Self-mutilization is common.

Treatment is not considered effective, feasible, or safe for the humans involved. An animal suspected of having rabies should be confined for 2 weeks. If the horse is then destroyed, care should be taken not to damage the brain. A veterinarian will remove the head and prepare it for submission to a laboratory for examination at once to confirm the diagnosis of rabies.

Horses may be protected against rabies by vaccination with an approved product properly administered by a licensed veterinarian.

Vesicular Stomatitis

Vesicular stomatitis occurs in the United States from time to time; some strains of the virus that causes it are foreign. Vesicular stomatitis gets its name from the appearance of blisters (vesicles) and raw ulcers in the mouth (stoma) of infected horses, swine, cattle, and humans. It is characterized by blisters on the tongue, teats, soles of the feet, and the coronary band.

Insects and the transporting of animals are probably responsible for the spread of the disease. The incubation period is about 2 to 8 days but may be longer.

No specific treatment is available. Animals should be protected from a secondary infection in the **lesions**. Prevention involves restricting the movement of animals during outbreaks, disinfecting trailers and stalls, and controlling insects. A vaccine is available.

Heatstroke

Heatstroke is not as common today as it was when horses were used to power machines, but it still occurs in horses during the summer months. It can be caused by overexertion on a hot, humid day; by confinement to a poorly ventilated stall on such a day; and by transportation in hot vans. Horses exercised without shade from the sun are also susceptible to heatstroke. Horses that have been idle and are not conditioned to the work or the climate are the most susceptible. A lack of adequate drinking water can predispose a horse to heatstroke.

Signs of heatstroke include collapse, a staring expression, vomiting, and diarrhea. The inside of the horse's mouth may be bright red, and the rectal temperature may reach as high as 109.5°F.

Veterinary assistance is required immediately in cases of heatstroke and emergency first aid measures must be started. First aid consists of placing ice packs on the horse's head between the ears and cold cloth packs along its spinal column. If ice packs are not available, cloth sacks saturated with cold water should be directed over the head and down the spinal column. A veterinarian can provide other cooling methods and supportive treatment.

ZOONOSIS

Humans rarely contract a disease from a horse, but it is possible. A disease passed from animals to humans is called a **zoonosis** or a zoonotic disease (Figure 14–13). Rabies is likely the most commonly known zoonotic disease. Other diseases common to horses and people may have the same name but are not transmissible (or zoonotic), such as influenza. The virus strain that infects horses does not infect people and vice versa.

Individuals working with horses need to know about zoonotic diseases and their symptoms for their own safety as well as that of their families and others. The zoonotic diseases in horses include: anthrax, brucellosis, cryptosporidiosis, leptospirosis, rabies, rain rot, ringworm, salmonellosis, and vesicular stomatitis.

Anthrax

Anthrax, a bacterial disease, has caused sporadic animal disease outbreaks in the United States for many years. The bacterial spore can live in the soil for decades, and animals can become infected through ingestion, inhalation and other routes. Infected horses often become acutely ill and die. People can be exposed to anthrax through contact with an infected animal's hide, tissues, or blood. Prevention includes complete protective equipment—including skin, respiratory and eye protection. Symptoms in people can range from blisters on the skin to vomiting blood, bloody diarrhea, stomach ache, flu-like symptoms, or chest pain.

Brucellosis

Brucellosis, another bacterial disease, causes abscesses and draining tracts on the withers (fistulous withers) and poll (poll evil) in horses and causes disease in many other animal species. People become infected by coming in contact with infected animals, especially cattle. Due to aggressive control measures for brucellosis in the United

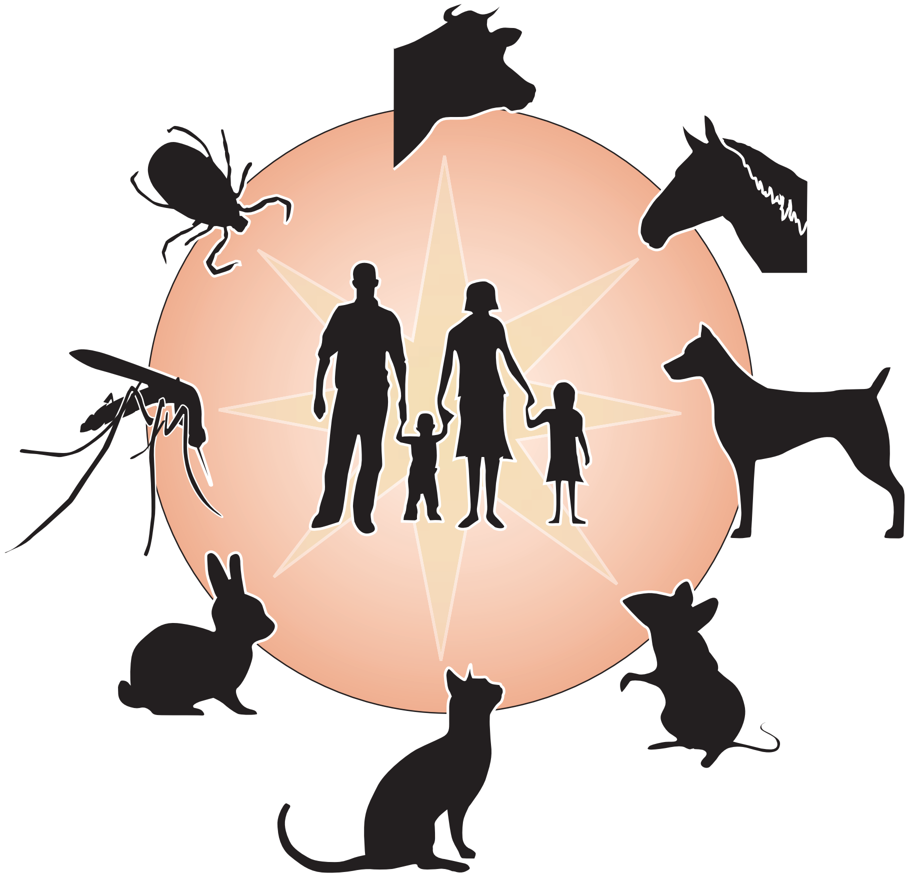


FIGURE 14–13 Zoonotic diseases come from many animals, not just horses.

States very few cases are reported in people. Transmission of brucellosis from horses to humans is rare because the disease is very uncommon in horses. Symptoms include fever, headache, back pain, and weakness.

Cryptosporidiosis

Cryptosporidiosis, a protozoal parasitic disease, sometimes causes diarrhea in foals, and can cause significant disease in other species. *Cryptosporidium* can infect many different animals and people through the fecal-oral route. Symptoms in humans include watery diarrhea, stomach cramps, nausea, and a poor appetite.

Leptospirosis

Leptospirosis, a bacterial disease, causes abortion, eye problems, and kidney disease in horses. Transmission from horses to people is very rare in the United States but can occur through direct or indirect contact with infected urine, as well as ingestion of contaminated water. Symptoms include headache, fever, nausea, muscle aches, and jaundice (yellow skin and eyes).

Rabies

Rabies, a viral disease of mammals, including horses, is transmitted to humans by the bite of a rabid animal or contact between the animal's saliva and open wounds or mucous membranes. Only 40 to 50 horses per year are confirmed as rabies-positive in the United States, but the disease is 100 percent fatal. Infected horses may show behavioral and neurologic changes that look like animals with colic or lameness. However, any horse with rabies will usually die within 10 days of the onset of clinical signs. Horses become infected by getting bitten by another rabid animal such as a skunk, raccoon, bat, fox, and others. Rabies vaccination for all horses is recommended by the American Association of Equine Practitioners (http://www.aaep.org/). In humans, symptoms develop one to three months after being bitten. Because of the seriousness of bacterial infections by animal bites, any human bitten by an animal should wash the wound and seek medical treatment. People exposed to a rabid animal and receiving immediate anti-rabies medical treatment have excellent outcomes.

Rain Rot

Dermatophilosis (rain rot) is a common bacterial skin disease in horses characterized by matted hair and skin lesions that ooze and form clumps. Although a rare zoonosis in healthy people, this disease can be transmitted to humans through direct contact with lesions. Symptoms are sores, usually on the hands and arms.

Ringworm

Dermatophytosis (ringworm) is a common fungal skin infection of many animal species. In horses the problem is primarily caused by *Trichophyton equinum*. Horses show circular patches of hair loss with crusting and scaling of the skin. People become exposed by direct skin contact with infected horses or potentially through contact with contaminated equipment. The most common symptom is itchiness.

Salmonellosis

Salmonellosis is a disease caused by the bacteria *Salmonella*. Most often horses with salmonellosis have acute or chronic diarrhea, but they can also have localized infections in abscesses, joints, eyes, and other areas. Wearing disposable gloves and washing hands after handling salmonellosis cases (or any animal with diarrhea) is especially important. Manure from horses with diarrhea should be composted or disposed of where humans and other horses cannot come in contact with it. Symptoms in humans include diarrhea, fever, and abdominal cramping.

Vesicular Stomatitis

Vesicular stomatitis, a viral disease, causes blisters and ulceration on the tongue and gums and inflammation of the coronary band in horses. Humans with open wounds can potentially become infected by direct contact with the blisters, which are filled with virus. Even during outbreaks of the disease, infection of veterinarians and laboratory workers is low. The most prominent symptom in humans is a rash.

Disease Prevention

A veterinarian can develop a comprehensive program designed to help protect horses and people from infectious diseases and provide early diagnosis that can save horse owners a significant amount of money in the long run. Caretakers should use disposable gloves to handle and treat any sick horse and thoroughly wash their hands after treatments. Some precautions include:

- With a veterinarian, develop a comprehensive preventive medicine program, including vaccinations and biosecurity
- Use a veterinarian to evaluate sick horses, especially those with behavioral changes, including aggression
- Isolate sick horses and take precautions by wearing protective clothing such as separate coveralls and disposable gloves and booties
- Always avoid hand to mouth or nose contact when handling infectious horses
- Wash hands thoroughly with soap and water after handling ill horses, especially those with diarrhea.
- Always consult a physician if you suspect exposure to a zoonotic disease or have any questions regarding a horse's symptoms, diagnosis, or treatment

People with challenged immune systems (immunocompromised), whether by disease, medication or age, can be more susceptible to infectious disease agents in a horse's environment. These individuals should speak with their physician about added precautions needed when anticipating direct contact with animals or their environments. In general, immunocompromised people should not work around sick animals, especially those with diarrhea. They should avoid contact with feces or urine, and thoroughly wash hands after contact with animals and prior to eating, drinking, using tobacco products, or applying cosmetics. Because of bacteria present in dusty horse environments, some people may be advised to wear an N95 mask (protects against micron-size particles) to avoid exposure to bacteria and other disease-causing agents. Disease-causing organisms on clothing can be a hazard to immunocompromised individuals, and this clothing should be laundered separately. Horse equipment and other materials should be left outside of the home, and the horse handler should wash his or her hands before entering the home.

POISONOUS PLANTS

Poisonous plants in the form of wildflowers or weeds may be found in both hays and pasture. Plants poisonous to horses can also include cultivated plants that were never intended for horse feed and trees near where horses are kept. Some of these common poisonous plants and their effect on horses are listed in Table 14–4.

Poisonous plants are not harmful until a horse eats them. The best way to protect your horse from eating poisonous plants is good management:

- Provide sufficient high-quality forage
- Manage pasture to prevent overgrazing and to control weeds
- Be knowledgeable and particular about the plants growing on your property
- Take time to inspect the hay you feed for weeds

Some plants are not poisonous but they can still injure a horse, causing the animal discomfort or pain. These include such plants as sand burrs, thistles, foxtail, cactus, goat head, stinging nettle, and cockle burrs. Most of these plants cause sores in the mouth that make horses slobber and have difficulty eating. Some plants may cause skin irritations or eye injury.

TABLE 14–4 Common Poisonous Plants

COMMON NAME	SCIENTIFIC NAME	LOCATION[1]	TOXICITY[2]	SIGNS
WILDFLOWERS AND WEEDS				
Blue flax	*Linum* spp.	Throughout North America	+++	Rapid labored breathing, frothing at mouth
Bracken fern	*Pteridium aquilinum*	Forested areas	+	Loss of flesh, lack of coordination, depression, paralysis
Castor-oil plant	*Ricinus communis*	Tropical areas	+++	No appetite, constipation and diarrhea, hard breathing, sweating
Death camas	*Zigadenus* spp.	North America	++	Stiff-leggedness, hypersensitivity, weakness, convulsions
Fiddleneck	*Amsinckia intermedia*	Pacific Coast	++	Photosensitization, weight loss, anemia, jaundice
Foxglove	*Digitalis purpurea*	Western United States	+++	Heart irregularities; diarrhea; labored, rapid breathing
Jimsonweed	*Datura stramonium*	North America	++	Colic, diarrhea, dilation of pupils, excitability, depression
Larkspur	*Delphinium* spp.	West, Midwest United States	+++	Hypersensitivity, trembling, collapse, convulsions
Locoweed	*Astragalus* spp.	West, Southwest North America	+	Strange behavior, incoordination, odd head carriage, weight loss
Milkweed	*Asclepias* spp.	North America	+++	Lack of coordination, depression, shallow breathing, unsteadiness, coma
Monkshood	*Aconitum* spp.	West, Midwest United States	+++	Hypersensitivity, trembling, collapse, convulsions
Nightshade	*Solanum* spp.	North America	++	Trembling, incoordination, diarrhea
Poison hemlock	*Conium maculatum*	North America	+++	Trembling, incoordination, salivation, colic, shallow breathing, coma
Pokeweed	*Phytolacca americana*	Eastern, Southern United States	++	Diarrhea

(*continues*)

TABLE 14–4 (*continued*)

COMMON NAME	SCIENTIFIC NAME	LOCATION	TOXICITY	SIGNS
WILDFLOWERS AND WEEDS (*continued*)				
Ragwort/ groundsel/ hound's tongue	*Senecio spp.*	North America	++	Weakness, liver failure, yellow mucous membranes, lack of coordination
Sagebrush	*Artemisia spp.*	Western North America	++	Excitability, falling, front leg lack of coordination
Saint John's wort/ Klamath weed	*Hypericum spp.*	Western U.S. plains areas	++	Photosensitization
Water hemlock	*Cicuta spp.*	North America	++++	Rapid respiration and heart rate, violent spasms, coma
White snakeroot/ Jimmy-weed	*Eupatorium spp.*	Eastern, Southern U.S. forested areas	+++	Sweating, stumbling, spreadlegged stance, congestive heart failure
Yellow star thistle/ Russian knapweed	*Centauria spp.*	Western United States, Canada	+	Inability to swallow food, tongue lolling, smile expression
CULTIVATED PLANTS				
Alsike clover	*Tribolium hybridum*	Eastern, North central North America	+	Depression, colic, diarrhea, photosensitization
Avocado	*Persea americana*	Southern United States	++	Colic, diarrhea, noninfectious mastitis in lactating mares
Azalea/laurel/rhododendron	*Rhododendron spp.*	North America	++	Diarrhea, colic, excessive sali vation, depression, lack of coordination, stupor
Johnsongrass/Sudan grass	*Sorghum spp.*	North America	+	Frequent urination/ defecation, tremors, gasping, convulsions
Oleander	*Nerium oleander*	Southern United States	++++	Sweating, bloody diarrhea, colic, difficult breathing, arrhythmia
Yellow oleander	*Thevetia peruviana*	Southern United States	++++	Sweating, bloody diarrhea, colic, difficult breathing, arrhythmia, tetany
Yew	*Taxus*	United States	++++	Nervousness, difficult breathing, lack of coordination, convulsions

(*continues*)

TABLE 14–4 (*continued*)

COMMON NAME	SCIENTIFIC NAME	LOCATION	TOXICITY	SIGNS
TREES				
Black locust	*Robinia pseudo-acacia*	Central, Southern United States, Canada	++	Diarrhea or constipation, stupor, laminitis, appetite loss
Black walnut	*Juglans nigra*	Northern, Central United States	+++	Increased temperature, lamini tis, swelling in legs, heart and respiratory rates increased
Chokecherry/wild black cherry	*Prunus spp.*	Southern, Northeast, Northwest United States	+++	Convulsions, frequent urination/defecation, gasping, tremors
Elderberry	*Sambucus spp.*	Forested areas of United States	+++	Gasping, tremors, frequent urination/defecation, convulsions
Horse chestnut/buckeye	*Aesculus spp.*	Southern, Eastern United States	++	lack of coordination, muscle tremors
Red maple	*Acer rubrum*	Eastern United States	+++	Mucous membranes dark, depression, colic, urine red or brown

[1] Location refers to areas where the plant occurs naturally. Many of these plants are cultivated outside the location indicated on this table.

[2] The number of plus signs (+) indicates the relative toxicity of the plant; four plus signs (++++) indicate the most toxic while one plus sign (+) is the least toxic.

Adapted from "Poisonous Plants: A Survival Guide," by J. Moore, *Equus*, 1995, pp. 28–37.

FIRST AID FOR HORSES

Equine first aid is the emergency care given to an injured or ill horse before treatment; it can be administered by a veterinarian or until the horse can be transported to a facility where help is available. The objectives include:

1. Intervening with a life-threatening situation
2. Recognizing serious or potentially serious, life-threatening conditions such as hemorrhage (bleeding), fracture, dehydration, and shock
3. Using measures to minimize further damage and prevent complications or aftereffects such as:
   - Extension of bone damage
   - Damage to blood vessels or nerves
   - Damage to soft tissue
   - Secondary laminitis

First Aid Kit

- Water-soluble antibacterial ointment and/or spray (e.g., Betadine)
- Bandage material:
  - 1 roll nonsterile cotton
  - Sheet cottons or quilts for leg wraps
  - Brown gauze or polo wraps
  - Elastikon
  - Tefla pads
  - Kling rolls
  - 4 × 4 inch sponges
  - Vetwrap™ or other self-adhesive wrap
- Poultice
- Rubbing alcohol
- Soap
- Epsom salts
- Thermometer with string and clip
- Scissors
- Stethoscope
- Clean towels
- Hoof pick and knife
- Shoe pullers
- Fly repellant
- Flashlight
- Prescribed, nonexpired medications
- Large syringe

Preliminary information—temperature, heart rate, respiratory rate, color of mucous membranes, and **capillary refill** time—are vital statistics that will help a veterinarian evaluate an emergency situation over the phone. Also, a description of what caused the emergency can help with initial diagnosis and/or treatment. A well-equipped first aid kit will help the horse owner treat many minor ailments and cope with emergencies while waiting for the veterinarian to arrive.

SUMMARY

Horse owners need to be able to recognize a healthy horse by observing the signs of good health. The immune system is essential to the health of the horse. Antigens induce antibodies that destroy harmful substances in the body. The immune system also remembers disease-causing invaders and is prepared for the next invasion. Vaccinations provide immunity to many problem diseases. Before the foal's immune system is developed, it receives its first immunity in the colostrum from the mare.

Many diseases can affect horses. These diseases can be grouped as infectious and noninfectious diseases. The infectious diseases can be caused by bacteria, viruses, or parasites. Noninfectious diseases are often due to a management problem. If owners are aware of the signs of these diseases, they can identify them in the early stages. Through good management and knowing which diseases are the most serious threat to horses, horse owners can minimize the spread of contagious diseases and effect prompt treatment of sick animals.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. A horse's weight can change by as much as 50 pounds depending on recent eating, drinking, or elimination.
2. All energy provided above maintenance for the horse will go toward the formation of fat.
3. Immunity refers to the ability of an individual who has recovered from a disease to remain well after a second exposure to the same disease.
4. Antibodies are provided to the newborn foal during gestation.
5. EIPH is a serious problem in pregnant mares.
6. Horses can breathe through their mouths like humans.
7. Colic in a horse is always an emergency.

Short Answer

8. List 10 signs of good health in a horse.
9. What are the normal heart rate, respiratory rate, and temperature of the horse?
10. Name eight points of a good horse health program.
11. What term describes the process by which the mare passes antibodies to the foal?
12. List the two reasons vaccines are given.
13. Name the virus that is the cause of rhinopneumonitis in foals.
14. What disease is produced by the neurotoxin *Clostridium tetani* and affects humans as well as horses?
15. List four diseases of the horse caused by bacteria and four caused by viruses.
16. What is zoonosis?

Critical Thinking/Discussion

17. List at least four pieces of information that will help a veterinarian evaluate an emergency situation over the phone.
18. Explain the two general responses of the immune system, and define the terms antigen and antibody.
19. Discuss the differences between infectious and noninfectious diseases, and give examples of each.
20. Describe the symptoms of and treatment for strangles.
21. Describe the general symptoms of colic, and list four steps to prevent its occurrence.
22. What is foal heat diarrhea?
23. Explain the difference between laminitis and founder and how they are related.
24. What is the best way to prevent a horse from eating poisonous plants?
25. Why is first aid important for horses and horse owners?
26. Describe the human symptoms for two zoonotic diseases.

STUDENT ACTIVITIES

1. Based on the information in this chapter, develop a checklist of things to observe when examining horses for signs of disease. Make the checklist complete enough that it could be given to a new employee.
2. From a biological supply house or the biology department at a college or high school, obtain prepared microscope slides of bacteria. Observe the different shapes—rods, spheres, or spirals.
3. Research and report the role of bacteria in human health and commerce. Some bacteria cause disease, while other bacteria have a positive role in human welfare.
4. Using Table 14–4, identify poisonous plants in your area. Make a collection of these plants.
5. Visit with a veterinarian to discuss types of antibiotics and their effectiveness.
6. Put together a first aid kit for a horse, and develop a brief first aid manual to go in the kit.
7. Ask a veterinarian to describe a typical vaccination schedule for horses in your area. Make a table showing the annual cost to vaccinate a horse.
8. Using the Internet, research new vaccines being developed and find out what progress is being made on other horse diseases. Report your findings.
9. Working with a professional, take the vital signs of a healthy horse.
10. Construct a table that compares the vital signs of a horse to those of an adult pig, cow, and sheep.

ADDITIONAL RESOURCES

Books

Crabbe, B. (2007). *The comprehensive guide to equine veterinary medicine*. New York: Carlton Books, Sterling Publishing.

Edwards, E. H. (2008). *The encyclopedia of the horse.* New York, NY: DK Publishing.

Evans, J. W. (2000). *Horses: A guide to selection, care, and enjoyment* (3rd ed.). New York: Owl Books.

Frandson, R. D., Wilke, W. L. & Fails, A. D. (2009). *Anatomy and physiology of farm animals* (7th ed.). Ames, IA: Wiley-Blackwell.

Kahn, C. M. (Ed.) & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

Kahn, C.M. & Line, S. (2007). *The Merck/Merial manual for pet health: The complete pet health resource for your dog, cat, horse or other pets - in everyday language.* Whitehouse Station, NJ: Merck & Co.

McAllister, T. (2008). *First aid: Horse illustrated simple solutions.* Irvine, CA: BowTie Press.

Pavia, A. & Gentry-Running, K. (2008). *Horse health and nutrition for dummies.* Hoboken, NJ: Wiley, Publishing, Inc.

Pavord, T. & Pavord, M. (2009). *The complete equine veterinary manual, 3rd ed.* Cincinnati, OH: David & Charles Book.

Vogel, C. (2011). *Complete horse care manual.* New York, NY: DK Publishing, Inc.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

disease in horses	horse conditioning	infectious/noninfectious
health management of horses	horse nutrition immunity	vaccinations

A search for any of the specific diseases will yield additional information. Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 15

Parasite Control

Internal parasites are those that are found on the inside of the horse. They include single-celled animals (protozoa), roundworms (nematodes), and flatworms (flukes and tapeworms). These parasites usually are found in the gastrointestinal tract but may be located in other internal organs. External parasites—lice, ticks, and mites—are found on the skin, in the ears, and at other places on the body.

Signs associated with both internal and external parasites depend on the type and number of parasites present and can range from no apparent effects to general unthriftiness, weakness, debilitation, and ultimately death of the host.

Every horse is infected by one or more of these parasites. So, horses should be on a parasite prevention and control program. A general knowledge and understanding of the nature of these parasites and their development is essential before necessary prevention and control measures can be effectively applied.

OBJECTIVES

After completing this chapter, you should be able to:

- Describe the life cycle of a typical internal parasite with an intermediate host
- Describe the symptoms of a parasite-infected horse
- List management techniques that help prevent parasite infections
- Give the scientific names for five common parasites
- Name the general categories of chemicals used to treat horses with parasites
- Describe the life cycle and damage caused by strongyles and ascarids
- Identify flying insects that are carriers of disease
- List the parts of the digestive system that internal parasites may affect
- Distinguish the different effects of mites, ticks, chiggers, and lice
- Discuss why young horses are more severely affected by parasites than older horses are
- Discuss the six sanitation and management practices used for reducing or controlling parasites
- Explain how a horse is checked for parasites
- List outward appearances of parasites on horses

KEY TERMS

aneurysm
anthelmintics
ascarids
bots
dermatitis
direct life cycle
ectoparasites
endoparasites
hosts
indirect life cycle
intermediate host
ivermectin
larvae
mange
mites
nematode
pinworms
protozoans
strongyles
summer sores
unthriftiness

INTERNAL PARASITES

More than 150 types of **endoparasites** (internal parasites) are known to infect horses. The most important ones are **strongyles**, **ascarids**, tapeworms, and **bots**. The digestive tract, or stomach and intestines, is the most commonly affected area, although **larvae** migrate through all tissues of the horse's body. Larvae, the first stage of the parasite, must go through several stages to become adults; each stage appears somewhat different (Figure 15–1).

Life cycles of strongyles and ascarids are similar. They are classified into a large group of parasites known as roundworms. Bots are the larvae of an insect, the botfly.

Internal parasites are widespread. Unless control measures are practiced, they are likely to increase and cause severe injury or death of the horse. Injury or harm inflicted on the horse is related to:

- Kind of parasites
- Number involved
- Time over which the parasites are acquired

Strongyles are the most injurious. Ascarids, bots, and tapeworms are generally less harmful. The horse may tolerate a few parasites without apparent signs of ill effect,

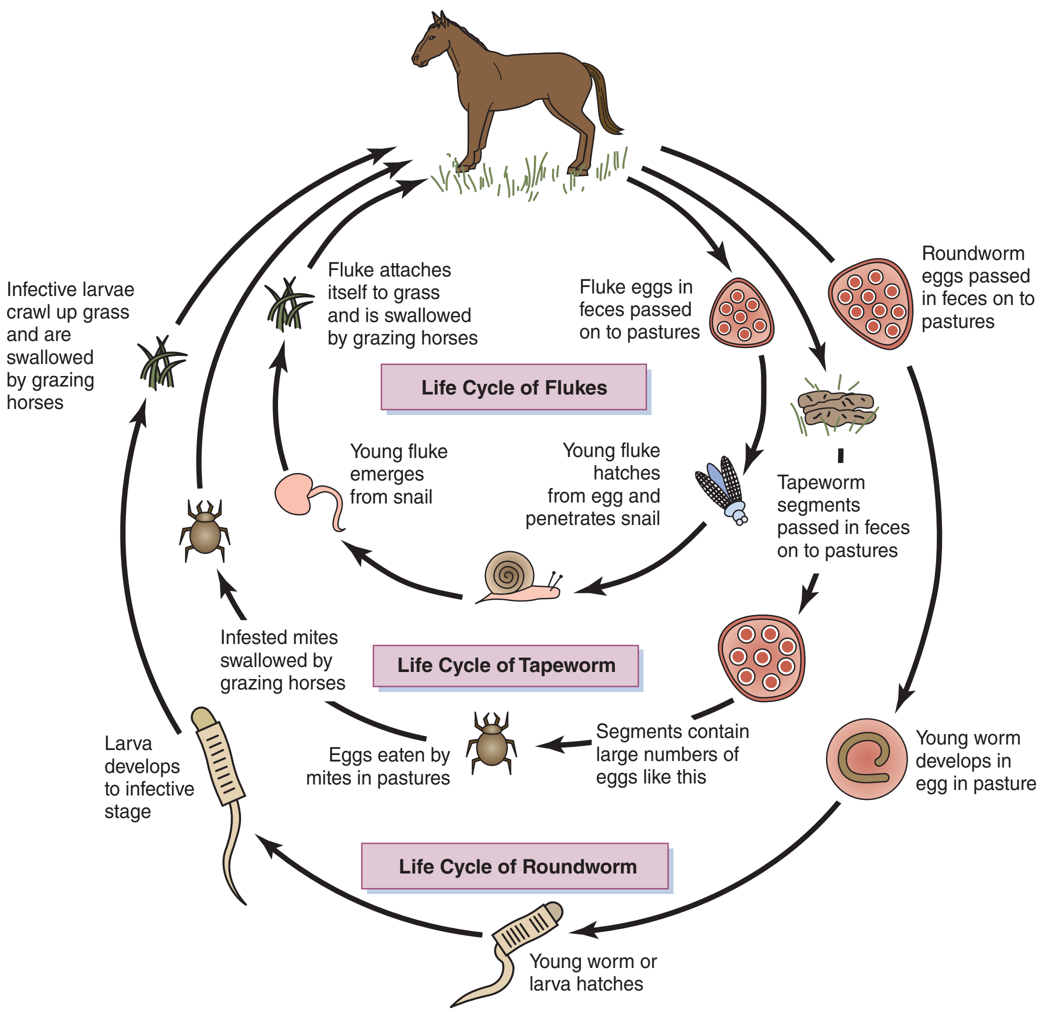


FIGURE 15–1 **The life cycles of some common internal parasites.**

TABLE 15-1 Common Internal Parasites of the Horse

PARASITE	WHERE FOUND	DAMAGE	SIGNS
Habronema adult *Habronema* larvae (stomach worm)	Stomach, injured skin	Causes tumors of wall, granulomatous ulcers	Gastritis, digestive disorders; summer sores, often healing spontaneously after first frost
Gasterophilus (bots)	Stomach, gums	Inflammation, perforation of stomach wall, gums	Digestive upsets and bowel irritation
Parascaris (large white worm)	Small intestine	Irritate intestinal wall, possible obstruction	Flatulence, diarrhea, rough hair coat; "hay belly" more common in young horses
Strongyloides (threadworm)	Small intestine	Erosion of intestinal mucosa, enteritis	Anorexia, loss of weight, diarrhea, anemia; common cause of trouble in suckling foals
Anoplocephala (tapeworm)	Small intestine	Ulceration of ileocecal valve, enteritis	Unthriftiness
Strongylus (bloodworm)	Large intestine and colon	Adults suck blood, cause ulcers on mucosa. Larvae cause enlargement and aneurysms of anterior mesenteric artery	Anemia, unthriftiness, colic, anorexia, malaise, soft feces with a foul odor; in large infections, legs and abdomen swell
Triodontophorus *Poteriostomum* *Trichonema* and others (small strongyles)	Large intestine and colon	Irritate intestinal wall, causing thickening and nodules with larvae in them feeding on blood	Anemia, anorexia, dark or black manure, soft feces with a foul odor; in large infections, legs and abdomen swell
Oxyuris (pinworm)	Large intestine	Adults feed on gut contents; larvae feed on mucosa	Restlessness, irregular feeding with consequent loss of condition, dull hair coat, tail rubbing

but larger numbers are quite likely to be harmful. Acquiring a large number within a few days may overwhelm and kill a horse. Getting the same number over a period of weeks or months is generally much less harmful.

Horses affected the most by parasites are young sucklings or weanlings and yearlings. In general, ascarid problems are restricted to young horses. This is because, in most cases, resistance or immunity is built up by the time a horse is 2 or 3 years old. Strongyles and bots affect horses of all ages. Even so, the young are much more severely affected than older horses. Table 15–1 gives a brief outline of some common internal parasites.

Life Cycles and General Characteristics

To survive and propagate themselves, well-adapted parasites live in harmony with their **hosts**, the animals from which the parasite obtains food. If a parasite were always to kill its host, it would be responsible for its own death, because by definition parasites are organisms that live in or on another organism of a different species for the purpose of obtaining food.

Parasites include protozoa, **nematodes** (roundworms), cestodes (tapeworms), trematodes (flukes), and acanthocephalans (spiny-headed worms). Most of the parasites affecting horses are nematodes.

Protozoans

Protozoans are single-celled animals that occur in the bloodstream and intestinal tract of horses. These organisms multiply by dividing and may be transmitted from horse to horse by an arthropod (insect or spider) vector (carrier) or simply by being ingested in food or water as a result of fecal contamination.

Nematodes

Roundworms are by far the most serious and economically important of the worms that occur in horses. These, as their name implies, are elongated, cylindrical worms ranging in size from 2 millimeters to 35 centimeters in length. Although the large worms cause significant problems, the small worms are far more important from both an economic and health point of view.

Some roundworm parasites damage the host by sucking blood. Others cause damage by migrating through body tissues such as the lungs, and still others can cause severe colic in horses by forming a mass of worms in the intestine that interferes with intestinal motility and to some extent, absorption of nutrients.

Most equine nematode parasites have a **direct life cycle**. This type of parasite requires no other organism except the definitive, or final, host to complete its life cycle.

Typically, females that live in the digestive tract lay eggs, which are passed to the outside with the horse's feces. The eggs hatch in 2 to 3 days, depending on temperature and humidity, into small wormlike organisms called first-stage **larvae** (L_1). First-stage larvae develop and molt to second-stage larvae (L_2), which molt to third-stage larvae (L_3). The L_3 are infective to the final host. They migrate up blades of grass, and the horse ingests them when grazing. These preparasitic stages are much the same for most of the strongyle parasites of the horse.

When the horse ingests the third-stage larvae, they develop into fourth-stage larvae, which may wander extensively through the body of the horse before becoming adults in the intestinal tract—large strongyles—or they may develop into adults in the gut with no migration through other organs—small strongyles.

Some nematode parasites require a second host in order to complete their life cycles. This second host is an invertebrate and is called the **intermediate host**. Typically, the intermediate host eats the eggs or first-stage larvae, which then develop in the intermediate host instead of on the ground. The definitive host becomes infected when the intermediate host (fly, tick, etc.) injects the infective stage of the parasite while it is taking a blood meal. Sometimes the definitive host gets the infective stage by eating the infected intermediate host.

Nematodes have a complete digestive system. They have a mouth through which they suck blood or intestinal juices, and they excrete their waste through an anus (Figure 15–2).

Cestodes

All cestodes—tapeworms—that occur in horses use pasture **mites** as intermediate hosts. The final host becomes infested by ingesting the mite containing the infective

FIGURE 15–2 **A nematode—the most serious and economically important of the worms that infect horses.**

cysticercoid while grazing. Mites become infected by ingesting tapeworm eggs deposited on the pasture with the host's feces.

The tapeworm that occurs in horses is a large worm consisting of a head, which attaches to the intestine of the horse, and a long ribbonlike body with similar segments called proglottids. Unlike nematodes, in which the sexes are separate (males and females mate to produce the next generation), tapeworms contain both sexes within the same worm.

Tapeworms absorb nutrients through their skin, having no mouth or anus (Figure 15–3).

The three species of tapeworms in the United States include: *Anoplocephala perfoliata, Anoplocephala magna,* and *Paranoplocephala mamillana.*

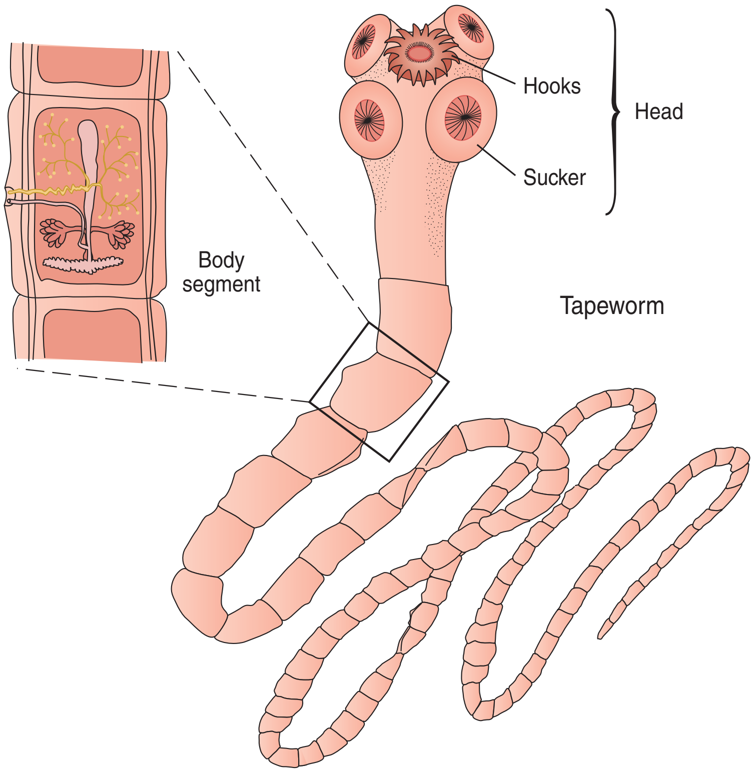


FIGURE 15–3 **A tapeworm—a member of group of parasites called flatworms, which also includes flukes.**

Trematodes

Flukes also require an intermediate host, most often a snail. Although flukes do occur in horses, they are of minor significance and will not be discussed here.

Large Strongyles

The group of nematodes called the large strongyles are the most damaging of all the parasites that occur in horses. Adult worms range in size from approximately 12.5 millimeters up to about 31 millimeters in length. They live in the large intestine and cecum, where they feed by eating plugs of the mucosal lining.

Far more damaging than the adult are the larvae that migrate through internal organs of the host. Some prefer to live in one of the large arteries supplying the small intestine of the horse. These larval strongyles damage the artery's lining, causing it to react and become very thickened, producing an **aneurysm**.

Often, blood clots form and are carried by the bloodstream to smaller vessels, where they can block the blood supply to a part of the intestine. Where other vessels supply this part of the intestine, no real damage is done. But if no other blood supply exists, this part of the intestine dies. Unless corrected surgically, the condition can be life threatening. Sometimes these blood clots find their way back to the arteries that supply the hind legs and can cause rear limb lameness.

The parasite causing these problems is called *Strongylus vulgaris* (See Figure 15–4). Other large strongyles (*S. edentatus* and *S. equinus*) migrate through different organs, notably the liver and pancreas, and inflict damage in their own particular way.

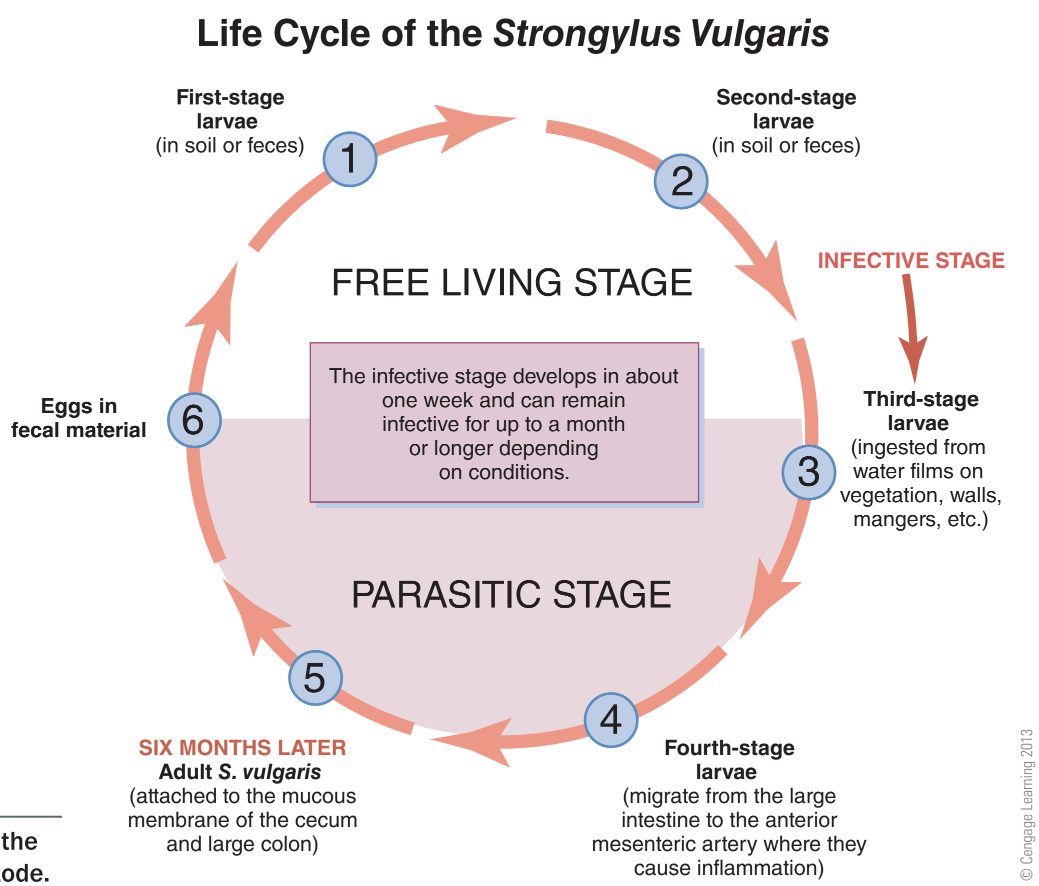


FIGURE 15–4 **Life cycle of the *Strongylus vulgaris*—a nematode.**

Small Strongyles

As their name implies, small strongyles are much smaller than the large strongyles—usually about 13 millimeters in length, although some are smaller. These nematodes are present in much larger numbers than the large strongyles. There may be hundreds of large strongyles in a horse, but usually there are thousands of small ones. While the small strongyles do not cause the damage or present the danger that large strongyles do, they can cause colic due to decreased intestinal motility, in addition to producing **unthriftiness**, diarrhea, rough hair coat, and other signs associated with heavy parasitic infections. These species of parasites usually are clumped into one or two genera (*Triodontophorus* or *Trichonema*).

As with the large strongyles, horses become infested by these parasites through ingesting the infective third-stage larvae while grazing. But unlike the large strongyles, these parasites require little time to reach maturity, start producing eggs, and further contaminate pastures. Consequently, they quickly build up large numbers of larvae to reinfest horses and assure their propagation. Like the large strongyles, small strongyles inhabit the large intestine and the cecum.

Hairlike Worms

Smallest of the nematode parasites occurring in horses is the stomach hairworm, *Trichostrongylus axei.* It is about 4 or 5 millimeters in length and very thin and hairlike. As with the large and small strongyles, the life cycle is direct. Eggs are passed in the feces, hatch, and develop into third-stage infective larvae in 4 or 5 days. Horses become infested by eating the larvae on the grass.

This parasite occurs in the stomach and the small intestine and damages the lining of these organs, sometimes causing bleeding into the gut. This is associated with dark, fetid diarrhea and, with heavy infections, can cause a rapid loss of condition.

The equine intestinal threadworm, *Strongyloides westeri,* is somewhat unique. These small, hairlike worms are 8 to 9 millimeters long and only the adult female is parasitic.

To add to the uniqueness of this parasite, the adult males and females can exist outside the host in a free-living state. When conditions become unfavorable for existence on the outside, the females produce eggs that hatch into third-stage infective larvae and either are eaten by the horse or penetrate the skin. If they penetrate the skin, the larvae migrate to the lungs, penetrate the alveoli, and after reaching the trachea, are coughed up and swallowed. They continue to develop to adulthood in the gut.

Some of these migrating larvae do not develop, but remain dormant in muscle tissue of mares until they foal. Then they migrate into the mammary gland and infest nursing foals via the colostrum. *S. westeri* has been thought to contribute to foal heat diarrhea, which occurs 12 to 13 days after birth.

Tapeworm

The most common tapeworm in horses is in the genus *Anoplocephala.* This cestode, or flatworm, *Anoplocephala magna,* is called the "large horse tapeworm" and occurs most often in the small intestine. It also is found in the stomach and sometimes in the cecum.

This is a fairly robust tapeworm about 25 centimeters long, with very short segments. It retains its position in the host by attaching to the small intestine lining by four suckers located on the head or scolex (See Figure 15–3). Like all tapeworms, both sexes are contained in each individual segment (proglottid).

This worm has an **indirect life cycle**: the eggs are passed in the host's feces and are eaten by pasture mites, which are the intermediate hosts. After the horse eats the oribatid mite containing the infective cysticercoid (larva), the larva develops into an adult in the horse's small intestine in 6 to 10 weeks. Typically, these worms don't live very long in their host.

With light infestations, horses show no signs. Heavy infestations cause horses to suffer colic and diarrhea and possibly go off feed. They often are depressed, may become dehydrated, and spend a lot of time lying down. When many worms are present, sometimes few feces are passed because the worms cause an intestinal obstruction. Heavy infestations of this parasite can produce complications that result in death.

Horse tapeworm infection is diagnosed by finding the eggs in the feces. But many horses do not pass eggs, especially with heavy infestations, so tapeworms may not be diagnosed when present.

Anoplocephaliasis in the horse is usually a disease of yearlings at pasture.

Lungworms

Although this parasite is most common in donkeys, horses also harbor worms *(Dictyocaulus arnfieldi)* that live in their lungs. The lungworm is another nematode, or roundworm, parasite. Females are about 60 millimeters long, and males can be a little over half that. Adults live in the lungs of horses, where they mate; the eggs produced by the females are coughed up by the horse, swallowed, and passed with the feces.

Dictyocaulus has a direct life cycle. Horses become infected by ingesting the third-stage larva. In horses, the lungworm adults may never produce eggs; in donkeys,

American Association of Equine Practitioners

An equine veterinarian is a veterinarian who treats horses. Horses are different from other domestic species in anatomy, physiology, pathology, pharmacology, and husbandry. Most veterinary schools produce graduates able to practice on a wide variety of species. Specialization in equine veterinary medicine is normally developed after becoming a DVM. Equine veterinarians in the United States are certified by the American Association of Equine Practitioners (AAEP).

The AAEP was founded in Louisville, Kentucky, in 1954 by 11 veterinarians. Its mission was to demand excellence among its practitioners and ensure methodical concern for the health and welfare of the horse. Since 1954, the AAEP membership has grown to over 10,000 veterinarians and veterinary students from 64 countries. Focuses of the AAEP include:

- Finding cures and treatments for particular problems
- Participating in equine research and development programs
- Educating the public through programs on preventing and treating injury and disease, providing nutrition, and dealing with parasite control
- Maintaining a presence with schools of veterinary medicine, equine research institutions, and organizations throughout the world
- Addressing animal welfare, medication, and injury issues
- Promoting the public image of the equine veterinary profession
- Improving ethics and standards, practice management, and owner education
- Providing an authoritative voice within the equine industry

Ethics and guidelines promoted by the AAEP can be downloaded from the AAEP Web site (http://www.aaep.org).

they may start producing eggs in 3 to 4 months. Although lungworms cause few clinical problems in donkeys, in horses they may cause coughing, an increased respiratory rate, and some nasal discharge. Because eggs often are not produced in horses, diagnosis becomes difficult; veterinarians cannot find eggs in the feces, so they must rely on history—including whether donkeys are grazing with horses—and clinical signs to diagnose the disease.

Stomach Worms

The habronemas, which consist of *Habronema muscae, H. majus,* and *H. megastoma (Draschia megastoma),* are the equine stomach worms that cause two rather distinct diseases in horses: gastric and cutaneous habronemiasis (a s kin disease caused in part by the larvae). Habronemas have indirect life cycles, with house and stable flies serving as intermediate hosts.

Habronema eggs, which pass with the horse's feces, are eaten by fly maggots and mature with the fly as it becomes an adult. Infective larvae are deposited around the horse's lips and nostrils where the flies feed, thereby gaining entrance into the horse's mouth. Horses may also become infected by ingesting infected adult flies that have become entrapped in food or water. The larvae are freed in the horse's stomach and develop into adults in about 2 months. In the stomach of horses, these parasites produce fibrous tumors, or numerous nodules that, if close together, form a tumor.

Another type of disease caused by this parasite is cutaneous habronemiasis or **summer sores**. This also is caused by species of *Habronema,* but is due to the larvae that the intermediate host deposits in existing wounds in the skin. (Some parasitologists think that the larvae can penetrate healthy skin.) Cutaneous habronemiasis occurs during the summer and is most common on areas where horses cannot switch flies, such as the inside of the legs, over the withers, the penile sheath, and fetlocks.

These lesions are brownish-red, angry-looking sores that may ooze serum tinged with blood. They seem to itch intensely and often disappear when cold weather sets in—only to reappear when the weather warms up again. The appearance of cutaneous skin lesions in the summer time when flies are numerous would suggest summer sores.

The gastric form of habronemiasis is more difficult to diagnose since few eggs are passed and, because the larvae do not float very well, they are sometimes missed during routine fecal floatation examination. Adult females are about 25 millimeters long. Males are somewhat smaller—usually about two-thirds to three-quarters the size of the female.

Ascarids

Parascaris equorum is the horse ascarid. This is a very large, robust roundworm. Females grow up to 35 centimeters long, though the males are somewhat smaller. The life cycle is direct; but instead of ingesting the larvae on the pasture, foals ingest the infective eggs that contain larvae. Because it takes about 2 weeks for the eggs to become infective, a foal could ingest freshly passed feces (a common habit) and not become infected.

After infective eggs are ingested, they hatch and penetrate the wall of the intestine, migrate in the bloodstream to the lungs where they may cause some respiratory problems, and are then coughed up, swallowed, and mature in the small intestine.

The adults start producing eggs about 12 weeks after the foal becomes infected. Because of a developing immunity, foals often shed the infection at about 7 months of age.

Clinical signs of ascarid infection in foals include a dry hair coat, potbelly, and abdominal discomfort (sometimes these foals kick their flanks). They will be undersized for their age and breed, and very often they have dry stools covered with mucus, although diarrhea sometimes is present. Ascarid eggs are very resistant and can survive for years in the soil.

Because some **anthelmintics** render these parasites unable to move, impaction due to a large mass of immobile worms sometimes can occur following deworming. A veterinarian can suggest an appropriate anthelmintic to use with a heavy ascarid infection.

Pinworms

Horses, like people and unlike dogs, can have **pinworms**. Two kinds of pinworms occur in horses. A rather large one, the females of which can be up to 63 millimeters long, is *Oxyuris equi.* The minute horse pinworm, *Probstmayria* sp., is only about 2 millimeters long and is of little consequence.

The life cycle of *Oxyuris* species is direct, and like horse ascarids, the egg is the infective stage. It is infectious for 3 to 5 days after being laid and is ingested by the horse with food or water. The parasite matures in the mucosa of the cecum, colon, and rectum and starts producing eggs in 120 to 150 days.

Because the females migrate out of the anus to lay eggs and then return to the colon, this disease causes an intense itching around the anus of horses. Owners will see horses rubbing their hindquarters, often resulting in all the hair being rubbed off over the tailhead.

Often these horses become restless, go off feed, and lose condition. Sometimes young mares may appear to be in heat. Although adult female pinworms occasionally can be seen around the horse's anus, diagnosis is by finding the eggs, usually with a transparent tape swab.

Babesiasis

Equine piroplasmosis (EP), or equine babesiasis, is a protozoan disease occurring in horses, mules, and donkeys in the southeastern part of the United States, particularly Florida and Georgia.

Two species of Babesia—*B. caballi* and *B. equi*—are known. These small, protozoan parasites occur in red blood cells. The life cycle is indirect. The tropical horse tick *(Dermacentor nitens)* serves as intermediate host. The brown dog tick *(Rhipicephalus sanguineus)* may be able to serve as an intermediate host for *B. equi.*

Equine babesiasis causes horses to have a fever and to become listless and depressed. They may go off feed, and may develop central nervous system disturbances causing rear leg weakness or even paralysis. The limbs may become swollen—stocked-up. This disease usually lasts 8 to 10 days and can cause death, although most horses recover and return to normal.

Because the clinical signs for EP are nonspecific and similar to many other diseases and conditions, it is difficult to diagnose; the disease without laboratory tests. If EP is suspected, state or federal animal health officials should be notified before veterinarians collect any samples. If an outbreak of EP occurs, APHIS must notify the World Organization for Animal Health and indicate the steps it is taking to control the disease.

The increasingly international nature of the horse industry presents potential risks for EP's introduction from foreign countries. Many areas of the United States have climates suitable for foreign ticks to act as vectors for disease or even for other ticks to act as vectors. Because EP is not considered endemic, most U.S. horses are highly susceptible to acute forms of the disease.

The U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS; http://www.aphis.usda.gov/) protects the U.S. equine industry against the entry and spread of EP. APHIS' Veterinary Services (VS) program regulates equine importation and maintains tick control and surveillance programs.

Equine Protozoal Myeloencephalitis (EPM)

EPM occurs throughout North America, affecting male and female horses equally. Thoroughbreds and Standardbreds are affected more frequently. Signs can appear at any age, but most cases occur in horses under 4 years old.

Symptoms vary depending on where in the central nervous system the organism is located. The most frequent signs include stumbling and lack of coordination. When cranial nerves are involved, the head tilts. Signs are frequently progressive, affecting several different areas of the horse and usually affecting one side of the horse more than the other. Because EPM also affects the fibers that run to the muscles, muscle wasting is seen in some cases.

The protozoan *Sarcocystis neurona* causes EPM. It has the most unusual life cycle for any species of Sarcocystis as unlike other species of Sarcocystis, S. neurona has wide host range for its intermediate hosts. Opossums (*Didelphis virginiana, D. albiventris*) are its definitive (reservoir) hosts and excrete oocysts and sporocysts (environmentally resistant stage) in their feces. Raccoons, armadillos, sea otters, skunks, cats, and possibly other mammals are intermediate hosts. These animals ingest the sporocysts , which after many asexual cycles, lead to the development of sarcocysts (resting stage) in their muscles. Infection of the final host is by the ingestion of the sarcocysts from the muscles of the intermediate hosts. The bradyzoites are released in the intestines of the definitive host. They undergo a sexual cycle and this ultimately results in the production of sporulated oocysts, which are excreted in the feces of the opossum. Horses are considered its aberrant hosts because only schizonts and merozoites (no sarcocysts) have been identified , confined to the brain and spinal cord (Figure 15–5).

Other diseases cause symptoms similar to those of EPM; they include bacterial and viral diseases of the brain and spinal cord, trauma, malformations of the spinal cord, poisons, hind-limb lameness, and vitamin E deficiency. Diagnosing EPM is a matter of matching up the history and symptoms and then ruling out other possible causes to arrive at a tentative diagnosis. Several blood tests are available, but none is definitively diagnostic. Many horses test positive on the blood tests but exhibit no symptoms. Recently, tests on cerebrospinal fluid have greatly improved the ability to accurately diagnose the disease. One of these tests is called a immunoblot analysis of serum and cerebral spinal fluid. It detects the horse's antibodies to the organism.

Since the life cycle of the protozoan is not completely understood, no proven methods of preventing EPM now exist. However, a vaccine is being tested.

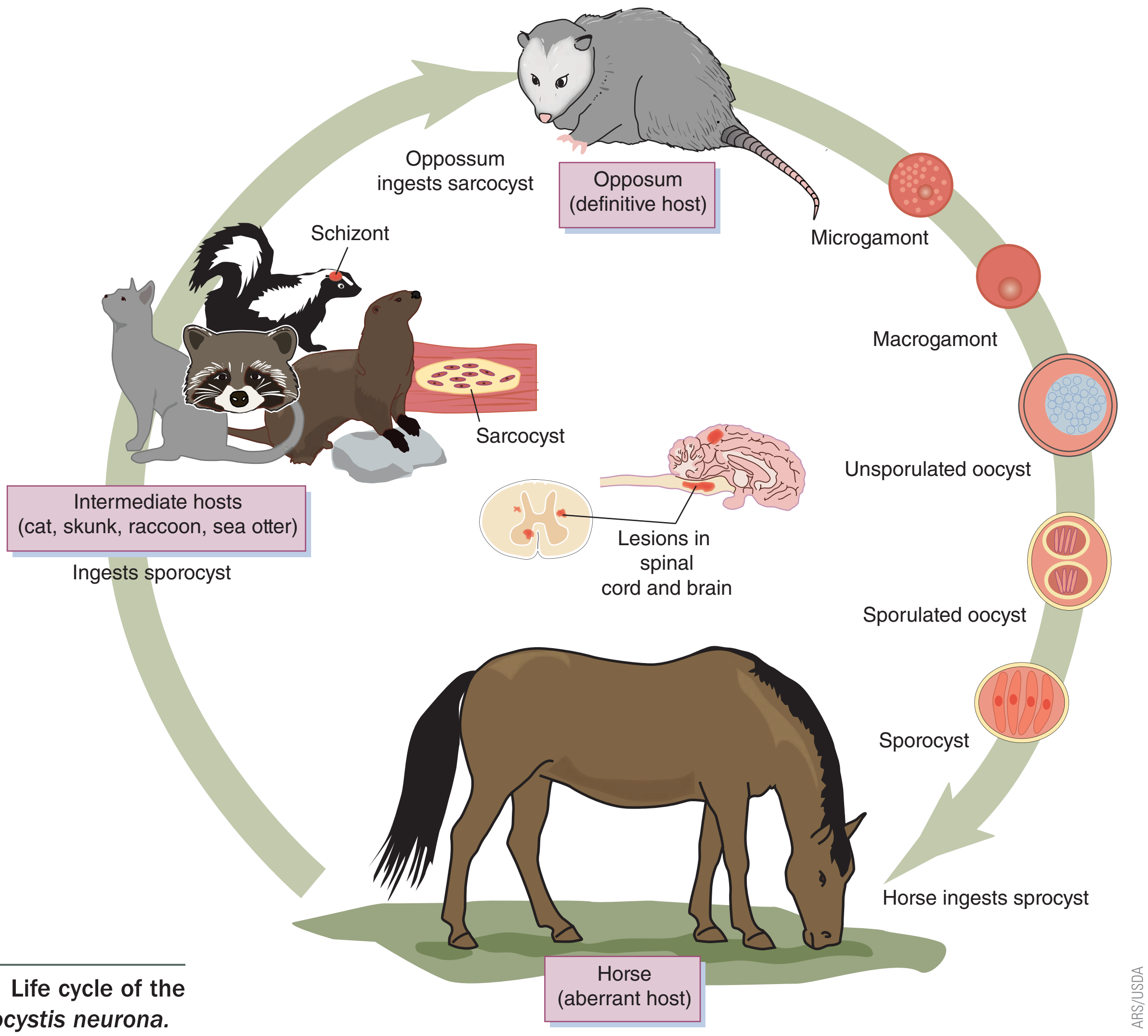


FIGURE 15–5 **Life cycle of the protozoan *Sarcocystis neurona*.**

Treatment regimens for EPM are costly; often of limited effectiveness; and in a small number of treated animals, symptoms recur when therapy is discontinued. Two drugs used to combat EPM are trimethoprim sulfa and pyrimethamine. The cost of treatment can be expensive, depending on the size of the horse and the drug formulations used.

ONCHOCERCIASIS

Onchocerca species are nematodes that occur as adults in connective tissue of horses, mules, and donkeys. They are fairly common parasites. About 75 percent of horses surveyed in the Midwest were infected with *Onchocerca cervicalis.* Adult females are quite long—up to 30 centimeters—but the males are small, 6 to 7 millimeters long. Females of *Onchocerca cervicalis* occur in the ligamentum nuchae, a large ligament in the neck of horses and mules.

Onchocerca reticulata occurs in the flexor tendons and suspensory ligaments. This nematode also requires an intermediate host and uses midges (*Culicoides* sp.) as an arthropod vector. Biting midges pick up the microfilaria in the skin of horses; these develop to an infective stage in the midge in about 3 weeks. When the midge takes a blood meal from a horse, the infective stage is injected—thus completing the cycle.

In addition to the **dermatitis** this organism can cause, it sometimes causes eye problems. *O. reticulata* causes occasional lameness. Species of *Onchocerca* do not cause fistulous withers or poll evil, as formerly believed. Because the new parasiticide, **ivermectin**, quickly kills *Onchocerca* microfilaria, horses sometimes mount an immune response to these dead microfilaria—resulting in tissue edema. This condition resolves itself spontaneously in about 7 days.

Eye Worm

The equine eye worm, *Thelazia lacrymalis,* is about 19 millimeters long and lives in the tear duct and conjunctival sac of the horse's eye. The female worms produce living larvae; they do not lay eggs. These first-stage larvae wander into the eye secretions and are picked up by face flies that serve as the intermediate host. In the fly, the larvae develop into the infective stage and can be transferred to another host when the face fly feeds on eye secretions.

Although most eye-worm infections go undetected, heavy infections cause mild eye irritation. On rare occasions, they result in blindness, probably due to secondary bacterial infection.

Diagnosis is made by observing adult worms in the eye. Treatment is best achieved by removing the adults from the conjunctival sac under ophthalmic anesthesia and tranquilization. Decreasing the prevalence of eye worms is best achieved by controlling face flies.

Sometimes the abdominal worm, *Setaria equina,* develops in the eye and causes damage. Normally, these nematode parasites, which use mosquitoes as intermediate hosts, occur in the abdominal cavity and are of little or no consequence.

EXTERNAL PARASITES

External parasites of horses include ticks, mites, chiggers, and lice. These cause irritation and may carry disease.

Ticks

Three kinds of ticks occur commonly on horses. Each has a preferred location on the horse. Some are more common in specific parts of the country.

The winter tick, *Dermacentor albipictus,* has become widely distributed because horses now are commonly transported from one part of the country to another (Figure 15–6). Although this tick occurs primarily on the horse, it is found on other farm animals, such as cattle, sheep, and goats, so these animals can also be involved in its spread.

Ticks differ from one another in that some use only one host as they develop from larvae to nymphs to adults, while other ticks use more than one host. The winter tick is one of the ticks that uses only one host. The entire life cycle takes place on the horse.

Tick infestations, like those of lice, are more common in the winter than in the warm seasons. Large numbers of winter ticks can cause horses to: become weak; lose their appetite and become thin; and, because of the blood loss, sometimes develop an anemia that makes them more susceptible to other diseases. Ticks can cause death, especially in foals.

The Pacific coast tick, *Dermacentor occidentalis,* is found chiefly in coastal areas of the West. Unlike the winter tick, this tick drops off the host to lay its eggs, and the larvae and nymphs feed on small mammals before becoming adults and parasitizing horses.

FIGURE 15–6 **The winter tick attaches to the host as a larva and remains attached throughout its life.**

The Pacific coast tick can transmit Rocky Mountain spotted fever, Colorado tick fever, African horse fever (piroplasmosis), and other diseases. It also can produce a condition called tick paralysis that can affect humans, dogs, and calves. Consequently, horses should be inspected for ticks after trail rides or cross-country pleasure rides in areas where these ticks occur.

The ear tick, *Otobius megnini,* like *Dermacentor albipictus,* is a one-host tick. It is common on horses but is also found in the ears of cattle, sheep, dogs, cats, and, occasionally, people. These ticks, however, do not occur on the horse in their adult stage: only the larvae and nymphs are found in the horse's ears. Adults have nonfunctional mouth parts but may survive for 2 years on the ground.

Ear ticks on horses cause irritation evidenced by excessive head tossing or rubbing of the ears. Horses that have drooping ears and shake their heads a lot may have ear ticks. Ear ticks also predispose the animal to secondary bacterial infection of the middle and inner ear and can, consequently, cause serious problems. This tick, unlike *Dermacentor,* does not itself transmit any diseases. Several topical preparations are available for treating ear ticks.

Mange Mites

Mites are **ectoparasites** that are closely related to ticks and cause a skin condition called **mange**. The entire life cycle of mange mites occurs on the horse. Mating occurs on the skin or in burrows the mites make in the skin. The eggs hatch on the host after about 4 days and are mature, egg-laying adults 12 to 15 days later.

Sarcoptic mange *(Sarcoptes)* causes lesions usually found on the neck, shoulders, head, chest, and flanks of horses. These mites burrow under the skin and cause severe irritation and itching. In trying to relieve the source of itching, horses will bite and rub the affected area until the hair is lost and large, scabby areas often result (Figure 15–7).

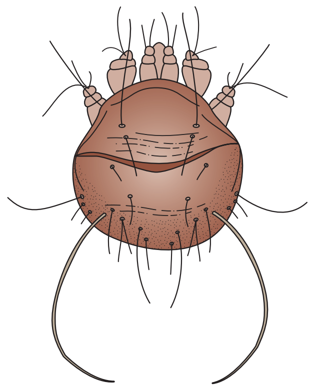


FIGURE 15–7 **Sarcoptic mange mite**

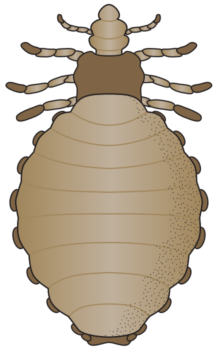


FIGURE 15–8 Horse-sucking louse.

Chorioptic mange *(Chorioptes)* produces lesions like sarcoptic mange, but since the mites occur more commonly on the lower extremities, it often is called foot mange. Horses affected with these mites will paw, lick, and bite at their lower legs in an attempt to relieve the itching.

Psoroptic mange occurs primarily on the poll or the tail. This mange mite *(Psoroptes)* also causes intense itching, with hair loss and scabs if the horse traumatizes itself extensively.

Mange mites can live off the host for a short time and can be transferred from one host to another on combs, blankets, and so forth. In the past, mange has been extremely difficult to control, but with the new ivermectins, mange should become a less serious problem.

Chiggers and Lice

Chiggers affect horses in much the same way they affect people. Chiggers are the larval stage of harvest mites *(Trombicula)* that affect horses' feet and muzzles as they walk and feed on infested pastures.

Lice can be a very serious problem in horses. There are two kinds of lice: biting lice *(Damalinia),* which feed on skin and hair, and sucking lice *(Haematopinus),* which pierce the skin and suck blood and tissue fluids (Figure 15–8).

Mites and lice are very host specific. They will not pass from horses to cows, sheep, goats, dogs, or other animals.

Infestation with both sucking and biting lice can be debilitating to horses. Biting lice cause skin irritation and itching, and horses will rub, bite, and kick at themselves to relieve the source of irritation. This results in a rough coat with loss of hair; if serious enough, secondary bacterial infection can cause major skin lesions. In addition, heavy louse infections can produce serious unthriftiness and weight loss.

Sucking lice and a heavy infestation of biting lice can remove enough blood to cause a horse to become seriously anemic, in addition to producing irritation and debilitation because of itching.

Louse infestations usually are more severe in late winter and early spring. Frequent grooming and applications of topical pesticides are helpful in louse control.

Flying Insects

Although not permanently associated with their host as worms and mites are, flies, mosquitoes, gnats, and other flying insects are important not only because of the worry and loss of condition they cause but also because some are carriers of disease

Fly control depends to a great extent on sanitation, good grooming, and common sense. Flies breed in manure and sometimes spilled grain, especially if it is wet. Removing spilled grain and manure from stalls on a regular basis, and changing bedding as it becomes soiled with feces and urine, will aid in fly control. Some flies serve as carriers of parasitic worms and viral diseases.

Mosquitoes transmit equine encephalomyelitis. Black flies and "no-see-ums" very often cause intense itching and attendant lesions in horses' ears, although they will bite other thin-skinned areas of the horse as well.

Bots

Bots are fly larvae that are parasites in the stomach of horses. *Gastrophilus intestinalis,* the common horse bot, and *G. nasalis,* the throat botfly, are the two common botflies found in this country.

Adult flies look somewhat like bees and are not seen often. These adult flies lay eggs on the hair of the legs or around the chin and throat of horses.

G. intestinalis lays its eggs on the forelegs and shoulders of horses. The eggs hatch when the horse licks itself, so the larvae quickly gain entrance to the horse's mouth. *G. nasalis* lays its eggs around the chin and throat, where they hatch spontaneously (the horse doesn't need to lick the eggs for them to hatch). *G. nasalis* eggs hatch and burrow under the horse's skin into the mouth.

Both species remain for about a month in the lining of the tongue and cheeks, where they may cause severe ulcers around the teeth and cause horses to go off feed. After about a month, the larvae are found in the stomach, where they produce a condition called gastric myiasis. Although in small numbers, bots cause virtually no clinical signs, in heavy infections there may be almost no part of the horse's stomach wall that does not have a bot attached (Figure 15–9).

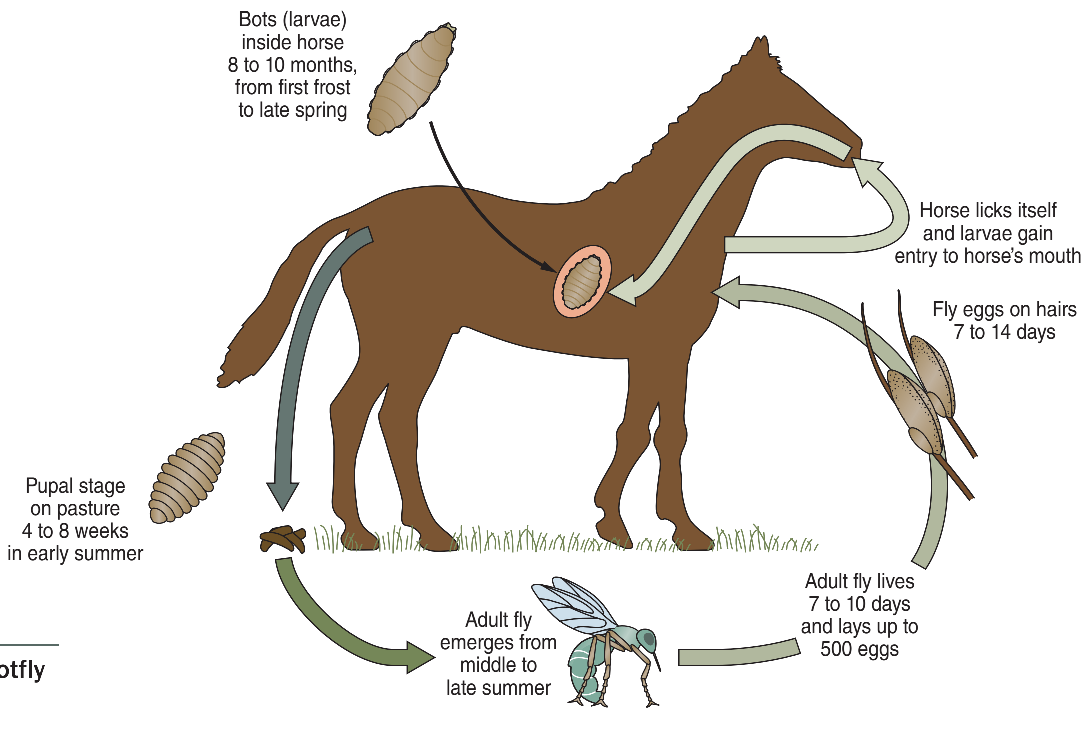


FIGURE 15–9 **The botfly life cycle.**

These botfly larvae are fairly large, about 2 centimeters long, and have large oral hooklets that they attach to the stomach wall. Sometimes they completely penetrate the stomach wall, causing peritonitis and subsequent severe problems.

Adult flies seriously annoy horses when depositing their eggs on the legs and chin. Washing the legs and chins of horses with warm water containing an organophosphate insecticide every week during botfly season aids in control.

Warble flies, which cause cattle grub, can affect horses. But they are seldom a problem except in cow ponies used to work range cattle.

PREVENTION AND CONTROL

Sanitation and good management practices should be used to control parasite infections. Foals are born free of internal parasites; their buildup of internal parasite infections is related to the degree of contact, either direct or indirect, with older animals carrying the infections. All of the worm parasites discussed here use feces or manure to spread infections by contamination of feed and water supplies or the environment.

Transfer stages of these worm parasites do not actively seek the host to complete the infection process. Instead, they rely on chance to be picked up and swallowed. Thus, only a very small percentage actually complete this step in the life cycle. To compensate for this, female worms produce large numbers of eggs to start the transfer process.

Sanitation and sound management practices aid in controlling or minimizing the spread of infections. These practices assist the natural destructive forces such as sunlight and drying during transfer stages. Susceptible animals also should be allowed only limited contact with contaminated pastures, paddocks, or stables. A checklist of sanitation and management practices effective in reducing numbers of parasites and flying insects includes the following:

1. Proper manure disposal
   - **Stable manure:** Compost before spreading on pasture, or spread on cropland and other ungrazed areas
   - **Small corrals or paddocks:** Pick up all manure and compost or dispose of as above
2. Pasture management
   - Practice frequent mowing and chain harrowing
   - Avoid overstocking
   - Rotate grazing as much as practical
   - Graze young animals separate from older horses
   - Follow horses with cattle or sheep before returning pastures to horses
3. Feed
   - Provide mangers, racks, or bunks for hay and grain
   - Do not feed off the ground
4. Water
   - Provide a clean water supply
   - Avoid water sources contaminated with feces
5. Removal of bot eggs
   - Clip egg-bearing hairs or sponge affected areas with warm water
6. Regular deworming of horses should be practiced under the supervision of a veterinarian who is familiar with local land and weather changes.

TABLE 15-2 Antiparasitic Compounds for Internal Parasites

CLASS	GENERIC NAME	METHODS[1]	PERCENT EFFECTIVENESS			
			BOTS	STRONGYLES	PINWORMS	ASCARIDS
Avermectins	Ivermectin	T, P	95–100	95–100	95–100	90–100
Benzimidazoles	Fenbendadzone (FBZ)	T, F, P	0	95–100	95–100	90–100
	Mebendazole (MBZ)	T, F, P	0	65–95	95–100	95–100
	Oxfendazole (OFZ)	T, F	0	95–100	95–100	90–100
	Oxibendazole (BZ)	T, F, P	0	95–100	95–100	90–100
	Thiabendazole (TBZ)	T, F	0	90–100	90–100	10–75
	MBZ + TCF	T, F, P	95–100	65–95	95–100	65–95
	OFZ + TCF	P	95–100	95–100	95–100	95–100
	TBZ + TCF	T, F	95–100	90–100	90–100	95–100
Oranophospates	Trichlorfon (TCF)	T, P	95–100	0	90–100	95–100
Phenylguanidines	Febantel (FBT)	T, F, P	0	95–100	95–100	95–100
	FBT + TCF	P	95–100	95–100	95–100	95–100
Pyrimidines	Pyrantel-pamoate (PRT)	T, F, P	0	65–100	60–70	90–100
	Pyrantel-tartrate[2]	F	–	–	–	–

[1]F = feed, P = paste, T = stomach tube.

[2]Infective larvae are prevented from entering the tissues.

Anthelmintic Drugs

For effective parasite control, horses often need to be treated with specific drugs, commonly referred to as anthelmintics (Table 15–2). These drugs remove the parasites from the intestinal tract. Depending on the type of parasite, the brand name of one of these drugs will be used for treatment: ivermectin, pyrantel, fenbendazole, or moxidectin. The treated animal is relieved of the immediate damage or injury caused by parasites, but probably more important, removal of parasites breaks the cycle. This serves to reduce contamination of the environment with transfer stages, limiting the spread of infections and protecting animals from reinfection.

The best method of strongyle control currently recommended is to administer a small quantity of a deworming compound to the individual horse's ration daily. This compound is very effective in those management systems in which horses are fed individually.

The best routine deworming program for any particular management system should be designed around individual client/horse requirements and may differ depending on the number of horses on a pasture, amount of time spent at pasture compared with time spent in a stable, availability of alternative pastures (for rotational grazing), age of the horses, and other conditions. The local veterinarian should guide the horse owner regarding the optimal deworming strategy.

If daily deworming cannot be undertaken, regular use of ivermectin is recommended (every 6 to 10 weeks depending on the local circumstances). Ivermectin has profoundly affected parasite burdens in horses. It is so effective that the old-fashioned deworming strategies that used stomach tubing or promoted the "rotation" of a number of weaker deworming compounds are no longer recommended. Traditionally, dangerous and toxic compounds were used to eliminate bots. Fortunately, ivermectin is as effective against bots as it is against strongyles and ascarids. Although tapeworm problems are uncommon, once-yearly deworming against tapeworms is recommended for horses that are routinely dewormed with ivermectin. This is especially true if the horse has access to permanent pasture grazing. The best method of deworming against tapeworms is to use a high dose of pyrantel pamoate.

The veterinarian's services can include a microscopic examination of fecal samples for an indication of the kinds and relative numbers of worm parasites in the animals. This, along with other information such as numbers and ages of animals and type and amount of pasture, provide the veterinarian with a rational basis for the selection of drugs and frequency of treatments for the particular situation.

With primary emphasis on strongyle control, some operations may require only one or two treatments per year, whereas others with factors or circumstances favoring heavy infections may take as many as six treatments per year to maintain effective control. All horses on a farm should be included in the control program. New stock or temporary boarders should be treated and quarantined for a week or so before they are placed on pasture or otherwise allowed to mingle with other horses.

Drug Resistance

Many anthelmintics introduced over the last several years are benzimidazole analogs to which nematode parasites are starting to develop a resistance. Resistance develops when a wormer does not kill all of the target worm population; some survive to contaminate pastures. Over time, pastures become contaminated with a high proportion of larvae that, when eaten, will develop into adults able to tolerate the doses of anthelmintic normally administered.

Before concluding that lack of response is due to benzimidazole resistance, other reasons should be considered to explain why horses have eggs in their feces after worming. Among them might be a low plane of nutrition, rapid reinfection, wrong choices of anthelmintic, an inappropriate dose, or faulty administration.

If anthelmintic resistance is a problem, two processes can be used. One is to use a given class of anthelmintic—for instance, a benzimidazole—for a year and then use a different compound such as pyrantel, an organic phosphate, or ivermectin for a year. Simply changing from one benzimidazole to another does not constitute changing anthelmintics. The second option is to change the classes of anthelmintics each time horses are wormed.

A prime objective of any strongyle control program should be to keep pasture contamination of larvae to a minimum. The worming protocol needed to accomplish this objective will depend on worm burden, stocking rate, and climatic conditions and so will vary from farm to farm. The horse owner with 50 acres to support two horses will have far fewer problems than will an owner who is trying to keep two horses on two acres.

SUMMARY

Parasites are grouped as internal and external. Many parasites can affect horses, but internal parasites create the greatest health problems. The person working with horses must learn to recognize the signs of parasitic infections early. Also, many good management practices will prevent or lessen the chance of severe infections. Based on local geography and weather conditions, a veterinarian can help develop a control program that also combines the use of chemicals to kill internal parasites.

Parasite infections are difficult to identify and hard to eliminate. Success in controlling them must be a determined and sustained effort. A continuing battle must be waged against internal parasites, the most common danger to the health and well-being of horses.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Keeping pasture contamination to a minimum will help in parasite control.
2. Botflies transmit equine encephalomyelitis.
3. All parasites require an intermediate host.
4. Lungworms cause more problems in horses than they do in donkeys.
5. Horses and people can have pinworms.

Short Answer

6. Name six sanitation and management practices for reducing parasites.
7. List three hosts of parasites.
8. Name five symptoms of any parasite infestation.
9. List five internal and five external parasites.
10. Name three ways the veterinarian can help in a deworming program.
11. List the major internal parts of the digestive system that any type of worm infestation may affect in the horse.

Critical Thinking/Discussion

12. What is the purpose of an anthelmintic?
13. Explain the life cycle or stages of a parasite.
14. Explain the difference in how ticks, lice, chiggers, and mites affect horses.
15. Why are young horses affected more by parasites than older horses are?
16. How are horses checked for parasites?

STUDENT ACTIVITIES

1. Based on the information in this chapter, develop a checklist of things to observe when examining horses for signs of parasites. Make the checklist complete enough that it could be given to a new employee. Using a word processor, put this checklist in a table format.
2. Visit or contact a veterinary clinic. Find out how to submit a fecal sample to be checked for parasitic infection.
3. Using the generic names for the antiparasitic drugs in Table 15–2, identify the brand name or trade name used to sell these drugs. This can be done by visiting a livestock supply store or veterinary clinic, by reading a livestock or equine supply catalog, or checking online.
4. Invite a veterinarian or sales representative to discuss the types of anthelmintics sold. Also, find out what types of restrictions are placed on the sale of these medicines.
5. Research and report the role of bacteria in human health and commerce. Some bacteria cause disease, while other bacteria have a beneficial role in human welfare.
6. Develop a program for regular deworming based on your location and weather conditions. Using a word processor, put this deworming program into a table format.
7. Learn how to check a horse for ticks. Write a paper describing this process.
8. Compare the types of parasites found in cattle, pigs, and sheep to those found in horses. Describe any similarities or differences. Put this information into a table format.

ADDITIONAL RESOURCES

Books

Crabbe, B. (2007). *The comprehensive guide to equine veterinary medicine*. New York: Carlton Books, Sterling Publishing.

Kahn, C. M. (Ed.) & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

Kahn, C.M. & Line, S. (2007). *The Merck/Merial manual for pet health: The complete pet health resource for your dog, cat, horse or other pets - in everyday language.* Whitehouse Station, NJ: Merck & Co.

Pavord, T. & Pavord, M. (2009). *The complete equine veterinary manual, 3rd ed.* Cincinnati, OH: David & Charles Book.

U.S. Department of Agriculture. (1923). *Special report on diseases of the horse.* Washington, D.C.: U.S. Government Printing Office.

Vogel, C. (2011). *Complete horse care manual.* New York: DK Publishing.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

anthelmintics	equine encephalomyelitis	parasites in horses
	parasite control	(internal and external)

A search for any of the specific parasites will produce additional information. Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 16

Common Management Practices

Successful ownership and enjoyment of horses depends on a solid knowledge of horses and good management practices. Management is knowledge in action. Many of the management practices for horses have already been discussed in other chapters. This chapter covers management topics not discussed elsewhere: dealing with stress in horses; identifying horses; neonatal, weaning, and castration decisions; stall maintenance; fly control; pasture maintenance; and wound management.

OBJECTIVES

After completing this chapter, you should be able to:

- Recognize stress in horses
- Describe methods of marking and identifying horses
- Discuss procedures for the neonatal foal
- List methods of fly control
- Describe common fly problems and the habits of several species
- Explain the best management practices for pastures and forages
- Describe wound types and their proper management
- Discuss the management considerations when weaning a foal
- Explain the importance of records to the management of horses

KEY TERMS

auditory
bedding
chestnuts
cowlicks
cryptorchid
dun
firing marks
freeze brand
grullo
hierarchy
mastitis
meconium
microchip
microsatellites
neonatal
olfactory
paddocks
pupae
RFID
ridgeling
roan
soil test
stress
tattoo
wound

RECOGNIZING STRESS IN HORSES

Stress is a demand for adaptation. Some stress is necessary, but each horse has its own tolerance level; when that level is exceeded, failure results. Knowing the signs of stress, monitoring the signs of stress, and reducing stress are all signs of good management.

Anyone working around horses needs to learn to recognize the signs of stress. A horse experiencing stress may appear frightened or nervous, it may be pacing or running, or it may develop a vice such as cribbing or stall weaving. Abnormal sweating may signal physical or psychological stress. Muscle tone can provide some clues. If the horse is tense, sweating, and the muscles are contracted, it may be tying up. If the muscles are flaccid and extremely relaxed and the horse is depressed, the central nervous system may be damaged. If any of these signs are observed, a closer inspection is needed. Intervention may be necessary.

Permanent Records

To recognize changes in the horse's condition, normal values must be known. They will be different for each horse, so each horse needs its own permanent record. Horse owners must keep a file on every horse that includes the following information:

- Permanent identification, birth date, and registrations
- Reproductive history, breeding dates, and foaling dates
- Weight and condition scores
- Normal temperature (T), pulse (P), and respiration (R), or TPR
- Deworming dates and products used
- Vaccination dates, diseases, and products used
- Illness dates, diagnoses, and treatments
- Injury dates and treatments
- Surgery dates and outcomes
- Allergy causes

This record can be a handwritten form, or it can be computerized. Figure 16–1 illustrates the types of records that should be maintained on horses.

Stress can be grouped into four different categories for horses:

1. Behavioral or psychological
2. Mechanical
3. Metabolic
4. Immunological

Behavior

Managing horses in a low-stress environment requires understanding how their senses perceive the world and a few principles of their behavior. For more information on behavior, refer to Chapter 19.

Horse Name:		
Gender:	Date Foaled:	
Breed:	Color:	
Registration No.:	ID/Tattoo:	
Markings:		
Owner Name:	Phone:	
Address:		
City:	State:	Zip:
Insurance Carrier:	Policy No.:	

Medical Record			
Date	**Problem**	**Vital Signs**	**Treatment**

Maintenance Record		
Vaccinations	**Date**	**Date Due**
Eastern Equine Encephalitis		
Western Equine Encephalitis		
West Nile Virus		
Rhinopneumonitis		
Tetanus		
Rabies		
Potomac Horse Fever		
Lyme Disease		
Influenza		
Wormer		
Farrier		

FIGURE 16–1 **Example of records that should be maintained on horses.**

Sensory Perception

Horses do not see the world as humans do. Horses have both binocular and monocular vision. Monocular vision allows them to see 220 degrees around them when their head is down to graze. Binocular vision allows them to focus on objects in front of them (see Figure 19–9).

Horses hear much better than people do, but olfaction is even more acute—smell is their strongest sense.

Horses are also very sensitive to touch. Their untrained natural response is to move into pressure.

Communication

Horses communicate with each other through visual signals. Recognizing these signals can help owners understand their horses. Anger is demonstrated by laying the ears back, pursing the lips, and swishing the tail. Interested horses cock their ears forward and have a relaxed body. A fearful horse may put its ears forward or to the side; its body is tense and its tail clamped or stiff. Relaxed horses have relaxed ears and one hind leg cocked. They may chew or lick their lips.

These behaviors can be easily recognized and may alert the owner to certain stereotypes of horse behavior. For example, some horses are sullen and difficult most of the time, while others are actually treacherous. Bad-tempered, resentful horses may bite, strike, or kick at any time.

Social Behavior

The social behavior of horses is controlled by the herd instinct. Horses seek out and enjoy the company of other horses (Figure 16–2). Social order is important, and there is an established dominance **hierarchy** in any herd of horses. Dominance is the ability to control access to resources. The dominance hierarchy requires that each horse recognize other horses and determine through some initial aggressive acts (biting or kicking) and submissive acts (running away) which horse is dominant and which is subordinate. After the initial conflicts establish the hierarchy, just the signs of anger from the dominant animal will be enough to warn subordinates. Pecking order can change if a horse is removed from a group for several weeks, or if a mare is in estrus or going to have a foal.

Initial contact across safe wooden fences can alleviate some social stress, and introducing horses gradually can help avoid injuries associated with fighting. Providing extra feeding stations and dividing the feed so horses all get adequate portions is another way to avoid conflict.

FIGURE 16–2 **Welsh ponies. Horses are gregarious animals that prefer to be in the company of other horses, where they feel secure. This is important to know when working with young and/or anxious horses.**

MECHANICAL STRESS

Structural injury can be detected by lameness, local inflammation, swelling, heat, and/or pain. Checking for injuries should be part of the daily routine.

NUTRITION AND METABOLIC STRESS

The horse's digestive system is designed to handle frequent small meals. They are continuous grazers by nature and usually do best when kept at pasture. If this is not possible, good-quality hay fed in frequent meals is the next best thing.

Nutritional programs are designed by evaluating each horse's weight and condition. Horses must be fed individually in most cases. Energy requirements of "easy keepers" and "hard keepers" can differ by up to 30 percent. About 80 percent of a horse's feed goes to meet its energy requirement. The hay used should contain the most nutrients per dollar.

To reduce stress, horses require that a certain proportion of the diet be roughage. Vitamin and mineral requirements must also be met but not exceeded for the stage and condition of the horse. Nutritional requirements and feeding guidelines are given in Chapters 12 and 13.

Three metabolic problems in horses are closely associated with nutrition:

1. Colic
2. Laminitis
3. Tying up

Horse owners need to learn to recognize these conditions. They can be serious health problems for a horse.

Colic

Colic is an acute abdominal crisis or stomach ache. In its most serious form it can cause death, and it often does. Abdominal pain can lead to shock, which causes dramatic changes in fluid balance. Signs of colic include pawing, looking at the belly, stretching out, rolling, not eating, violent movement, kicking and biting at the flank, and depression. Every sign is not seen in every case. If colic is suspected, the horse's temperature, pulse, and respiration should be taken and recorded and a veterinarian called. An elevated heart rate and/or respiration signals a potential emergency. The many causes of colic include sudden changes in diet, parasites, twisting of the intestines, gastric ulcers, lack of a quality water source, cribbing, compaction, and gas. Colic is discussed more completely in Chapter 14.

Laminitis

Laminitis is any condition that leads to separation of the sensitive and insensitive lamina of the hoof. Early signs include a rapid heart, pounding digital pulse, depression, elevated temperature, and circulatory impairment. As the condition progresses, the horse will become lame. The horse will extend its legs out in front and rock back over its hocks and will be reluctant to move or pick up its front feet. A veterinarian needs to be called at the earliest signs of laminitis. Laminitis is covered more completely in Chapter 14.

Tying Up

Tying up, or exercise-related muscle problems, are metabolic conditions related to nutrition and exercise. Signs include an altered gait, rapid breathing, stiffness in the hindquarters, rigid back, trembling muscles, sweating, reluctance to move, collapse, muscle damage, brown urine, kidney failure, and laminitis. Some contributing factors include excess soluble carbohydrates in the diet, stress, metabolic and hormonal disturbances, electrolyte imbalances, and selenium and vitamin E deficiencies.

Tying up can occur shortly after exercise begins or after the horse has been worked hard, such as after an endurance ride. If the horse is exhausted and overheated, rest it immediately in the shade, cool its extremities by bathing them with cool water, and give the horse an electrolyte solution. Commercial electrolyte solutions are available through a veterinarian or feed store.

If the horse ties up shortly after the start of exercise, it should not be moved. Instead, dry off the horse and cover its hindquarters with a blanket, then call a veterinarian.

Once a horse has tied up, the condition will likely recur. Altering the horse's diet may help correct the problem.

Immunological Stress

Stress caused by disease and/or parasites can range from superficial discomfort to death. A good vaccination program is the best defense against infectious diseases. A veterinarian will help form a vaccination schedule based on disease prevalence, the use of the horse, the season, and the effectiveness of vaccines. Some of the vaccines available include protection against tetanus; influenza; rhinopneumonitis; Eastern, Western, and Venezuelan encephalomyelitis; strangles; Potomac horse fever; rabies; leptospirosis; and clostridium. Diseases and vaccination programs are discussed more completely in Chapter 14.

An effective deworming program must include good management practices as well as regular use of antiparasitic drugs. Parasite infections and control are discussed in Chapter 15. Some important guidelines include:

- Treat all horses at the same time
- Rotate clean horses to clean pastures
- Design feed and water facilities to prevent fecal contamination
- Remove manure frequently from stalls and paddocks
- Clip and harrow pastures regularly
- Consult with a veterinarian on selection and use of antiparasitic drugs
- Monitor the effectiveness of the parasite control program by checking egg counts in feces

MARKING OR IDENTIFYING HORSES

In today's competitive world of equine sports, proper identification is a high priority. Thorough and effective identification ensures that a horse being bought, sold, raced, or bred is indeed the horse claimed. Some circumstances in which positive identification is important include:

- Health and disease control
- Theft prevention, documentation, and recovery
- Slaughter
- Breeding
- Recovery of animals lost or killed in natural disasters
- Fraud prevention

The Jockey Club was the first organization in the United States to set up an accurate identification system for horses. In the early 1900s, the Thoroughbred racing industry was having problems with "ringers" running under assumed names. A ringer is a falsely identified horse entered in a race below its class, giving it an almost certain chance to win.

Today there are many methods used to identify a horse, including body markings, tattooing, freeze branding, blood typing, **microchip** implantation, and DNA testing.

Body Markings

Obviously, coat colors such as bay, blue **roan**, **dun**, **grullo**, and palomino can be used to identify horses (Figure 16–3).

Distinctive markings or patterns such as a star or blaze on the head and stockings or distal spots on the legs provide more detail (Figure 16–4). The correct terms to use in identifying coat colors and facial and leg markings are listed and explained in Chapter 8.

Unique body markings used for identification include **chestnuts**, **cowlicks**, and dimples. Body markings are recorded as a picture or drawings.

- Chestnuts or "night eyes" are horny, irregular growths on the inside of the horse's legs. On the front legs, they are just above the knee. On the rear legs, they are toward the back of the hock. Chestnuts are like human fingerprints because no two are alike, and they do not change in size or shape throughout the horse's adult life.
- Cowlicks are permanent hair whorls that cannot be brushed or clipped out. They are located mainly on the forehead and neck.
- Dimples are permanent indentations in the muscle under the skin. They are usually located at the point of the shoulder or in the neck muscles.

Courtesy Botts/Watson Photography

FIGURE 16–3 **A haflinger has unique coloring.**

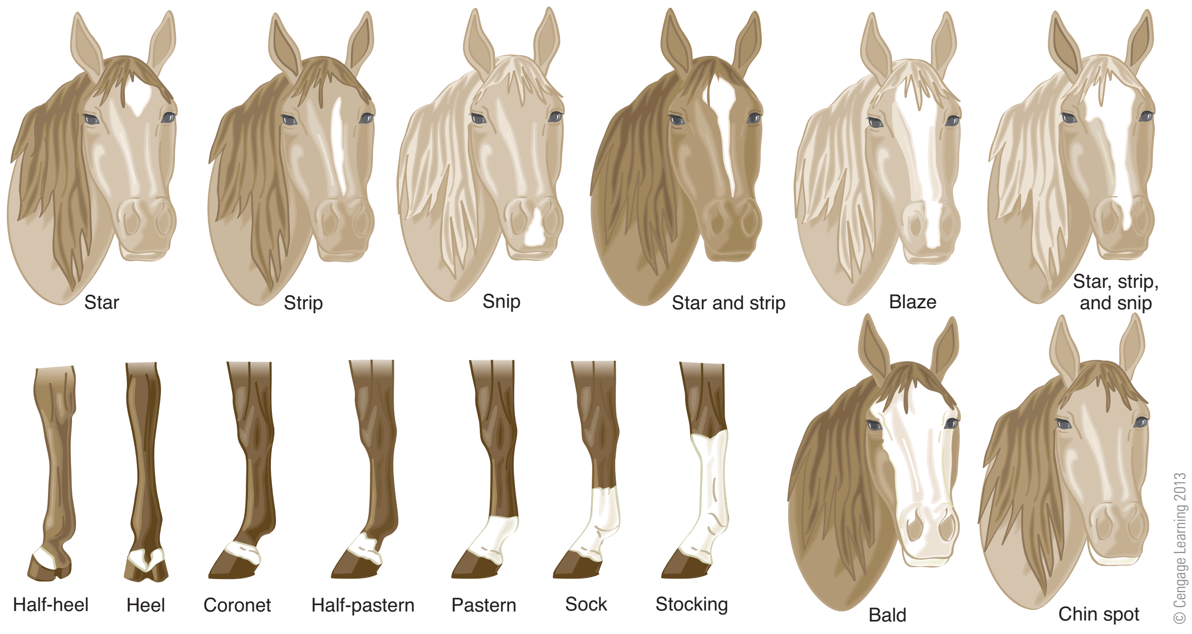


FIGURE 16–4 **Face and leg markings.**

- Other markings can include white or black patches on the body and scars. **Firing marks** on the legs (where one leg strikes another) are also useful for identifying horses.

Tattooing

A **tattoo** consists of a letter corresponding to the year the horse was born and a number matching the registration number of the horse. The tattoo may be placed in several areas, but the upper lip is the most common site (Figure 16–5). The actual tattoo instrument consists of a chrome-plated brass block containing a pattern that uses a varying number of needles, depending on the particular number or letter. The needle pattern developed over several years until a specific pattern was obtained that could not easily be altered.

Before the tattoo is applied, the horse is carefully examined for color, markings, cowlicks, chestnuts, and other easily identifiable traits. Once the identity of the horse is ensured, the mucous membrane on the upper lip is exposed using a lip clamp. The area is cleaned with alcohol, and the proper digits are placed in the tattoo gun. The gun is then dipped in an antiseptic and applied to the lip. Finally, ink is rubbed into the perforations.

Lip tattooing was perfected by the Thoroughbred Racing Protective Bureau (TRPB). The Jockey Club uses this method of identification to guarantee the identity of every racing horse at a track that is a member of the Thoroughbred Racing Association (TRA).

Freeze Branding

A **freeze brand** uses an unalterable system of angular symbols developed by Dr. Keith Farrell, a veterinary medical officer with the U.S. Department of Agriculture. As with

FIGURE 16–5 **Checking a lip tattoo.**

Courtesy Rick Parker

FIGURE 16–6 **Freeze brand showing dark hair that has turned white.**

© Dale A Stork/www.shutterstock.com

tattooing, the first symbol represents the year the horse was born, followed by the registration number. The brand is most commonly applied to an area approximately 2 inches by 7 inches midway on the neck, underneath the mane.

The identity of the horse is double-checked before the brand is applied. Copper stamps or marking rods are cooled in liquid nitrogen or dry ice. An area under the mane is shaved and washed with 98 percent alcohol, which aids in conducting the intense cold. The copper stamp is applied to the animal's skin for 10 to 20 seconds. An indentation is left in the skin immediately after the brand is applied. Some swelling may occur in the first few days. However, after 2 months, a distinct and permanent mark remains. The intense cold kills the pigment-producing cells, called melanocytes, leaving an area of pigment-free skin. On dark-colored animals, the hair grows back white (Figure 16–6); on white animals, an area with no hair results.

Freeze branding has many advantages over fire branding. A freeze brand produces minimal changes in the hide, is more distinct and legible, does not produce an open wound, and is relatively painless.

The Arabian Registry uses freeze branding to identify purebred Arabians. An "A" is placed in the first position of the system of marks to indicate "Arabian."

Blood Typing

Although markings, tattooing, and freeze branding are effective in differentiating individual horses, blood typing has been developed over recent years and is an equally effective alternative. Horses have eight recognized blood groups: A, C, D, K, P, Q, T,

EQUINE BLOOD TYPING/ANTIBODY SCREEN TEST FORM

Owner/Clinic: ______________________________

Address: ______________________________

____

____

Phone #: ______________ FAX #: ______________

Clinician: ______________ Date collected: ______________

Results will be faxed unless indicated otherwise.
Please photocopy this form to send with the sample.

Type of test:	Tubes to send:	Price:
☐ NI antibody screen	2 mL serum	$60
☐ Blood typing	5 mL EDTA or ACD	$50
☐ Plasma donor	2 mL serum	$60
☐ Whole blood donor	2 mL serum & 5 mL EDTA or ACD	$110

☐ Other ______________________________

☐ Stallion's blood included for crossmatch with mare (EDTA)

*Test results are valid 3 weeks before foaling.
**Antibody screen using mare's serum.

			NI ANTIBODY SCREEN					BLOOD TYPE
Horse ID	Breed	Sex (M/S/G)	Expected foaling date*	Previous confirmed NI? (Y/N)	Mare bred to donkey? (Y/N)	Stallion's blood for Xmatch (Y)	Confirm NI** (date foal was born)	Mare/Stallion compatibility (Y)

Additional comments:

Make checks payable to: XYZ Lab

American Express *Visa* *Master Card*	*LAB USE ONLY*
Credit card #: ______________________	LAB NUMBER:
Name on card: ______________________	
Signature: ______________________	
Expiration date: __________ Security code: __________	ANTIBODY SCREEN (7009) $60 x ______
Daytime phone: ______________________	BLOODTYPING (7002) $50 x ______

FIGURE 16–7 **Form for submitting blood samples for typing.**

and U. Traditional blood typing consists of testing blood samples for seven of the blood groups and 10 biochemical marker systems to show genetic differences and differences for 40 factors including red cell antigens and serum proteins. Testing requires two tubes of blood—one collected in an anticoagulant and one in a serum tube (Figure 16–7).

Uses of blood typing include: parentage verification, paternity testing, and identification of individual horses where switching is suspected. Traditional blood typing is used by the majority of breed organizations including: the Jockey Club, the American Quarter Horse Association and the Arabian Horse Registry.

Microchip Implantation

Radio frequency identification microchip (**RFID**) technology consists of a sterile microchip, about the size of a grain of rice, implanted under the skin (Figure 16–8). The microchip contains identifying information about the horse, such as a registration number, thus allowing any horse to be quickly identified by a reading device. RFID technology is becoming commonplace. It is used on other animals including pets. Outside the animal industry, businesses use RFID to monitor and track product inventory. RFID technology has benefited hundreds of stolen horses. Slaughterhouses are required by law to check a horse for an RFID chip implanted under its skin. The RFID process is quick and painless.

The veterinarian uses a specially designed needle and syringe to implant the microchip. A local anesthetic is administered about midway down the horse's neck, just below the crest. The chip is then inserted into the ligament in the neck, using the custom syringe. The chip is actually lodged about an inch underneath the skin's surface and made nonmigratory to ensure that it stays in place.

The microchip identification cannot be altered. The chip is read by using a handheld scanner. Many slaughterhouses and brand inspectors have scanners for identification in several states.

FIGURE 16–8 **Size of an RFID tag in comparison to the human hand.**

DNA Testing

The newest technology in identifying horses is DNA testing. DNA is fixed at the moment of fertilization and can be determined from an analysis of blood or tissue samples. The DNA test for horses assigns an individual horse's genetic variation at 10 to 15 different genes of a general type known as **microsatellites**. Microsatellites are composed of simple repeats of DNA subunits, primarily in chromosomal regions not used as templates for protein synthesis. These genes are chosen as effective for identifying individuals and verifying parentage, not for their value in making horse-breeding decisions.

Each gene has about 5 to 12 recognizable variants, which differ from each other in the length of the repeated sequence. The variants are assigned letter designations using an internationally accepted nomenclature. Taken together for all the genes tested, the marker types define a genetic profile and provide a powerful tool for individual-specific identification and evidence for parentage exclusion.

DNA can be extracted from hair, blood, or any tissue. DNA types and blood types are not interchangeable. DNA types can be generated from stored serum samples that were used for blood typing.

MINIMIZING THEFT OF HORSES

Horses are stolen from barns, farms, pastures, boarding and training facilities, competitive events—even from backyards. Tracking stolen horses can be difficult because theft reports are often delayed and stolen horses can change hands frequently and at remote locations. Thieves are less likely to steal horses that are permanently marked and stolen horses are easier to track and recover if marked by one of the permanent methods already discussed:

- Freeze brand—using customized, number or letter iron and by alpha angle code methods
- Hot iron brand
- Microchip/RFID implant
- Lip tattoo

Current photographs are also helpful. Horses should be photographed from all sides, as close as possible, to get the entire frame of the horse. Close-up photos of any unique, identifying characteristics such as brands, scars, or markings are also useful.

Owners should establish an organized, easy-to-find proof of ownership file including:

- Registration papers, if the horse is registered with a breed association
- Dated bill of sale and/or breed association transfer of ownership paperwork
- Photographs
- Description of mark or brand and written description of all unique characteristics

Finally, the permanent brand or mark must be registered with the county clerk's office in the county where the horse lives. Registration helps law enforcement officers and brand inspectors communicate and determine ownership and can speed the process of filing theft reports.

NEONATAL PROCEDURES

The first important **neonatal** task is treatment of the foal's navel with a tincture of iodine solution. The umbilical cord should be allowed to sever naturally, rather than being cut or tied off. The navel stump should be saturated with tincture of iodine immediately after tearing. Treating the navel stump will prevent joint infection or navel ill. This is a bacterial infection usually resulting from poor navel treatment—umbilical infection is its source. It develops in foals less than 30 days of age and is considered a medical emergency. Aggressive therapy is needed to prevent permanent cartilage or bone damage. Symptoms of navel ill include sudden lameness with or without systemic illness, swollen and painful joints, and stiffness. More than one joint may be involved, such as stiffness through the back or neck pain.

The naval stump is an ideal growth environment and entrance for potentially life-threatening bacteria into the newborn's system. Simple iodine treatment quickly and easily minimizes the risks of navel ill and other infections. The treatment should be repeated daily until the navel stump is completely dry. If the navel does not close properly or begins to leak urine, additional treatment and veterinary attention may be needed.

The second task to be attended to is a foal enema to prevent impacted **meconium** and to stimulate intestinal peristalsis. The meconium is a soft, dark greenish-brown substance consisting of digested amniotic fluid, glandular secretions, mucus, bile, and epithelial cells that accumulates in the digestive tract during development. Natural elimination of the meconium should occur within 3 hours after birth, but retention and constipation may occur anywhere from 6 to 24 hours after birth and after prior fecal passages. The meconium needs to be passed for normal intestinal activity to begin. Foals often have trouble expelling the meconium and have a tendency toward painful constipation if it is not passed soon after birth.

There are two types of meconium retention: in the large colon (high), and in the rectum (low). The signs of meconium retention and constipation are similar: restlessness, tail switching, attempts to defecate, elevated tail, straining, colic pain, rolling, getting up and down often, and lying upside down with knees and forelegs extended toward the head.

An enema is used to treat and prevent meconium retention. The foal's rectum and anus are easily damaged. The enema should be administered with 1 pint of warm, soapy water through a soft, narrow, pliable rubber tube inserted no more than 4 to 5 inches into the rectum. Mixtures of warm water and mineral oil or commercially obtained human enemas can also be used.

Exercise often helps foals pass their meconium. Weather permitting, a foal with signs of impaction should be turned out.

Exercise

The timing for a mare and foal to be first turned out depends on the climate, time of year of foaling, and weather conditions. Turnout on the first day after birth is fine if the temperature is mild and the ground is not icy or muddy. The pair should not be allowed to become fatigued or overly stressed by temperature extremes or by overheating as a result of exercise or excitement. This can be minimized by frequent turnout of the mare before she foals. Often, only the mare is led to the turnout area and the foal

FIGURE 16–9 This Paint horse with her foal can be turned out together, as long as there is adequate space and appropriate precautions are taken.

is simply guided behind her. If the foal is led to the turnout area, a rump rope and halter should be used properly, without jerking or pulling, so as not to hurt the foal.

The mare should be released first into the turnout area since she will usually want to run and kick for a moment or two. This prevents the potential disaster of the foal being accidentally in her way. The pair should be turned out alone for the first week or so, and then allowed to join any other mares and foals. Observation is required for the following 10 days, as problems could still occur (Figure 16–9). The mare's udder should be closely watched and the foal's temperature monitored daily. A subnormal, out-of-range temperature indicates an infection and requires immediate attention.

WEANING AND CASTRATION

After being separated from the mare, the foal usually experiences more contact with human handlers who require certain standards of behavior. Therefore, the foal should be taught to accept basic handling and discipline before weaning. Haltering, brushing, and leading the foal while it is still at the side of the mare will make training easier.

Because weaning can be very stressful, the foal should be in good health before being separated from its dam. The only exception would include weaning to facilitate medical treatment of the foal or mare, as recommended by a veterinarian.

Elective surgery to correct conditions such as umbilical hernias and angular limb deformities should be performed well ahead of weaning. Not only will early treatment aid in more complete correction of some conditions, the stressful period surrounding the weaning process can be avoided.

Time of Weaning

The best age for weaning foals depends on the health of the mare and foal, the temperament and vices of the mare, the environment in which the foal will be weaned, the maturity of the foal at a given age, and the management level on a given farm. If necessary, foals can be weaned as early as a few days after birth, but the usual age for weaning is between 4 and 6 months. A newborn foal relies on the mare for nutrition, protection, and security. A foal weaned at an extremely young age requires intense nutritional and behavioral management. By 4 months of age, the foal should be eating feed and less dependent on its dam for protection and emotional support. Weaning before this age may increase weaning stress, especially if environmental conditions are harsh, the foal is not eating grain, or the foal is heavily dependent on the mare.

Little nutritional or social support is gained by waiting until 6 months of age to wean. In fact, later weaning may promote some unwanted behavior in foals. A breeder may want to separate a mare that has an adverse disposition or vices from her foal as early as possible. Some behavior patterns can be learned from the mare and, with early separation, the dam's behavior will have less influence on the foal's behavior.

Weaning Methods

The management level of the breeding farm, the condition and temperament of the mare and foal, the facilities available, and the number of foals to be weaned during a given period all affect the method with which foals are weaned. Foals weaned together and those consuming creep feed prior to weaning experience less weaning stress.

Weaning methods range from an abrupt separation in which the foal and mare are separated immediately from all contact, to gradual separation in which the foal and mare are allowed visual, **auditory** (sound), and **olfactory** (smell) contact before complete removal. Complete abrupt separation usually involves moving the mare to another turnout area, or moving the foal into a confinement completely separated from any contact with the mare. Advocates of abrupt weaning suggest that mare and foal injury is lessened when contact is completely prohibited.

However, some research indicates that foals weaned by complete, abrupt separation exhibit more behavioral problems associated with weaning stress than foals weaned by a more gradual separation. Gradual methods usually involve placing the mare and foal next to one another in enclosures that allow for visual contact for a period of several days to weeks. Fences or stall partitions used in gradual systems must restrict suckling (Figure 16–10). Again, weaning in pairs and preconditioning the foal to solid feed before weaning will reduce weaning stress.

One of the best ways to lessen weaning stress is to maintain familiar surroundings. This can be done by leaving foals of like size and age together. When other foals are not available, an older, nonlactating, well-dispositioned mare or gelding may be used for companionship. Some farms have successfully used goats for the same purpose. Use of other livestock species or mature horses as weaning companions may be especially beneficial when it is necessary to wean single foals that are very young or unusually nervous. The foal appears to experience far less stress when other elements of the environment are the same and when companionship is available. This limits weight loss, decreases the incidence of disease, and makes the transition to self-sufficiency less traumatic.

FIGURE 16–10 **To lessen the possibility of behavior problems, some research indicates that gradual separation is best. Advocates of abrupt weaning believe there is less chance of injury to the mare and the foal when any contact is completely prohibited.**

Regardless of the method used, facility construction and design must emphasize safety. Any protrusions such as feed troughs can cause injury to nervous foals. Also, any area that is wider than a foal's hoof has the potential for trapping the foal's leg if it should strike or rear next to a stall wall.

Mare Care during Weaning

A mare usually calms down more quickly than a foal, although the time required for her to resume normal behavior may vary from a few hours to a few days. Just as foals should be weaned in pairs or small groups, newly separated dams may need to be maintained in pairs or small groups. Unless aggressive behavior between mares is evident, such grouping may aid in more rapid calming following separation from their foals.

If the mare still has significant milk production, grain intake should be decreased and exercise increased. If the udder becomes very tight, a small amount of milk may periodically be extracted by hand, but this practice is discouraged unless necessary. If the udder is still tight 4 days after weaning and the mare's temperature rises significantly or if other indications warrant it, the milk should be checked for the presence of **mastitis** (infection) and appropriate therapy started. A veterinarian's assistance is recommended.

Castration

A castrated horse is called a gelding. Geldings are easier to care for and not as prone to injury as stallions, they are easier to haul, and several geldings can be kept safely in a paddock.

How RFID Works

RFID stands for radio-frequency identification. The acronym refers to small electronic devices that consist of a microchip and an antenna. The chip carries 2,000 bytes (2 kilobytes) of data or less.

RFID devices serve the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. And, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information. However, RFID devices do not need to be positioned precisely relative to the scanner, as do bar codes and credit cards.

RFID devices will work within a few feet (up to 20 feet for high-frequency devices) of the scanner. If RFID devices were used on all groceries in a cart or bag, the scanner could query all of the RFID devices and total the purchase immediately.

RFID technology has been available for more than fifty years. Only recently has the cost to manufacture the RFID devices has fallen to the point where they can be used as a "throwaway" inventory or control device.

An RFID system has three parts:

1. A scanning antenna
2. A transceiver with a decoder to interpret the data
3. A transponder–the RFID tag–that has been programmed with information

The scanning antenna puts out radio-frequency (RF) signals. The RF radiation does two things: (1) provides a means of communicating with the transponder (the RFID tag) and (2) provides the RFID tag with the energy to communicate (in the case of passive RFID tags). This is a key part of the technology. RFID tags do not need to contain batteries, and can therefore remain usable for very long periods of time.

The scanning antennas can be permanently attached to a surface or handheld. Scanning antennas can be placed in a door frame, on a post, to the side of a gate or many other locations to accept data from person, animal or objects passing through.

When an RFID tag passes through the field of the scanning antenna, it detects the activation signal from the antenna. This "wakes up" the RFID chip, and it transmits the information on its microchip to be picked up by the scanning antenna.

RFID tag may be of one of two types. Active RFID tags have their own power source. The advantage of these tags is that the reader can be much farther away and still get the signal. Even though some of these devices are built to have up to a 10-year life span, they have limited life spans. Passive RFID tags, however, do not require batteries, and can be much smaller and have a virtually unlimited life span.

Overall RFID tags can be read in a wide variety of circumstances, where barcodes or other optically read technologies are useless. The tag need not be on the surface of the object and is therefore not subject to wear or other hazards. In animals like pets and horses the RFID tag is placed under the skin. The read time is typically less than 100 milliseconds.

Large numbers of tags can be read at once rather than item by item.

Use of RFID has taken a long time to come into common use due to the lack of standards in the industry. This is changing. RFIDs used in horses contain a unique, registered number that can be matched to the records for a horse, a phone number and some can also provide a temperature reading. Other information can also be coded into the tag.

Horses can be castrated at any age, but most horses are castrated between birth and 2 years of age. Colts with poor conformation or poor pedigrees are usually castrated as soon as the testicles descend into the scrotum. Testicles usually descend at birth or certainly by the 10th month after birth. If a horse has good conformation and a good pedigree he is generally kept intact until he fails to meet certain performance criteria.

Timing of castration depends on weather conditions and development of the individual animal. Spring, before fly season and hot weather, is the best time for castration. Most often castration is performed by an experienced veterinarian.

When one or both testes fail to descend into the scrotum, the animal is referred to as a **cryptorchid** or **ridgeling**. In horses, colts are considered cryptorchid if the testes are not descended by 15 months. These animals are difficult to castrate and since some tissue may continue to produce testosterone, they may retain their stallion attitude.

BEDDING

One of the more fundamental and less glamorous aspects of horse ownership is stall maintenance. A significant part of this is the choice of **bedding**. Good bedding protects the horse's feet from thrush. It encourages the horse to lie down to rest and cushions its feet and legs from the hard stall floor. The horse needs to have some material under it that will also soak up or drain off the urine and the moisture from the manure. Ordinary stall floors are unable to do these things.

The best bedding material should be absorbent, dust-free, readily available, easily disposed of, unpalatable, and affordable. One of the first things to look for in a bedding is its absorbency. The more absorbent the material, the less of it required, and the less frequently it must be replaced.

Cost is often the major consideration in choosing a bedding. Since many crop wastes can be made into bedding, owners should look around to see what is plentiful in the area. A specific bedding material may not be the most dust-free or the most absorbent, but if it is plentiful and cheap that may be enough to justify overlooking the disadvantages, since it may be the most practical choice.

Of the common kinds of bedding, the most popular is straw. Straw makes an attractive bed, and many people are willing to put up with its disadvantages just because they like to see their horses knee-deep in a nice, shiny yellow bed. Straw is the bedding of choice for foaling stalls on many breeding farms, since there is the potential for finer bedding materials, such as shavings, to readily stick to the newborn's body and airways. However, straw is bad for horses that like to eat their bedding. It is also highly combustible.

Straw is very absorbent and has a high comfort rating. Straw can be relatively dust-free, if carefully selected. However, other drawbacks include the high labor requirement in cleaning stables, the large volume of resulting material, and the difficulty in disposal.

The best time to buy straw is at harvest time, but facilities are necessary for storage. Straw is best if it is stored indoors.

Two other highly absorbent materials for bedding are wood shavings and sawdust. Horses will seldom eat these materials, and they burn much more slowly than straw. Shavings and sawdust also help keep down odors and require less frequent cleaning than many other materials.

Black walnut, however, should never be used. Severe laminitis (founder) has resulted in horses where black walnut shavings were used for bedding. Black walnut *(Juglans nigra)* wood contains a number of aromatic chemical agents, some of which are quite toxic to horses. Eating just a few of the fresh shavings will cause severe gastrointestinal irritation and severe founder.

Softwood shavings such as pine are generally a safe and practical material to use. Pine shavings produce considerably less disposable material than straw and are generally disposed of more easily. Although shavings may be more expensive to use than straw, the additional cost can usually be justified in labor saved. Purchasing a large volume rather than buying it by the bale or bag saves money but a considerable storage area may be necessary. The shavings must be as dust-free as possible. Often, shavings are mixed with sawdust; however, too much sawdust can cause respiratory problems in some horses. The wood-shaving particles should be relatively large.

Sawdust and shavings should be stored indoors. If they are wet, their value as bedding is worthless and they will take a long time to dry.

A good, cheap bedding can be made from cornstalks or ground corncobs if they are readily available. After the corn has been picked, stalks can be chopped into bedding with a flail chopper. The cornstalks should be dry. At times, horses will eat chopped cornstalks. Ground corncobs can also make an absorbent bedding.

Another comparatively new bedding product is recycled newsprint. This product is pollen-free and has less dust than straw and shavings. As a result, horse owners with allergies or contact lenses and horses with respiratory conditions may benefit from its use.

Newsprint weighs less than that of an equal volume of other bedding products. Weekly stripping of stalls with newsprint bedding may not be necessary if the stalls are thoroughly picked daily and existing bedding is fluffed to keep it dry longer. Newsprint is very absorbent, softer, and more comfortable than either shavings or straw.

While good ventilation is obviously a part of stable management, proper ventilation can also lower the humidity, keeping most bedding drier and extending its effectiveness.

Basically, the choice of bedding material should be determined by:

- Availability and price
- Absorptive capacity

TABLE 16–1 Bedding Materials and Amounts Needed

MATERIAL	POUNDS OF WATER/ 100 POUNDS DRY MATTER
WOOD PRODUCTS	
Hardwood chips	150
Hardwood sawdust	150
Hardwood shavings	150
Pinewood chips	300
Pinewood sawdust	250
Pinewood shavings	200
Processed wood pellets	400
STRAW	
Barley	210
Oat, long	280
Oat, chopped	375
Wheat, long	220
Wheat, chopped	295
OTHER	
Cornstalks, dried	250
Corncobs	210
Hay, chopped	200
Peat moss	1,000
Shredded newspaper	400

- Ease of handling
- Ease of cleanup and disposal
- Nonirritability from dust or components causing allergies
- Texture and size
- Fertility value of the resulting manure

Table 16–1 compares the absorbency of various bedding materials.

FLY CONTROL

A sound sanitation program is of paramount importance to fly control. All other types of control are doomed to failure without this important first step. Control of stable flies in barnyards, stables, or corral areas usually involves several methods, which also apply for the housefly (Figure 16–11). Chemical control directed at larval and adult stages of both insects is usually required periodically during the fly season.

Sanitation around Stable or Corral

The basic aim of a sanitation program is to reduce or eliminate fly larval development sites. Several areas require attention because the larvae of these flies can develop in varied habitats. Manure management is essential. Timely spreading of manure promotes drying and prevents larvae from developing. In small areas manure provides an ideal breeding site for large numbers of both stable flies and houseflies. Wet areas where manure, mud, and plant debris accumulate also form ideal breeding habitats. Modifications to the drainage around corrals to reduce excess moisture can eliminate fly production sites and make chemical control efforts much more successful.

Chemical Control

Various chemical control techniques are available to the horse owner. Generally, control of adult flies using insecticides on surfaces and as sprays to kill existing adult flies are the most effective techniques. In most barnyards a combination of surface treatment and aerosol sprays is used, often on an alternating schedule. Treatments applied directly to horses are not as effective for control of stable flies or houseflies as are residual surface treatments. In practice, both techniques usually are needed.

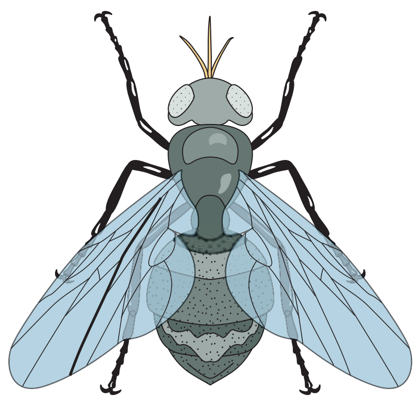


FIGURE 16–11 **Stable fly.**

Applications of residual insecticides to premises are frequently used to control houseflies and stable flies. Longer-lasting residual insecticides provide control for an extended period when sprayed onto sites where adult flies congregate. Flies contact the insecticide when they land on the treated surfaces. Sides of buildings, inside and outside surfaces of stalls, and fences may be potential day or night resting sites for these flies. Observation of the barnyard situation will quickly indicate the favored resting sites for flies.

Knockdown sprays are effective for killing adult flies present at the time of application. The chemicals used for these applications are usually short-residual insecticides that have a quick knockdown and high-contact toxicity. Several types of spray or fogging apparatus may be used. Wind velocities should be low at the time of application, and the droplet or particle size should be small (50 to 75 microns) to ensure drift through the corral area. This method requires less application time, but the disadvantage is that it kills only those flies present at the time of application and thus provides only short-term relief.

Direct applications of sprays and dusts to animals may be used in some situations to protect them. Materials used for direct animal application usually have short-residual activity, and this type of application is labor intensive.

Other methods of fly control, such as baits, electric grids, and traps, have some limited use for housefly control but are ineffective for the blood-feeding stable fly. Baits may be used effectively for housefly control in enclosed areas. Fly papers, cords, and strips may also help alleviate fly problems in these areas. Such methods are usually ineffective in open areas.

Control of immature flies (larvae) is sometimes possible. Usually, the best approach is to remove the potential source of fly production with sanitation practices. When this is not possible, a larvicide can kill the developing flies. A larvicidal insecticide may be applied directly to places where eggs are laid and larvae develop.

Biological control has potential for controlling barnyard fly problems. A number of parasites and predators of both houseflies and stable flies exist that help to reduce fly numbers. Some of these natural parasites are available commercially; but to date, research has not demonstrated their cost-effectiveness.

Management efforts are needed to control horseflies and deerflies, blackflies, gnats, horn flies, and general nuisance flies like houseflies. The following information briefly describes these flies, their life cycles, habits, and control.

Horseflies and Deerflies

Horseflies and deerflies are large, biting flies that can inflict painful bites on horses and humans. Several species may become abundant enough to constitute a problem for grazing horses, particularly animals pastured near streams or low, wet areas. Both types of flies have been incriminated in the transmission of equine infectious anemia. Further, because the bite is painful, horses may become restless and unmanageable when trying to ward off attacks by these flies. Immature larval horseflies are aquatic or semiaquatic, and the last-stage larva overwinters. Life cycles are long. Most species have only one generation per year, and some species may have a 2-year life cycle. Only female flies feed on blood. Control is difficult. Treating individual animals with repellents or insecticidal sprays may reduce fly bites.

Blackflies

Blackflies or buffalo gnats are small (1⁄2 to 1⁄15 inch long), humpbacked, biting flies that may reach high populations in the spring and early summer, particularly in pasture areas along streams. The immature stages are found in flowing water. Pupation occurs under water, and the adults float to the surface—ready for flight, feeding, and mating. Adult flies feeding on horses and other animals can pose serious animal health problems, and the irritation caused by blackfly bites can make horses unmanageable. Anemia, as a consequence of blackfly population, is high. Bites may also cause severe reactions such as toxemia and anaphylactic shock, which can result in death. Control is difficult. Species that feed in the ears of horses can be controlled by applying insecticides or petroleum jelly inside the horses' ears. When possible, horses can be stabled during the day and pastured at night. Blackflies feed only during daylight hours and usually do not enter stable areas. Area sprays or general topical applications of insecticides are not very effective.

Biting Gnats

Biting midges—better known as "no-see-ums" or "punkies"—are a serious pest of horses. Blood loss and irritation associated with the feeding of these very small (usually less than 0.04 inch), blood-feeding flies can be significant. The immature stages of these flies complete development in water in a variety of locations, from tree holes or manufactured containers to lakes and streams. Adults often are unnoticed because of their size and because they are active at night, late evening, or early morning. Direct treatment of horses with wipes or sprays containing insecticides or repellents can provide them relief.

Horn Flies

The horn fly is normally a pest of grazing cattle. However, when cattle and horses are pastured together, this fly will feed on horses. Horn flies are about half the size of stable flies and, like stable flies, are biting flies. The horn fly usually remains on the host animal almost continually, both day and night. Females lay eggs on fresh cattle droppings. Sprays or wipes can be used successfully on horses.

Nuisance Flies

Several types of nuisance flies may be associated with horses or their premises. These include the housefly, bottle flies, false stable flies, and other species of barnyard flies. Face flies, usually a pest of cattle, may also affect horses, particularly when cattle are nearby.

Two major pest species that bother horses are the stable fly and the housefly, a nonbiting species. A distinguishing feature, visible to the naked eye, separating the two species is the distinct stiletto-like proboscis of the stable fly that extends forward beyond the head. This sharply pointed beak is used to pierce the skin and draw blood. The housefly cannot bite because it has sponging mouthparts.

Housefly

Both male and female houseflies are grayish-brown with a black- and grey-striped thorax. The housefly is a medium-sized fly ranging from about 1⁄4 to 1⁄3 inch long with sponging mouthparts. Houseflies do not bite but feed on a variety of plant and animal wastes and garbage, as well as other sources of carbohydrates and proteins (Figure 16–12).

Housefly eggs are about 0.04 inch long, whitish, and slightly curved. The females generally deposit eggs in batches of about 100 eggs at a time. Each female may deposit four to six batches of eggs during an average lifetime of 2 to 4 weeks during the summer.

The three larval stages are similar in appearance to stable fly larvae. The third stage reaches approximately 1⁄2 to 2⁄3 inch in length. Differentiation of the two species is based on the size and shape of the posterior spiracles (or respiratory tract openings).

Housefly **pupae** are barrel-shaped. They are of the same approximate size and coloration as stable fly pupae.

Housefly females lay their eggs in clusters, preferably in moist, decaying organic material. Eggs hatch within 8 to 40 hours, depending on temperature. Larvae feed on yeast, bacteria, and decomposition products in their development site. Larval development through three stages takes from 3 to 8 days. Larvae crawl to drier areas to pupate when feeding is completed. The pupal stage lasts from 3 to 10 days, depending primarily on temperature. Adults emerge from the puparia and begin feeding within 24 hours. Males are ready to mate shortly after emergence, and females begin mating by the 2nd or 3rd day. Most females mate once and deposit eggs in batches every 2 to 4 days.

The flies feed on carbohydrates and proteins. Females require protein to produce viable eggs. Solid foods are first liquefied with saliva and are then ingested using the sponging mouthparts.

The entire life cycle from egg to adult can be completed in as little as 10 to 14 days during warm weather. Like the stable fly, houseflies overwinter in sites, such

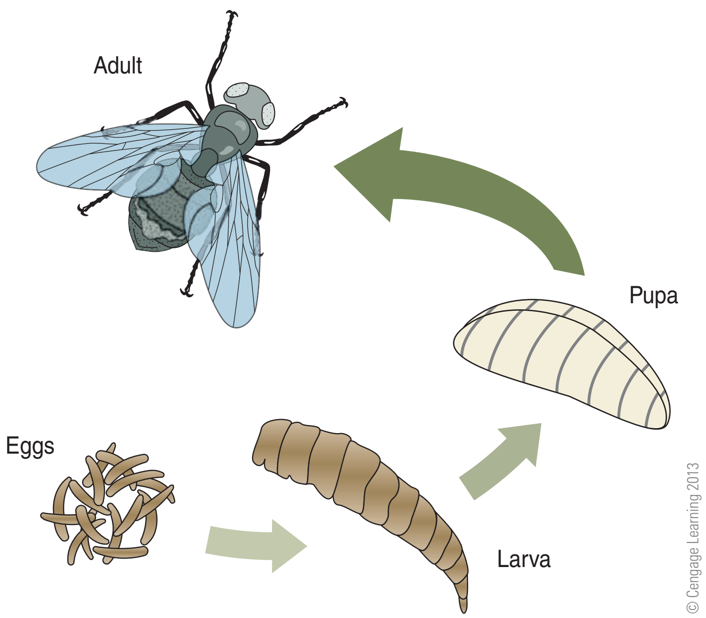


FIGURE 16–12 **Life cycle of the housefly.**

as silage or manure piles, where microbial fermentation heats the larval habitat. Houseflies may develop throughout the year in heated livestock facilities. They are active near sources of food during daylight hours and generally rest at night on stationary objects both indoors and out. The flies prefer shaded areas during much of the day and commonly move inside structures where livestock are held.

Housefly management, like stable fly management, is based on a strong farm sanitation program. The methods for reducing houseflies are the same as those discussed for the stable fly.

Face Fly

The face fly is usually a pest of grazing cattle. However, when horses are pastured with or close to cattle or when face flies are numerous, these flies will feed on secretions around the eyes of horses. Adult face flies look much like houseflies. The face fly does not bite, but the persistent feeding behavior of the fly makes it a nuisance pest. In addition, the face fly can mechanically transmit parasites or pathogens to the horse. Control of face flies is difficult. Relief can be obtained by stabling horses during the daytime when the face fly feeds. Also, since the face fly feeds predominantly on cattle, pasturing horses separately from cattle will lessen the incidence of these flies on horses. Topical insecticide applications are usually not effective, because face flies spend little time on the vertebrate host.

MANAGEMENT OF PASTURES

Horses do best when they are allowed to graze, so maintaining good pastures is an important management priority. Sound management is essential to keep the desired grass species persistent and productive. Pastures can be improved by using lime and fertilizer or by reseeding. The following are management tips for pastures.

Avoid over- or undergrazing. Horses are notorious spot grazers. They will seriously damage desired species in some areas unless they are moved into new pastures frequently. Some form of rotational grazing is desirable. The correct acreage per horse changes with the season as well as with other factors. However, a good rule is to provide at least one acre of good-quality pasture per horse. Five or six **paddocks** should be set up and horses permitted to graze first in one area for about a week and then changed to another. This system helps to keep the legumes and grasses growing better and increases the feed available per acre. Rotating horses from pasture to pasture also breaks the life cycle of some parasites (Figure 16–13).

Clip pastures regularly during the growing season. Clipping to a height of 2 to 3 inches after horses are moved to a new paddock helps to control weeds, prevent grasses from heading, and in general keeps the pasture in a more desirable condition.

Drag pastures with a chain-link harrow at least once per year. Dragging helps to spread manure droppings, which reduces parasite populations by exposing them to air and sunlight. Dragging also helps to smooth over areas dug up by horses’ hoofs on wet soil.

Apply fertilizer as needed. Improved horse pastures must be fertilized annually if legumes and grasses are to survive and remain productive. The fertilizer to use depends on the grass species present. A complete **soil test** every 2 or 3 years is the best guide.

FIGURE 16–13 **To maintain good, strong pastures, it is important to rotate horses from pasture to pasture to avoid overgrazing.**

Pasture Improvement

Pastures with good stands of desirable grass and legume species need proper soil fertility combined with good management to assure continuing good horse pasture. Most permanent bluegrass pastures produce less than 2,000 pounds of dry matter per acre per year, which is far below their potential. Yields on many pastures can be doubled simply by applying lime and fertilizer. Liming and top-dressing Kentucky bluegrass pastures with phosphate, potash, and nitrogen costs much less and is less work than complete pasture renovation.

However, sometimes lime and fertilizer are not enough to restore a pasture, and complete renovation is necessary. When renovating an old pasture, the following points should be considered:

1. Perform a soil test to determine lime and fertilizer requirements. This is the only sure way of knowing how much lime and fertilizer are needed.
2. Apply required lime several months before doing the actual seeding. Disking or plowing will help to mix the lime evenly throughout the soil.
3. Select a seed mixture that complements the pasture drainage characteristics.
4. Destroy or suppress the old pasture by plowing or using herbicides.
5. Use the appropriate method of seeding based on extent of tillage.
6. Protect the seeded area until the new plants are well established. Where recommended mixtures are seeded without a companion crop and weeds are controlled, new seedings can become established in a single year.

In heavy-traffic areas, along fences and around gates and water troughs, tall fescue may be used. Fescue is generally considered less palatable than bluegrass, but tall fescue produces one of the toughest heavy-traffic sods of any adapted grass. Older stands of fescue often are infested with an endophyte (within the plant) fungus. Toxins associated with this fungus can cause lowered reproductive rates, abortion, agalactia (lack of milk), and prolonged gestation with mares. Thus, whenever establishing new fescue stands for horses, endophyte-free tall fescue seed should be used. Broodmares should be removed from pastures containing endophyte-infested tall fescue at least 90 days prior to foaling.

Managing Health Concerns of Forages

Horses are extremely susceptible to molds, fungi, and other sources of toxic substances in forage. Mold problems generally occur in hay that has been baled at too high a moisture level (20 percent or more) without the use of a preservative. This is especially a problem with first-cutting hay because it is harvested during a period of time when it rains frequently and the weather conditions are less than ideal for hay drying.

Horses should always be fed clean, unmoldy forages. In addition to molds and fungi, some forage species contain chemical compounds that can have negative health effects on horses.

Sudangrass and sorghum-sudangrass hybrids contain compounds that can cause muscle weakness, urinary problems, and death in severe cases. Do not feed these grasses to horses!

Older varieties of tall fescue contain an endophyte fungus that could cause severe health problems if horses have only tall fescue to eat during the summer months. Newer tall fescue varieties that are free of the endophyte fungus are now available.

Another health problem occurs when horses are fed hay that contains blister beetles. When consumed, the beetle causes irritation to the lining of the digestive tract that usually results in death. The danger of blister beetles is discussed in Chapter 14. Alfalfa hay produced in southern areas of the United States is most generally associated with blister beetle contamination. Do not feed any hay containing blister beetles to horses.

Poisonous plants in pastures or hay can also be fatal to horses. Ornamental shrubs and nightshade are common poisonous plants. Any plant poisonous to other animals is probably poisonous to horses. Some are highly palatable and should be identified and removed from pastures, but many poisonous plants are not palatable and horses will not eat them unless the forage is inadequate to meet their needs. A list of common poisonous plants is found in Table 14–4 in Chapter 14.

WOUND MANAGEMENT

A **wound** is a disruption in the integrity of living tissue caused by physical means. Managing wounds requires recognizing the types and characteristics of wounds and the associated symptoms in the horse. Characteristics of a wound include:

1. The horse's temperature is usually normal, but will be elevated when infection is present and below normal if the horse is going into shock.
2. Pulse is often normal even with severe wounds, but may be increased if blood loss is excessive.
3. Mucous membrane color will range from normal to pale in cases of excessive blood loss.
4. Capillary refill time will be normal except in the case of blood loss and shock, when it may be over 2 seconds.

Wounds can be classified as clean wounds, contaminated wounds, and infected wounds; or they can be characterized as open or closed wounds.

1. A clean wound is a sterile or noncontaminated wound less than 6 hours old. After this time, the wound may or may not become infected.
2. A contaminated wound is less than 6 to 8 hours old and, despite the presence of bacteria, the wound is not infected.
3. An infected wound is usually more than 6 to 8 hours old, during which time bacterial activity has infected the wound. The result is pus and dead tissue, and there may be septicemia (the presence of bacteria or their toxins in the blood).

Open wounds include incisions, lacerations, abrasions, punctures, perforations, and penetrating.

Closed wounds include contusions, hematomas, seromas, abscesses, or traumatic hernias.

Veterinarians need to examine, or at least discuss, a wound on an emergency basis during the first 6 to 8 hours after an injury occurs. Suture repair has the best chance for healing if performed within this time period. Once this time has elapsed, wounds that are sutured invariably break down and, for that reason, older wounds are often left to heal by granulation after they have been cleaned, rather than sutured.

Tetanus toxoid booster should be given if the horse has not had one within 6 months. If the vaccination status of the horse is unknown or uncertain, both tetanus toxoid and tetanus antitoxin should be administered.

A well-equipped first aid kit (see page 349) can be useful in coping with wounds.

SUMMARY

Good management is knowledge in action. Good managers learn to recognize horses under stress and, where possible, take action to alleviate stress. Stress can be caused by mechanical injury, poor nutrition, and disease. Horses indicate stress through behavioral changes.

Positive identification of horses is practiced by a good manager. Horses can be identified by body markings, tattoos, freeze brands, blood typing, and microchips. Positive identification prevents theft, fraud, and is necessary for insurance.

Two of the most critical times in the life of a horse are the neonatal and weaning periods. Good management practices here ensure a healthy foal for training and a healthy mare for future foals.

Proper selection of bedding is necessary for stall maintenance. Selection of bedding depends primarily on availability, price, and absorptive capacity.

All good managers will have a sound sanitation program for fly control. This program can also include various chemical methods. An understanding of the types of flies, their life cycles, and their habitats is a necessary part of control.

When possible, horses should be pastured. Sound management keeps pastures productive and improves poor pastures through renovation.

Horses sometimes receive a wound. Wound management requires that the owner recognize the characteristics of the various types of wounds.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. The Jockey Club was the first organization to set up an accurate identification system for horses.
2. A clean wound is one that has been cleaned properly.
3. A foal's navel cord should be allowed to sever naturally.
4. A foal should be taught to accept basic discipline and handling at weaning time.
5. Horses have only binocular vision.
6. Social order is important in a herd of horses.

Short Answer

7. List the four categories of stress for a horse.
8. List the 10 types of information every horse owner should keep on file for each horse.
9. What are the three metabolic problems closely associated with nutrition in a horse?
10. Identify four characteristics of a wound.
11. List the five factors that determine the best time for weaning a foal.
12. Name the two substances that could be added to a pasture to double its yield.
13. What is the most popular type of bedding material?

Critical Thinking/Discussion

14. What are the reasons for marking or identifying a horse?
15. Why is bedding for a horse important, and what are the factors that determine the type of bedding used?
16. Discuss three management practices for pastures.
17. Discuss a fly control program.
18. Why would an enema be used on a foal?
19. Indicate the differences among a relaxed horse, an angry horse, and an interested horse.
20. What is the best method for permanently identifying a horse?

STUDENT ACTIVITIES

1. Using Table 16–1, collect some bedding materials and develop a demonstration to show the water-absorbing ability of each material.
2. Draw a diagram that explains monocular and binocular vision. What type of vision do humans have?
3. Observe behavior of horses within a herd. Record your observations in a written log and with a video camera.
4. Research the tying-up syndrome. Use the Internet or other resources to develop a report or presentation that gives the recent physiological explanations for the condition.
5. Draw diagrams or collect photos from the Internet of the different types of wounds.

6. Visit several horse pastures and describe their conditions. Identify management practices that are being practiced or those that are missing. Collect, press, mount, and label plant samples from the pastures.
7. Make a set of flash cards to teach someone how to identify the common body markings of horses.
8. Make an insect collection of the flies found around horses. Using an insect key, label the flies with their common and scientific names.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). *Horse industry handbook: A guide to equine care and management*. Lexington, KY: Author.

Bishop, R. (2005). *The horse nutrition bible: The comprehensive guide to the correct feeding of your horse*. Newton Abbot, Devon, England: David and Charles Publishers.

Briggs, K. (2007). *Understanding equine nutrition: Your guide to horse health care and management.* Lexington, KY: Blood-Horse Publications.

Edwards, E. H. (2008). *The encyclopedia of the horse.* New York, NY: DK Publishing, Inc.

Evans, J. W. (2000). *Horses: A guide to selection, care, and enjoyment* (3rd ed.). New York: Owl Books.

Gore, T., Gore, P., & Griffin, J. M. (2008). *Horse owner's veterinary handbook.* Hoboken, NY: Wiley Publishing, Inc.

Hill, C. (2007). *Horsekeeping almanac: The essential month-by-month guide for everyone who keeps or cares for horses.* North Adams, MA: Storey Publishing, Inc.

Kahn, C.M. & Line, S. (2007). *The Merck/Merial manual for pet health: The complete pet health resource for your dog, cat, horse or other pets - in everyday language.* Whitehouse Station, NJ: Merck & Co.

McAllister, T. (2008). *First aid: Horse illustrated simple solutions.* Irvine, CA: BowTie Press.

Pavia, A. & Gentry-Running, K. (2008). *Horse health and nutrition for dummies.* Hoboken, NJ: Wiley, Publishing, Inc.

Smith, F. D. (2004). *First horse: The complete guide for the first-time horse owner.* Colorado Springs, CO: Western Horseman Magazine.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases:

castration of horses	horse body markings	marking horses
DNA testing	horse freeze branding	neonatal care
fly control for horses	horse microchip	nutrition in horses
foal care	implantations	pasture management
horse behavior	horse tattooing	stress in horses
horse blood typing	identifying horses	weaning of foals

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 17

Shoeing and Hoof Care

Foot and hoof care are essential to the horse because neglect can lead to lameness, a change in the flight of the foot, and a rough gait. The adage "no foot, no horse" is as true as ever. Lameness of feet and legs has many causes. If a problem is not treated immediately, permanent disabilities can result. The foot care a horse receives can hasten or delay permanent unsoundness.

OBJECTIVES

After completing this chapter, you should be able to:

- Describe the internal and external parts of the hoof
- Explain the three main functions of the hoof wall
- Explain why the condition of the frog of the horse's foot is a good indication of the health of the horse
- Discuss how corrective shoeing can help toed-in and toed-out horses
- List steps involved in picking up a horse's feet
- Explain the importance of inspecting feet daily
- List five tools used in caring for a horse's feet
- Describe how to shoe a horse
- Discuss why it is important to start foot care early in a horse's life
- Describe why trimming should be done carefully
- Explain how the weight of the horse is carried on the foot/hoof
- Name common problems of the feet
- Describe trimming and how trimming can correct minor problems

KEY TERMS

anvil
bars
clinch cutter
coffin bone
cold-fitted
commissures
coronet
deep flexor tendon
frog
hammer
hoof knife
hoof leveler
hoof pick
hoof wall
horseshoeing
hot-fitted
laminae
navicular bone
nippers
periople
pincher
plantar cushion
puller
rasp
rings
shod
shoeing apron

STRUCTURE OF THE FOOT

To understand proper care of a horse's feet, the structure of the foot and the functions of its various parts must be known and understood. The major parts of a horse's foot are the **hoof wall**, **coronet**, sole, **frog**, and the internal structures such as the bones, cartilages, tendons, and connective tissue (Figures 17–1 and 17–2).

Hoof Wall

The hoof wall is a horny substance made up of parallel fibers. It should be dense, straight, and free from **rings** (ridges) and cracks. Viewed from the side, the wall at the toe should be a continuation of the slope of the pastern.

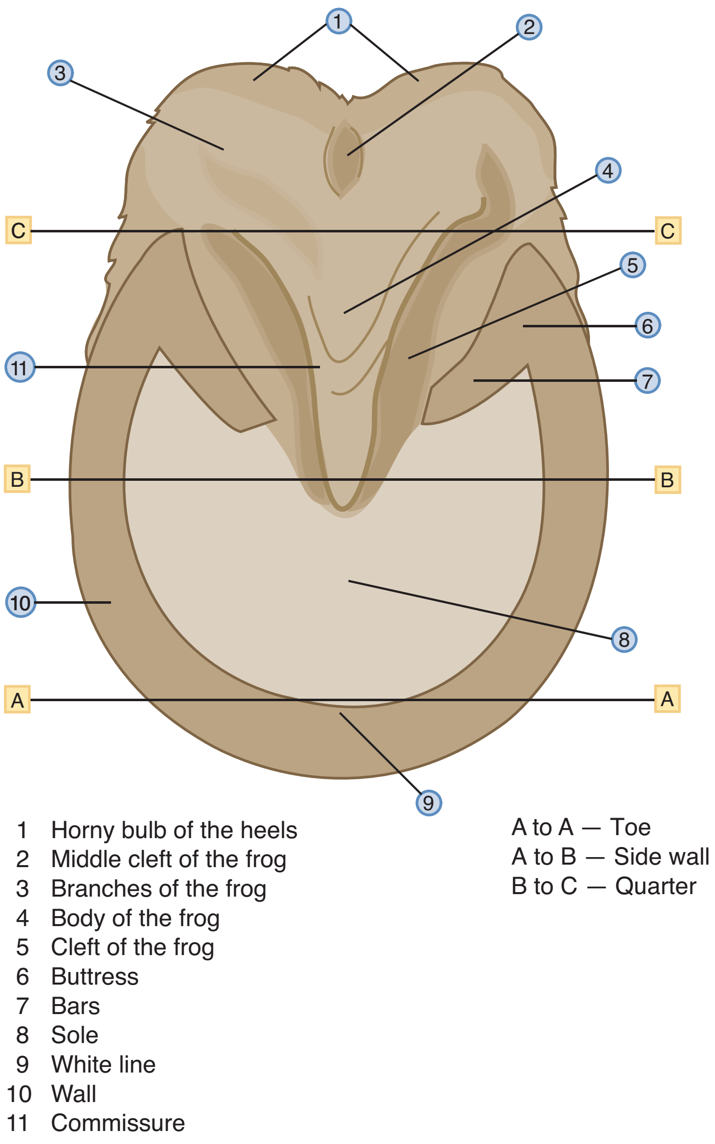


FIGURE 17–1 **Parts of a horse's hoof.**

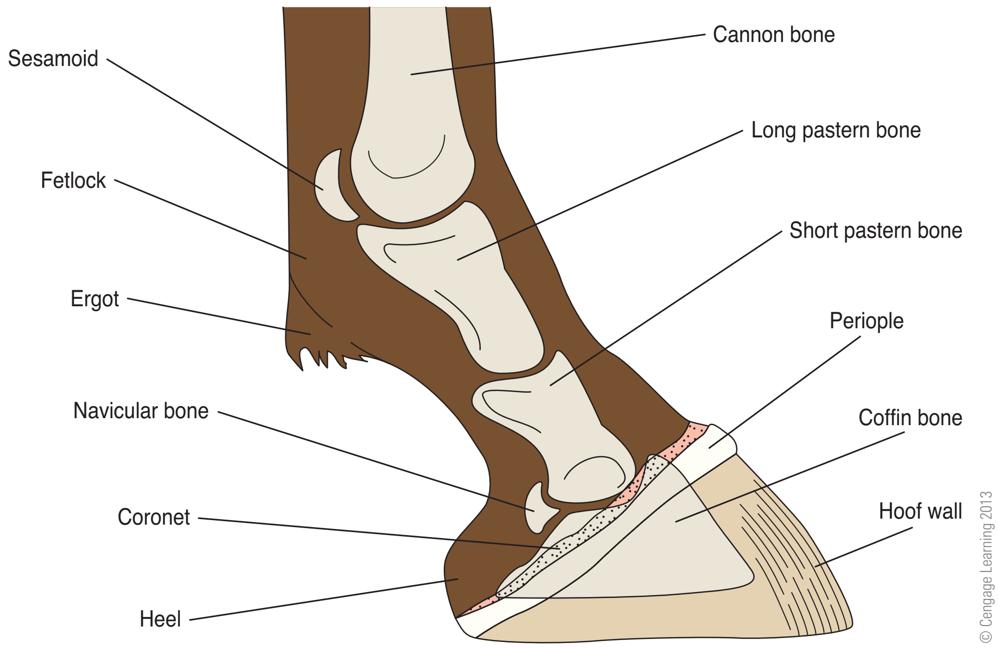


FIGURE 17–2 **The bones in a horse's lower leg and hoof.**

The main functions of the hoof wall are to:

- Provide a weight-bearing surface not easily worn away
- Protect the internal structure of the foot
- Maintain moisture in the foot

Usually, the hoof wall is thicker at the toe than at the quarter (side) and heel. The hoof wall is protected by the **periople**, a varnish-like coating that also holds moisture in the hoof (Figures 17–1 and 17–2).

CORONET

The coronet, or coronary band, is the source of growth for the hoof wall. It is directly above the hoof wall and is protected by a thick layer of skin and dense hair. A healthy foot will grow about 3⁄8 inch per month. A change in the growth rate of the hoof can be caused by a change in the amount of exercise, the ration, illness, and the animal's general state of health and condition. Injury to the coronary band can result in irregular growth of the hoof wall and can develop into a permanently unsound hoof wall (refer to Figure 17–2).

The hind feet may grow faster than the forefeet, and unshod feet may grow faster than shod feet. The feet of mares and geldings seem to grow faster than those of stallions.

SOLE

The sole of the foot is a horny substance that protects the sensitive inner portions of the foot. It should be firm, slightly concave, and of uniform texture. The horse has no feeling at the exterior sole surface.

A flat-footed horse tends to receive more bruises and injuries to the sole. Also, horses that have experienced founder and have developed a dropped sole are more easily bruised at the sole.

Frog

The frog, located at the heel of the foot, forms a "V" into the center of the sole (refer to Figure 17–1). The frog is a spongy, flexible pad that is also a weight-bearing surface. It is the intermediate organ between the **plantar cushion** and the source of pressure from the horse's weight. The frog is separated from the sole of the foot by two lines called **commissures**.

The condition of the frog generally is a good indication of the health of the foot. Without proper flexibility, expansion, and ground contact, the frog cannot perform its function in complementing the circulation of blood and absorption of shock throughout the foot.

Internal Foot Structure

To be able to provide proper foot care, the owner or handler needs to understand the important internal parts of the horse's foot and their functions (Figure 17–2).

The **coffin bone** provides the shape of the foot and the rigidity needed to bear weight.

The plantar cushion expands and contracts to absorb shock and pumps blood from the foot back toward the heart.

The **navicular bone** serves as a fulcrum and bearing surface for the **deep flexor tendon**, which is responsible for extension of the foot as it progresses through a stride.

Sensitive **laminae** serve not only as a means of attachment for the hoof wall and the coffin bone but also as the main area of blood circulation within the foot.

CARE OF THE HOOF

Foot care is one of the most neglected of all horse management practices. Most lameness that impairs the usefulness of a horse can be prevented by proper foot care and reasonable management.

Most foot care practices can be done by the average horse owner. But horse owners should know when to seek the help of a professional, especially for corrective shoeing and disease treatment and control. A farrier is a person who cleans, trims, and performs the actual **horseshoeing**. The farrier and the veterinarian should work together to keep the horse sound (Figure 17–3).

Foot care should be as routine as feeding and watering. It should include:

- Routine cleaning
- Periodic trimming
- Corrections of minor imperfections
- Treatment of foot diseases and injuries

Ideally, a horse's feet should be inspected and cleaned every day. A **hoof pick** or fine-bristled wire brush can be used for cleaning the sole, frog, and hoof wall. This will improve the likelihood of detecting problems early. A nail or other object stuck in

Courtesy of Rick Parker

FIGURE 17–3 **A farrier heats a horseshoe before shaping it.**

the foot is a serious medical condition that should be treated as soon as possible. It is important to note that too much pressure from the wire brush can damage the periople, which would disturb the moisture balance of the foot.

The hoof wall grows an average of 1⁄4 inch per month. Most horses' hooves are trimmed and **shod** every 6 to 8 weeks. This depends, of course, on the rate of growth and the wearing of the hoof wall. If the horse spends time on hard surfaces, the hoof wears down faster than it does on a horse in a soft, lush pasture.

Sometimes, the sides of the hoof will grow or wear at different rates. This causes the legs to look, and possibly be, crooked. Corrective trimming can level the hoof.

Care of the Foal's Feet

Foot care should begin early by teaching foals to allow handling and cleaning of their feet. If this practice is followed, it will save both the young horse and the farrier considerable trouble later when it is time to trim and shoe. Handling a foal or young horse's feet may be somewhat tricky at the start, but when owners follow proper procedures, young horses will soon become very easy to handle and trim. Many foals have crooked legs. Corrective trimming can help straighten their legs by evening the wear on their hooves.

Tools

As with any trade, special tools are used in caring for the horse's feet. The farrier's basic tools include (Figure 17–4):

- Hoof pick—used to clean any dirt or rocks from hoof crevices
- **Nippers**—used to remove extra hoof wall
- **Clinch cutter** and **pincher** or **puller**—used to remove shoes that have been worn and are ready to be taken off

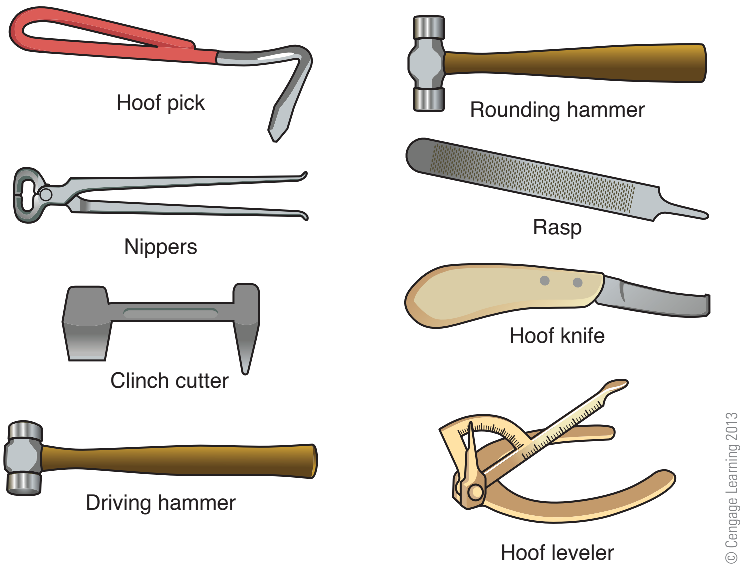


FIGURE 17-4 **Basic farrier tools—hoof pick, nippers, clinch cutter, hammers, rasp, hoof knife, and hoof leveler.**

- **Hammer**—two kinds can be used: one for driving the nails in and the other for shaping or rounding the horseshoe on the **anvil**
- **Rasp**—needed for leveling the foot
- **Hoof knife**—flat part of the blade is used to trim the bottom of the hoof wall and the curved part to make grooves or cut holes
- **Hoof leveler**—used to determine the angle of the hoof wall and check that the hoof is level to the ground

Additional equipment often includes a heavy **shoeing apron** to protect the horseshoer and an anvil to shape the horseshoes.

Foot Cleaning

The foot should be cleaned from the heel toward the toe with a hoof pick. Special care should be taken to clean the commissures on each side of the frog and the cleft of the frog itself, but the heel should not be opened excessively. This weakens the area and interferes with proper contraction and expansion of the heel (Figure 17–5).

After the horse has been ridden, its soles must be cleaned and checked for gravel or other foreign objects that could be lodged in the natural depressions of the foot. A nail, gravel, stick, or other object can work into the foot and cause lameness for a long time. Objects have been known to exist in a horse's foot for as long as a year before emerging at the heel or along the coronet. When a foreign particle emerges at the coronary area, a sore, called a quittor, usually develops. This problem can easily lead to serious infection.

Periodic Trimming

Trimming of the feet is important, although it is not needed as frequently as cleaning. Trimming should be done at about 4-week intervals on horses kept in stalls or paddocks, or about 6-week intervals for horses used heavily or running in pastures.

FIGURE 17–5 **Cleaning hooves on a routine basis is good preventive medicine for horses.**

The main goal in trimming is to retain the proper shape and length of the foot. Most people should feel comfortable pulling shoes and trimming feet while they wait for the farrier.

The bottom of the foot should be kept level, and the inside and outside walls should be maintained at equal lengths. The toe of normal feet and pasterns should be 3 inches long; the quarter, 2 inches; and the heel, 1 inch.

The hoof wall should be trimmed with nippers to remove excess length, then a rasp is used to smooth and level the bottom of the foot. Each stroke of the rasp needs to run from the heel through the toe to prevent uneven areas in the hoof wall.

A white line is external evidence of the lamination (sensitive laminae) between the hoof wall and the coffin bone. The sole of the foot is usually the same thickness in a normal horse. The sole should not be trimmed to an unnatural shape. To do so would make parts of the sole dangerously thin and tender.

Trimming the sole, referred to as lowering the sole, is done to keep the pressure on the hoof wall rather than on the sensitive inner parts of the foot. The dead, flaky tissue should be trimmed from the sole. Live tissue, elastic when stretched between the fingers, should not be trimmed away.

The frog should not be trimmed excessively because it should contact the ground with each step. It is trimmed only enough to remove dead tissue and to provide a uniform and adequate fissure along the junction of the sole and the frog.

After the bearing surface has been rasped to a level surface of proper length, the edges of the wall should be rounded if the horse will not be shod. This prevents chipping and peeling as the foot contacts rocks, logs, or other obstructions.

Trim the heels low enough to promote expansion and prevent contraction of the heels. The main concern is to trim often enough to prevent cracking and uneven wear, which could eventually contribute to the improper set of the feet and legs. With a little practice, most horse owners should be able to routinely trim the feet of horses that do not need corrective work. To prevent harmful mistakes, owners need to seek the help of a professional farrier when trying to correct an improper turn or set of the feet and legs. A more detailed discussion of foot trimming appears later in this chapter.

Maintaining Hoof-wall Angle

Horse owners should maintain the proper angle of the hoof wall in relation to the ground and the angle of the pastern. Shoes that are left on too long change the angle of the foot relative to the pastern and can cause lameness. The angle of the hoof wall should approximate the angle formed by the shoulder and the pastern—usually 45 to 55 degrees.

Because the hoof wall is narrower at the heel than at the toe, heels wear first, whether the horse is barefoot or on shoes. Low heels put more stress on the tendons of the leg. If a horse is shod at a 50-degree angle, this angle may change. A 50-degree angle might be down to 46 or 47 degrees in 4 to 6 weeks. This affects the action of the horse and puts more strain on tendons and ligaments.

As the hoof grows larger, the walls at the heels will overlap the shoe. When a shoe presses on the **bars**, the danger of producing corns in the foot exists. Running a horse with shoes that have been left on too long also can cause bowed tendons. Regular trimming and shoe resetting are essential in avoiding these problems.

Foot angle varies from breed to breed, and much variation is found among horses of the same breed. Generally, the Western breeds have steeper pasterns and a greater angle at the ground than the other breeds. Unless some correction is needed, as in forging and scalping, the foot should be trimmed to its natural angle because any change would result in stress to other areas of the column of bones in the leg.

Corrections of Minor Imperfections

The most common deviations from a normal set of feet and legs are when either front or rear feet toe in (pigeon-toed) or toe out. Other problems commonly corrected by trimming are cocked ankles, buck knees, calf knees, sickle hocks, and slight rotations of the cannon bone. Also, some common faults in the movement of feet in a stride—forging, scalping, interfering, and brushing—are corrected by careful trimming.

When trimming feet, conformation of the horse needs to be considered. For example, a splayfooted horse (feet turned out) bears more weight on the inside wall and heel than on the outside. Wear is greatest, both shod and barefoot, where weight is borne. The objective in corrective trimming is to remove more of the outside wall and heel than the inside. This will shift the horse's weight near the center of its feet. A pigeon-toed horse is trimmed exactly the opposite.

Bone structure of adult horses cannot be changed much, but their action can be improved. Corrective trimming of young horses every 6 weeks or 2 months up to 2 years of age will substantially improve bone structure.

Treatment of Foot Diseases and Injuries

Disease organisms concentrate where animals are confined, so cleanliness is important. Horses kept in a stall or small pen should have their feet picked or cleaned daily to reduce the risk of thrush. Thrush is the condition resulting from bacterial penetration into the frog and surrounding area. The bacteria produce a foul odor and cause the frog to become soft and mushy. If allowed to go untreated, thrush can cause serious lameness and extensive treatment will be necessary.

How to Stay in Good with Your Farrier

Answer these questions about yourself:

- Was the farrier bruised from head to foot by an old spoiled horse while you stroked the horse's neck, proclaiming it wouldn't hurt a fly?
- Did you tip or offer to pay more when the farrier committed extra time and patience to a young horse being shod for the first time?
- Did you call the farrier out to shoe three horses, then decide to shoe only one when he or she got there?
- Did the farrier have to help chase the horse all over the farm to catch it before shoeing?
- Did you pay the farrier promptly and in full?
- Answer these questions about the farrier's work:
- Was the shoe shaped to fit the foot?
- Were the foot and shoe both leveled?
- Was the shoe set fully forward, foot not dubbed off?
- Were the frog and bars "opened up" but not pared away?
- Was the experience satisfactory for the horse or were its ribs bruised from blows of the rasp?

Honestly answering these questions will help you build a solid relationship with your farrier.

Extremely wet conditions such as a muddy lot or wet stall promote rapid drying of the feet. The natural oils and protective films of the foot are eroded from constant contact with external moisture. Large horses with small feet commonly have hoof dryness problems.

Moisture

Moisture in the horse's feet helps to maintain flexibility and prevent cracking. Most of the moisture needed in a healthy and well-protected foot can come from within.

One way to maintain proper moisture in the foot is to regularly apply a good hoof dressing containing some animal fat such as lanolin. If the dressing is not a petroleum derivative, it can be massaged into the coronet, the frog, and the sole as well as on the hoof wall. The dressing helps to keep the sole pliable and to eliminate dead tissue around the frog and heel. Also, massaging the coronet stimulates growth of a healthy new hoof wall.

Lost Shoes

When a shoe is lost, it is important to promptly cut the hoof wall level with the sole to prevent it from breaking above this point while awaiting the farrier. Removing the opposite shoe and lowering the hoof wall to equal the length of the other hoof will balance the gait of the horse.

Nail Pricks

Much lameness results from nail pricks. Horses should not be ridden in areas littered with trash and boards containing nails. Injury caused by nails can ruin a horse.

As soon as a nail prick is identified, prompt medical attention and packing is needed to prevent infection by ground-borne disease organisms. Horses usually are fitted with a protective boot after being pricked by a nail, and they may be shod with a pad after the condition has been treated and shows signs of recovery.

Founder

Fat horses tend to have problems with laminitis (founder). This is especially common among horses with some Shetland pony breeding. Grass founder in the spring produces more laminitis than any other single cause. If the horse is fat, grazes abundant grass, and is not exercised, there is great risk of laminitis.

Laminitis commonly causes lameness. Horses with laminitis have extreme pain and soreness, especially in their front feet. They try to bear their weight on their back legs and lighten the front end as much as possible by carrying their front feet forward and their back feet up under their bodies. Therapeutic trimming and shoeing may make a horse with laminitis sound enough for light work and normal reproduction. Chapter 14 provides more details on laminitis.

HORSESHOEING

Many sizes, shapes, and types of shoes are available (Figure 17–6). Many different types of prefabricated shoes are available that are either **hot**- or **cold-fitted** to the horse. The most important aspect of shoeing is fitting the shoe to the horse and *not* the horse to the shoe.

Learning and practicing safe handling of the horse's feet are important steps in performing routine foot care. In shoeing a horse, farriers follow a number of steps to assure a correct fit.

Picking Up a Horse's Feet

Pick up the front foot by rubbing the leg up high and gently working down to the ankle. Brace a free hand against the horse's shoulder for more stability. If the horse fails to lift its foot, gentle pressure on the tendon behind the cannon bone with thumb and forefinger

Courtesy of Rick Parker

FIGURE 17–6 Examples of the many different types of horseshoes.

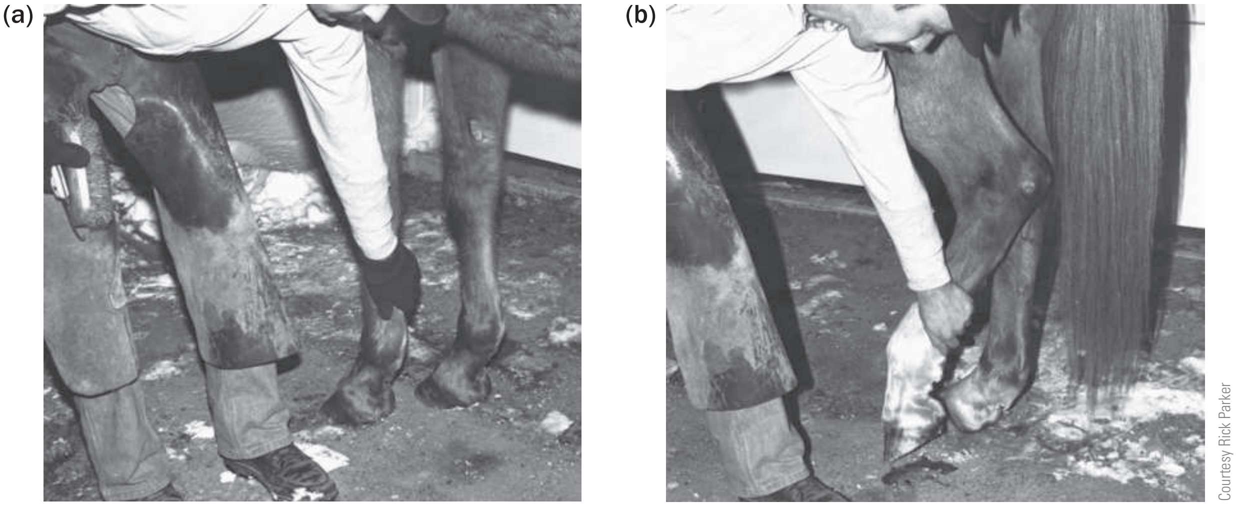


FIGURE 17–7 **The proper way to pick up a horse's feet: (a) Near forefoot: Slide your left hand down the cannon to the fetlock. Lean with your left shoulder against the horse's shoulder. When the horse shifts weight and relaxes on the foot, pick it up. Reverse for picking up the off forefoot. (b) Near hind foot: Grasp the back of the cannon just above the fetlock and lift the foot forward. Reverse sides for picking up the off leg.**

usually will persuade the animal to cooperate. Once the foot is raised, allow the horse to hold it in a comfortable position. Figure 17–7 shows how to pick up a horse's feet.

If the horse is uncomfortable, it will not stand well. Trying to maintain a relaxed and comfortable position is best for both horse and yourself when holding the horse's leg between your knees. For this reason, shoeing young horses for the first time in fly season can be a challenge unless effective fly repellents are used. Picking up the hind foot of foals and young horses is dangerous unless done correctly. Pick up the left foot first, since most horses are accustomed to being handled from this side. Approach the horse from the front and place the left hand on his hip; then run the right hand down the back of the horse's leg to just above the ankle. Pull forward on the cannon until the horse yields its foot. If you feel tense muscles, go more slowly. Step promptly under the raised foot with the inside leg and pull the foot into your lap. Lock it in place with your elbow over the hock and your toes pointed toward each other. Hold the foot in this position so both hands are free to work. If the horse resists, move more slowly.

To lift a hind foot, keep one hand near the hip and go down the leg slowly with the other. Work in close to the horse. If the horse won't yield the foot, squeeze the tendon to get the horse to yield the foot. Move the hand in front of the cannon or fetlock as the foot rises. Position the foot firmly between your knees. If the horse struggles and wishes to regain its foot, let it do so. Repeat the procedure until the horse learns to yield its feet willingly.

Now gently push the horse away with the left hand while pulling its foot toward you with the right hand. Next, step to the rear of the horse with the inside foot, pulling the leg straight behind it, and at the same time drawing the hock up under the left arm. The same procedure is followed for the right hind foot except that it is worked left-handed. The foot, bottom up, can now be rested comfortably on your knees for trimming or shoeing. A satisfactory trimming job can be accomplished with a hoof knife, a rasp, and a nipper.

Removing shoes and cold shoeing, however, require additional tools—including shoe pullers, clinchers, shoeing hammer, punch, clinching block, clinch cutters, hoof pick, anvil, shop hammer, and of course shoes and nails. When trimming or shoeing, an apron should always be used. If a shoeing apron is not available, a pair of heavy chaps are good.

Trimming should begin by cleaning the hoof with the hoof pick. Make sure to draw the pick from the heel toward the toe. This method does a good job of cleaning and is safer for the horse. Don't clean from the toe toward the heel. If the horse jerks its foot and the hoof pick from your hand, it can experience severe injury when it steps on the pick in this position.

Removing Old Shoes

Clinches of old nails must be cut or straightened to remove the shoe. If the shoe is pulled without this operation, it will not only be more difficult to remove, but the walls of the hoof may be injured. Clinches may be cut with the clinch cutter or rasped off. A "pull-off" rasp is an old rasp no longer used to level the foot.

Place the blade edge of the clinch cutter under the clinch and straighten it for pulling by light hammer blows. If you have difficulty getting it started, lean the top out and use the back corner nearest your hand.

Most commercial farriers rasp the clinches off with the fine side of their rasp because it is faster than using a clinch cutter. Place the shoe pullers under the shoe at the heel and push down toward the toe to remove the shoe. This operation is repeated on the opposite heel, always working toward the toe, until the shoe is completely free. Do not pry sidewise because of danger of sprains to the horse's tendons.

Trimming Feet

Begin trimming the foot by removing the loose, flaky (outermost) part of the bars. Next, trim each side of the frog just enough to open the seams on each side at the heel of the hoof. This helps keep filth from collecting. Do not lower the frog. This structure should touch the ground when the horse stands on the trimmed foot.

After the frog and bars have been trimmed, use your hoof knife to trim out the soft, flaky part of the sole in order to determine how much of the hoof wall should be trimmed away (Figure 17–8). Observe the juncture of the sole and wall at the toe. Decide how much will need to come off the toe, with a lesser amount at the heels.

Start the nipper at the heel of the hoof at a depth level with the sole. Often beginners get too deep at the heels and not deep enough at the toe. Proceed around the hoof until the opposite heel is finished. The hoof wall should not be trimmed below the level of the sole. Now the hoof should appear relatively level, and both heels should be the same height.

A relatively level hoof that requires a minimum of rasping is not easy for beginners to accomplish. Beginners do not adequately lower the sole, which serves as a guide for the nippers. This results in unevenness or not removing enough of the wall. Such a condition is not serious, but requires unnecessary rasping.

Use the rasp to finish trimming. Draw the rasp from the heel toward the toe, always taking care to keep the pressure equal over the entire foot.

Move the rasp around over the sides and toe, being careful not to get too deep in one spot. Use a sharp rasp for ease and speed in trimming.

FIGURE 17–8 **A farrier trimming the hoof of a Percheron draft horse. A hoof knife is used in conjunction with the nippers to pare the dead and flaky tissue from the sole. Nippers will be used to cut the horny wall (outer surface) to a proper angle and length to fit the conformation of the animal. The rasp will be used to prepare a ground-bearing surface by eliminating jagged and sharp corners on the bottom of the hoof wall.**

The rasp may be reversed and drawn from the toe toward the heel when trimming the inside of the hoof. Too much pressure on the rasp at the heel will lower the heel too much, and the hoof will not have the correct angle.

Checking Foot Levelness

When you think the foot is level, check levelness by sighting down the hoof from heel to toe. Drop the hoof down so it rests in a normal position with the hoof hanging free. Holding the hoof itself may result in its being slightly twisted, and it may therefore appear level when it is not. Be sure neither heel is high and that there are no low spots around the wall.

The hoof should have an angle of 45 to 55 degrees, depending on the conformation of the particular horse—slope of shoulder and length and slope of pastern. If a horse tends to overreach, trim the hind feet 2 or 3 degrees less than the front. For example, if the front feet are 53 degrees, the hind feet should be 50 degrees. This will permit the front feet to break over faster and prevent overreaching.

Both front and both hind feet must have the same angle. This can be checked by using a hoof level. A hoof level is not absolutely necessary for amateur trimming and/or shoeing, but it helps develop skills and improves accuracy.

If the hoof is to be trimmed and not shod, all that remains is to round the edges of the hoof wall and lower the sole. Round the edges of the wall with the fine side of the rasp. Remove the sharp edges to about one-fourth the thickness of the wall. This reduces the chance of having pieces of the wall break out. If the hoof is to be shod, this step is omitted.

Shaping the Shoe

For the beginner, one of the most difficult parts of shoeing is shaping the shoe. The first rule to remember is to shape the shoe to fit the foot. Shaping the shoe may be made easier by marking the heels of the foot and making a paper tracing from heel to heel.

Use a white grease pencil if the hoof is dark, and mark the back of the heel where the heel of the shoe stops on each side of the foot. Trace the outline of the foot on stiff cardboard or a tablet attached to a clipboard.

A well-shaped front foot is uniformly round and wide at both heel and toe. Since horseshoes seldom come in this shape, substantial shaping will be necessary. Shaping is made easier by using the pattern.

Most new shoes are too narrow for the front feet and must be spread and the heels bent in. This is corrected by hammering the shoe on the anvil and comparing it to the pattern or the hoof.

Check the levelness of the shoe on a flat surface. The face of some anvils will do. The shoe will rock if it has a high spot in it. The ultimate test is a flat board. Raised points caused from hammer blows will have to be beaten down or rasped off before passing this test. Perfect levelness is desirable for both shoe and foot to achieve equal weight distribution. High spots cause a shoe to rock and work loose as well as placing undue strain on that part of the hoof.

Most horses' hind feet are somewhat narrow and pointed at the toe. Shoes are initially round at the toe, so each side will need to be flattened on the back of the anvil. Upon flattening, the shoe will be widened considerably at the heel and must be drawn together.

Nail holes are too small in most manufactured shoes to accommodate the nail. A special punch increases the hole size until the nail head protrudes about 1⁄16 inch. If the nail head goes flush into the shoe, it cannot be tightened. If it does not go deep enough, it will wear off and the shoe will loosen. Finally, the heel of the shoe should extend to the end of the heel of the front hoof but not beyond. On the hind foot, 3⁄8 inch of the shoe may extend beyond the heel of the hoof.

Nailing the Shoe On

Now the shoe is ready to be nailed on. The white line on the bottom of the hoof marks the outer edge of the junction between the sensitive part of the hoof and the horny hoof. Any nail driven inside this line will cause pain to the horse and will result in lameness. All nails are driven along or just outside this line. If nails are driven very far outside the white line, they will split the hoof out and the shoe will come off prematurely (Figure 17–9).

Horseshoe nails are beveled on one side, both top and bottom, and are straight on the other side (Figure 17–10). The beveled side is always put on the inside or nearest the center of the foot. This allows the point of the nail to drift toward the outside of the hoof wall when driven. Most inexperienced people are reluctant to drive a nail. They fear "quicking," or driving the nail into sensitive tissues. This is almost impossible unless driving inside the white line or unless the nail is turned to drift inward. Driving high in the wall does not quick the horse. When preparing to nail, position the shoe so that it is fitted flush with the toe of the hoof. Some farriers prefer to drive a toe nail first because this allows easier positioning of the shoe. If the heel nail is driven first, however, the shoe will move less and will be more stable after driving one nail. The two heel nails and two toe nails should be the first four nails driven. Nails should be at least 1 inch deep

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FIGURE 17–9 **Nailing a horseshoe on a hoof.**

Courtesy Rick Parker

FIGURE 17–10 **Horseshoe nails are beveled on one side, both top and bottom, and are straight on the other side.**

before they come out through the wall. Once through the hoof wall, each nail should immediately be bent over with the claws of the hammer and twisted off flush with the hoof wall. An apron or chaps should always be used when driving nails, even if the horse is completely gentle. Under some conditions, even the gentlest horses will react.

After all nails are driven, they must be set by placing a clinching bar or nipper under the nail stub and striking the head of the nail. This tightens the shoe on the hoof and locks the nail head in the shoe. Excessive hammering will pull the clinches too far down to be rasped under. Many professional shoers use nippers for clinching.

Before clinching, the burs of splintered hoof wall under each nail are rasped off with the fine edge of the rasp. Also, the twisted ends of the nails on top are rasped with the flat, fine side of the rasp before clinching.

Although clinching can be completed with the hammer and clinching bar, it is much more easily accomplished by using clinchers. This tool is placed over the nail and squeezed together, clinching the nail down.

The goal is evenly spaced nails of adequate height and a shoe fitted "full"—that is, out to the edge of the hoof, with no gaps or "daylight" between hoof and shoe (Figure 17–11). A space under the shoe that allows a knife blade to enter suggests a poor job.

After all nails have been clinched, excess hoof that may protrude over the shoe can be dressed off. Very little, if any, of this should exist. Rasping above the clinched nail injures the hoof wall and may result in drying out or cracking of the hoof.

After-shoeing Care

Many horse owners apply a hoof dressing following shoeing, and some even apply it every day or so. This practice is very easily overdone and may reduce both the strength and pliability of the hoof. If the hoof becomes excessively hard, a small amount of lanolin (wool fat) may be applied to the coronet and the bulbs of the heel.

Courtesy Rick Parker

FIGURE 17–11 **Well-shod feet.**

Additional moisture can be applied by packing the bottom of the hoof with a special type of mud designed for this purpose. One of the simplest and easiest ways to keep a horse's hooves in good condition is to keep the area muddy where the horse goes to drink. This will usually be sufficient moisture to prevent dry cracking, cracked heels, and other problems related to dry hooves.

SUMMARY

Foot care is one of the most neglected of horse management practices, even though it is essential to the horse. The most important aspects of good foot care are regularity, frequency, cleanliness, and use of proper corrective measures. An experienced farrier can properly clean, trim, and shoe horses for general soundness or for corrective help. Horses should be taught early in life to yield their feet.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Permanent lameness can result from improper foot care.
2. Feeding practices can affect the horse's feet.
3. Corrective trimming does not help a foal's feet.

4. Hooves should be trimmed once every 3 months.
5. Mud around the water source is good for horses' feet.

Short Answer

6. Which grow faster, the hind feet or the forefeet?
7. List four internal and four external parts of the hoof.
8. What part of the horse's foot bears the weight?
9. Name five tools used in horseshoeing.
10. What four problems in the set of the feet and movement of the feet are commonly corrected by good horseshoeing?

Critical Thinking/Discussion

11. Explain why the frog is a good indicator of a horse's health.
12. Discuss the importance of starting hoof care early.
13. Describe, simply, the process for shoeing a horse.
14. Why is it important to check a horse's feet daily?
15. What are the dangers of trimming incorrectly, cleaning incorrectly, or shoeing incorrectly?

STUDENT ACTIVITIES

1. Visit a farrier to learn more about shoeing and hoof care. Find out how farriers are trained, how much their equipment costs, and approximately how much they charge.
2. Make a drawing or collect some of the types of horseshoes. Indicate the use of each type.
3. Develop a checklist describing how to lift each foot; include any precautions.
4. Obtain a prepared specimen of the bones of the foot. Use this to present a report on laminitis (founder).
5. Develop a checklist that stresses the points of good horseshoeing.
6. Diagram the anatomy of a hoof showing a shoe properly nailed.
7. If possible, go with a farrier to observe the shoeing of a horse.
8. Create a display of the common tools used for hoof care.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). *Horse industry handbook: A guide to equine care and management*. Lexington, KY: Author.

Duncan, S. (2007). *Lameness*. Shrewsbury, UK: Kenilworth Press.

Hill, C. (2007). *Horsekeeping almanac: The essential month-by-month guide for everyone who keeps or cares for horses.* North Adams, MA: Storey Publishing, Inc.

Hill, C. & Klimesh, R. (2009). *Horse hoof care*. North Adams, MA: Storey Publishing, Inc.

Stashak, T. S. (1996). *Horseowner's guide to lameness.* Media, PA: Lippincott Williams & Wilkins.

Thomas, H.S. (2006). *Understanding equine hoof care: Your guide to horse health care and management.* Lexington, KY: Blood Horse Publications

Vogel, C. (2011). *Complete horse care manual*. New York: DK Publishing, Inc

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases:

farrier	hoof cleaning	horse hoof
hoof anatomy	hoof injuries	horseshoeing
hoof care	hoof trimming	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 18

Buildings and Equipment

Horse owners use many types and styles of fences, barns, and shelters. Most people have one type or design they like better than others. But as long as the barn is well built and meets local building codes, the fence is safe and strong, the shelters are strong, and water is always available, the style and design is not particularly important. This chapter provides some general building guidelines for welfare, safety, health, and cost.

OBJECTIVES

After completing this chapter, you should be able to:

- Recommend an environment for horses that addresses welfare, safety, labor, and cost
- List the planning stages of construction
- Identify the space requirements for a horse facility
- Discuss the importance of ventilation in a building housing for horses
- Name materials commonly used for stall floors
- Describe the requirements for a horse stall
- Provide guidelines for the selection of feed and water facilities
- Discuss reasons for fencing horses and how to select the right fence
- Name four types of fences

KEY TERMS

air requirements
flight
polyvinylchloride (PVC)
R value
space requirements
stalls
ventilation

RECOMMENDED ENVIRONMENT

Horses have lived outdoors with natural windbreaks as their only housing for centuries. So, the simplest housing is the best and healthiest for horses. A large field or paddock along with a simple shelter is adequate housing. When housing is built for horses it should provide for:

- Welfare of the horses
- Safety, health, and comfort of human handlers
- Efficient use of labor
- Cost-effectiveness

Providing for the welfare of horses begins with understanding their environmental needs. The environment involves four main areas:

1. Physical: The physical environment includes such things as temperature, heat-loss factors, stall space, feeder space, and flooring.
2. Social: The social environment involves behavioral considerations related to how horses interact with other horses.
3. Chemical: The chemical environment includes water quality; various gases such as oxygen, carbon dioxide, and ammonia; and air contaminants like dust and molds.
4. Biological: The biological environment primarily includes disease organisms in the air, water, feed, stall materials, and other animals.

Horses use **flight** as a primary defense mechanism. In attempting to flee danger, horses can injure themselves. They are generally nonaggressive; but when threatened, frightened, or in pain, they may strike, bite, kick, or attempt to break out of their stalls or stables. Facilities should provide for the safety of the horses and handlers when these behaviors occur.

Under natural conditions, horses do not spend long periods of time in an enclosed area, such as a stall or stable. In barns, some horses will become bored and develop vices. Providing adequate stall space tends to minimize vices.

When horses are brought into a building, fresh air needs to be provided. Metabolic products including carbon dioxide, water vapor, and manure need to be removed. Adequate **ventilation** reduces the presence of air contaminants—such as dust, molds, and irritating gases from decomposing manure—that can cause respiratory problems.

SPACE REQUIREMENTS FOR HORSES

The first step in building is knowing the recommended **space requirements** of horses. Table 18–1 provides these recommendations.

BUILDINGS

Horses are housed in buildings primarily for the convenience of the horse owner and handlers. As a result, human environmental needs and wants play a major role in designing horse facilities. Often, human wants may conflict with the environmental needs of the horse.

TABLE 18–1 Space Requirements for Horses

USE	SIZE (FEET)	HEIGHT OF CEILING	HEIGHT OF DOORS	WIDTH OF DOORS
Smaller horses	12 × 12	8 to 9 feet	8 feet	4 feet
Broodmare and foaling barn	12 × 12 to 16 × 16	9 feet	8 feet	4 feet
Stallion barn	14 × 14	9 feet	8 feet	4 feet
Barren-mare barn	150 sq. feet per animal	9 feet	8 feet	4 feet
Weanling or yearling barn	10 × 10	9 feet	8 feet	4 feet
Breeding shed	24 × 24	15 to 20 feet	8 feet	9 feet
Isolation barn	12 × 12	9 feet	8 feet	4 feet
Training, boarding, riding stables	12 × 12	9 feet	8 feet	4 feet

A horse can do well in nearly any temperature if the humidity can be held to a comfortable level and there is enough air movement through the building to keep the air clean and free of condensation. Conditions that are most detrimental to a horse's health occur when there is high moisture and the barn is either cold or hot. These are the conditions most likely to harm the horse's respiratory system and to allow the inhalation of pathogens.

Several items must by considered in the preconstruction planning stage:

- Purpose of the facility
- Number and breed of animals to be housed
- Room for future expansion
- Regulatory requirements
- Budget
- How layout facilitates day-to-day activities

Buildings represent a major cost and, consequently, can represent costly mistakes. Valuable information can be obtained by examining buildings designed by others to observe good features and recognize mistakes (Figure 18–1).

Site Selection

Local zoning requirements should be checked before buying a farm or designing a new building. Some areas restrict the number of acres necessary to house livestock. The distance from boundary lines, dwellings, and neighbors may also be regulated. If these regulations cannot be met, it is necessary to apply for a variance and receive approval from the zoning board before building can commence.

The site should allow water to drain away from buildings, working rings, and training tracks. A site with a slope of 2 to 6 percent provides rapid removal of water without causing erosion. A detailed site plan should be developed before making a final decision. The site plan helps ensure that sufficient space is allowed for the buildings, roads, paddocks, working rings, training tracks, and manure storage and use.

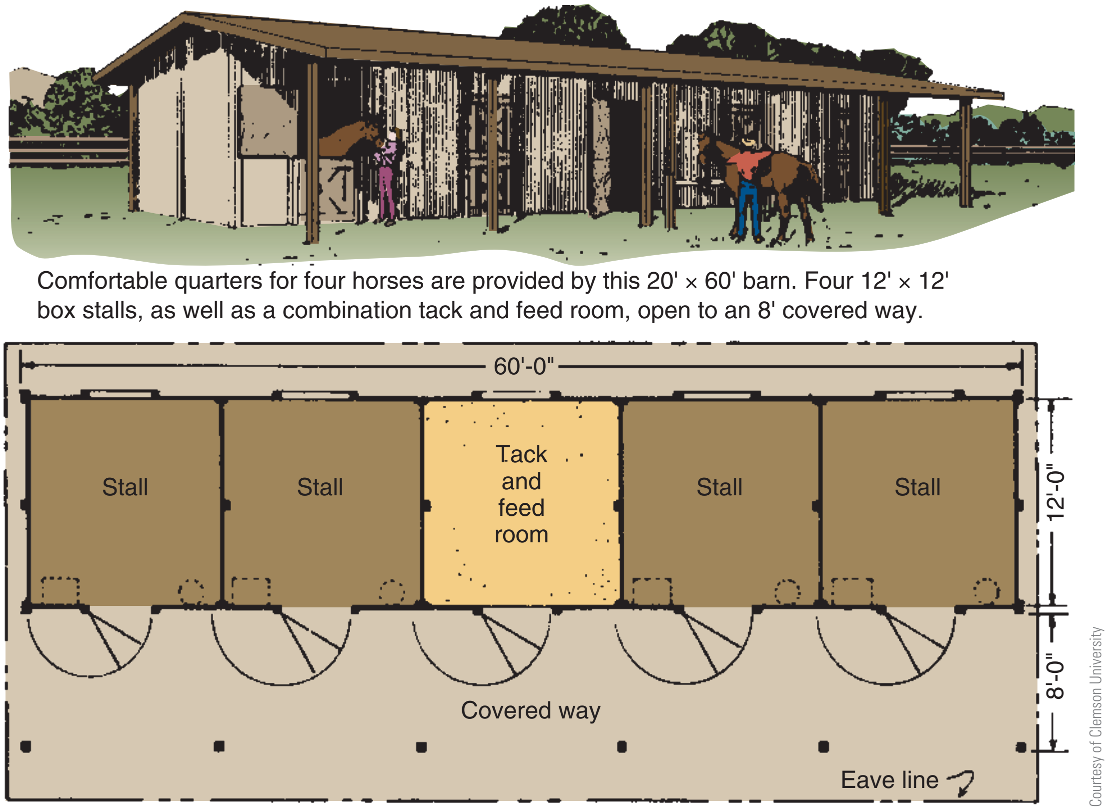

FIGURE 18–1 **A four-stall horse facility.**

Manure handling is frequently overlooked and can be a major obstacle to enjoyment and convenient function of the facilities.

The site plan should indicate where water, sewer, and electrical lines enter the building. The building should be situated to take advantage of prevailing winds to effectively use the natural air flow. In the plan, consideration should be given to clients, traffic, impact on neighbors, manure handling, and conditions in the neighborhood that will startle or distract horses.

Site Preparation

Getting a particular location ready for a building involves removing the topsoil, leveling the area, and bringing utilities such as water and electricity to the site. The nature of the work usually means that local contractors will be engaged.

Type of Construction

Buildings can be metal frame, pole, or conventional construction (Figure 18–2). All three have been used with equal success for nearly every type of farm building. There is no general rule as to which type is most economical for any one situation. In fact, it is not unusual to find more variation in price among similar types of construction than among different ones.

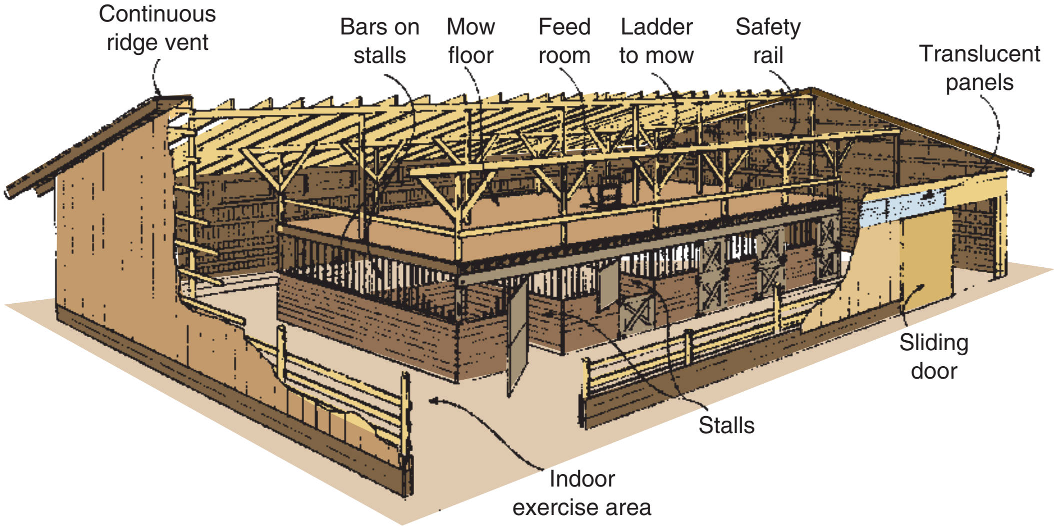

FIGURE 18–2 A pole-type, nine-stall horse barn with an indoor exercise area.

Options in the Building

There are many options and alternatives to consider. Even "packaged buildings" offer alternative or optional items. Some of these choices are listed here, along with their advantages and disadvantages.

Windows

Windows are expensive additions to farm buildings and, to keep costs at a minimum, are being used less and less. The only place they are essential is in those structures that must conform to health regulations. When windows are used for light, the window area should equal 8 to 10 percent of the floor area. Plastic roof panels can also be used as a good light source for uninsulated, cold buildings.

Siding

Metal is a low-maintenance siding material, and it is available in prepainted finish colors that will last 15 to 20 years without refinishing. However, metal siding is subject to damage when exposed directly to livestock.

Wood siding will withstand abuse, and it has a better insulating value than either metal or masonry, but it requires periodic painting or stain to preserve its appearance and durability.

Masonry requires very little maintenance, but it has a high initial cost and is difficult to insulate. When masonry is used with pole or steel-frame buildings, it requires a separate foundation.

Roofing

Metal roofing can be of aluminum or steel. White-colored roofing has slightly better reflective quality than natural metal. Metal roofing requires less roof framing than shingles and is lower in cost. A roof with a solid deck and shingles has a better insulating value than a metal roof.

Insulation

Insulation is an increasingly important part of modern farm building construction. Even buildings that are considered cold structures are minimally insulated to moderate summer and winter temperature extremes.

Many choices of insulating material are available. To provide a basis of comparison between buildings, insulation should be specified based on its **R value**. General recommended levels are as follows:

- Cold buildings operated at outside temperature
- Ceilings (roof): R2 to R4 for summer heat
- Walls: No insulation
- Buildings where animal heat provides only winter minimum temperatures
- Ceilings: R16 Walls: R9 to R12
- Buildings with supplemental heating systems
- Ceilings: R24
- Walls: R13

Interior Finish

Choices of material for the interior finish in farm buildings are almost infinite (Figure 18–3). A performance specification rather than identification of a specific material usually will provide a better comparison among building manufacturers. Items that should be considered in developing performance specifications include:

- Mechanical strength. If interior finish is exposed to animals, it will have to take considerable abuse.
- Moisture resistance
- Ease of cleaning
- Color

Courtesy Rick Parker

FIGURE 18–3 **Inside facilities at Cutter's in Hailey, Idaho.**

Ventilation

A good ventilation system must (1) provide fresh air to meet the respiration needs of the animals, (2) control the moisture buildup within the structure, (3) move enough air to dilute any airborne disease organisms produced within the housing unit, and (4) control and/or moderate temperature extremes.

Each of these four provisions requires some optimum rate of air exchange. If respiration and temperature control are provided for, moisture buildup and disease control will be satisfactory.

The basic process that occurs with all successful ventilation systems is as follows:

1. Cool, dry air is drawn into the building.
2. Heat and moisture are added to the air.
3. Warm, wet air is expelled from the building.

Failure to provide for any part of this process will result in failure of the ventilation system.

Air requirements vary with animal size and outside environmental conditions. The ideal ventilation system would be infinitely variable. During extremely cold weather, it should move just enough air to satisfy respiration needs, and in hot weather, the maximum rate should eliminate heat stress.

A ventilation system should be designed to provide at least three levels of air movement. The lowest, or minimum, level provides enough air to meet respiration requirements and operates continuously. This lowest level provides all the air necessary during periods of extremely cold weather or in buildings where a supplemental heating system is in operation. A thermostat may be used to shut off the minimum level when the building temperature drops to near freezing.

The second, or intermediate, level of ventilation provides enough additional air movement to control both temperature and moisture during normal winter conditions. Fans that provide this additional air are usually controlled by thermostats that turn them on whenever the building temperature reaches the desired level.

The high, or maximum, ventilation rate is intended to provide some degree of temperature control during summer months. Maximum-rate fans are controlled by thermostats that turn them on when interior temperature exceeds some set level, usually 75°F to 80°F.

Table 18–2 shows the recommended ventilation rates for horses.

Natural ventilation is the most common and cost-effective ventilation system for horses. In post-frame construction, the space between the bottom of the roof surface and the top of the girder that supports the roof truss is left open on both sides of the barn. Air enters on the windward side of the barn and exits on the downwind side.

TABLE 18–2 Recommended Ventilation Rate for Horses in a Building at 55°F

SEASON	CUBIC FEET PER MINUTE
Winter, minimum	25
Winter, normal	100
Summer	200

Warmer air and moisture that accumulate at the peak of the roof must be allowed to escape. This can be done with cupolas or openings at the ridge. These should be unobstructed air outlets.

The air inlets and outlets must allow unobstructed airflow with minimal interior obstruction. Roof slopes of at least $\frac{4}{12}$ pitch are most effective in causing air to move from the animal space to the ridge openings or cupolas. Avoiding any overhead storage enhances air movement and reduces the risk of fire. Hardware cloth from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch can be installed to discourage bird entry. Grillwork, rather than solid wall partitions, facilitates air movement through the stalls.

Since wind forces air to move through the building, the barn should be oriented with the long axis perpendicular to the prevailing winds. Other buildings and land features, such as trees, should not block the wind.

Heating

The heating system should be designed to maintain a specified interior temperature when the outside temperature falls. The interior temperature desired will depend on the building's use. An automatic temperature control system should be specified.

Electrical System

The electrical system provides lighting, general outlets, and outlets for special equipment. Adequate lighting can have a positive influence on workers' attitudes, plays a major role in safety, and enhances the management level by increasing people's ability to see potential problems. Horses can sleep in either light or darkness, but they tend to hesitate in moving past areas with high contrast. Shadows and sharp differences between light objects and their background should be avoided.

Two types of electrical fixtures are common in the stable area: incandescent bulbs and fluorescent tubes. Fluorescent lighting is four times more energy efficient than incandescent. Protective coverings over tubes or bulbs are essential in stalls, alleys, and anywhere horses could reach the fixtures, and in the feed room where broken glass is undesirable.

Light levels are measured at 30 to 36 inches from the floor with a lux meter. For general lighting, such as passageways and recreation areas, 10 foot-candles of light is considered adequate. For task areas such as grooming stations, tack-care areas, indoor riding arenas, and offices, at least 30 to 40 foot-candles of light is needed. For reading and fine detail work like veterinary care, 70 foot-candles of light is required.

A common mistake in many horse barns is failing to provide enough electrical outlets. At least one double receptacle is needed for every two stalls. Outlets should be above the level of the horse's back or recessed into the wall.

Floor

A 4-inch-thick concrete floor is sufficient for most farm buildings. Reinforcing is not necessary if floors are placed over a well-drained, compacted fill material. Floors should be thickened to 8 inches for a distance of 2 feet in from doors where equipment will be entering the building. A six-sack mix concrete made with air-entraining cement should be used, and the floors should slope $\frac{1}{8}$ inch to $\frac{1}{4}$ inch per foot to floor drains.

Stall floors for horses must be made of durable material that is not slippery. It should be absorbent, easy to clean, and resistant to pawing. Floors should require a minimum amount of expense and time to be maintained in a satisfactory condition. Some of the more commonly used materials include clay, a sand and clay mix, limestone dust, wood, concrete, asphalt, and rubber floor mats.

Some important notes about the various types of flooring materials include:

- Good clay is hard to find. Maintaining level, dry clay floors is difficult.
- A mixture of two-thirds clay and one-third sand will allow drainage, and it is easy to obtain materials for filling holes and replenishing the surface when necessary.
- Limestone makes a level, hard surface. The thickness of the limestone needs to be 4 or 5 inches over 6 to 8 inches of sand or other base material that allows drainage.
- Wooden floors are made of rough-cut hardwood at least 2 inches thick that has been treated to retard decay. Wooden floors are slippery when wet, and they are prone to attract rodents by creating an environment for urine to accumulate and feed to fall through the cracks.
- Stall floors made of concrete are easy to clean and sanitize, but they require more bedding. The use of concrete floors is of general concern because of its association with increased leg problems.
- Asphalt can be used for stall flooring, but many of the problems associated with concrete can occur with asphalt.
- Rubber floor mats need to be placed on a stall floor that is level and packed well. The mat should be a single piece, at least ⅝ inch thick, and made of a durable rubber that will withstand pawing. Some bedding may be required.

Some alternate flooring for stalls that could be considered include interlocking rubber paving bricks, fiber-reinforced polyethylene interlocking blocks, and fiber-grade polypropylene. All of the alternate flooring materials will add to the cost of stalls. The additional cost needs to be weighed against the benefit of the flooring material.

Special Additions

Almost every building will be modified to provide some special feature for the farm it is located on (Figure 18–4). Some of the more common additions are:

- Bathroom
- Office
- Handling facilities
- Feed storage room
- Tack room
- Special equipment space

Insurability

Farm buildings are becoming extremely complex structures and usually represent a considerable investment that must be protected with insurance. Owners need to make sure the structure will be eligible for appropriate insurance coverage.

Courtesy Rick Parker

FIGURE 18–4 **Tack should be kept in a room with moderate temperatures where it can be kept dry to prevent damage to the leather.**

HORSE BARNS

When building a barn, the owner must consider many important characteristics. The barn must be able to hold a uniform temperature while being ventilated and maintaining a dry atmosphere. Condensation in the barn can dampen the food, which will become moldy. The floors must be dry and firm, preferably with a nonslip footing. Good drainage is necessary so that ammonia from urine can be washed away and to keep molds from growing. Surfaces should be easily disinfected. Adequate lighting is needed for moving horses around or working in the barn after dark.

Horse barns can be designed for small, medium, or large operations. Some variations on barns include:

- Broodmare and foaling barn
- Barren-mare barn
- Stallion barn and paddock
- Breeding shed and corral
- Weanling and yearling quarters
- Riding stables
- Training stables
- Boarding stables

STALLS

There are many different sizes of **stalls**. A 12-by-18-foot enclosure usually is the largest, and a 12-by-12-foot stall is the most common and the smallest comfortable size for today's large horses. Smaller stalls often lead to sanitation problems because they must be constantly kept clean. They can also create a high risk of injuries because the horses are constantly bumping into the walls and have little room if they lie down.

FIGURE 18–5 **To provide enough room for foaling, a stall should measure 12 × 16 or 12 × 18 feet.**

For a foaling mare, a 12-by-16-foot or 12-by-18-foot stall is highly recommended. This gives the mare plenty of room to deliver the foal and allows extra room for a veterinarian or other experts, if needed (Figure 18–5).

Stall Doors

A stall door must safely hold the horse within the stall. The door should be easy to open and close for the safety of both the horse and the handler, and it must be strong and simple to operate. The stall door should be a minimum of 4 feet wide and at least 8 feet tall.

A sliding door is the most suitable for safety and ease of operation. Sliding doors should possess sturdy tracks and rollers, as well as a safe latch. Doors with drop-down bars or latches that protrude can injure a horse. The most common is the half-wood, half-bar door that allows some ventilation and light into the stall. A full-mesh door allows maximum ventilation and light. Mesh doors are valuable in a foaling barn because they permit foals to receive plenty of fresh air; in a barn that is properly designed and ventilated, they do not allow drafts.

The weight of a full one-piece swinging door can cause hinges and latches to sag, making the door difficult to close properly. Swinging doors also can be a safety hazard when opened into alleyways or other high-traffic areas.

Double doors have two sets of hinges and two latches, so the doors tend to sag and must be reset. Two latches present a greater risk because one may not be closed. The advantage of double doors is that the top door can be left open, allowing the horse to stick its head outside and take an interest in its surroundings. However, a horse may try to go over the top if it becomes nervous or excited.

Stall Guards

Some horse trainers prefer stalls constructed of webbing, or chains, or half-metal doors with a neck yoke. Stall guards are the least costly, but they are the least desirable for containing the horse because they are easy for a horse to push out, go over, or break through.

ARENAS AND INDOOR TRAINING FACILITIES

Arenas and indoor training facilities are basically clear-span structures that are part of, attached to, or close to the main horse barn. Arenas should be at least 36 feet wide and can be used for exercising and training horses. This width will limit the arena to riding, as it is too narrow to turn a cart around in. Clear-span structures 50 feet wide or wider are used as exercise, training, and riding arenas. Widths of at least 60 feet are best for group riding or driving horses inside a building.

The ceiling height in an arena must be a minimum of 14 feet for the horse's and rider's safety. The higher the ceiling, the better lit the arena or training area must be to minimize shadows. A 16-foot ceiling will allow the training of hunter/jumper horses with ample headroom for the rider (Figure 18–6).

SHELTERS

Shelters in pastures to allow horses to get out of the sun, wind, rain, or other types of weather are common. Some have just a top for shading. Others are enclosed on three sides. In that case, the open side needs to be away from the wind. Metal strips on all edges will prevent the horses from nibbling on the wood and destroying the shelter (Figure 18–7).

FEED AND WATER FACILITIES

The design of feed and water facilities is controlled by fads and the likes and dislikes of owners. Design will also be a function of the overall type of facility. For the horse, these facilities need only be simple, safe, and effective. For the caregiver, these facilities need to be located so that they can be conveniently filled, checked, and cleaned.

"Green" Buildings

Anyone starting a building now needs to ask: Should the building be "green"? Not a green color but a "green" building, also known as green construction or sustainable building. This is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle, from siting (location and position) to design, construction, operation, and maintenance.

LEED (or Leadership in Energy and Environmental Design) is a third-party green building certification that is recognized worldwide. It is primarily directed at residential, commercial, office, school, and health care buildings constructed or renovated in urban environments.

LEED is a voluntary certification and is primarily used for marketing purposes to show that the project meets and exceeds environmental design criteria. None of the LEED categories apply to agricultural structures, but many of the principles of environmental design can apply to agricultural structures.

While LEED is voluntary, the new CalGreen code implemented in California requires of all buildings, including agriculture, to be reviewed and approved for new "green" standards and techniques. These requirements deal with water conservation in the structure plumbing fixtures and on the site, with energy conservation for heating and cooling, with construction using recycled or recyclable and sustainable materials, and with reduction of construction waste through recycling. Other states could implement similar codes or require LEED certification.

Some newly designed equine facilities use both active and passive solar components, rainwater harvesting, recycled products, and renewable products such bamboo lumber.

For more information on the LEED certification visit their Web site: http://www.nrdc.org/buildinggreen/default.asp

Courtesy Rick Parker

FIGURE 18–6 Popularity of equine programs requires planning of large equestrian centers such as this one at Kirkwood Community College in Cedar Rapids, Iowa.

Courtesy Rick Parker

FIGURE 18–7 An outside shelter at Rivergrove Farms in Hailey, Idaho.

Feeders

Feeders include hayracks, mangers, grain containers, mineral boxes, and self-feeders. The most important point of design should be to keep feed off the ground. Feeding on the ground encourages sand colic resulting from the horses eating every single scrap off the ground.

Locating pipes in front of feeders and waterers helps to keep horses from leaning on them and thus increases the lifetime of the facility. Concrete aprons under feeders keep the horses off mud in the winter and from eating the dry dirt in summer. A roof over the feeding area keeps the horse, food, and dirt dry.

Rubber tires are excellent feeders as they are easy to eat in and hard to pull food out of. But they are also harder to clean out. Before being filled, feeders should always be checked for any uneaten toxic weeds or moldy hay and to make sure the horses are not off their feed.

Watering Devices

Horses must have constant access to clean, fresh water from either a large waterer that is filled with a hose or from an automatic waterer. Automatic waterers are more convenient, but they must be checked frequently to ensure they are working and that the pipes do not freeze in winter. Also, some horses are frightened by the hissing noise pipes make while filling up.

A frost-free hydrant, hose, and bucket is the least costly watering system to install. The water hydrant should be recessed in the wall to eliminate the possibility of a horse getting hurt on it or the farm staff hooking it with the wheel of a tractor, manure spreader, or other piece of equipment.

The water hydrant is a trouble-free system that permits the caregiver to estimate how much water a horse is drinking. The major concern is keeping it from freezing during the winter. In most cold climates, the waterline will need to be 4 feet or more below the surface of the ground.

Many farms now use automatic waterers in order to save labor. Special attention should be given to the design of the waterer and its location in the stall. Round waterers that require an angled support brace at the bottom are a hazard to a horse rolling in the stall. The horse or foal can get its leg caught in the angle brace. Automatic waterers are best placed in a back corner of a stall so an overflow tube can be attached and run to the outside of the barn. Automatic waterers must be checked daily to ensure adequate water supply and cleanliness.

FENCES

Sooner or later, every horse owner must provide fencing for the pasture, turnout lots, arena, or aisles. The most important considerations are that fences be safe and strong enough to contain the horses and that the price and appearance be acceptable to the owner.

Reasons to Fence in Horses

Horses are much healthier outside in the sun, rain, and even mud than they are when kept inside. But in order to have horses outside without exposing them to the danger of automobiles, poisonous weeds, and other hazards, safe fences are essential. Fences keep animals away from the property of others and, at the same time, fences discourage people from entering the horse's environment. In most areas horses are considered "attractive nuisances" that can be dangerous and, except on the open range, horse owners in most states are required by law to fence in horses.

Fences are also important in making the handling, moving, and sorting of horses easier and less stressful for the horses and less labor-intensive for the handlers. They help separate horses that are not compatible, protect pastures that are not suitable to be grazed, and provide boundaries for other essentials such as exercise paddocks, round pens, riding arenas, and protection from driveways. Fences are a major investment for any horse farm or stable manager.

SELECTING THE RIGHT FENCE

Many types of fences and fencing materials can be used for horses (Figure 18–8). The type of fence needed depends on several factors:

- Type of horse being managed
- Intended use of the area
- Density of animals on the fenced area
- Availability of shelter
- Neighbors
- Desired aesthetics
- Projected budget

FIGURE 18–8 **Different fencing may be chosen depending on the type of horses being managed, use of the area, desired appearance, and cost: (a) metal piping, (b) wire mesh, (c) PVC plank, and (d) wood.**

Obviously, draft horses require taller and stouter fences than those required for miniatures. Mare and foal pastures need to be made safe and solid to protect curious foals from danger. Usually old pleasure horses that are used to fences require less sturdy and visible barriers than do young horses or horses that have never been in pastures with groups before.

Stallions should have taller and stronger fences to keep them in and to keep children and curious visitors out. When fencing stallions, unacquainted horses, or very valuable horses, the area between paddocks should be double fenced or separated by a 12-foot empty aisle.

If the pasture provides a significant share of the horses' nutrients, at least 2 acres per horse should be allowed. If the area is primarily an exercise lot, then the space should be more than 500 square feet per horse. If activity is expected on the inside of the enclosure, then the boards (or other material) should be attached on the inside of the posts. This is primarily for safety reasons in riding arenas where the fence surface protects the cart or the rider's leg from hitting the post. In pastures, it prevents horses from pushing boards away from the posts.

Dividing the total number of horses by the available acreage determines the animal density. Basically, the higher the animal density per acre, the stronger the fence needed. For large pastures with only a few horses, an open wire-type fence may be adequate. But when confining several horses in smaller areas, stronger fencing is required.

Either allow the horses access to wooded areas, build a three-sided shed, or fence the area in a manner that provides a stall or lean-to shed to provide shelter from the sun and weather. The arrangement of fences and gates selected depends on whether it is necessary to allow the horses to get into a building or shelter to access water. Horses tend to congregate near shelter, feed, or water, so the fences in these areas need to be more solid and safe than at the periphery.

If things attractive to horses—such as grain crops, other horses, or even the barn—are present on the other side of the fence, then the fence should be stronger and possibly taller. Generally, the closer they are to the barn and other horses, the stronger the fences need to be. This situation often calls for a 12-foot easement or aisle between the fence and the attraction on the other side.

The importance of appearance depends on personal likes as well as the priorities in the neighborhood. Fences should be safe, require as little maintenance as possible, and be affordable for the owner. Few people can afford to install and maintain a four-board fence for a large acreage, but this type may be desired for appearance around the barn, entrances, and front of the property.

Prices for most fences range from less than a dollar to more than four dollars per linear foot. The criteria involved in matching the horses' needs to the attributes of the specific fence should be the most important factors in determining costs. Building fences takes a lot of time. A person's ability to build the fence and the availability of time to do it are factors to consider. Paying someone to install the fence often results in quicker installation and higher-quality fences. Fences using high-tensile wire and polyvinylchloride (PVC) should be installed by professionals.

Types of Fences

Fences need to be specific for the situation. The types of fences available for horse facilities change and improve every year. Fences discussed here include post-and-board, woven wire, high-tensile wire, **polyvinylchloride (PVC)**, pipe, diamond wire, electric wire, and various combinations.

Post-and-Board

This type of fence includes three or four boards hung on wooden posts. Board fences are suitable for line fences, paddocks, and arenas. The standard design usually includes 16-foot, rough-cut, 1-by-6-inch hardwood boards fastened on the inside of 4-inch (minimum) diameter wooden posts with each staggered board spanning two posts.

Several variations of the post-and-board fence include:

1. Setting the posts on 10-foot centers and using 20-foot boards
2. Using square 5-inch posts instead of the round 4-inch posts
3. Using 2-by-6-inch milled planks rather than the full 1-inch-thick rough-cut boards
4. Deleting the fourth board and increasing the space between boards to 10 inches (between the bottom board and the ground to 16 inches). A good practical distance between the ground and the bottom board is just greater than the height of the lawn mower deck. This makes trimming fencerows much easier.

Advantages of the post-and-board fence include safety, sturdiness, high visibility for the horses, and popular aesthetic appearance. Disadvantages include high maintenance costs and board replacement.

Woven Wire

Field-livestock woven-wire fence can be purchased in rolls of 39- to 55-inch widths. The top and bottom wires should be at least 9 gauge with the intermediate wires 11 to 12 gauge. Woven wire with the vertical strands a maximum of 6 inches apart should be used. The standard design is to hang a 47-inch woven wire 5 to 6 inches off the ground on the inside of 4- to 5-inch-diameter round wooden posts. A 1-by-6-inch hardwood board is then nailed above the wire, making the total fence 60 inches tall.

Depending on the topography, the wire may need to be higher off the ground, and the board could be replaced by an electric wire no more than 4 inches above the woven wire. Posts on 8-foot or 10-foot centers work well with 16- or 20-foot boards. As with any wire fence, strong brace-post sections must be placed in the corners to stretch the wire tight. Brace sections also must be in the lowest points of valleys and at the top of hills to allow straight stretching without the wire pulling the posts out of the ground.

Advantages include high visibility and low maintenance. Disadvantages include stretching and costs.

Diamond Wire

Much like the livestock woven-wire fence, the diamond-wire fence is normally made with 48-inch wire hung 6 inches off the ground with a 6-inch board along the top, making the whole fence about 60 inches tall. Brace-post sections are needed to adequately stretch the wire. Wire of 9 to 11 gauge diameter is available in this design. The wire should be all galvanized steel.

The unique interwoven design provides smaller holes than the livestock fence does and less danger to horses that might put a foot through the fence or walk up the fence. Standard 16-foot 1-by-6-inch rough-cut hardwood boards are nailed to the top of 5- to 6-inch wooden posts with both the wire and the boards fastened to the inside of the posts. Advantages of the diamond-wire fence are safety and low maintenance. Disadvantages are primarily cost, the need for brace sections, and having to devise ways to stretch the wire tight.

Pipe Fence

Fences made of pipe are constructed from 2-inch to 4-inch horizontal pipes welded to 4-inch posts. As with wooden posts, the pipe posts should be driven or set 30 to 36 inches into the ground. The horizontal pieces should be welded to the inside of the fence or holes cut in the posts so the rails can be slid through the posts. Usually four or five horizontal rails are set 6 to 8 inches apart. The top of the posts must be rounded or capped so sharp edges are not exposed.

Depending on the availability of used well-casing pipe, this type of fence can be economical and sturdy and require relatively low maintenance costs. The construction requires metal cutting and welding expertise. This fence is more popular in the South, where fewer temperature changes reduce the need for repainting.

High-Tensile Wire

High-tensile wire fences are made with five to seven strands of smooth 12.5 gauge wire spaced 8 to 12 inches apart. Rigid brace sections are required at corners, gates, and fence ends. Eight-foot wooden or fiberglass line posts set 30 to 36 inches into the ground are placed at 50- to 75-foot intervals with fiberglass spacers of the same height every 20 to 30 feet. Alternating wires should be electrified, so plastic insulators must be put on the posts on the top and bottom strands and alternating wires in between.

Considering the curiosity of horses, the electrification of this type of fence is essential. Bracing, in-line strainers, or tighteners adequate to allow 200 to 250 pounds of tension are needed. The advantage of this fence is that it is sturdy and needs relatively little maintenance, although it does require frequent checks for damage, electrical shortages, and tension loss. Disadvantages are that it has low visibility to the horse, it takes specific expertise and equipment to install, foals can get through the fence, and if a section is damaged, the whole line must be repaired or retightened. Generally, this type of fence should be used only with electricity and in areas of at least 5 acres.

Polyvinylchloride (PVC)

PVC fence is made of a weather-resistant polyvinylchloride material available in flat or round shapes that resemble boards or pipe. Round rail fences consist of 5-inch-diameter round posts and 3-inch-diameter rails 16 feet long that span through three posts. Posts with three or four rails are most common. The plank-shaped rails, $1\frac{1}{2}$ inches by $5\frac{1}{2}$ inches, usually interlock into slots in the 5-inch round or square posts. These single- or co-extrusion polymer products can be made in white, brown, or black and have a UV light protection mixed in to keep the product from fading. Advantages of this type of fence are that it looks great, does not need painting, and requires very little maintenance. Disadvantages are that it is expensive to install and is less sturdy in small areas with high animal density.

Covered Boards

These products consist of a 2-inch by 6-inch wood plank, usually 16 feet long, covered with polyvinylchloride or plastic. The advantage is that it combines the sturdiness of wood fences with PVC protection that eliminates the need for painting. The board inside can still break and need to be replaced, however.

Cable

Usually these fences are made with pipe posts 4 to 5 inches in diameter. Twisted-wire cables either run through holes in the posts or are fastened to the inside of the posts. At least six cables should be used, with the bottom cable about 6 inches off the ground and the top strand 54 inches high. Cables with a minimum diameter of $\frac{1}{2}$ inch should be used. This fence is not recommended in small areas or with foals. It is difficult to keep horses from entangling themselves in the strands.

Electric and Fiberglass Webbing

Electric-wire fences can have two to four strands of either smooth wire or wire woven into colored fiberglass webbing. This webbing can be 1 to 4 inches wide and comes in a variety of colors. The key to any electric fence is to make sure that the electrical current is not shorted out by poor insulators, tall weeds, or broken wire. Posts can be wooden with insulators nailed or stapled to the inside of the posts, or they can be metal with plastic clip-on insulators.

The electric material must be kept tight, but not with the tension of a high-tensile wire fence. The posts can be 20 to 30 feet apart and should be set deeper than 30 inches in the ground for permanent fences. Advantages of these fences are their economical features and that they can be made temporary by using metal posts. Disadvantages include the low visibility to the horse (with smooth wire) and the constant need to check for breaks and shortages so the horses do not become entangled or injured. The fiberglass webbing is safer and more visible.

Nylon or Rubber Fencing

These are fences made of 2- to 4-inch strips of belting or inner-tube rubber from the tire industry. These strips should be stretched, so the considerations of tension and bracing are the same as they are with wire fences. Rubber and nylon are very durable and safe but tend to stretch in colder climates and become brittle with time.

Caution should be used in selecting a product, to ensure that it does not have exposed nylon threads, because horses will playfully ingest these and experience colic. This fence can be very safe, but curious foals may weave their way through it. It will need to be replaced regularly in colder climates.

Barbed Wire

Barbed wire is inexpensive but very dangerous for horses. Whether electrified or not, this type of wire is not recommended for horses.

Other Considerations

Regardless of the material used, horizontal fencing must be fastened onto the inside of the posts so that when horses lean against the fence, they push the boards, pipe, or wire against the posts rather than off the posts. If boards are put on the outside of the posts, they can easily be detached, allowing the horses to escape. When boards are put on the inside, there is no need for vertical face boards.

Round posts generally come from tree stock similar in diameter to the finished post. Square posts, on the other hand, must be milled and wood removed from the original blank; this removes strength as well. Thus a 4-inch round post is stronger than a 4-inch square post of the same type of lumber.

Posts should be western red cedar, osage orange, western juniper heartwood, or black locust that is hard enough to be useful untreated. Treated softwood posts appear to be more expensive; however, pressure-treated posts last 25 percent longer than untreated posts, and they are often guaranteed for 20 years. The best plan is to buy either treated posts or hardwoods and then cover the posts with paint or other coating before setting them in the ground.

The top of a horse fence should be 54 to 60 inches above ground level. Line posts should be set 30 to 36 inches deep, requiring either 7½- or 8-foot posts. Corner posts should be 8½ or 9 feet long and set 36 to 42 inches deep. Square posts should be 5 inches square as line posts and 6 inches for corner posts. Round posts should be a minimum of 4 inches top diameter as line posts and 6 inches as corners.

All fences that rely on tension must have strong corner and brace sections in the line fences. The strength of the brace is based on the cross wires that pull the top of the second and third posts toward the corner and away from the tension. The corner posts should be set in concrete at 48 inches; landscape timbers or 4-inch-square posts can be used for the horizontal braces. Eight- to 9-gauge wire should be used with any hardwood piece to twist the post tight.

SAFETY FIRST, AND ALWAYS

When working with horses and people, the first concern should always be a safe, accident-free environment. To accurately assess the safety of stables, these questions need a truthful answer:

1. Is each building's service-entrance equipment located in a dry, dust-free location?
2. Is service-entrance equipment mounted on fire-resistant material?
3. Is service-entrance equipment free of rust and other signs of deterioration?
4. Are electrical fixtures properly covered so they do not fill with cobwebs, dirt, or chaff?
5. Are circuits properly fused with correctly sized breakers?
6. Is all wiring in good condition with no signs of fraying or deterioration?
7. Are all lighting fixtures properly protected?
8. Are stable aisles well lit and at least 12 feet wide?
9. Are stable aisles and walls free of objects that might harm horses?
10. Are all stalls designed to prevent contact with neighboring horses?
11. Are all stall doors equipped with horse-proof latches to prevent escape?
12. Are all electrical fixtures and wiring inaccessible to horses or properly protected?
13. Are stalls cleaned and rebedded daily?
14. Is all grain and feed kept in covered containers or bins?

Some general questions needing a truthful evaluation include:

1. Are areas surrounding buildings free of high weeds, grass, and debris?
2. Is hay properly dried and cured prior to inside storage?

3. Are all roofs, walls, windows, and doors weather-tight on hay storage buildings?
4. Are fire extinguishers:
   - Located in each building?
   - At least 5-pound ABC or better?
   - Conspicuously hung within 50 feet of any point in the building?
   - Protected against freezing?
   - Inspected and tagged annually?
5. Are lightning rods properly installed and grounded with conductor cable showing no signs of corrosion?
6. Is a responding fire department within 5 miles of the farm?
7. Is the telephone number of the fire department conveniently located near telephone?
8. Are NO SMOKING signs posted and enforced?

In the pastures:

1. If post-and-rail fencing is used, are rails secured to the inside of the posts?
2. Are pastures and paddocks free of harmful objects?
3. Are isolated groups of trees fenced off or protected by lightning rods?
4. Are pastures rotated to break the life cycle of parasites?
5. Are shelters provided in pastures and paddocks?

Safety requires constant monitoring of the surroundings, the building, stalls, shelters, feed and water facilities, and the fences.

SUMMARY

In the past, horse housing designs have developed at the whim of humans. Horses are the one species of large animal that many people have tried to fit into the pet category. Building requirements frequently have been established for the comfort and benefit of people and have not considered the health of the animals. Many horse barns are built with poor or nonexistent ventilation and, especially in colder climates, horses are required to spend many hours each day in a moisture-filled, dust-laden environment.

Minimum air exchanges per hour, size and orientation of buildings, stall sizes, and flooring should be not only comfortable, but safe for equine charges.

The most important consideration in selecting and building fences for horses is that they must safely contain the animals. After determining what type of horse will be fenced and other important criteria, build the strongest fence you can afford. The cost of building the fences will likely be second only to the cost of the property itself and the barn. But for the horse owner, nothing is more comforting than knowing that the horses are outside where they are the most healthy, in a fence that will keep them there safely. Safety of the horses and the owners must be monitored first and always in the surroundings, the building, stalls, shelters, feed, and water facilities, and the fences.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. The primary defense of the horse is flight.
2. Fencing needs to be on the outside of posts.
3. Natural ventilation is the most common and cost-effective ventilation system for horses.
4. Plastic roof panels should not be used as a light source in cold buildings.
5. The higher the ceiling, the better lit the arena or training area must be to minimize shadows.

Short Answer

6. List the four main provisions for an equine facility.
7. Name four considerations that are part of the environment for the horse.
8. Identify at least five items to be considered when planning to construct a horse facility.
9. List five variations on barns for different horse operations.
10. Name three types of fencing available.
11. Give one advantage and one disadvantage of the three types of siding—metal, wood, and masonry.
12. What are the stall space requirements for a stallion, a mare with a foal, and an older horse?

Critical Thinking/Discussion

13. Describe how the ventilation of an equine facility is different in the winter as compared to the summer.
14. What is the purpose of fencing horses?
15. Name three types of stall flooring and describe the advantages and disadvantages of each.
16. Why is moisture resistance an important feature in a horse building?
17. Describe why adequate lighting is important inside a horse facility.
18. Explain one advantage and one disadvantage for each of the following types of fencing: wood, PVC, electric wire, and pipe.

STUDENT ACTIVITIES

1. Make a display showing four types of fencing used for horses. Include the cost, advantages, and disadvantages of each type of fencing.
2. Using graph paper or a computerized drafting program, design an equine facility.
3. Visit some horse facilities and, using a video or still camera, document your visit. Use the camera to compare windows, flooring, siding, ventilation, feeders, and waterers.
4. Compare the cost of building materials in your area. For example, compare the cost of siding materials, such as metal, wood, and masonry.
5. Collect samples of at least five types of material used in stall floors.
6. List features and materials that would be considered "green" when constructing a new horse barn.

ADDITIONAL RESOURCES

Books

Ambrosiano, N. W., & Harcourt, M. F. (2006). *Complete plans for building horse barns big and small* (3rd ed.). Emmaus, PA: Breakthrough Publications.

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INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google, or Bing, find more information by searching for these words or phrases:

building construction	horse buildings	space requirements
horse arena	horse fencing	for horses
horse barns	horse stalls	green building

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 19

HORSE BEHAVIOR AND TRAINING

Without a clear understanding of horse behavior, individuals cannot become good riders, trainers, or owners. Horse psychology—understanding how a horse perceives the world—is used to encourage horses to respond to the goals of the trainer and rider. This training begins when the foal is still at the mare's side. Those horses that are fit are easier to train.

OBJECTIVES

After completing this chapter, you should be able to:

- Name and describe 10 behavioral categories
- Discuss the role of reinforcement in training
- Describe imprinting
- Describe the horse's senses of vision, touch, smell, and hearing
- Identify how to read the emotions of a horse
- Discuss how the gregarious nature of horses can influence their training
- Describe the role of the sense of touch in training
- Characterize longeing and its uses
- Describe the role of aerobic and anaerobic fitness in training horses
- Discuss how a horse is taught during training

KEY TERMS

agonistic behavior
allelomimetic behavior
barn sour
conditioned response
cue
eliminative behavior
epimeletic behavior
flehmen reaction
flighty
hard mouth
herd obedience
imprinting
ingestive behavior
interval training
longeing
mimicry behavior
pig-eyed
reactive behavior
reward training
stay apparatus
unconditioned response

BEHAVIOR DEFINED

Some horse behavior is genetic. This part of their "programming" directs how they interact with their environment to maintain themselves and to survive. Other horse behavior is learned as horses respond to their environment. As with all animals, horse behavior can be categorized. Different names are given to these behavioral categories, but most names are similar to these:

- Reactive
- Ingestive
- Eliminative
- Sexual
- Caregiving and care-seeking
- Agonistic
- Mimicry
- Investigative
- Grooming
- Sleep and rest

Reactive Behavior

Reactive behavior is a classification of activities used by an animal to keep itself in harmony with its environment and adjust to sudden, potentially harmful situations. One form of reactive behavior is a simple reflex, for example, withdrawing a limb in response to a local pain.

Communication and vocalization are also forms of reactive behavior. Some communication is merely body language; for example, horses exhibit group association by maintaining visual contact. Vocalization is used to exchange signals between mare and foal or between other bonded individuals when they are separated.

Another form of reactive behavior is shelter seeking. In cold weather, horses augment their shaggy coats by seeking protection from the cold and wind. During a storm, horses turn their backsides to the wind. Following a cold night, they stand broadside to the sun to expose as much of their bodies as possible to the sun. On the other hand, during hot weather, they seek shade or a cooling breeze.

Ingestive Behavior

Ingestive behavior includes eating, drinking, food preferences, daily patterns of feeding, the mechanics of obtaining food, and chewing food. The first behavioral trait of all mammals including foals is suckling. Foals start eating solid food when they are only a few days old. They start nibbling on feed and rapidly learn to eat it.

Horses in a pasture eat small amounts of feed all day long (Figure 19–1). Obviously, horses kept in a stall or corral eat at the convenience of the owner or handler. If food is freely available, horses have a tendency to overeat.

When horses graze they take a bite of grass, move a few steps, and take another bite of grass. So they are moving most of the time they are grazing. Horses graze over a large area. If plenty of grass is available, horses will eat the top of the stalks and leave the bottom. If pasture is insufficient, horses will overgraze an area and eat the grass down to the surface.

Horses use their molars for chewing before swallowing, whereas cattle ingest large quantities of food with minimal chewing.

Feeding behavior is influenced by learned patterns and preferences, palatability of the feed, the environment, and social associations. Exactly how genetics and

FIGURE 19–1 **Grazing is a form of ingestive behavior. Horses will walk and graze for most of the day. Because they are grazers, horses that are confined to stalls with little or no turnout may begin to exhibit behaviors such as stall walking and cribbing. So it is important that horses be given appropriate exercise and moments of freedom to graze.**

environmental contributions affect feeding behavior is not completely clear. Thirst, on the other hand, is controlled by centers in the brain that work at maintaining a specific level of body fluid. The control factors regulating thirst are influenced by hormones, salt intake, moisture content of the feed, and environmental factors (Figure 19–2).

Eliminative Behavior

Eliminative behavior refers to urination and defecation. While urinating, all horses have the same characteristic stance. The neck is lowered and extended, the tail is raised, and the hind legs are spread apart and extended toward the back. Most horses urinate about every 4 to 6 hours, but they are often reluctant to urinate on a hard surface because the urine splatters on their legs.

Horses defecate every 2 to 3 hours, but they will also usually defecate when nervous. To defecate, a horse raises its tail and may hold it off to one side. Horses will defecate while they are moving. Stallions prefer to defecate in a small area and will even back up to a pile of manure to defecate. In a corral, often mares and geldings choose no particular place to defecate and will scatter their feces everywhere. In pastures, however, horses tend to deposit their urine and feces in certain areas and graze other areas.

Sexual Behavior

Sexual behavior involves courtship, mating, and maternal behavior. It is controlled by hormones, but some of it may be learned. Stallions find females in heat by sight and smell. Exposure to a mare in estrus prepares the stallion for mating. It is characterized

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FIGURE 19–2 Horses need plenty of clean, fresh water to maintain fluid balance.

by neighing, smelling, and pinching the mare with his teeth by grasping the folds of the skin in her loin-croup area. Often the stallion will extend his head and upcurled upper lip when around a mare in heat. This is called the **flehmen reaction** and is in response to the scent of a female's urine. In addition to horses, animals that exhibit the flehmen reaction include the males of domestic cats, cattle, bison, tigers, tapirs, lions, giraffes, and llamas (Figure 19–3).

Sari ONeal/www.shutterstock.com

FIGURE 19–3 Welsh stallion showing the flehmen reaction.

Reproductive hormones are responsible for the behavior of mares in estrus. To check the behavioral traits exhibited at estrus, a mare is "teased" or tested for receptivity to the stallion. A mare in estrus demonstrates receptivity by standing quietly when a stallion approaches, urinating frequently, exposing the clitoris (also known as winking), raising the tailhead, and spreading the hind legs. When the mare is ready for mating, she is said to be in standing estrus or in heat.

A wide range of individual expression of estrus exists between different mares. Some mares will allow a stallion to bite and smell them, but some are quite aggressive even while demonstrating other signs of estrus when teased. They may even back up into the stallion. Others show minimal change in their behavior but allow the stallion to mount. Estrus signs are usually constant in a single mare from one cycle to the next. Most mares will not show signs of estrus unless a stallion is present. Occasionally mares show signs of estrus when strange horses are present. Reliably determining estrus is nearly impossible if a mare is stabled only with other mares and geldings.

Caregiving and Care-seeking Behavior

Giving care or attention is very common in horses (Figure 19–4). Another name for caregiving behavior is **epimeletic behavior**. Horses seek attention and care from each other and display this behavior in several ways. During fly season horses stand head to tail and mutually swat flies for each other. Using their incisor teeth, they nibble at areas including the base of the neck, withers, back, and croup during mutual grooming. Mutual grooming is frequent during the spring and summer. Licking as a means of caregiving is limited to a mare licking her foal for about the first half hour after parturition.

Courtesy Botts/Watson Photography

FIGURE 19–4 **Mutual grooming is common and very relaxing for both parties. Both Bob and Joe look relaxed and content as they groom each other.**

Horses also signal their desire for care and attention—care seeking. All age groups show this type of behavior, which is most often seen when horses are separated from each other. For example, a young foal when separated from its mother will nicker or whinny for her. Mature horses that are used to being together become upset and call for each other when separated. At the beginning of the separation, they will frequently whinny for each other and act very excited. They may also become so nervous and excited that they will try to run through fences.

Agonistic Behavior

Agonistic behavior includes fighting, flight, and other reactions associated with conflict. In all species of farm animals, males are more likely than females to fight. Aggression is used to establish the dominance hierarchy of horses kept together. Most dominant hierarchies are linear, but sometimes they can be complex—one horse low in one dominant order may rank above another horse in another dominant order.

Hierarchy is established by some characteristic behaviors. Unacquainted horses approach each other with their heads high; they may also toss their heads. Their necks are arched and ears point forward. The face-to-face encounter is made by smelling or exhaling at each others' nostrils. They may squeal, rear up, and threaten to strike during this face-to-face encounter. As the encounter continues the horses may continue smelling each others' necks, withers, rumps, and genitals. At some time during this encounter, one horse may decide to turn its hind end around to the other horse and kick with one or both hind legs. Once dominance is established, only threats of aggression are necessary to maintain the hierarchy. To avoid or reduce this type of behavior, a newcomer horse can be penned adjacent to the group. Obviously, this requires strong, high, safe fencing. Horses that are run together from a very young age seldom fight.

Mock fighting is a variation of play. During mock fighting it is common for animals to circle each other; in a group, they will push, nip, and chase each other. Sometimes they will rear on their hind legs and paw at each other. This activity is especially prevalent among young colts (Figure 19–5).

Mimicry Behavior

Horses learn to copy the behavior of other horses at a very young age. This is called **mimicry** or **allelomimetic behavior**. When one member of a group does something, others will do the same thing. For example, horses moving toward water and crossing a pasture display allelomimetic behavior. As one horse starts toward the water, others follow. The first horse continues because the rest of the herd is following. Finally, even the most timid horse will follow the group. This type of behavior is closely related to gregarious behavior. The close presence of other animals provides companionship and has a quieting effect.

Investigative Behavior

Horses like to explore and investigate a new environment. This curiosity subsides once the environment becomes familiar. If any change or novelty is introduced, investigative behavior reappears. Horses use their senses of sight, hearing, smell, taste, and touch to investigate.

FIGURE 19–5 **Rearing begins as playful behavior in young horses. In some horses, such as the Lipizzaner, it is encouraged on cue.**

Foals are more curious than older horses. A mare becomes very nervous as she watches her foal investigate. But foals spend much of their time looking and sniffing at objects in their pastures or stalls. Exploratory behavior is sort of a trial-and-error learning activity (Figure 19–6).

Grooming Behavior

Besides mutual grooming, horses also groom themselves. Horses will paw a dry area and roll on their backs in the dirt. When they get up they shake their whole body. This is a grooming behavior.

Horses get rid of annoying insects on their bodies by several methods. Rapidly contracting superficial muscles on the trunk and forelegs causes insects to fly away. On their forelegs, shoulders, ribs, flanks, and thigh areas, horses use their heads to remove insects. Insects on the belly are removed with the hind leg, while the tail swats at flies on the hindquarters.

Itching is often relieved by rubbing against some fixed object. The horse will also use its head or a hind foot to scratch an itch. Horses scratch their forequarters, sides, croup, and hindquarters with the head, while the hind foot is used on the neck and head.

FIGURE 19–6 **Foals are very curious and as they get older are more apt to wander further from their mother's side to explore. The mare in this photo is very relaxed and not at all disturbed by her foal's need to wander. Obviously the mare feels comfortable and safe in this environment.**

Sleep and Rest Behavior

Sleep and rest behavior allow the horse to restore its physiological status. During sleep the body makes metabolic recoveries in a short time. During rest, the body conserves energy; the animal may be drowsy but wakeful. The horse rests while standing.

As in humans, sleep in horses occurs in two forms–brain sleep and body sleep (REM). In brain sleep the brain puts out slow electrical waves. In body sleep some electrical currents of the brain are of the same pattern as when the animal is awake. During this time, the eyes move rapidly behind closed eyelids. This form of sleep is known as rapid eye movement, or REM, sleep. During REM sleep the animal needs to be lying down unless it can prop itself up against something. Horses lie down for about four or five periods per day. REM sleep is a deeper sleep than slow-wave sleep. During REM sleep the mind is very active but muscle tone is almost completely lost.

In slow-wave sleep or brain sleep, the muscles are not fully relaxed. Horses can be in slow-wave sleep while lying down or while standing up. Because a horse can lock its knees and hocks with a series of tendons controlling leg flexion, the horse can sleep while standing up.

In the course of a 24-hour day the horse is alert and active just a little more than 19 hours. It spends almost 2 hours in a drowsy, resting state. So the horse is awake about 21 hours a day. The horse actually sleeps—brain sleep and REM—for a total of about 3 hours a day.

Horses sleep standing up, but of course they can and do at times lie down to sleep. When they sleep standing up, they have a system of tendons and ligaments called the **stay apparatus**. This allows them to "lock" their legs and relax their muscles and not fall over. In the front leg, the stay apparatus is always in place, and a horse need only relax to take advantage of it. However, to use the stay apparatus in the hind leg, a horse must rotate its hip and literally hook one bone up over a knob on another bone. Horses also use their stay apparatus while they're awake to minimize fatigue due to standing.

Abnormal Behavior

Horse owners, trainers, and riders need to learn the normal patterns of horse behavior so they can recognize abnormal behavior. For example, abnormal reactive behavior in horses includes such activities as:

- Weaving
- Head nodding and shaking
- Pacing and pawing
- Self-mutilation
- Tail rubbing
- Destructive behavior

Abnormalities of ingestive behavior include:

- Crib biting
- Tail biting
- Tongue dragging
- Wind-sucking
- Wood chewing
- Eating feces, hair, or soil

LEARNING

Training involves learning new behaviors. The horse learns to make a desired response. Stimuli cause responses. If the response occurs without practice, it is an **unconditioned response**. A response that is learned is called a **conditioned response**. Many of these are used in horse training. The stimulus used to train horses is called a **cue**. Responses are chained together into maneuvers.

Cues

Horses must learn to recognize cues. Trainers start with the cues that are the closest to being natural. A horse is not ridden from hand to leg. It is always from leg to hand. The leg is the most crucial aid to give the horse cues.

As the horse learns the basic cues, the trainer will advance the horse to new cues. The rate of learning depends on the individual horse and the clarity with which the cues are paired. The new cue should always be given first, followed by an old cue that the horse knows. If the horse seems confused, the trainer should go back to the previous cue until it is clear, then advance. Communication must be clear, so cues must be very specific. Indiscriminate cues will only confuse the horse.

Reinforcement

Reinforcement is something that can strengthen the response to certain stimuli. Primary reinforcers have natural reinforcing properties. Feed, for example, is a primary reinforcer. Very few primary reinforcers are used in training. Secondary reinforcers are learned. Acts of kindness are secondary reinforcers to horses. For example, a soothing voice and rubbing a horse's neck are secondary reinforcers.

All reinforcement is either positive or negative. Positive reinforcement is sometimes called **reward training**, and it is effective because the horse wants to give the desired response. Negative reinforcement means the horse will respond to avoid or get rid of the stimulus. The three methods of conditioning with negative reinforcement are punishment, escape, and avoidance. For any reinforcement to be effective, it must be contingent on the response and given immediately. Three seconds is considered the appropriate time limit. Otherwise, the horse may not understand which behavior is being rewarded or punished.

Young horses are trained using continuous reinforcement. Gradually, this becomes intermittent reinforcement as training progresses. A horse trained on an intermittent schedule will perform longer without reinforcement than a continuously reinforced horse will. This is what is referred to as a finished, or fully trained, horse.

The more effort required by the horse to make a particular response, the more difficulty the horse will have learning the response. For example, less time is required to train a pleasure horse than to train a jumping horse. This is why it is so important to break each response down into smaller steps. Horses with a greater natural athletic ability have greater potential than those with less ability, so it is important to know and understand a horse's conformation and physical limitations when training.

What Is Ethology?

Ethology is the zoological study of animal behavior. The modern discipline of ethology began during the 1930s with the work of Dutch biologist Nikolaas Tinbergen and Austrian biologists Konrad Lorenz and Karl von Frisch, joint winners of the 1973 Nobel Prize in Physiology or Medicine.

Ethology is a combination of laboratory and field science, with a strong relation to certain other disciplines such as neuroanatomy, ecology and evolution. Ethologists have a special interest in genetically-programmed behaviors known as instincts. The predictable behavioral programs are inherited by animals through their parents and portions of the programs are open to natural selection and modification. Thus, these behaviors are adaptations that have an evolutionary history.

There are two schools of thought as to how animals acquire their behavior patterns. Some hold to the view that animals, including humans, learn all their behavior during the course of individual (ontogenetic) development. Others think that behaviors are built-in and not learned.

Very complex behavior patterns can be passed on through the genes. A spider's orb web, for example, is built perfectly the first time a spider attempts construction, despite the fact that they may have no prior experience with webs. Female spiders construct egg sacs in the fall, and then die. The spiderlings emerge in the spring, and never had experience with an orb web before building their own.

Ethology differs from the study of animal behavior, in that animal behaviorists generally are interested in learned behaviors while ethologists concentrate on innate (instinctive) behaviors. Also, animal behaviorists tend to be trained in psychology, while ethologists are zoologists.

Konrad Lorenz, along with Karl von Frisch and Nikolaas Tinbergen are generally recognized as the "fathers of ethology. " But the origins of ethology can be traced back to Charles Darwin and his work on the expressive movements of man and animals Darwin was the first to use a comparative evolutionary (phylogenetic) method in the study of behavior.

Konrad Lorenz wrote about his work in the book *King Solomon's Ring*. The book's title refers to the legendary Seal of Solomon, a ring that supposedly gave King Solomon the power to speak to animals. Lorenz claims, with a little exaggeration, that he likewise achieved this feat of communication with several species. He did this by raising them in and around his home and observing their behavior. *King Solomon's Ring* describes the methods of his investigation, and his resulting findings about animal psychology.

In humans, Irenus Eibl-Eibesfeldt, was the first to successfully apply ethological methods to the study of human behavior. He carefully recorded the activities of humans using a side-viewing camera so the subjects did not know they were being observed. By comparing gestures and body language across cultures, he identified numerous innate behavior patterns in humans.

IMPRINTING

Handling and accustoming a foal to human stimulus during the first 48 hours after its birth has been shown to psychologically prepare the foal for later handling. This **imprinting** of human contact is most effective if done within the first 24 hours of the foal's life. Handling the foal's feet, muzzle, ears, rectum, and girth help prepare it for the future when it becomes necessary to pick up the feet, clip the muzzle and ears, pass a stomach tube, take temperatures, and tighten a saddle. Time devoted to handling foals in the first few days of life is well spent (Figure 19–7).

SENSES

How an animal behaves is influenced by its senses of vision, hearing, touch, and smell. Using these senses, the horse interprets and responds to its environment and training (Figure 19–8).

Vision

A horse has a field of vision that is approximately 220 degrees for each eye, allowing it a panoramic view. Its only real blind spots are directly behind and directly in front; however, a horse can certainly use its sense of smell when an object is directly in front. Because horses are capable of monocular vision (independent viewing) from each eye, a horse may shy at a plastic bag on the ground it has just passed when heading in a different direction. The rider may think, "My horse just saw that bag. Why is he spooking now?" He spooked because he may have seen the bag from the eye on the side that it passed first but when he changed directions he was seeing it for the first time

DaCek/www.shutterstock.com

FIGURE 19–7 **Proper handling of a newborn makes it easier to handle the horse later.**

FIGURE 19–8 **Well-trained horses interpret and respond appropriately to new environments, such as being in a parade.**

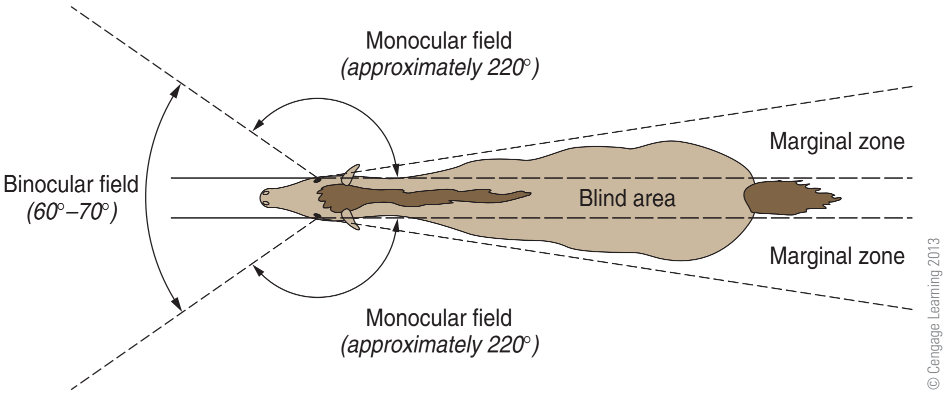

FIGURE 19–9 **The visual fields of a horse. Understanding how a horse sees the world leads to better understanding of horse behavior.**

with the other eye. A horse has to focus its attention forward in order to use binocular vision, which is limited to 60 to 70 degrees (Figure 19–9). A young horse will probably use monocular vision in new situations until it is better experienced.

Generally speaking, horses see poorly. Their eyes have a ramped retina. That is, it does not form a true arc, so parts of the retina are closer to the lens than other parts. The horse adjusts its range of vision by lowering and raising its head, much as a human does with trifocal glasses.

Such a visual arrangement is most convenient for grazing and watching for enemies at the same time, but it is a real handicap in judging height and distance. As a horse approaches a strange jump, it lowers its head, then raises it to appraise the height of the jump. At the point before takeoff it cannot even see the jump since its eyes see separately.

Horses taken from a brightly lit area for loading into a trailer may lower their noses to the floor of the trailer, then raise their heads rather high for loading. Besides smelling the trailer for identification, they may be trying to find the head position that gives them the best possible vision. They also may be taking time for their eyes to adjust to the light change, a much slower process than for humans.

Young horses that resist trailer loading are doing what saved the lives of their ancestors, who would have regarded a trailer as a dark cave. Horse handlers should allow plenty of time for loading young horses until they are well trained. A good system is to park a trailer in the horse lot and feed young horses in it.

Horses are color blind. They do not perceive blue streams running through green fields, framed in trees with fall-colored leaves. They see a drab mosaic landscape with different amounts of light reflecting from it.

Objects that remain still convey very little information to the horse's brain. A sitting rabbit or bird may be seen readily by the rider, but may remain obscure to the horse until it moves. Horses see movement instantly and react according to temperament, experience, and confidence in the rider. A stall-raised horse may shy sharply at sudden movement.

Young horses need to gain confidence by being gently urged toward objects they fear. If they are concentrating on the fearful object and are punished, they assume the object caused the pain and their suspicions are reinforced. If the rider practices patience in early training, the horse realizes the rider will not ask it to go into dangerous situations, and it will lose its fear of strange objects.

Size and position of the eyes and width of the head and body determine front and rear vision. Horses with large, wide-set eyes have more forward and rear vision than others. Even so, there are blind spots at both ends of the horse. This is why you should not approach a horse directly from the rear and why you should speak to the horse when passing behind it.

Frontal vision is affected by width of forehead and how the eyes are set in the head. Most horses probably do not see objects nearer than 3 feet directly in front of their faces without moving their heads. With their heads in normal position, they do not see the feed they eat or the ground they step on.

Pig-eyed horses, or those with sunken eyes, see less in front and behind than others. They have often been classified in song and verse as being "mean." Many pig-eyed horses are normal and useful, but one researcher suggests that those growing up in groups of foals may be "picked on" more than others and develop disposition problems.

When being ridden, the horse needs free rein in negotiating obstacles so it has good vision. Horses must be allowed to concentrate when traversing rough terrain, because they must remember their earlier view of the ground now under their feet since they can no longer see it. Undoubtedly, some stumbling results from the horse's not watching the area over which it travels and not remembering where the obstacles are.

Hearing

The hearing of most horses is quite good. Rotating ears on movable heads and long necks are advantageous for hearing. Since the horse's sense of hearing is better than its sight, the eyes and ears work together. The ears will point toward a sound so the horse can hear it better. Then the horse will try to see what is making the sound. Horses hear high tones not perceptible to human ears—for instance, the blowing of horns in fox hunting. This may cause high-strung Thoroughbred hunters to show anxiety and break out in a sweat.

Fear of parade bands, loud machines, and gunshot noises may result from actual pain to the horse's ears. U.S. cavalry mounts used on pistol ranges would lose their hearing after a few years use in target practice areas.

Touch

The horse's skin is a very specialized sense organ. It tells the animal whether something is hot or cold, hard or soft, or whether it causes pain. Some horses will learn to check an electric fence daily with the hairs on their upper lip and will promptly tear it down when the battery fails.

Nerve endings in people are more abundant in the mouth, feet, and hands. Spots of most sensitivity in horses seem to be in the mouth, feet, flanks, neck, and shoulders. The mouth is sensitive to pain rather than light pressure. Bitting should be done with care and reins handled with light hands, or else sensitivity in the mouth is lost and a **hard mouth** results.

Some horses are so sensitive to contact in the flank that they may buck when a rider's leg is used too strongly or incorrectly.

Horses vary greatly in skin sensitivity. They love to be groomed and have their backs scratched. Selecting mild grooming equipment is necessary for some thin-skinned horses. Currycombs and "shedding" blades should have fine teeth.

Saddling is a bruising experience for some horses, whereas others seem immune to any feeling when a saddle is placed on them. If a horse humps up and tries to avoid the saddle, flapping cinches and stirrups may be hurting it, it may have back pain, or the saddle may not fit correctly. This reaction needs to be taken seriously and investigated.

Smell

Most animals in the wild state have a good sense of smell. Horses in a research project in England were first frustrated by circling in closed trailers but then were able to head directly homeward from a downwind distance of 5 miles. Domestic stallions can identify mares in heat for great distances downwind.

Colts being saddled for the first few times should be allowed to smell the saddle and the blanket before saddling. This reassures them that the equipment is not dangerous and that it has been used by other horses.

Smell probably dictates grazing habits of horses, although it does not always keep them from eating poisonous plants when forage is abundant.

WORKING WITH HORSE BEHAVIOR

Every time people use horses, they exercise psychology, because their strength is no match for that of horses. If we do not use psychology, a horse may use us to achieve objectives that are not consistent with our intended goal. Such a situation results in owner dissatisfaction and a spoiled or confused horse. Modern horse psychology attempts to anticipate possible behavior of the horse under a variety of conditions and then tries to provide a comfortable condition that will calm and encourage the horse to respond correctly to the handler. Refer also to Chapter 16.

Reading a Horse

Unmanageable situations can often be avoided by correctly reading the emotions of a horse. Ears pinned backward indicate anger or a warning. These signs warn handlers that they may be bitten or kicked. Horses sometimes "fake" anger in an attempt to bluff and scare off a potential intruder. The ear position of horses performing with great resolve, such as hard trotting, pacing, or running a race, should not be misinterpreted, as the ears are sometimes held in a backward position during extreme effort. However, mares with newborn foals are probably not bluffing when their ears are "pinned back," and they should be respected.

Ears forward show interest or suspicion. Some horses show interest in everything they see in new surroundings without finding anything fearful to be avoided. Such horses maintain a good attitude and seem to enjoy their work. Others keep their ears forward and eyes open, afraid of a sudden attack.

Eyes and nostrils show emotion and reflect temperament. Dilated nostrils reflect interest, curiosity, or apprehension. When the eyes flash, nostrils dilate, and muscles tense, the horse is likely about to react. It might be only a slight start, a reverse in direction, or both. But if the cause of fright intensifies, the horse may bolt, rear, or buck. Riders who read their horses' emotions accurately can often steady the horse with reassuring words or control through appropriate hand, leg, and upper body connection (Figure 19–10).

Memory

Horses usually are considered to have memories second only to elephants. In the wild, if an attack came at a certain place, the herd avoided that spot in the future. This caution is still practiced by wild horses in the United States. If not for its good memory, the horse would be considerably less useful to people. A well-trained young horse never forgets its training. Neither does the poorly trained one. For this reason, bad habits should be recognized and corrected before they become fixed.

Horses have not ranked outstandingly well on limited intelligence tests, although they do very complex things routinely when trained. Some horses may be considered highly intelligent because they can open most gates and doors on the farm. But idle horses tend to seek activity, some of which may involve gate latches. Once they succeed, their good memory keeps them trying to open doors. When they get the grain bin open, they remember only the joy of eating. They can't associate overeating with the ensuing colic or loss of hooves from founder.

Gregariousness

Horses are gregarious in nature; they band together. This tendency has practical implications. Wild horses in the center of the herd were safer from attack. This can be seen today with zebras in Africa.

The gregarious tendency can be used to advantage in training young horses. A young horse may be fearful of working alone. Horses walk too slowly and jog too fast until they are well trained. A good training method is to jog them away from the barn and walk them toward it. **Barn-sour** horses result from allowing them to run back to the barn, where they can be reunited with the herd and thus rewarded for their behavior. The routine should be changed so the horse does not expect this result.

Situations that produce barn-sour horses need to be avoided. Young horses should be sufficiently trained to be obedient before they are asked to leave the premises with a rider. Ground driving helps. If they show anxiety to get back to the barn, change the routine. A good method is to turn away from the barn each time they try to go to it. A useful technique may be to head the horse away from the barn when

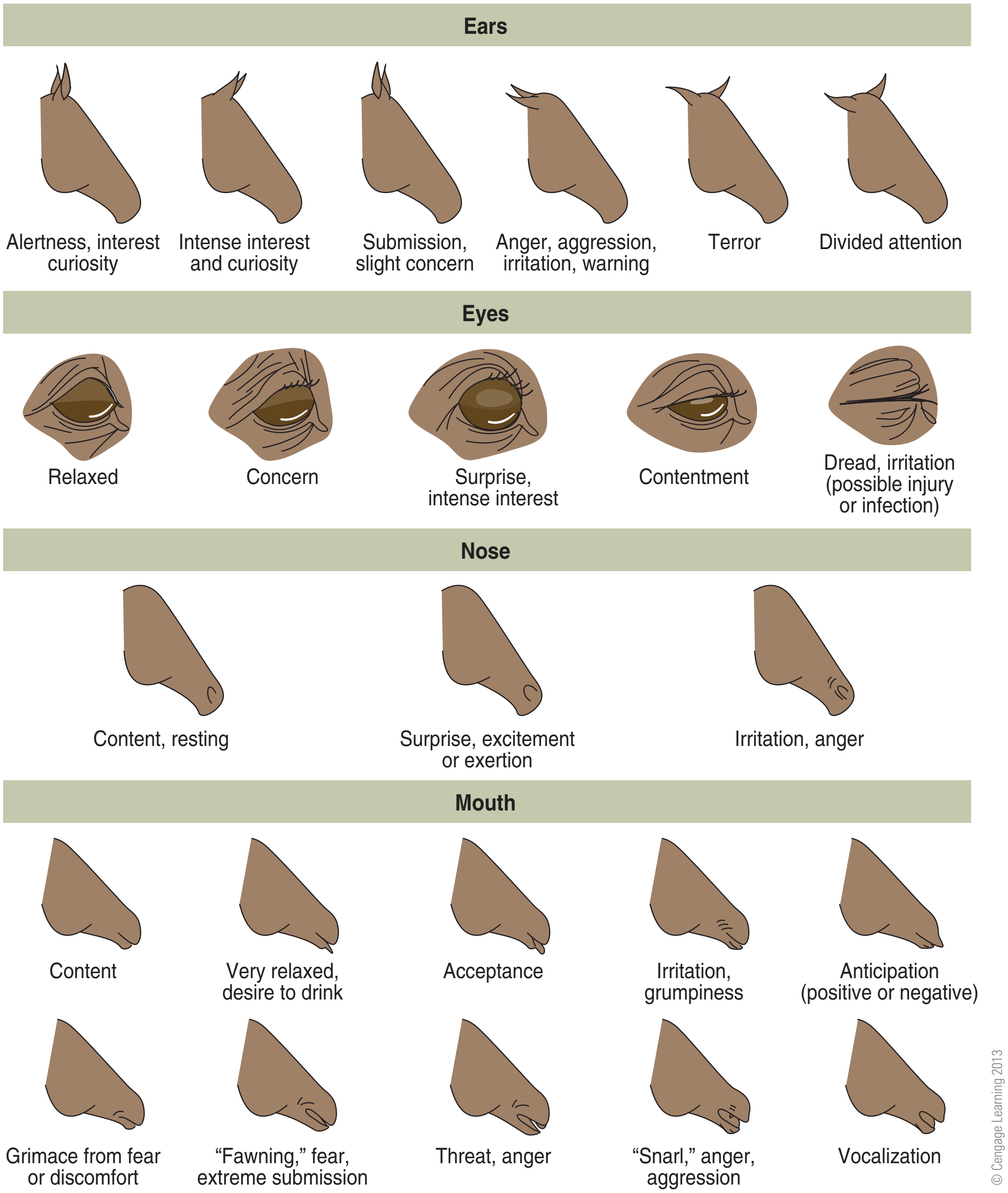

FIGURE 19–10 **When working with horses it is important to recognize warning signs of aggression. Key features to watch are the horse's ears, eyes, nose, and mouth. For example, the ears held flat back accompanied with a "snarl" is a sure sign of anger. On the other hand, a soft expression of the mouth along with a soft expression in the eye is usually a good sign of contentment.**


Courtesy of USDA

FIGURE 19–11 **Trail riding near Spearfish, South Dakota.**

bringing it to stop at the end of the training session. After the rider dismounts, the horse is led back to the barn. This method is useful in ring riding.

Group riding brings out the **herd obedience** tendency in horses. That is, they all tend to do what others do. For example, if one enters a stream, the others tend to follow (Figure 19–11).

In the wild state, obedience to leadership meant survival. If the stallion called for silence, every horse stood still. If he commanded flight, they ran at the heels of the lead mare. The stallion ran at the back of the herd to nip those who needed more speed. Horses today are dependent on people for leadership and survival.

Understanding Behavior Means Safety

Recognizing the horse's natural defense mechanisms promotes safety. Frightened or aggressive horses may panic, escape, or fight. They may have little regard for human dominance or safety. Learn to recognize the differences between fear and aggressive behavior. A frightened horse will need slow, consistently applied reinforcement to build security. Horses that initiate dangerous, aggressive behavior must be corrected. Understand horse behavior as it relates to herd social order, stallion sexual behavior, and mare and foal relationships. Expect some horses to be more aggressive than others.

Watch for the visual signs of behavior and attitude. Recognize the signs of a frightened, confused, or aggressive horse. Don't try to herd or lead a horse when standing directly behind or in front of it. These are blind areas in a horse's visual field. A horse may bolt forward or kick when frightened or aggressive.

Approach a horse at its left shoulder. This allows you to use your body to hinder movement while positioning yourself in a safe location. Make a horse stand in place when turning it loose until you are safely positioned to avoid being run over or kicked. Position the horse so that its head is facing a wall or fence before removing the halter. This will keep the horse from bolting. Don't allow yourself to be trapped between a frightened or mad horse and a stall wall or other barrier. Do not chase horses when trying to catch them. This action reinforces the horse's desire to escape. Use position reinforcement when catching a horse.

Be cautious in new environments. Recognize small changes in the environment that may frighten a horse. Move slowly and deliberately around horses, letting them know where you are at all times. Avoid sudden movements that may confuse the horse or be perceived as a prelude to punishment. Punishment usually involves quick movements. Introduce clippers, blankets, and saddles in a safe, familiar place. If possible let them look at and smell a new object. With experience, most horses learn to ignore the sound, sight, smell, or movement associated with routine procedures. Always be prepared for unexpected stimuli that may frighten a horse, especially in new environments.

COMMUNICATION AND TRAINING

Training begins while the foal is still on the mare. Handling and teaching it to lead at this young age will help develop a more dependable horse through the years. Halter breaking is not difficult if done appropriately while the foal is young.

Numerous books and videos are available on the subject of breaking and training horses. Many people have their own methods and their own opinions. This is only a start.

Riders should not constantly correct or interrupt the thought train of a horse doing a job that requires deep concentration. The horse can think of but one thing at a time. The rider who continually punishes or corrects the horse distracts attention from the task at hand and the horse can become confused or angry.

Quick reflexes and panic characterized prehistoric horses. Indeed, their life depended on them. Horses will panic into flight without much consideration of the need for or consequences of such a decision. Young horses fleeing with or without riders may sustain severe injury from running into objects or from total exhaustion. The runaway horse is simply carrying out the kind of behavior that allowed its ancestors to survive. As some horses get older, they tend to become calmer; others do not.

Speed, quickness, and willingness to serve, even at great sacrifice, have made horses most useful to humans. This also poses some dangers and problems.

Flighty horses should be handled by experienced riders and must not be hurried into new and strange situations. Even though they are controllable at home, they may not be in strange surroundings and could be dangerous for the novice rider. The object is for the rider or handler to provide the support and will without provoking an unmanageable confrontation with the horse.

Communication of rider to horse is accomplished through voice, legs, and hands—in this order of importance. Voice cues for starting and stopping are easy to give and easily understood by the horse. Rein cues are more complex for both rider and horse, and signify more complicated maneuvers than simple starts and stops. Leg cues are needed for most complex responses, such as rollbacks. A horse's skin is so sensitive that it can react to the lightest pressure of the rider's leg.

Horses are equally sensitive to insecurity or confidence in their riders and will respond accordingly. If the rider lacks assurance, the horse will feel insecure and perform below its capability.

The horse is a strong, sensitive creature, capable of great speed and quick reactions. It has great ability to adapt to unfamiliar situations. This is why we like horses. Many of the things humans ask them to do are strange to their nature, so we need to understand their reaction to these new situations.

Catching and Haltering

If the mare is gentle, use her to help catch her foal. Lead her into a box stall with the foal following and get the foal in a corner. The mare will help hold the foal while you ease the halter on. Work slowly with a lot of rubbing and quiet talking to calm the foal.

The foal probably will be nervous and scared, but if the mother shows no concern, the job will be easier. After haltering, turn them both loose and let the foal wear the halter about 2 days. This will give the foal time to get used to the feeling of having a halter on. Then go through the same procedure as before, catching and haltering in the box stall. This is the time to begin leading the foal.

Teaching to Lead

Snap a good lead rope in the foal's halter ring and put a rump rope over its hips with one end coming through the halter. A cotton rope makes a good rump rope. Lead the mare out of the stall and let the foal follow. Stay in front of the foal, pulling forward on the lead rope attached to the halter while also pulling sharply on the rump rope. The foal may jump forward when the rump rope is tightened, so be careful not to get stepped on.

If the mare and foal are led around together while pulling on the lead and rump ropes, soon the foal will be leading. Once the foal begins to lead well, work away from the mare to make sure the foal is leading and not just following the mother. Do this for 2 or 3 days (Figure 19–12) for about 10 to 15 minutes each time.

Courtesy of USDA

FIGURE 19–12 Early training is required to show this Appaloosa filly at a state fair.

When the mare and foal are brought in for weaning, the foal probably will not be afraid because it will remember the prior experience of not being hurt. Halter and lead it for a few days. Trim its feet and worm it if necessary. Any handling at this age is time well spent. The foal's gentleness and learning to lead will save time during breaking at 2 years of age when the foal will be saddled, bridled, and mounted for the first time.

LONGEING

Longeing is a procedure in which the horse travels in a large circle around the handler on a long strap or line. It is useful in training young horses and in exercising others. Longeing affords the horse an opportunity to improve balance and develop stride and action. It is also a good way to reduce energy in overactive horses before they are ridden. Longeing can be started after weaning, if the trainer is careful not to let a young horse hurt itself by being jerked off-balance on a longe line (Figure 19–13).

Before horses are longed, they should be taught to lead from either side, and to stop, stand, and back. They should be gentle and reasonably obedient or easy to control.

The horse should be groomed at the site of training the first time it is longed. This relieves some anxiety and puts it at ease. Also, protecting the horse from flies with repellent allows it to give its undivided attention for the lesson.

Starting

Horses are trained to longe in a small pen. After the horse has circled the ring a few times, the trainer should start to drop away from the shoulder, keeping the horse moving forward by tapping the ground lightly with the whip. The trainer should drop toward the rear of the horse.

Courtesy Botts/Watson Photography

FIGURE 19–13 **Longeing has a multitude of purposes. It is a great way to allow a horse to release excess energy and warm up before being ridden.**

To keep the horse moving forward, the trainer should stand by the horse's left leg and hip as the circle is gradually made larger. The trainer should still make a small circle as the line feeds out. The whip will keep the horse from stopping or closing the size of the circle.

The horse should learn to stop and stay on the perimeter of the circle. At the command of "whoa," it may turn and face the trainer. In later lessons, the horse should stop in place on the perimeter until commanded to face inward and come to the trainer. The horse should not be allowed to anticipate commands and make its own decisions. When the horse is stopped in the center of the circle or at the perimeter, it should be taught to stand in place.

Some horses keep a longe line tighter than others. A tight line on a horse is desirable. Short pulls and releases will restrain it. A soft nylon or leather halter, compared to a longeing cavesson, may encourage tight line pulling. When the horse is going in a large circle around the trainer with the right tension on the line, the trainer can stand in one position and give the lesson with minimum effort.

Many horses are definitely one-sided in their preference in longeing. The trainer should change directions to work the weaker side more than the stronger side until the horse will longe in both directions in good form.

Other Uses

One of the best uses of the longe line is to "tune up" an old, well-trained horse. If a horse is suspected of being lame, longeing is a great way to assess its movement. And it is an excellent way for a horse to learn self-carriage. Also, a stabled horse can be exercised on a longe line when it is not possible to ride it.

Horses can be trotted across cavalettis or fence posts to regulate length of stride. This is particularly useful in jumping horses and in young horses that do not extend enough in the trot. Gaited horses with a pacing tendency can often be improved by this procedure, as can Western horses that need more length of stride in their extended trots.

Some horses jump well on longe lines. It is good exercise for trained horses and a good way to start young jumping prospects.

Longeing is an important step in preliminary training. A young horse can learn to start, stop, stand, walk, trot, and canter on command. Longeing establishes authority and routines that reduce mounted training time.

Seasoned performers can be exercised, refreshed, or even prepared for new activities from the longe line. Longe line training is a skill that most accomplished horse owners have found worthwhile to develop.

FITNESS

Fit horses are easier to train. Aerobic fitness is probably the simplest and safest type of stamina to train into a horse. Aerobic training requires low-intensity, long-duration types of work. The heart rate should reach about 120 beats per minute for 10 to 15 minutes. About 3 to 4 weeks are required to achieve the training effect. After that time, the intensity or duration must be increased to improve the fitness level (refer to Chapter 6).

Horses need to be able to expend large amounts of energy anaerobically and then replenish that energy aerobically for the next maximum contraction of the muscles. Anaerobic training begins after aerobic training, and this second phase is related to specific skill training.

One of the newest concepts in the conditioning of horse athletes is **interval training**. Interval training is simply the use of multiple bouts of work interspersed with a relief interval when partial recovery is allowed. The theory behind this is twofold. First, it allows more total work to be done; and second, it allows fatigue to be brought on gradually and controlled. While interval training is most applicable to anaerobic types of training, it can be adapted to fit any type of training.

Warming Up and Cooling Down

Some general concepts apply to all athletes regardless of species or event. These guidelines improve performance, prevent injury, and minimize the soreness associated with exercise. The first of these is the warm-up. This stretches and relaxes the muscles to allow for greater flexibility. Warm-up increases the muscle temperature, allowing greater use of its energy stores. It also increases blood flow to the muscles, allowing more efficient transfer of oxygen. Trotting, side-passing, two-tracking, longeing, and backing are examples of warm-up exercises.

After exercise, the horse should be cooled down. Many trainers do this using a mechanical walker or by hand-walking their horses 10 to 15 minutes after the end of exercise (Figure 19–14). The cooldown period should consist of light work decreasing in intensity. This cooldown period helps remove metabolic by-products such as lactate out of the muscles. Also, it prevents muscles from tightening up after exercise, thereby minimizing soreness.

Elite Equestrian Products, Inc.

FIGURE 19–14 **A mechanical walker often used by large horse facilities to ensure proper warming up and cooling down of horses. Caution: horses should never be left unattended on a mechanical walker. It is unsafe.**

Fatigue

Trainers must be aware of fatigue during all phases of training. When exercise is intense or of long duration, ATP (adenosine triphosphate) supplies for muscular contraction decline and the by-products of metabolism build up (See Chapters 3 and 6). When this happens, the muscle either runs out of fuel or it is "poisoned" by the harmful by-products. The result is that the muscle can no longer contract efficiently. At that point, other muscle groups start contracting to perform a motion they are not accustomed to. The horse may misstep and injure itself.

Fatigue can be prevented by decreasing the intensity of the exercise and allowing the horse to rest for a period of time. A complete stop is not advisable, just a slowdown. Once the heart rate drops below 100 beats per minute, the work can be continued.

Muscles require 26 to 46 hours to replenish their glycogen (energy) stores, depending on the severity of depletion. Horses need at least 1 day a week completely off if they are being worked at high intensity or for extremely long periods.

SUMMARY

How horses interact with their environment is genetic and learned. The behavior of horses can be categorized as follows: reactive, ingestive, eliminative, sexual, caregiving and care-seeking, agonistic, mimicry, investigative, grooming, and sleep and rest. Understanding these 10 behavioral categories helps trainers and riders successfully interact with horses. The senses of vision, hearing, smell, and touch influence how a horse interacts with its environment and how a horse learns. Training is a process of teaching the horse to respond to cues. This begins when the foal is still at the mare's side. First the foal learns to lead. Training continues as the horse is saddled, bridled, and mounted for the first time. Longeing also requires training.

Fit horses are easier to train. Fitness includes an aerobic and anaerobic component. Like human athletes, horses in training need a warm-up and cooldown period. They are also subject to fatigue.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. For horses, training involves learning.
2. The horse has a very short memory.
3. A horse owner should be able to read the emotions of a horse to avoid unmanageable situations.
4. Idle horses tend to seek activity, such as opening barn doors and latches.
5. During sleep, the horse has a period of rapid eye movement.

Short Answer

6. List the 10 behavioral categories.
7. Name the senses a horse uses to interpret its environment.
8. When should training begin?
9. What are three ways to communicate with a horse?
10. How are the emotions of a horse read?

Critical Thinking/Discussion

11. What is the difference between a conditioned and an unconditioned response?
12. Define imprinting.
13. Explain how a horse sees.
14. Define cues, stimuli, response, and reinforcement.
15. Describe the difference between aerobic and anaerobic training in horses.
16. Describe the process of longeing and discuss its uses.

STUDENT ACTIVITIES

1. Develop a report on imprinting. Extend the discussion to animals other than horses, for example, poultry.
2. Observe a group of horses each day at the same time for 1 week. Document their reactive behavior, ingestive behavior, eliminative behavior, sexual behavior, caregiving and care-seeking behavior, agonistic behavior, mimicry behavior, investigative behavior, grooming behavior, and sleep and rest behavior. Also note any signs of their emotions, for example, ears pinned back, licking of the lips, tense muscles, etc.
3. Groom a horse and write a description of the process and the tools used.
4. Visit with an experienced rider or trainer. Ask what type of secondary reinforcers can be used with horses. Make a list of these and note the expected response.
5. Choose one of the vices horses develop. Describe the vice and any possible solutions.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2004). *Horse industry handbook: A guide to equine care and management*. Lexington, KY: Author.

Baucher, F. (2006). *The principles of horsemanship and training horses*. Worcestershire, England: Read Books Ltd.

———. (2010). A method of horsemanship: founded upon new principles: including the breaking and training of horses: With instructions for obtaining a good seat. Charleston, SC: Nabu Press.

Boy Scouts of America. (2004). *Horsemanship.* Irving, TX: Boy Scouts of America.

Cavendish, W., Steinkraus, W. C. (2000). *General system of horsemanship*. North Pomfret, VT: Trafalgar Square

Dawson, J. (2003). *Teaching safe horsemanship: A guide to English and Western Instruction*. North Adams, MA: Storey Publishing.

Grandin, T. (Ed) (1997) *Genetics and the behavior of domestic animals*. New York: Academic Press.

Hill, C. (2006). How to think like a horse: The essential handbook for understanding why horses do what they do. North Adams, MA: Storey Publishing.

Hill, C. (2011). *What every horse should know: A training guide to developing a confident and safe horse*. North Adams, MA: Storey Publishing.

Kahn, C. M. (Ed.) & Line, S. (Ed). (2010). *The Merck veterinary manual* (10th ed.). Whitehouse Station, NJ: Merck & Co.

Loriston-Clarke, J., Langrish, B. (2003). *The young horse: Breaking and training*. Devon, UK: David & Charles Publishers.

Lyons, J., Denison, J. J. (2002). *John Lyons' bringing up baby: 20 progressive ground-work lessons to develop your young horse into a reliable, accepting partner*. Los Angeles: Primedia Enthusiast Publications.

Miller, R. W. (1974). *Western horse behavior and training*. New York: Doubleday.

Thomas, H. S. (2003) *Storey's guide to training horses*. North Adams, MA: Storey Publishing.

Wallace, J. (2002). *Teaching children to ride: A handbook for instructors*. Boonsboro, MD: Half Halt Press.

Xenophon, M. H. Morgan. (2006). *The art of horsemanship*. Mineola, NY: Dover Publications.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google, or Bing, find more information by searching for these words or phrases:

conditioned response	horse fitness	horse training
horse behavior	horse imprinting	unconditioned response
horse communication	horse senses	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 20

EQUITATION

Equitation is horsemanship, or the art of riding and managing horses. In a sense this whole book is about equitation. This chapter, however, is limited to some necessary skills and information for riding horses in two common ways—English and Western. Methods of mounting, sitting in the saddle, and dismounting differ slightly but are still basically the same. A rider who gains proficiency in English riding can easily master Western riding, and vice versa. Selecting the proper saddle, safety, hauling, haltering, and tying are other important components of general equitation.

While this chapter ignores many of the other areas of equitation such as harness, gaited horses, showing horses, hunters, and so on, there are numerous books and videos available on these areas of equitation.

OBJECTIVES

After completing this chapter, you should be able to:

- Name three styles of saddles and describe their uses
- Indicate the four criteria for selecting a saddle
- Describe the anatomical points on a horse that must be checked when considering a saddle
- Discuss the results of a poorly fitted saddle
- Discuss the effect the rider's being forward or sitting back in the saddle has on the performance of the horse
- Describe the process of saddling and bridling a horse
- Identify guidelines for proper dress around horses, especially for Western riding
- List the steps for proper mounting of a horse
- Name three types of equitation competition
- Give the rules of safe riding
- Describe how to load and haul a horse and how to check the safety of a trailer
- Name three types of halter material
- Describe the process of haltering and adjusting a halter
- Indicate three safe ways of tying a horse

KEY TERMS

breast collar
cinch
cross-tying
curb chain
dressage
halters
hunter seat
pommel
quick-release knot
rigging
romal reins
saddle seat
throatlatch
trailer sour
tree

SADDLES

A saddle is one of the first pieces of equipment most people buy after they acquire a horse. It is a major investment; selection and purchase require deliberation and knowledge. The life span of most saddles is several times that of a horse. The selected saddle should fit the needs of the rider and the type of horse. Personal preference should be supplemented with knowledge of the advantages and disadvantages of the many different styles and types of saddles.

Styles of Saddles

The style of riding determines the type of saddle. But a great deal of variation among the saddles within one riding style still exists. Tradition, experience, and exposure to other riders must then be considered. It is also crucial to a rider's success and a horse's physical condition and performance to fit a saddle to both horse and rider. Table 20–1 summarizes the styles of saddles based on the type of riding.

Western or stock saddles tend to be large and heavy. They are nearly impossible for youngsters to handle. However, they offer a great deal of security for a beginner. The thickness of the saddle and the amount of leather under the leg, knee, and seat isolate the horse from the rider, which can limit communication. Western saddles are probably more versatile, rugged, and durable than other styles. They are available in a wide range of designs and prices. Western saddles can also be purchased in child size. It is important, however, to check the fit on a horse.

Hunt-jump saddles are usually rather light and easily handled. A wide variety of designs and prices are available. In most cases, this type of saddle allows the rider to sit closer to the horse, to feel the horse, and to communicate more readily with seat and legs. As a rule, these saddles require more training of the rider in developing a sure seat than stock saddles do. But this usually leads to much better equitation form (Figure 20–1). Saddles used to ride and exhibit gaited or park horses, such as the Lane Fox saddle, are rather limited in use. They retain many of the advantages of the hunt-jump saddles. They are lightweight and allow ease of communication. This style of saddle provides minimum security for the rider. As with any style of saddle, proper equitation requires proper training.

Dressage saddles were originally designed for accommodating women's ankle-length skirts. Now they are designed to give the rider maximum ease of communication

TABLE 20–1 Styles of Saddles

STYLE	USE
Stock	Roping, cutting, general purpose, and specialty
Hunt-jumping	Forward seat, balance seat, and polo
Gaited	Lane Fox
Dressage and miscellaneous	Racing, sidesaddle, track, and parade

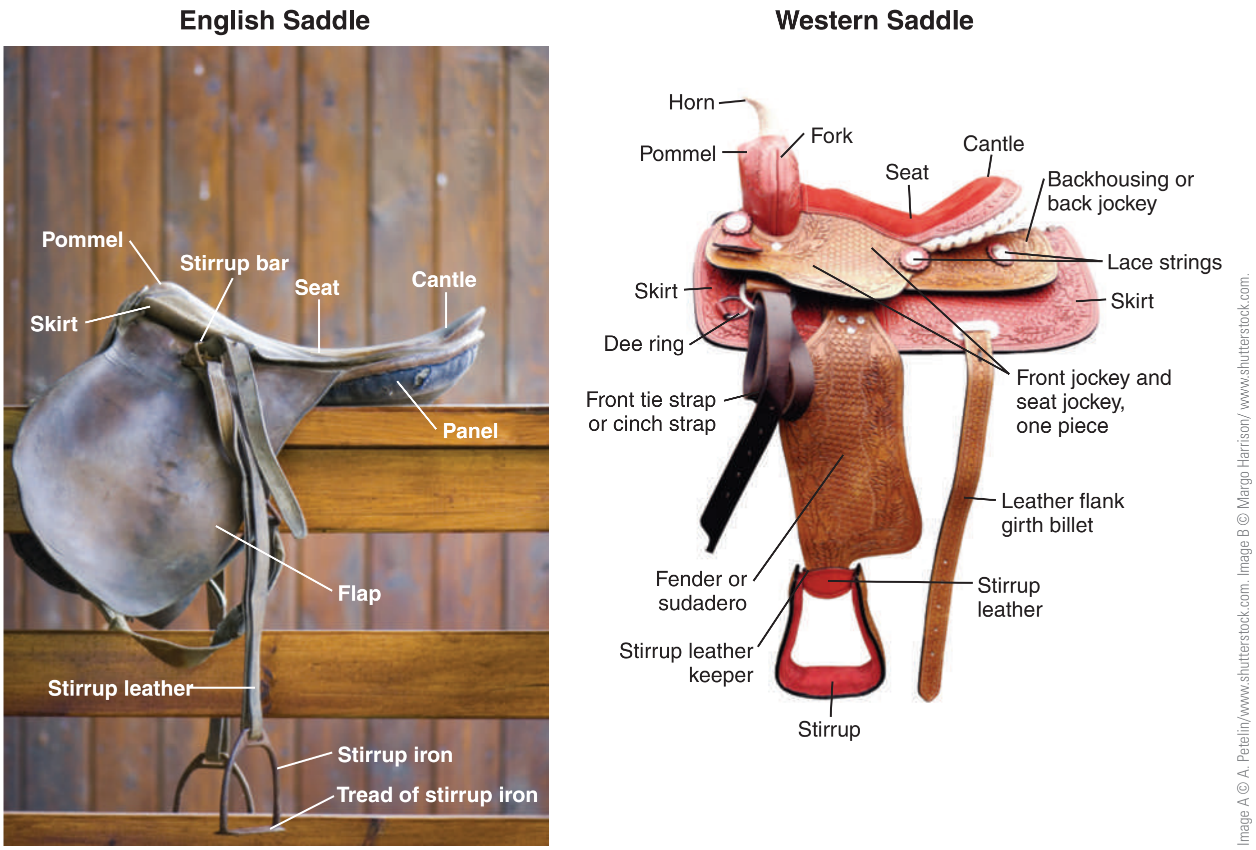

FIGURE 20–1 **The parts of the English saddle (A) and the Western saddle (B).**

with the horse and help the rider maintain perfect balance and form, whether the horse is highly collected or mildly extended.

Many saddles are designed for very specific purposes. These include side-saddles, trick saddles, and special show or display saddles. Using these saddles for anything other than their intended purpose should be discouraged. Safety, comfort of the rider, and ability to maintain soundness of the horse must be considered before beauty or the desire for a unique design.

The selection of a saddle must meet these four basic criteria:

1. It must fit the horse.
2. It should not interfere with the performance or the ability of the horse to perform.
3. It must fit the job or the activities desired.
4. It should fit the rider physically.

Fitting a Saddle to a Horse

Not every saddle fits every horse, just as one size or shape of boot does not fit every person. Some points of the horse's anatomy that must be checked when considering a saddle include:

- Size and shape of the withers
- Length of back
- Slope of shoulder

- Spring of rib
- Muscling, especially of the shoulder

To some extent, the rider needs to consider the overall size of the horse, especially with smaller horses and ponies.

Most saddle fitting problems occur at the withers. Ample clearance at the withers is needed to prevent injury, yet not to leave so much space that security is lost. Pressures should not be concentrated on small areas of the back and withers. In a stock saddle with rider mounted, there should be about 2 inches of clearance between the withers and the gullet (underneath front) of the saddle. Insufficient clearance, even with a heavy saddle blanket, means the fork of the saddle is too wide, or the withers of the horse are too high and narrow, or both. Adding a heavy pad or a second or third blanket may help. A narrower saddle is a better solution.

Injury to the withers is usually the result of a poorly fitted saddle. In addition to being painful to the horse, it frequently results in bad habits such as bucking and head slinging, and it may cause the horse to resist saddling. Ill-fitting saddles are sometimes a result of the rider's inconsideration, but more often they result from a lack of knowledge and attention to the welfare of the horse.

Horses with flat, "mutton" withers often wear saddles that are too narrow. This causes the saddle to sit much too high in front. Additional blankets will help prevent a sore back, but little else can be done to alleviate the problem. To avoid the pain and fatigue that result from this situation, the saddle or the horse needs to be changed. No roping should ever be attempted using an excessively narrow saddle on such a horse.

To fit a horse properly, owners measure the width of the withers. Width taken at a point 2 inches below the top of the withers should correspond to the fork width of the saddle. Since blankets and pads will compensate for some misfitting, some variation can be tolerated. Width of the fork of stock saddles varies from 5½ inches to 7 inches. Average saddles are between 6 and 6¾ inches wide. This width accommodates most horses with use of a good blanket or pad. Every secondhand or used saddle should be measured despite claims of size as some spreading occurs with use.

The width of an English saddle **tree** is just as critical as the fork width of a stock saddle; however, it is more difficult to determine as a result of saddle design. A "cut-back" **pommel** may be necessary to prevent damage to the withers. The cut-back can range from very slight to over 4 inches. One major advantage of a cut-back pommel is that the saddle can fit a wide variety of horses. The tree of hunt-jump saddles, especially less expensive brands, can spread a great deal without breaking, which can drastically change the fit. When considering a used saddle of this type, owners should regularly check the width between the points of the tree. This is true especially if the saddle is to be used in shows. Very little can be done to improve the fit of a wide-fronted hunt-jump saddle except to find a horse with an appropriate anatomy.

A stock saddle should lie directly over the upper end of the horse's shoulder blades. This allows maximum area of contact between horse and saddle, distributing the load and pressures to minimize sore backs.

If the horse is straight-shouldered or if the saddle tends to slip back because of poor riding habits, the sides of the saddle place great pressure on the back edge of the shoulder blades. Even blankets cannot completely eliminate this concentration of pressure. For this condition, a **breast collar** is needed to keep the saddle well forward over the shoulder blades.

Length of a stock saddle should also be considered. A long saddle on a very short-backed horse can cause too much pressure over the loin and kidney area of the horse's back, resulting in injury and soreness. The square-cut skirts on some stock saddles may also irritate the flanks of short-backed horses.

USING A SADDLE

Performance of any horse can be hindered if the rider does not remain over the horse's center of balance. Since the center of balance changes with different speeds and kinds of activity, a saddle must be selected that provides comfort for both horse and rider so the rider can maintain balance during a specific type of performance. This aids not only in achieving maximum performance but also in giving comfort and security to both horse and rider. The center of balance of a horse standing or walking freely lies directly over a point a few inches behind the withers.

As the horse moves forward at speed, the point of balance moves forward. Jockeys are a good example of keeping weight well forward yet centered over their legs with the ankle, knee, and hip joint acting as shock absorbers so they can balance and move freely with their mounts, permitting full potential performance of the horse. Pleasure riders find that "getting into a half seat" not only is comfortable for themselves but also seems to allow freer movement of the horse (Figure 20–2).

A horse jumping is another rather extreme example of shifting the center of balance. The center of balance shifts as the horse approaches the jump; then the weight drops back, levels, and comes forward. A rider must be in time with his or her horse and follow the shifting of balance. Stock seat riders who have attempted to jump

Courtesy Botts/Watson Photography

FIGURE 20–2 **A horse and its rider have a constantly changing center of balance. For a balanced ride they must be in harmony with each other, as shown in this figure.**

in stock saddles can appreciate what the expression "being behind one's horse" means. Not only is this hard on the rider's back and neck, it is also uncomfortable for the horse and usually causes it to refuse a jump.

The more collected a horse is, the farther to the rear the center of balance is displaced. Therefore, the rider of a gaited horse needs to be well back from the withers to free the forehand legs and put his or her weight more over the horse's hindquarters.

Cutting horses work primarily off the hindquarters and are very light on the forehand legs. Saddles traditionally used have been designed to keep the rider well back from the withers.

The basic design of a saddle usually allows some latitude in placement. The hunt-jump saddle positions the rider through the center of the seat. A rider can use various billet strap combinations, however, to change the position by as much as 3 to 4 inches. This permits the saddle to be placed properly for different activities or to accommodate a variety of conformation differences. Placement of stock saddles is governed by position of the **rigging**. Rigging can be anywhere from full rigging (directly below the horn) to the center-fire rigging (halfway between the horn and the top of the cantle). The average pleasure rider who does not use a rope will probably find seven-eighths rigging most comfortable and readily available (Figure 20–1).

The full-rigged saddle was designed especially for roping. It places the horn rigging and **cinch** in a straight line directly over the withers. This permits maximum strength of construction and correctly places the stress from the rope at the withers. Such a design also places the average pleasure rider well behind the center of balance, especially when the horse moves at speed. It does, however, permit the rider to be in balance when the horse is working off its quarters.

Shape of the seat of a saddle is important to both pleasure and equitation riders. Steep seats force the rider to the rear and may offer security, but experienced riders usually find them uncomfortable. This is especially true of pleasure riders with uncollected mounts. Equitation riders must be able to stay in balance with the horse.

Tradition often dictates what type of saddle should be used. Tradition, however, must not replace common sense. It is important to select a saddle designed to permit a specific type of performance.

The stick-forked, flat-seated, low-cantled stock saddle frequently advertised as a roping saddle is not designed for pleasure riding. It is excellent for roping. A roping saddle offers little security in front and little or no support for the hips. Rigging placement also detracts from its usefulness as a pleasure saddle.

The forward seat jumping saddle was designed specifically for jumping. The rider must use relatively short stirrups and ride in the half seat or two-point—that is, the seat is out of the saddle and the rider has two points of contact, the calves. Most saddle makers advertise their saddles using such expressions as roper, cutter, or equitation. Keep in mind that these are advertising claims, to be viewed in the same light as the claims for headache remedies, razor blades, or automobiles.

Fitting a Saddle to a Rider

The saddle should also fit the rider. Saddle size is more critical with English saddles, especially hunt-jump saddles, than with stock saddles. The rider's safety, comfort, and show-ring success all depend on proper saddle size. Length of a hunt-jump saddle is measured from the pommel to the center of the top of the cantle. Standard lengths are

16, 17, and 18 inches when the saddle is constructed on a straight-head tree. Lengths on a slope-head tree usually are 1 to 1½ inches less. Probably the most critical test for hunter-seat riders is the position of the knees in the knee pockets. Regardless of length of seat, unless the knees fit into the knee pockets with proper length of stirrup, the saddle does not fit. Although measurements can be made, it is usually advisable to try a hunt-jump saddle for size as it rests on a horse before purchasing it.

Saddle Construction

The tree is the foundation of every saddle. One of the first steps in evaluating a saddle is to check the tree. Until recently, all quality stock saddles were made on a wooden, rawhide-covered tree. Some cheap saddles are made with canvas-covered trees; others are made with the tree only partially covered with rawhide. A relatively recent innovation in saddle-making is the extruded plastic tree. These plastic trees seem to be strong, durable, and free from warping. They reduce weight and cost because they eliminate a great deal of the hand labor of building up a ground seat.

English saddles are usually built on a rigid tree with a straight head or on a spring tree, usually with a sloped head. Slope-head spring trees are relatively new with only a few manufacturers using them, but they seem to be increasing in popularity. Another innovation is the recessed stirrup bar. The combination of slope head and recessed stirrup bar nearly eliminates the hump under the thigh on old models.

Ornate finishes on stock saddles are not always simply decorative. The designs serve to hide scratches and to increase the rider's grip. Hand-carved saddles are usually quite expensive. Carving creates a cleaning problem. Embossed saddles are far more common than carved saddles. The high quality of most embossing plates may make it difficult to distinguish between carving and embossing without careful inspection or looking at the underside of the leather. Poor-quality embossing is especially noticeable on the swells, where it tends to fade out.

Stirrup adjustments vary considerably. The ease with which adjustments can be made is important if several people use the saddle. The patented Blevins buckle is usually found only on better-quality saddles. It is one of the best and easiest to use. Double-tongued and sometimes single-tongued buckles are normally used on less-expensive saddles with narrow stirrup leathers. Such buckles are satisfactory for adjusting stirrups, yet the overall quality of the saddle may not be acceptable. The quick-change buckle is one of the most common. It usually works well, but it may jam if it is not kept aligned and free of rust. Stirrup pins replace leather laces, which were traditional until recent years.

After final deliberation and selection, the real work of the saddle begins. The saddle is a device to help the rider maintain a proper and secure seat.

Saddling

When saddling a horse for *any* form of equitation, the following rules are crucial:

1. Groom the horse thoroughly to be sure there are no sores on its back or in the cinch area, as this could cause more injury to the horse or cause the horse to wring its tail or buck. If there are saddle sores, consider using extra padding or a girth pad, or give the horse time off until the sores heal. Blankets need to be checked for foreign objects or dirt buildup, and they need to be dry.

2. The blanket or saddle pad should have no wrinkles and offer adequate padding for the horse. Some horses require more padding than others, and some may require extra padding at their withers to prevent binding the shoulders. The saddle cinch (Western) or girth (English) must be clean because dirty cinches or girths can cause saddle sores.
3. Raise the saddle as high as you can and set it down gently on the horse's back. This helps prevent back soreness and helps assure the horse that the saddling experience is nothing to fear. Throwing the saddle onto the horse's back can cause bruising and may aggravate any existing back problems.
4. Place the saddle properly. This may vary from horse to horse. Do not place the saddle too far forward, which restricts shoulder movement and causes discomfort, or too far back, which can cause kidney damage and sore backs. Until you are proficient at saddling, always have an experienced rider or trainer check your saddle placement before riding (Figure 20–3).
5. For a Western saddle, let the cinch and stirrup down, making sure they do not slam down on the horse's side. For English saddles, hook the girth on one side. Never release the cinch and stirrup by pushing them over the saddle from the left side. This could hurt or startle the horse.
6. Reach under the horse and grasp the cinch or girth with your left hand, facing the rear of the horse. If using a martingale or breast collar, you may need to thread the cinch or girth through the end of the martingale or breast collar before fastening.

   In Western riding, if you use a rear cinch, tighten the front one first. Put the cinch strap through the cinch ring and the rigging ring twice. Then you can either tie a cinch knot to secure the cinch, or you can buckle it if the cinch has holes for it (Figure 20–4).

FIGURE 20–3 **Saddling a horse.**

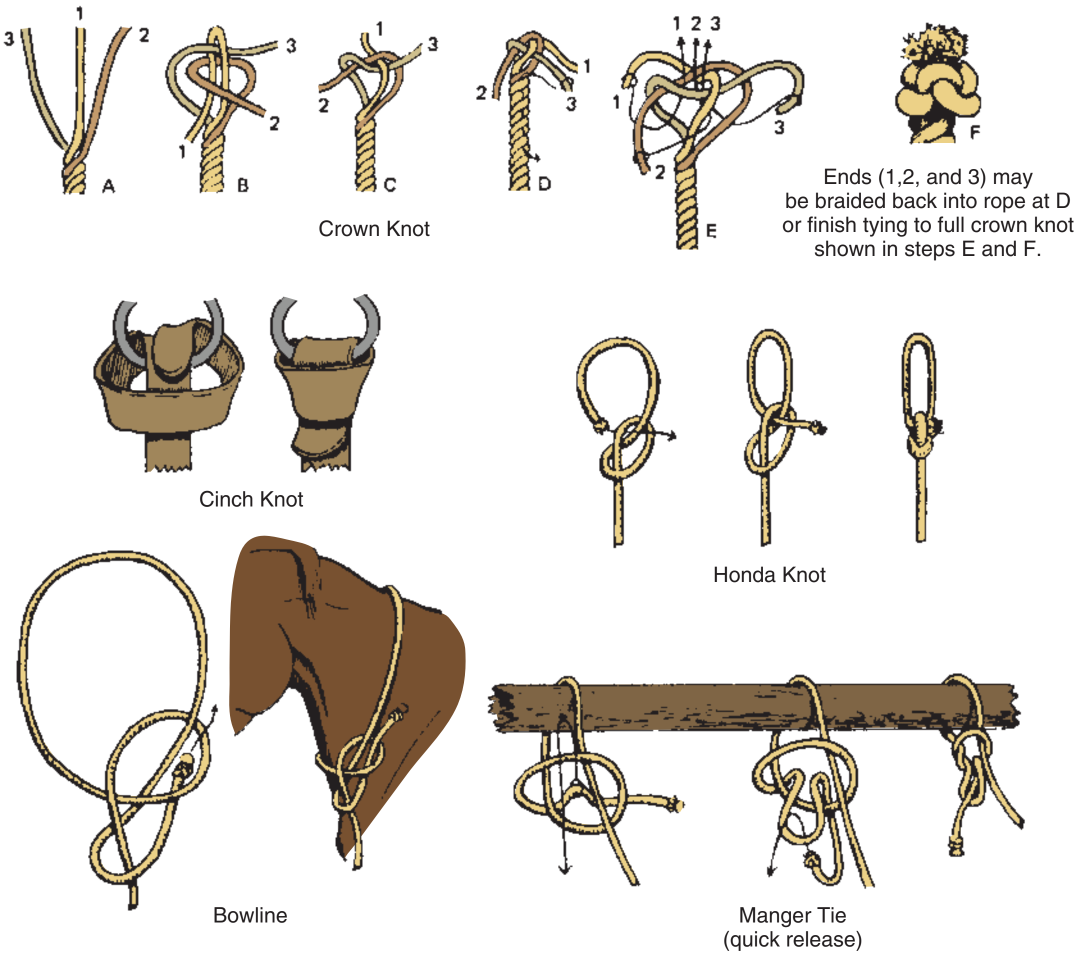

FIGURE 20–4 **Knots commonly used by horse owners.**

7. In Western riding, with the left hand under the buckle to prevent pinching, tighten the cinch slowly, 1 or 2 inches at a time. In English, slowly buckle the girth but not too tight. Tightening it too quickly can cause your horse to be "cinchy," or irritable, during saddling. Some horses may even begin biting or rearing when you tighten the cinch if they anticipate discomfort. Tighten the cinch until it is snug enough to hold the saddle on the horse. You can tighten it more before mounting.

   If you have a rear cinch, fasten it so that your hand can fit flat between cinch and horse when the rider is mounted. It should not be excessively tight when the horse is first saddled, nor should it be so loose that a back foot could get caught in it. Rear cinches should have a strap connected to the front cinch to prevent them from getting into the flank area.
8. After walking the horse to the mounting area, recheck the cinch or girth. You probably will be able to take it up another hole or two without getting it too tight. For riding, the cinch should be snug under the heart girth, but not too tight. You should be able to fit two fingers under the buckle without much difficulty. Check the cinch again after mounting since some horses will "blow out" their lungs during saddling—only to relax after you mount, suddenly making the cinch too loose.

9. To unsaddle, simply reverse the process just described.
10. If you have had a hard ride, loosen the cinch gradually before removing the saddle. This allows the blood to flow back under the saddle slowly.

Bridling

Untie your horse before bridling. Working on the horse's left side again, drop the nosepiece of the halter off the nose and refasten the crown strap around the neck. Avoid placing your face too close to the horse's head during bridling, and use caution when handling the ears. This helps ensure that you do not get hit in the face should the horse toss its head (Figure 20–5).

If you have **romal reins**, or closed reins, place them over the horse's head and neck. If you have split reins, place them over your right shoulder, making sure they do not droop where you or the horse could step on them. Throughout this process, be particularly careful not to wrap any piece of equipment attached to the horse around your hand or arm, as it could cause serious injury.

Spread the crown of the bridle with the right hand and hold the bit in the left. Place your right arm over the horse's head between its ears and approach the horse's mouth with the bit. Be sure to keep the cheekpieces out of its eyes and avoid banging its teeth with the bit.

With the bit pushed lightly against the horse's lips, insert the left thumb in the corner of the mouth. There are no teeth here, so if necessary you can put pressure on the bar of the mouth with your thumb to encourage the horse to open its mouth. Many horses will open their mouths readily as you approach with the bit.

Lift the bridle upward with the right hand as you gently feed the bit over the teeth. Never jerk the bridle, and move with the horse if it moves its head. Place the crown of the bridle over one ear and then the other, bending the ears forward gently as you pull

FIGURE 20–5 **Bridling a horse.**


Courtesy of USDA

FIGURE 20–6 **Before mounting, always make sure the bridle is properly adjusted. The brow band should not hang down in the horse's eyes, the bit should be properly adjusted, and the excess leather straps should be secured in keepers.**

the bridle over them. Rough handling of the ears can cause horses to be head shy and difficult to bridle. Be careful not to drag the cheekpieces over the horse's eyes. Straighten out the forelock to avoid irritation. Then fasten the **throatlatch**, allowing enough room for you to insert your hand sideways throughout the jaw area (Figure 20–6).

The bridle should be properly adjusted before you ride. Be sure the brow band does not hang down in the horse's eyes and that the bit is neither too high nor too low. The bit should rest on the bars of the mouth. It should be high enough that it creates a small wrinkle at the corners of the mouth. For a snaffle bit, there should be two wrinkles; however, for some other bits it is only one. Be sure you know what is correct for your bit. If the bit hangs so that it comes in contact with the incisor teeth, it is too low.

Also in Western riding, check the **curb chain**, or curb strap. You should be able to fit three fingers sideways between the horse's chin and the chain, but the chain should be tight enough that it places pressure on the chin when you pull back on the reins. This ensures that you have enough control of your horse.

WESTERN EQUITATION

The horse and rider need to be suitable for each other. Beginners should ride only calm, dependable horses—preferably older horses—until they are proficient enough to handle more difficult ones.

Equipment must be adequate for the situation and in good repair. Riders should check the rigging, cinches, latigo straps, and billets of their saddle to be sure they are strong and not in danger of breaking. Also, riders need to check bridles and reins, especially at stress points, making sure the leather is strong and supple. Leather that is dry and cracked can break easily.

PROPER DRESS

Wear hard-toed boots with a heel at all times when handling or riding horses. The heel will help prevent your foot from sliding through the stirrup, and the hard boot will protect your toes should the horse step on them (Figure 20–7).

Always wear long jeans, which protect your legs from saddle sores and from hazards on the trail. Avoid shorts and any type of pant made from slick material, such as nylon.

You may want to wear gloves for hand protection, particularly in the winter when they will be exposed to harsh weather. Gloves also may help in the summer because your hands may sweat and make the reins slippery. If you longe your horse before riding, always wear gloves in case your horse tries to pull away, pulling the line

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(d)

FIGURE 20–7 **Riding attire varies between (a) Western, (b) gaited, (c) dressage, and (d) jumping.**

through your hand in the process. Chaps are another option as well. They protect your legs and clothing, and they help to keep you warm in winter.

Avoid dangling jewelry that could get caught on the horse. Loose shirts are a hazard because they can catch on the saddle horn when you dismount. Long hair should be pulled back so your vision is not restricted.

All riders should wear an approved riding helmet to protect their heads in case of a fall.

Wear spurs only when necessary, and be sure you have a well-developed leg before attempting to use them. Riders who do not have control of their legs can accidentally gouge or startle their horse. Have an experienced rider or trainer show you how to use spurs properly, as incorrect use can injure the horse and cause it to buck or run away.

Mounting

Mount your horse in an area away from buildings, trees, fences, and objects on the ground. Pick a spot with good footing, and be sure your boots are clean on the bottom. Otherwise, your foot may slip out of the stirrup as you are mounting.

Avoid using deep stirrups or oxbow stirrups for pleasure riding. These are meant for roping and cutting horse riders, and it is difficult to keep the foot in the proper position for pleasure riding using these types of stirrups. The depth of a deep stirrup makes it easy for a small foot to go through and get caught.

Before mounting, check the cinch again to make sure it is neither too loose nor too tight. Take one more look at your equipment to be sure everything is adjusted properly. It is proper to mount from the left side, but horses should be trained to allow mounting and dismounting from both sides in case you ever need to use the far side in an emergency. Handling the horse from both sides also helps prevent you and the horse from becoming "one-sided."

Hold the reins in your left hand, positioning your fingers on the reins just as you would when mounted. Take up the slack so that you have light contact with the horse's mouth. Facing the rear of the horse, twist the stirrup to receive your left foot. Make sure your horse stands still during this process. If it tries to walk away, tell it to whoa and pull back on the reins until it stops.

Keep your left hand at the base of the horse's neck and place the right hand on the fork of the saddle on the opposite side. Balance your left hand on the neck to be sure you do not bump the horse's mouth while mounting. If necessary, grab the mane or hold on to the bony part of the withers.

Take one or two hops on the right foot and swing yourself up into the saddle, making sure your leg swings clear of the horse's rump. Bumping the horse could startle it, cause it to anticipate discomfort, or prompt it to move off before you are seated. Restrain the horse if it wants to walk off. Be sure your left toe is not pushing into its side.

Sit down softly in the saddle. Flopping down in the saddle could cause a horse to show anxiety or even buck. Even the calmest horse may learn to dislike mounting if you do not show it respect throughout the process. Cold-backed horses usually can be spotted by their tendency to have a "hump" in their backs before riding. The back of the saddle may raise up slightly, and the horse may exhibit a stiff walk. Consider longeing such horses before riding to prevent a bucking episode.

If the horse tries to buck, lift your hands and sit deep in the saddle to keep its head up and your body secure, keeping the horse moving forward. The tendency for beginning riders is to lean forward, but this only makes it easier for the horse to buck you off. It is harder for the horse to buck with its head up, and you must sit up straight to keep the head up.

Horses should learn to stand after mounting, and they should not walk away until asked. Stand quietly for several seconds before moving off, so your horse learns that it must be patient and wait for you.

Many short videos on how to mount a horse are available on YouTube; for example this one from the Certified Horsemanship Association: http://www.youtube.com/watch?v=6NLWL2WJx-A.

Basic Safe Riding

Start out by riding in an area that is familiar to both horse and rider. Make sure you have the kinks out before riding on the trail or in new surroundings. The horse should be quiet and should listen to your cues. Ride with your reins at a comfortable length to encourage the horse to relax and move forward.

When riding on a road, ride facing oncoming traffic. Riding on roads where there is high-speed traffic can be extremely hazardous and should be avoided. Beginners should never ride on the road unless accompanied by an experienced rider.

Be extremely careful when crossing pavement or other hard road surfaces, especially if those surfaces are wet or have oil spots. Ride in these areas at a walk to prevent slipping and to preserve your horse's legs. Give yourself adequate time to cross between cars without hurrying.

Be aware that horses see differently than humans and may spook at strange objects. Keep this in mind as you approach unfamiliar territory so your horse does not jump out into traffic.

If your horse does spook at something new, do not increase its fear by punishing it. Simply keep it moving forward, possibly in a circle, moving back and forth past the object of its fear. Circling in this manner will give the horse an opportunity to see and smell without exaggerating the importance of the object, which will probably reinforce the horse's fear. Allowing the horse to stop and look at the object teaches it that spooking is a way to get out of work. Speak quietly to your horse and give it reassuring pats when it responds properly. Be sure that you remain calm.

When riding with friends, keep a safe distance between horses, whether riding side by side or in a line. When riding single file, keep at least a horse's length between horses. If you tailgate or ride up on the rear of another horse, you may be kicked or your horse may step on the other horse's heels.

When riding side by side, know that some horses do not like this and will try to kick the other horse. Be on the lookout for warning signs, such as pinned ears and one horse swinging its hind end toward the other horse.

If you ride in a group, remember that horses are herd animals and do not like to be left behind. For example, if one rider is left behind to close a gate, the horse may become anxious and want to catch up. This makes mounting difficult and creates a dangerous situation for the rider. It is best to wait until the entire group is ready before moving away. Young horses may become particularly anxious when left behind, and some may even panic.

Avoid riding up quickly behind other riders, as it is the horse's nature to join in when other horses start to run. For example, do not lope past another horse at the walk; this may catch the other rider unaware and cause that horse to take off running with you. If they are not allowed to join in with others horses that are galloping by, young, green horses will often panic and buck.

Riding double is not as safe as riding alone. Not all horses will tolerate two riders, so if you ride double, be sure your mount is suitable. The person riding behind should be a balanced, experienced rider, because if the horse gets nervous, the beginner's tendency is to squeeze with the legs or clench onto the front rider, which will only worsen the situation. Horses are particularly sensitive in the flank area. If the

The Western Saddle

Western saddles are the "cowboy" saddles familiar to movie viewers, rodeo fans, and those who have gone on trail rides at guest ranches. The Western saddle originated in Spain with influence from Celtic, Roman, and Arabian/Moorish riding traditions. The Moorish saddle came to the United States by way of Mexico as a working saddle. The early Spanish colonists modified the Moorish saddle used by the Conquistadors to better meet their needs for working cattle. These modifications eventually led to the Mexican Vaquero saddle, which remains relatively unchanged since the early 1700s.

The Mexicans perfected the art of carving the saddle tree from wood and covering it with wet rawhide, producing an exceptionally strong and durable base still seen in the wood and leather saddles of today. The tree defines the shape of the bars, the seat, the swells, horn and cantle. In the U.S., saddles have been built on trees made of wood for over 100 years. Some are covered with cheesecloth or canvas. Others are covered with fiberglass or rawhide or a heavy hide from a bull."

The Mexican saddle also featured a saddle horn invented as an alternative to tying the rope to the horse's tail when roping cattle. The saddle horn allowed vaqueros (cowboys) to control roped cattle by dallying (wrapping without a knot) the rope around the horn.

The Mexican cowboy saddle evolved into the Texas saddle, characterized by double rigging that greatly increased the stability of the saddle and rider under rough working conditions. During the 1880s, fenders to protect a rider's legs were added to the saddle.

The need for added comfort and durability for the long cattle drives in the late nineteenth century also influenced the evolution of the Western saddle into the saddle of today. The look and feel of contemporary Western saddles can be traced back to the Hamley and Company saddle makers in Oregon (http://www.hamleyco.com) and the Visalia Stock Saddle Company (http://www.visaliastocksaddle.com) in California. As the art of saddle making spread, saddle styles were named after geographical areas, companies, individuals, and various other things.

Improvements in strength, comfort, and functionality continued into the century with innovations such as wider stirrup treads and rough-out seats. Improvements continue today with the use of synthetic materials such as one-piece polyethylene saddle trees and Cordura (a durable and tear-, abrasion-, and scuff-resistant fabric) to produce a wide variety of choices and a wide range of styles to fit particular needs.

Trees for Western saddles today come in a limited range of sizes: regular, semi Quarter Horse, Quarter Horse, Arabian, Haflinger, draft, and pony. Custom-made saddles will likely include alterations to the standard tree.

The Western saddle of today may have a seat with foam rubber or other materials added between the tree and the top layer of leather to provide additional comfort to the rider. Leather or foam padding may be used to slightly alter the contours of the seat. Sheepskin is placed on the underside of the saddle, covering both the tree and the underside of the skirts.

The rigging holds the saddle on the horse. It is an arrangement of rings (cinch) and plate hardware connecting the billets and girthing system. Western saddle rigging can be either single or double. The metal cinch rings are attached to the tree.

For decoration the saddles include metal conchos (decorative pieces) lacing, and small plates, usually silver or a silver-like substitute. The leather parts of the saddle are often tooled into designs that range from simple to complex. The finest-quality saddles often have hand-carved leather tooling.

second rider is not careful, he or she can easily clench the horse in this area, causing the horse to buck or try to run away.

Allow your horse plenty of time and plenty of rein when crossing obstacles on the trail. Horses see differently than humans do, and they need enough rein to raise and lower their heads to judge height and distance. This also allows them to balance themselves properly. Do not hurry your horse over rough ground. Give the horse time to pick its footing properly.

Always walk back to the barn. If you allow your horse to run home, it will become barn sour and may become anxious or start trying to take off with you every time you turn toward the barn. A barn-sour horse also may begin misbehaving upon leaving the barn. For this reason, it is a good idea to walk the last quarter mile of your ride, which also allows the horse to cool down.

Clowning and showing off will increase the likelihood of an accident. Good riders do not need to exhibit their horsemanship skills in these ways. The calmest, safest horse can panic in unusual situations, so always keep this in mind.

ENGLISH EQUITATION

A correct seat in the saddle is basic to all successful activities with horses. It not only indicates sophistication in horse riding, but affords balance to the rider and aids performance of the horse by correct weight distribution. Accomplished riders do everything possible to divert attention from rider and mount in performance classes; they reduce fatigue of the horse on trail and pleasure rides by sitting balanced in the saddle.

Preparing to Lead

Stand at the left shoulder of the horse with the reins in your right hand and the excess, or bight, of reins in your left hand. Lead from this position—not from in front of the horse. Remember, the reins should be over the horse's head and not in riding position.

Mounting

Hold reins with the bight on the right side and your left hand on the horse's withers, while your right hand positions the stirrup over your left foot. If the horse tends to move toward you, keep the right (off) snaffle rein tighter than the left (near) snaffle during mounting, thus reducing the chance of getting stepped on. Whenever possible, use a mounting block.

With your left hand firmly on the withers, grasp the off side of the cantle with your right hand. Take one or two hops on the right foot to attain momentum to mount. Whenever mounting from the ground, it is best to have a rider stand on the right side and put weight in the right stirrup to prevent unnecessary torque on the horse's back. Swing your right leg clear of the horse's hips.

Position your right foot in the stirrup before easing your body weight into the seat of the saddle. Avoid dropping heavily into the saddle of strange or cold-backed horses (Figure 20–8). The Certified Horsemanship Association's Web site offers a helpful video related to proper mounting of a horse. See http://cha-ahse.org/videos_cha.html,

FIGURE 20–8 Steps involved in mounting: 1. The horse is mounted from the near (left) side. 2. Begin mounting by placing the left foot in the stirrup. 3. The rider hops on the right foot to gain momentum and springs up. 4. Swing the right leg over the horse. Do not allow it to drag on the horse's rump. 5. The right foot is slipped into the stirrup before the body weight is settled into the saddle. 6. When in proper seat position, the rider is relaxed in the center of the saddle.

Hand Position

Hands should be held in an easy position, neither perpendicular nor horizontal to the saddle, and should show sympathy, adaptability, and control. Height of the rider's hands above the horse's withers is determined by how and where the horse carries its head. Elbows should be held at the sides in a natural position, neither in too tight nor out too far.

Basic Position in the Saddle

Much of the success of good riders can be attributed to their mastery of this position. To take a basic position, the rider should sit comfortably in the center of the saddle with the feet and legs hanging under the body in a relaxed, natural position. Properly adjusted stirrups will rest between the ankles and insteps of the feet, depending on the rider's build. The irons should then be placed under the balls of the feet with even pressure on the entire width of the soles. The position of the feet should be natural (neither extremely in nor out). The ankles and insteps should be flexible, with heels positioned lower than toes.

When a whip or crop is carried, it should be held in the left hand, butt upward, in mounting (and dismounting). Then it should be transferred quietly to the right hand and held in the same position with its body resting along the rider's right leg.

When the crop is carried as an aid in warm-ups or practice, it may be necessary to change it from hand to hand to support the rider's leg when necessary. Unnecessary motion or use of a crop upsets the horse and may result in poor performance. Use of the crop as an aid is supported by some trainers; others do not promote its use.

Preparing to Dismount

Dismounting generally is the reverse of mounting. With your left hand on the withers holding the reins, right hand on the pommel, support yourself in the stirrups in preparation to dismount.

Swing your leg over the horse's back and place your right hand on the cantle of the saddle in preparation for stepping to the ground with your right foot. It is correct either to step down or slide down from this position, depending on the size of the horse and/or the rider.

Proper Dress

An approved safety helmet must be worn at all times. As in Western riding, a good riding boot should be worn. If a riding boot is not worn, a good leather shoe with a reinforced toe and heel is the next best choice (see Figure 20–7).

EQUITATION COMPETITION

Equitation competition occurs in the Hunter seat, Saddle Seat, Dressage, and Western disciplines. A good equitation rider is always in balance with the horse; maintains a correct position in every gait, movement, or over a fence; and possesses a commanding, but relaxed, presence, able to direct the horse with nearly invisible aids.

In the United States, the largest organizer of equestrian competitions is the United States Equestrian Federation (USEF; http://www.usef.org).

Hunter Seat

Hunter Seat Equitation is a division that is judged on the ability and the style of the rider. The riders can be judged both over fences and on the flat. In over fences classes the riders are judged not only on their ability to negotiate a course of jumps on their horses, but also on their style and position while they do it. The rider should demonstrate that they have a good understanding not only of what the questions of the course are, but how best to answer them.

Riders are trying to execute a smooth and consistent round, using invisible aids, and trying to make their round seem completely effortless. Their position should remain both accurate and stylish throughout the round. On the flat, riders are tested at the walk, trot, and canter at the lower levels, and at more difficult gaits, such as strong or collected walk, trot, and canter, or counter canter and hand gallop, in higher level classes. They are to demonstrate proper riding of the horse at all these gaits, as well as accurate and stylish position. Hunter seat equitation riders can be tested in both flat and over fences classes. These tests are outlined in the USEF Rule Book and include such things as halting, backing, trot jumps, riding without stirrups, and others.

Saddle Seat

In **Saddle Seat** Equitation classes, riders should convey the impression of effective and easy control. To obtain proper position, the rider should be placed comfortably in the saddle and find the center of gravity by sitting with a slight bend at the knees but without use of irons. The rider should not be sliding off the back of the saddle nor should there be excessive space in the seat behind the rider's back. Foot position should be natural (neither extremely in nor out) with heels down. Hands should be held in an easy position, neither perpendicular nor horizontal to the saddle and should show sympathy, adaptability and control. Hands are held above the horse's withers, and hand placement directly affects how and where the horse carries his head.

Position of the rider in motion is judged during a walk, trot, canter, slow gait, and rack (see http://www.usef.org).

Dressage

The word **dressage** comes from the French word *dresser,* "to train." It's an Olympic equestrian sport. Dressage teaches a horse to be obedient, willing, supple, and responsive. The horse freely submits to the rider's lightest aids or body signals, while remaining balanced and energetic. The object of dressage is the harmonious development of the horse in both mind and body.

Dressage principles are a logical, step-by-step progression from simple to increasingly complex movements. More and more is asked of the horse as it becomes mentally and physically ready to respond to these demands.

Dressage requires the horse and rider to combine the strength and agility of gymnastics with the elegance and beauty of classical form. The result is a blend of sport and art. The highlight of a dressage competition is the Musical Freestyle, in which the rider creates and choreographs to music an original ride of compulsory figures and movements.

Western

Open Western classes are open to horses of any breed or combination of breeds measuring 14.1 hands and over. Junior exhibitor classes are open to both horses and ponies. Stallions are prohibited in junior exhibitor classes. Horses must be serviceably sound, in good condition, and of stock-horse type. A Entries may be judged for soundness and conformation before entering the arena.

Open Western classes may include Western Pleasure, Working Cow, Trail, and Western Riding. The classes may be held at Open Western Competitions, breed-restricted, or multi-breed competitions.

Complete details for all of the equitation competitions (international and national) can be found on the Web site for the United Equestrian Federation (http://www.usef.org).

THERAPEUTIC HORSEBACK RIDING

Besides being used for transportation, work, sport, recreational activities, and as a companion, the horse has become recognized as an integral partner in working with people in therapy and education. In equine-facilitated therapy (therapeutic horseback riding) and therapeutic driving activities, the horse is viewed as a tool in therapy, sport, and education for people who are physically or mentally challenged (see Figure 20–9). For someone who cannot walk or has difficulty walking, the horse provides input to the rider, very similar to the motion required in human movement.

The three-dimensional movement of the horse at a walk (side to side, up and down, and front and back) is transmitted to the rider. The rider is not only receiving the physical benefits of the horse but also having fun and experiencing mental stimulation.

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FIGURE 20–9 Therapeutic horseback riding.

Recognizing the number of skills and the amount of mental preparation required by a rider suggests this activity is also useful to someone who has difficulty in learning. The value of equine-facilitated therapy includes:

- Exposure to a nontraditional environment. For someone who has a disability, a trip to the farm or horse barn may be quite an excursion and a break from their normal routine. Many people are not accustomed to being around animals—especially an animal as big as a horse.
- Visual experiences. Many scenes associated with animals are new and exciting when seen for the first time.
- Auditory experiences. Describing the sounds associated with horses and life around the barn is difficult to do without the experience.
- Olfactory experiences. The smells of new hay, mixed sweet feed, a new foal, or just the horse itself stimulate the senses.
- Tactile experiences. Physically touching the horse can teach the meaning of coarse, soft, or hard; the feel of a mane or tail, a short, smooth summer coat, or the feel of a heavy winter coat; the textures of hay and grain, the feel of leather, and the feel of saddle pads.
- Physical involvement. The rider's use and strengthening of muscle groups, reactions, balance, and coordination that occur during equine-related activities may be different than at any other time. Also, being mounted on a horse requires the development of spatial awareness skills.
- Psychological experience. The horse presents many challenges that, when mastered by the rider, enhance a psychological profile. Many people benefit by just being able to lead a horse where they want it to go.
- Expanded vocabulary and identification skills. The words and terms used when referring to the horse and its surroundings are different and new.
- Risk factor. The ability to work and move around horses with ease takes skill and courage. People learn that they need a certain amount of risk and knowledge in their lives to be healthy and to develop other skills.
- Eye-hand coordination. The experienced "horseperson" uses an incredible amount of dexterity and skill to accomplish seemingly simple tasks—locating the horse, catching it, haltering, tying, and grooming.

Therapeutic riding instructors incorporate educational goals into the riding process. They place numbers, letters, shapes, and associated pictures around the arena to use in the lesson. Riders learn all equine management and riding skills to the best of their ability. The horse is a great therapy and teaching tool for people who are physically or mentally challenged, or both.

LOADING AND HAULING

Horse owners will sometimes find it necessary to trailer their horses. Hauling may be necessary at the time of purchase or for horse shows, trail riding, or medical emergencies. Being prepared and maintaining the trailer in roadworthy condition prevents needless delays when it is time to haul.

Make sure that the trailer is securely and properly hitched to the towing vehicle before loading your horse. Unhitched trailers can easily tip up under the weight of a moving horse.

Loading and unloading must be practiced in advance of any scheduled events. Horses not familiar with being hauled can create an unpleasant beginning to a day's journey. When working with young horses in trailers with partitions, you can boost their confidence if you enter first on the opposite side of the partition. Never go into the same stall you want the horse to go into unless there is an open escape door.

Promptly fasten the bar or chain behind the horse after it loads to prevent it from backing out before you are able to tie its head. When tying its head, use a **quick-release knot** or a tie with a panic/safety snap. Make sure the horse has enough rope length to permit head movement for balance, but not enough to get its head too low or over to the horse traveling alongside.

Once the horse is loaded and the gate is closed, check the latches to be sure they are tight and that they cannot bounce up and come loose. There are many types of latches, so be sure that the type you are using cannot come unfastened.

When on the road, stay back from the vehicle in front of you to allow for adequate room to stop. The extra weight of the trailer will increase the distance normally required to stop your vehicle. Avoid hard stops; as they tend to throw horses down. Even if the animals are not injured, they may become fearful and **trailer sour**, which causes difficulty in future hauling.

When you arrive at your destination, be careful where you unload. Leave enough room behind for unloading, and unload on ground that will give the horse good footing. Be sure you have untied the horse before releasing the tail chain or gate. Horses that get unloaded partway and find their heads caught may panic and injure themselves.

Trailer Safety Checklist

Before the horse is loaded, the safety of the trailer should be checked.

1. Hitch—Be sure that the hitch is secure and your trailer is properly fastened. Use heavy safety chains to secure the trailer to the towing vehicle.
2. Tires—Follow the manufacturer's recommended inflation pressures. A good rule of thumb for safe tire tread is a minimum of ¼-inch tread depth. Inspect tires for signs of dry rot. A tire with dry rot is not dependable. Don't forget to have a spare tire that is well maintained.
3. Brakes—Replace worn components, and test brake operation before beginning the haul.
4. Lights—Check for correct and full operation of brake, turning, and marker lights. Interior lights are handy when loading and unloading at night.
5. Jacks and safety triangles—Have these available and in good working order in case of roadside breakdowns.
6. Floorboards—Horses apply a great deal of pressure on the small area under their hooves. Floorboards should not be in a rotted or weak condition. Rubber mats on the floor and tailgate provide traction and cushion during loading, unloading, and travel.
7. Wheel bearings—These need to be repacked with grease and checked at least every year.

HALTERING

Halters are designed to help catch, hold, lead, and tie horses and ponies. They are nothing else. Every horse should have its own halter, correctly sized and adjusted to fit.

TYPES OF HALTERS

Some horses are delivered to the new owner in shipping halters. Shipping halters are made of jute fiber (burlap), are light, and usually have a string throatlatch. A shipping halter is inexpensive and adequate for temporary use but is completely unsatisfactory for use as a permanent halter. It cannot be adjusted well (only the throatlatch can be changed), and the fiber lacks strength and durability. This type of halter is not only difficult to keep in place on the horse's head, but it is almost impossible to keep clean.

Rope halters made of braided cotton are very popular. They are strong, relatively inexpensive, and readily adjustable. They are also available in various sizes. The chief disadvantages of rope halters are that they are difficult to keep clean, have a tendency to rot and mildew if not kept dry, and lack the durability found in top-quality leather halters.

Another problem with rope halters is that they shrink. Rain, heavy dew, or even high humidity will cause cotton rope halters to shrink. Unless care is taken to frequently readjust rope halters, the shrinking can cause severe pain and even choke the horse.

To eliminate shrinking, a new rope halter should be soaked in water for a few hours or overnight and then thoroughly dried. Clothes dryers, ovens, and other sources of high heat should not be used because they tend to overshrink the halter; heat can also damage the fiber, thus weakening the halter. The type of rope halters used with cattle should not be used with horses. Pulling on the lead rope draws down under the jaw and over the top of the head, much as a lariat rope would. Use these halters only in an emergency. Tie a knot at the point where the lead rope passes through the eye of the halter, and the lead rope becomes a halter shank.

Nylon halters have all the advantages of cotton rope halters and more. They are easily cleaned, not usually affected by dampness, not subject to rotting and mildew, and come in a variety of colors. Nylon does not shrink; instead, it tends to stretch. In some cases, nylon halters tend to slip at the adjustment points, especially at the crown and under the chin. Therefore, it is necessary to occasionally readjust nylon halters. Nylon halters are more expensive than cotton.

Nylon halters can also be obtained in a flat web design. They look like and are designed like leather halters. They are cheaper than leather, last longer, and require less care. However, nylon web halters are difficult to adjust and repair, and they do not break. Because of this, they can also be dangerous. When using a nylon halter, it is best to have a "breakaway" leather crown piece. It is better to have a halter break than to have a horse in a crisis situation. Like nylon rope, nylon webbing stretches easily. The ends of some pieces of a nylon halter that have been cut with a hot device have a sharp, abrasive edge. These may be removed by cutting with a knife or scissors.

Leather halters are available in a variety of types and an even wider variety of prices. Some are adjustable only at the crown piece. These usually must be buckled and unbuckled to be put on and taken off. Some halters have an adjustable chin strap to accommodate various muzzle sizes, as well as adjustments in the crown piece to fit various head lengths. This type of halter is especially well adapted for use on young growing horses or when one halter is used on a number of horses.

Some halters have snaps at the cheek, so unbuckling is not needed when putting on or removing the halter. Leather halters require a great deal of care and attention to keep them in good condition. They must be cleaned regularly and inspected frequently for wear or damage. They are most easily repaired, easiest to individualize with nameplates, and look dressier than other types of halters. In general, they are also more expensive.

Halters of all types may be purchased in various sizes. Most manufacturers list sizes according to breed, age, type, or weight. Care should be taken when buying halters to save the sales slip and insist on the right of return or exchange if the size selected is incorrect.

Haltering

Putting a halter on a horse is easy if the horse has good manners and has been properly trained. To halter a horse in a corral, paddock, or pasture, the horse first must be caught. The horse should be trained to let you approach from either side.

Carry the halter, unbuckled or unsnapped, in your left hand. The right hand can then grasp the mane at the top of the neck and behind the ears. Or the right arm may be placed under the neck with the fingers extended palm upward, palm toward the neck to grasp the mane from the horse's right side. The left hand can then slip the noseband of the halter over the nose.

At this point the right hand can grasp the crown piece and pull it in place, either pulling it back over the ears or by lifting the crown piece strap over the neck behind the ears. Buckling or snapping completes the job. In the case of halters with snaps at the cheek, it may be easier to use the left hand to push the halter back over the ears and use the right to fold the ears forward under the crown piece. A lead shank can also be used to catch the horse. This is accomplished by placing the lead around the neck and holding both ends as a noose, while the left hand puts the halter in place. This procedure is especially recommended on horses or ponies that resist being haltered.

Haltering Rules

Halters should not be left on horses that will not be watched or inspected at least daily. Young horses especially should not be turned out wearing halters.

Halters can catch on fences, tree branches, or brush. The young horse, unable to free itself, panics—usually with serious consequences. This is why breakaway halters (Figure 20–10) are used when it is necessary to have a halter on a horse that is turned out. A horse should not be turned out wearing a loose-fitting halter. Horses use their rear feet to scratch their heads, and loose-fitting halters are an open invitation for a back foot to be caught, or hung-up.

TYING THE HORSE

The only rules for tying a horse are those dictated by safety and common sense. Tying is only a matter of keeping a horse in one place. Most horses learn to "tie" simply because they find it easier to stand quietly than to fight. All horses should be taught to stand tied and should not be considered fully trained until they do so.

FIGURE 20–10 **A breakaway halter.**

The first requirement in correctly tying a horse is using a knot that can be untied quickly, will not slip, and can be untied even though the horse may be pulling back on the tie rope. The recommended knot for tying a halter rope to a fixed object is a quick-release knot.

Take special care to prevent a horse from breaking loose when tied. Once a horse breaks loose, either from improperly tied knots or by breaking equipment, it is apt to try harder to break loose the next time it is tied. Halters, tie ropes, and the objects to which they are to be tied should be strong and sound to minimize any chance of the horse breaking free. However, breakaway snaps can be used for emergency situations where you need to unhook a horse quickly.

Horses should be tied far enough apart so they cannot kick or bite each other. They should be separated by ropes, rails, or distance. A recommended distance between strange horses when tied to a fence or along a picket line is 20 feet. At no time should they be tied closer than 10 feet apart.

Any horse that is tied, even in a stall, should not be left unobserved for long periods of time. This is particularly important with young horses. When possible, tie horses where they can watch activities around them. When tied this way, they become less bored and less easily frightened. Horses should never be tied fast with bridle reins. Bridles were not designed to act as halters. Neither were reins intended to be used as tie ropes. A quick pull on a bridle can also cause the bit to injure and damage a horse's mouth.

Problem Horses

Some horses dislike being tied and are known as halter pullers. To help prevent halter pulling or to get around this problem, a lariat rope may be placed around the girth of a horse with the standing part of the rope extending forward to the halter ring from between the front legs of the horse. The end of the lariat is then tied to a fixed object. As the horse backs up, the lariat loop tightens around the horse's middle and the rope through the halter rings pulls the head down, without injuring the neck at the atlas joint. After only a few short sessions, the horse learns to stand quietly.

Another method of tying a halter puller is to use a ¾-inch or 1-inch soft cotton or soft nylon rope. This is tied around the neck. The other end of the rope is threaded through the halter ring and fastened to something solid with a quick-release knot. Although very hard pulling can injure the horse, the size of the rope will usually prevent this. This method may not stop a horse from pulling back, but it is a very effective means of keeping it tied. This technique should be used only by a qualified trainer in a unique or controlled situation.

Tying to a Post

To tie a horse to a post, stake, or smooth vertical pole or tree trunk, use a knot to prevent the rope from dropping down the pole and from slipping. A much better arrangement, and one that can be untied easily, is to wrap the lead around the post two or three times used then tie a quick-release knot and draw out all the slack. This will be apt to slip down the post if not tied tightly, but it is much safer than a hitch, quick-release combination.

The knots should be tied about 3½ to 4 feet above the ground, with 2 or 3 feet of tie rope between the knot and the halter. It is important to keep the horse from dropping its head down and stepping over the rope. It must, however, be able to get its head up to its normal height.

Tying a horse to a smooth horizontal pole or to a picket line can be safely done in a manner very similar to the procedure used for a vertical pole. In this case, an additional wrap should be made in the hitch, followed by the quick-release knot, to keep everything in place. Just as with the vertical post, the hitch knot may be difficult to untie when the horse pulls back too hard. Therefore, the procedures outlined earlier should be used.

Ground Ties

When there are no suitable objects to which a horse can be tied, it may be possible to use a ground tie. This can be useful on trail rides, when stopping in an open park or pasture. The first step is to dig a small hole about 1 foot deep. Then tie a long rope such as a lariat to an object such as a large stone, a branch, or even a hammer. Draw the rope tight and place the object in the hole. Carefully pack the dirt into the hole. The other end of the rope is then attached to the halter ring, with a quick-release knot, or it may be placed around the horse's neck and secured with a bowline knot. Unless the horse is especially unruly, there should be no problem.

Before using the ground-tie method, or staking a horse out where the rope will lie in similar fashion along the ground, the horse must be trained not to become entangled in the rope. The horse should allow the rope to rub against both the outside and inside of all four legs and should stand quietly if he does become entangled.

Cross-tying

Cross-tying restricts movement of the horse more than tying it with a single rope. Two ropes are used to cross-tie a horse. Cross-tying not only requires special equipment, it requires special training. Most horses object at first to having their heads held with limited movement. To start training, allow lots of slack in both ties. Gradually shorten the ties until the desired control is obtained. The ropes are usually anchored 6 to 8 feet off the ground, and they are long enough to allow the horse to stand with its head level.

SUMMARY

After acquiring a horse, saddles are the first piece of tack an owner purchases. The style of saddle depends on the type of riding a person intends to do. Saddle styles include the Western or stock, hunt-jump, gaited, dressage, and specialty saddles. Saddles need to be selected to fit the horse and the rider. Saddles range in quality and cost depending on their style and construction.

Saddling a horse is the first step in preparing to ride. This requires time and practice to ensure the comfort of the horse and the safety of the rider. After the horse is saddled, it is bridled and led to a safe place for mounting. Proper dress is important for a safe ride, and it is important to the type of riding.

In all areas of equitation, safety needs prime consideration. Rules and guidelines of safe riding must always be followed. Loading and hauling of horses presents a safety hazard for the handler and the horse. Tying a horse can be another hazard if not done properly. Halters are designed to help catch, hold, lead, and tie horses. Reins were never intended to be used as tie ropes.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Every saddle fits any horse.
2. Every horse should have its own halter, correctly sized and adjusted to fit.
3. A recommended distance between strange horses when tied to a fence or along a picket line is 5 feet.
4. In all areas of equitation, safety needs prime consideration.
5. Any horse will take two riders easily.

Short Answer

6. What are the four basic criteria for selecting a saddle?
7. List the five points of a horse's anatomy that should be checked when fitting a saddle.
8. Identify two main differences between Western and English saddles.
9. Name three types of riding competition.
10. List five checkpoints for trailers before loading a horse.
11. What are the two main purposes of a saddle?

Critical Thinking/Discussion

12. Discuss haltering rules and how to halter a horse.
13. Explain ground-tying, tying to a post, and cross-tying.
14. Discuss why proper clothing is needed while riding a horse.
15. Discuss precautions for safe riding.
16. Briefly describe how to saddle a horse.

STUDENT ACTIVITIES

1. Make price comparisons of different saddles, from low end to high end. Determine their ornateness and what features are included. Find out what kind of materials are used in making the saddles. Present this information in a table.
2. Using a software presentation program, develop a presentation covering safety guidelines when riding, loading and hauling, or tying horses. Or, compare differences between Western and English saddles.
3. Develop a report that compares the differences between English and Western riding. Include a comparison of the tack used by each.
4. Halter and saddle a horse; longe a horse; lead a horse; mount a horse; and tie a horse.
5. Watch videos (YouTube) on Western riders and jumpers, and note differences in their positions.
6. Make measurements on several horses to see differences in their anatomy and note how important that is when selecting a saddle. Try to use horses of different sizes.
7. Go to the Web site for the United States Equestrian Federation (USEF) and develop a report/presentation on one of the international or national equestrian events/competitions.
8. Search YouTube for "therapeutic riding." Develop a report/presentation on this aspect of horse riding.

ADDITIONAL RESOURCES

Books

American Youth Horse Council. (2005). *Start with safety: Horse safety guidelines* (2nd ed.). Colorado Springs, CO: Author.

Berenger, R. (2010). *The history and art of horsemanship, Volume 1*. Charleston, SC: Nabu Press.

Bowers, N. & Reiff, K. B. (2010). *4-H guide to training horses*. Minneapolis, MN: Voyageur Press.

Boy Scouts of America. (2004). *Horsemanship.* Irving, TX: Boy Scouts of America.

Cavendish, W., & Steinkraus, W. C. (2000). *General system of horsemanship.* North Pomfret, VT: Trafalgar Square.

Dawson, J. (2003). *Teaching safe horsemanship: A guide to English and Western instruction.* North Adams, MA: Storey Publishing.

Hassler-Scoop, J. K., & Kelly, K. (2002). *Equestrian education: Professional development for instructors.* Goals Unlimited Press <http://www.equerry.com/goals/>.

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Hill, C. (2011). *What every horse should know: A training guide to developing a confident and safe horse*. North Adams, MA: Storey Publishing, Inc.

———. (2010). *101 Horsemanship & equitation patterns: A Western & English ringside guide for practice & show.* North Adams, MA: Storey Publishing.

MacKenzie, S. (1998). *Equine safety.* Clifton Park, NY: Thomson Delmar Learning.

Myers, J. (2005). *Horse safe: A complete guide to equine safety*. Collingwood, Victoria, Australia: CSIRO Publishing

Pate, C. (2004). *Ranch horsemanship: How to ride like the cowboys do.* Colorado Springs, CO: Western Horseman Books.

Wallace, J. (2002). *Teaching children to ride: A handbook for instructors.* Boonsboro, MD: Half Halt Press.

Xenophon & Morgan, M. H. (2006). *The art of horsemanship.* Mineola, NY: Dover Publications.

Certifications

Certified Horsemanship Association (CHA): <http://www.cha-ahse.org/cert.htm>

Certified Professional Rider Instructor: <http://www.horsecoursesonline.com/riding_instructor.html>

Dressage Certified Riding Instructor: <http://www.dressage-at-romra.com/classical_riding/riding_instructor_certification.htm>

John Lyons Certified Horse Trainers: <http://www.johnlyons.com/>

North American Riding for the Handicapped Association, Inc. (NARHA) Certification: <http://www.narha.org/>

United States Eventing Association (USEA) Certified Trainer: <http://useventing.com/education.php?section5instructor&id5127>

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases:

bridling a horse	hauling a horse	saddles or types of
English equitation	horse trailering	saddles
equitation	loading a horse	Western equitation
haltering a horse	saddle fitting	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 21

Business Aspects

Under the right conditions, and with careful preparation, an equine business can be profitable, both financially and emotionally. However, for someone poorly prepared and uninformed, a business venture can be a disaster. Beginners should consider starting small and thoroughly understanding the basics of running a business. Beginners should also seek expert legal, tax, and accounting advice before going into business. As experience in the industry is gained, the business manager may expand operations. Another option is to work with someone who successfully operates a business in the horse industry before going into business for yourself.

OBJECTIVES

After completing this chapter, you should be able to:

- Identify terms related to horse industry business management with their correct definitions
- List reasons for keeping records
- Distinguish between basic kinds of records
- List guidelines for building and maintaining a good credit standing
- List factors that a lender looks for in a borrower
- List factors that a borrower looks for in a lender
- Identify indicators of good loan repayment ability
- List the essential components of all budgets
- List six types of credit
- Define related management terms
- Describe functions in the management process
- Identify management considerations in planning an equine business
- Explain important skills of managers
- Describe the importance of records and reports
- Explain important human relations skills
- List three types of insurance needed in equine businesses
- Describe the elements of a good boarding contract

KEY TERMS

accounting
accrual accounting
assets
balance sheet
boarding contracts
break-even analysis
capital
cash-basis accounting
cash flow
collateral
corporations
debt financing
enterprise
enterprise budget
equity
evaluation
fixed costs
goals
income
interest
liabilities
limited liability company (LLC)
line of credit (LOC)
liquidity
mortality insurance
net worth
partnerships
principal
profitability
shareholders
sole proprietorship
solvency
strategic planning
variable costs

EVALUATING THE COSTS OF DOING BUSINESS

No one should enter an equine business without calculating the costs. These costs can include personal or social considerations that may affect the success of the business venture. Or, these costs can be the actual costs of getting into the business and staying in business.

Personal or Social Costs

Some of the personal or social costs to consider before entering an equine business can be gathered from the following checklist:

1. Are you willing to work long, hard, and irregular hours—for example, 16 hours a day, 7 days a week?
2. Do you get along well and communicate effectively with people? Business owners and operators must promote and market themselves and their product.
3. Are you comfortable with problem solving and troubleshooting?
4. Will you seek help when needed?
5. Do you have the technical expertise to manage the operation?
6. Can you afford to hire qualified help?
7. Do you know others in the business who will provide help or information?
8. What related associations or organizations can you join or do you need to join?
9. Are you willing to learn of current practices and new developments?
10. Are you familiar with the legal issues of marketing your product?
11. Do you have the resources to construct and operate a facility?
12. Do you have the right location for the business you wish to conduct?
13. Is the prospective business site located near your markets?
14. Do you live close enough to the business site to visit and monitor it as needed, and to ensure security?
15. What utilities are available at the site of business?
16. Are the available water resources adequate?
17. Can you effectively manage any waste produced by your operation?
18. Will your neighbors and others accept your business operation?
19. Have you discussed your planned operation with the appropriate local, state, or federal agencies?
20. Have you identified the permits and insurance required to construct and operate the business?
21. Do you have the resources—financial, technical, and special—needed?
22. Are support services and industries available?
23. Do you have access to a dependable workforce for physical labor?

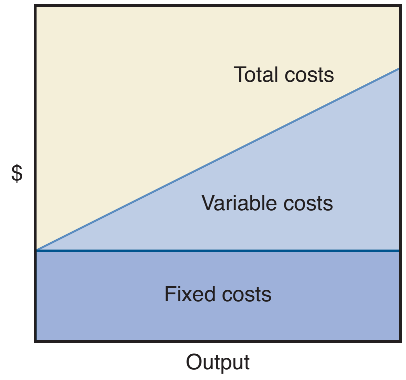

FIGURE 21–1 **A simple visual explanation of the relationships between fixed, variable, and total costs. Variable expenses change based on production output.**

BUDGETS

Estimating the costs and returns for a particular activity is called developing an **enterprise budget**. This procedure reflects the economic value of producing a specific output using a given set of inputs by following specific production practices. **Profitability** can be estimated by subtracting all the costs from the expected revenues.

Two types of costs should be considered in developing enterprise budgets: variable and fixed (Figure 21–1). **Variable costs** are the expenses that change based on production output, such as feed, veterinary supplies, bedding, and fuel. **Fixed costs** are the expenses that do not change, regardless of whether production occurs—expenses such as depreciation, **interest** on investment, insurance, and taxes. Variable costs can often make up the largest portion of the total costs of doing business.

Each business owner faces different situations when trying to analyze the economic feasibility of a business. So, estimates in enterprise budgets should be used only as a starting point for planning.

RECORDS IMPROVE PROFITABILITY

Businesses need a complete and accurate records system in order to make informed management decisions that help maintain or improve business profitability. Records systems serve four functions:

1. To assist in reporting to the Internal Revenue Service (IRS) and other taxing entities, creditors, other asset owners, and others who have a vested interest in the financial position of the business
2. To indicate progress
3. To diagnose strengths and weaknesses
4. To plan

With the proper records, owners determine the actual cost of doing business. Profitability is no longer determined by the money in the bank left to spend.

Records can also help the manager plan and implement business arrangements and do estate and other transfer planning. Managers can use records to determine efficiencies and inefficiencies, measure progress of the business, and plan for the future.

Business owners do not need to be accomplished accountants or experts on taxes and law. They do need to know how to keep the required records for their businesses.

They must realize that all business decisions have income tax consequences, and they must be able to evaluate the **accounting** and legal professionals who serve their businesses.

Choosing a Records System

Records systems range from simple, hand-accounting systems using pencil and paper to sophisticated double-entry computer accounting systems. Some require a mix of hand and computer operations.

A system should not only meet the accounting and planning needs of the operation but also satisfy income tax, legal, and other outside reporting requirements. Computer programs should be selected with good detailed instructions for use.

Accounting Methods

Two types of accounting methods are used in agriculture—cash basis and accrual.

Cash-basis Accounting

This method is used primarily for income tax reporting purposes in service industries. Generally in **cash-basis accounting**, **income** is recorded as income when it is received, and expenses are recorded as expenses when they are paid. Cash-basis accounting is simple and can provide some income tax advantages for businesses that are heavily dependent on inventory changes.

This method also has drawbacks. Cash-basis accounting can grossly distort the financial position, profitability measures, and operational results of the business. Cash-basis accounting needs to be converted to **accrual accounting** for analysis and decision-making purposes.

Accrual Accounting

This method is required for tax purposes for most trading and manufacturing businesses. In accrual accounting, expenses are considered expenses when they are accrued (or committed), and income is counted as income when it is earned. This includes changes in inventories. This method does not depend on how the cash moves in the business. Expenses incurred are matched with related income to determine net income. This approach provides a better continuous picture of profitability. An assessment of cash flow is still needed to determine the financial feasibility of a business.

Basic Record Keeping

Record keeping need not be a complex managerial activity if some simple rules are followed. A well-designed records system makes the job easier as well as more efficient. Six suggestions for better record keeping in a business are:

1. Always record the gross or total amount. Never, never use the net amount.
2. Always go through all the steps for each transaction.
3. Run everything through a checking account.
4. Separate business income and expenses from personal income and expenses.
5. Do periodic accuracy checks.
6. Keep supporting documentation so you can refer to it again if needed.

TAX RECORDS

The IRS requires a set of records to show all taxable income and expenses that are deductible. This can be done in many different formats. The manager or record keeper must maintain accounts to show the three different types of farm income:

1. Sale of items purchased for "resale"
2. Other ordinary income
3. Sale of capital items

According to the IRS, farm income is a distinct class of income. Records must also be kept of the two types of expenses—ordinary expenses and capital expenses—along with some expenses that could be classified in either category. Included in the expense category is the annual depreciation record.

The records system chosen should support items on a tax return. The records must provide evidence of the types of income and expenses. This requires sales slips, invoices, receipts, deposit records, and canceled checks. Income and expenses should be clearly identified. Records of loans, debt repayment, and interest expenses must be kept as long as they have any income tax or legal ramifications.

Other required records might include capital item (equipment, physical improvements) records, Social Security records, Occupational Safety and Health Administration (OSHA) records, Federal Unemployment Tax records, worker's compensation, retirement plans, health insurance, operating agreements, carryovers and carrybacks, net operating losses, and income tax credits.

BALANCE SHEET

The **balance sheet** shows where the money is invested and how the business is financed. It provides a snapshot of the financial position of the business at a particular point in time. It shows the financial and credit soundness of the business. The balance sheet provides comparative data that can be used for evaluating the business and for developing the farm earnings statement (Figure 21–2).

The balance sheet is part of the "big three" in accounting. The other two are the farm earnings statement and the cash-flow statement (Figure 21–3). The general accounting equation for the balance sheet is:

$$\text{Assets} = \text{Debt} + \text{Equity}$$

or

$$\text{Assets} - \text{Debt} = \text{Equity}$$

The balance sheet is divided vertically into two parts—the left part lists **assets** (what the business owns) and the right part lists **liabilities** (what the business owes). The total of the two parts must be equal. Two kinds of liabilities are included: (1) debt or outside **capital** and (2) **equity** (**net worth**) or inside capital. The debt represents claims lenders have on the assets, while equity represents claims owners have on the assets.

Horizontally, the balance sheet can be broken into three categories.

1. ***Current Assets.*** The first category, current assets, contains those assets that are in cash or are usually turned into cash during the course of the year. For tax purposes, they are assets that would be considered ordinary income if sold or ordinary expenses if purchased.

BALANCE SHEET

FORM 8A

NAME: Market Depreciated Cost DATE:

CURRENT FARM ASSETS	Line No.			Value
Cash, checking balance	14			
Prepaid expenses and supplies	15			
Growing crops	16			
Accounts receivable	17			
Hedging accounts	18			
	19			
Crops held for sale or feed	Line No.	Crop Code	Quantity	
	20			
	21			
	22			
	23			
	24			
	25			
	26			
	27			
	28			
	29			
Crops under govt. loan	Line No.	Crop Code	Quantity	
	35			
	36			
	37			
	38			
	39			
	40			
Livestock held for sale	Line No.	Lvstk. Code	Quantity	
	45			
	46			
	47			
	48			
	49			
	50			
	51			
Total Current Farm Assets	60			
INTERMEDIATE FARM ASSETS				
Breeding livestock			Number	
Farm machinery and equipment				
Total Intermediate Farm Assets	65			
LONG TERM FARM ASSETS				
Farm real estate			Acres	
FLB stock and co-op equity				
Total Long Term Farm Assets	70			
TOTAL FARM ASSETS				
NONFARM ASSETS				
Vehicles				
Household goods				
Cash value of life insurance				
Stocks and bonds				
Total Nonfarm Assets	75			
TOTAL ASSETS				

CURRENT FARM LIABILITIES	Line No.				
Farm accounts payable and accrued expenses					Amount
Judgments and Liens					
Estimated/Accrued Taxes:					
Property					
Income Tax and Social Security					
Accrued Interest: Current					
Intermediate					
Long term					
Subtotal accounts payable and accrued expenses	79				
Current farm notes payable	Due Date	Interest Rate	Annual Installment	Amount Delinquent	Principal Balance
Total Current Farm Liabilities	80				
INTERMEDIATE FARM LIABILITIES					
Description	Due Date	Interest Rate	Annual Installment	Amount Delinquent	Principal Balance
Total Intermediate Farm Liabilities	85				
LONG TERM FARM LIABILITIES					
Description	Due Date	Interest Rate	Annual Installment	Amount Delinquent	Principal Balance
Total Long Term Farm Liabilities	90				
TOTAL FARM LIABILITIES					
NONFARM LIABILITIES					
Nonfarm accounts payable and accrued expenses					
Nonfarm notes payable	Due Date	Interest Rate	Annual Installment	Amount Delinquent	Principal Balance
Total Nonfarm Farm Liabilities	95				
TOTAL LIABILITIES					
NET WORTH					

FIGURE 21–2 The balance sheet.

2. ***Intermediate Assets.*** The second category includes intermediate assets. They are not true current assets, but neither are they true long-term assets. They are assets used in the production of income and are generally viewed as non-real-estate property, such as machinery and productive animals.
3. ***Long-term Assets.*** The third category is composed of long-term assets. These generally include real estate property used for producing income.

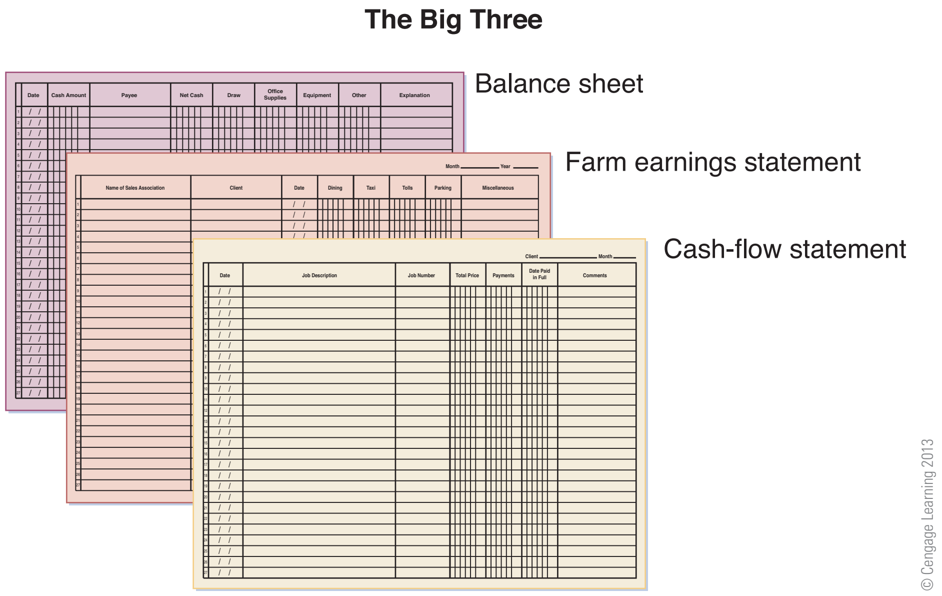

FIGURE 21–3 **The big three.**

Asset Value

Determining the appropriate asset values is the biggest challenge when developing a balance sheet. The values selected depend on their use. Two sets of values can be shown for analysis purposes. One value should be the market value, which is what a willing buyer would pay a willing seller (given adequate time and sufficient knowledge). Creditworthiness and loan soundness are measured using this column. Another value sometimes included is the adjusted tax basis, but this data is readily available from properly kept tax records.

Farm Earnings Statement

The second of the big three statements focuses on current activity. It shows the income earned by the business before taxes. The general accounting equation is:

Sales − Cost of Goods Sold − Operating Expenses ± Inventory and Capital Adjustments = Income Before Taxes or
Revenue − Expenses = Income Before Taxes

The earnings statement is divided into three sections:

1. Cash operating statement
2. Adjustments for inventory
3. Adjustments for capital items

The first section shows all cash income and cash expenses and produces a figure called net cash farm income. The second section shows the inventory adjustment, which results in a figure called adjusted net farm operating income. The inventory adjustment is the difference between the ending current assets and beginning current assets, adjusted for changes in accounts payable. The third section shows the capital account adjustment, which results in net farm earnings—or the return to unpaid labor, unpaid management, and equity capital. The capital adjustment is the difference between the intermediate and long-term assets at the end of the year and the intermediate and long-term assets at the beginning of the year.

The earnings statement ties together the information from the balance sheet with cash-basis income tax accounting data. The bottom line is an excellent measure of the profitability of the business.

CASH-FLOW STATEMENT

The most action-oriented of the big three, the cash-flow statement shows how cash moves into and out of the business. The general accounting equation is:

$$\text{Inflows} = \text{Outflows}$$

A complete cash-flow statement can also serve as a cash accuracy check.

Many different formats for developing a cash-flow statement are available. One way is to divide the **cash flow** into four sections:

1. Income—the marketing plan
2. Operating expenses—the production plan
3. Capital purchases—the investment plan
4. Principal, interest, and additional borrowing—the debt service plan

This type of organization gives a better perspective of total cash flow and aids in planning and control.

Three columns are necessary for each accounting period; one set of these columns should be for each month or at least for each quarter. The first column would be called "projected," the second column "actual," and the third column "variance." In this fashion, the cash-flow statement can be used as a financial management control tool. In cash-flow planning for income, operating expenses, and investment, the business manager is asking three things:

1. How much am I going to sell or buy?
2. At what unit price am I going to buy or sell?
3. When am I going to buy or sell?

Debt service information can be obtained from credit records and the balance sheet. A 2- to 3-year cash-flow history is useful. Then, the manager can find out how the current year is going to differ from previous years. This helps make budgeting easier and more accurate (Figure 21–4).

The cash-flow statement is useful as an evaluation, control, and planning tool. But used by itself, it can relay false information because it considers only cash. For best results, the cash-flow statement should be used with the balance sheet and earnings statement. Used together, the big three provide a complete set of financial statements (Figure 21–5).

OTHER KEY ACCOUNTS

Several other accounts feed into or supplement the big three financial statements. These include income accounts, expense accounts, capital item accounts, depreciation records, enterprise accounts, labor records, marketing records, feed records, experimental records, individual machine records, and family records.

Cash-Flow Worksheet

FOR YEAR ________	JAN	FEB	MAR	APR	MAY	JUNE	JULY	TOTAL/YR
BALANCE ON HAND								
DESCRIPTION								
INCOME:								
RIDING LESSONS								
HORSE SALES								
HORSE TRAINING								
CAPITAL ITEMS								
STUD FEES								
BREEDING FEES								
INTEREST INCOME								
OTHER INCOME								
TOTAL INCOME								
EXPENSES:								
HIRED LABOR								
TAXES								
INSURANCE								
LEASE RENT								
LOAN PAYMENT								
HORSE PURCHASES								
CHEMICALS								
PESTICIDES								
VACCINATIONS								
FUEL, OIL, ETC.								
FARRIER FEES								
TACK								
STUD FEES								
FEED PURCHASES								
OTHER EXPENSES								
SUPPLIES								
OTHER EXPENSES								
TOTAL EXPENDITURES								
NET INCOME								
LIVING EXPENSES								
ENDING BALANCE								
AMOUNT TO BORROW								

FIGURE 21–4 **A sample 6-month cash flow used to project or track cash, income, and expenditures each month.**

Accuracy Checks

Single-entry cash-basis accounting can result in significant errors. It is best to balance the checkbook against the record book on a monthly basis. Then at the end of the year, the manager can make three accuracy checks:

1. Cash flow
2. Profit/net worth
3. Liabilities

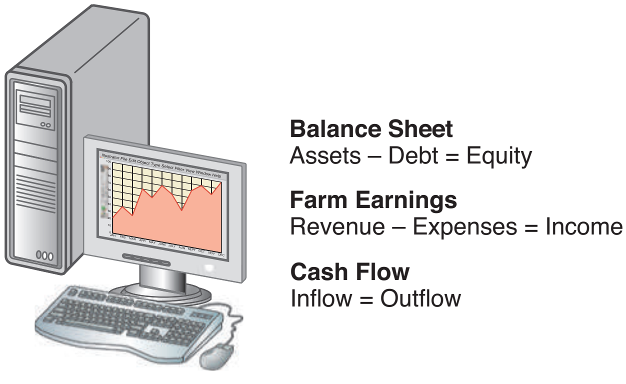

FIGURE 21–5 **Formulas for the big three.**

When these three accuracy checks balance, the business manager can proceed to file income tax returns and use the records to analyze and manage the business.

USING AN ACCOUNTING SYSTEM FOR ANALYSIS

Before decisions can be made or analyzed, the necessary information must be available. The primary goal of any accounting system should be to provide business management analysis and control. The accounting system should be geared toward the manager. If the accounting system is not used, it is worthless. The accounting system should supply three types of information:

1. Scorekeeping or evaluating performance (generally, a retrospective view available in the financial statements)
2. Attention directing to flag ongoing operating problems, inefficiencies, and opportunities (identified by analyzing the financial statements)
3. Problem solving or analyzing the relative merits of alternative courses of action

The accounting system provides information the manager needs for external reporting for taxes and credit. Accounting also provides financial control of routine operations, business management analysis, and reporting to multiple owners.

TAXES

The IRS and most state income tax authorities require that enough business records be kept to justify all income and expense claims reported on an income tax return. The lack of standardized requirements for a minimum acceptable set of records has led agribusinesses to store their cash register receipts, invoices, bank statements, and canceled checks in a box or file drawer and do little more. Legally, such records are sufficient. This system can become an extremely expensive one in the event of an IRS examination.

Much information on tax records for agricultural operations is available from the IRS in Publication 225, Farmer's Tax Guide (http://www.irs.gov/publications/p225/index.html).

Credit

Lenders now stress repayment capacity of loans as well as **collateral** security. Most borrowers now need to show that the investment for which the loan is intended will be able to generate enough income to pay back the interest and **principal** owed within the specified period.

Financial Control of Routine Operations

Astute business managers concern themselves with cash-flow management. Cash budgeting involves all the steps required in the whole business planning process: marketing (including price projections for inputs as well as outputs), yield projections, and **enterprise** combinations.

Despite the difficulty of preparation, the cash-flow budget helps document managerial abilities and loan repayment capacities. The cash-flow budgeting process can be extended one more step to provide an extremely effective financial control device. If monitored monthly or quarterly, the cash-flow budget can indicate potential problems before they arise. This ability to foresee problems allows the manager to adjust before the fact rather than react afterward.

Business Management Analysis

If a business owner is disciplined enough to develop and maintain a records system to meet income tax reporting and credit application needs, then virtually all the needed information will be available to meet what is probably the most important goal of a records system—business management analysis. Good business managers know exactly what their variable and total costs of production are. They know whether they are meeting the goals of their marketing plans or their cash-flow budgets. They have analyzed their strengths and weaknesses in physical as well as financial terms. They know where their business has been, where it is now, and where it is going.

Reporting to Multiple Owners

Multiple-owner forms of business organization require more detailed records because of more intricate tax reporting requirements, state corporation laws, and additional documentation needs of lenders. Perhaps the most important need for more detailed records in **partnerships** and **corporations** comes from the likelihood of problems and potential conflicts among the individuals involved.

Individuals involved in informal family partnerships, joint ventures, and share leases need to rely on a detailed records system to ensure fairness in distribution of profits and contributions.

USES AND INTERPRETATIONS OF THE STATEMENTS

Just doing the scorekeeping—producing the financial statements—is not enough. It takes interpretation and analysis of the financial information to meet the attention-directing and problem-solving needs.

Interpretation begins by evaluating net worth—a key measure of financial wealth. On a market-value basis, net worth shows what would be left if all assets were converted to cash and all liabilities paid. Next, the net income should be sufficient to meet withdrawals for family consumption. More cannot be taken out of the business than is earned. On a cost basis, the change in net worth from one year-end balance sheet to the next equals net income minus withdrawals. The next step is to use data from the financial statements for a systematic financial analysis of the operation.

FINANCIAL ANALYSIS

The first step in financial analysis is to identify appropriate criteria that will facilitate a comprehensive analysis; then measures for each criterion must be established. For each of the following five criteria, one or more measures are suggested (Figure 21–6).

Liquidity

Liquidity is a short-run concept describing a firm's ability to meet short-run obligations when due without disrupting the normal operation of the business. The ratio of current assets to current liabilities is a common measure.

FIGURE 21–6 **Criteria for financial analysis.**

Solvency

A longer-run concept, **solvency** relates to capital structure and a firm's ability to pay all obligations if assets were liquidated. The focus is on total debt in relation to equity. It is a financial risk measure because the risk of not being able to repay borrowed capital and interest increases as the proportion of debt to net worth increases. Another equally useful measure is debt as a percentage of total assets.

Profitability

Net income, or profitability, relates to revenue less expenses. But a dollar measure of net income is not sufficient, because the size of the business is not considered. Furthermore, net income is typically a return to unpaid labor, management, and capital, in contrast to other businesses where it is a return only to capital. Return on assets and return on equity are two common measures of profitability. Net income is typically adjusted to get a return to capital expressed as a ratio to total assets.

Financial Efficiency

Financial efficiency is a measure of the efficiency of a business in generating profit out of gross production. The secret of a successful business is to maximize the dollar value of profit out of each $1,000 value of farm production—a measure of gross production. Net farm income divided by the value of farm production is one useful measure. Similarly, operating expenses, interest, and depreciation can individually be evaluated as a proportion of the value of farm production.

Repayment Capacity

This is an assessment of the firm's ability to repay debt. Ability to repay capital debt and interest is a major concern. One measure is all interest plus principal payments on capital debts, expressed as a percentage of the value of farm production. A nonratio method—capital debt repayment capacity—is calculated as net income plus depreciation less withdrawals.

How Are We Doing?

Financial measures and ratios can be interpreted in three ways:

1. Comparative analysis
2. Trend analysis
3. Actual versus budgeted.

Comparative analysis is a comparison of one's operations results with those of operations of comparable size and type. For example, if an operation's debt to asset ratio is 40 percent, how does this compare with the debt level of other successful operators?

Trend analysis compares results in one year with results achieved in past years. A trend analysis shows strengths and weaknesses and helps focus attention on areas needing further strengthening.

Comparing actual performance with the cash-flow budget requires developing an operational plan for the year ahead and then comparing monthly or quarterly performance with projections. Management should focus on variances, or the differences between budgeted and actual performance.

INCOME TAX AND BUSINESS TYPE

Individuals conducting an equine business choose from five different business types for tax purposes: sole proprietorship, partnership, Subchapter C Corporation, S Corporation, or **Limited Liability Company**.

Sole Proprietorship and Partnership

A business run as a **sole proprietorship** pays no federal income tax. Instead, the taxable income of the business is included in the proprietor's personal income, and taxes are paid at the individual tax rates. Federal income taxes for a partnership are treated similarly. The partnership files an information return showing the business's income and expenses, the names of the partners, and how the partnership earnings will be divided among the partners. The profits, losses, capital gains and losses, and tax credits are allocated to partners according to the terms of the partnership agreement. The partners pay taxes on their respective shares of partnership income as individuals.

Subchapter C Corporation

Federal income tax savings may occur if a business incorporates and becomes subject to federal income taxation under Subchapter C corporations of the Internal Revenue Code. A Subchapter C corporation is a legal entity that is separate and distinct from its owners. The C corporation can hold bank accounts, own property, conduct business and borrow money. Owners of a C corporation are protected from personal liability for the business' debts and legal liabilities.

Because a corporation is considered a separate taxpayer, the corporation can divide its income among the corporation, owner-operator employees, and **shareholders**. The corporation pays individuals associated with the corporation for their contributions—owner-employees receive a salary for their labor, and management and shareholders receive dividends for their capital investment. Residual income after all expenses are paid is taxed to the corporation at corporate income tax rates. Whether federal income taxes will be lower after incorporation depends on the corporation's earnings level, the tax rates for individuals versus that for corporations, and the allocation of earnings.

When the corporation is owned primarily by a family, the tax objective is to minimize the family's total annual income tax burden. This means that the total taxes paid by the corporation, in addition to the personal income taxes paid on the stockholder-employee's salary, and any other personal income should be less than the total personal income taxes paid by the owners before incorporation.

Another tax advantage of incorporation is the increased business deductions available because the owners who work for the corporation become employees of the corporation. In addition to the employee's salary, the corporation can take a deduction for fringe benefits such as group life insurance plans, medical and hospital plans, pension and profit-sharing plans, and others. It permits the corporation to use pretax dollars to pay for benefits received by a stockholder, which the same individual not in a corporation would acquire by using after-tax dollars. This results in more after-tax total income available to the stockholder-employees.

A disadvantage of C corporations is that double taxation is possible. It occurs when corporations pay dividends to their shareholders. Dividends are distributed from the corporation's after-tax income, and shareholders must include dividends in their taxable income. Thus, shareholders are in effect paying taxes a second time on the same profits.

S Corporation

If a corporation elects to be taxed under the special tax option or Subchapter S method, the corporation is not a taxpayer for income tax purposes. That is, the corporation itself is not taxed on an income. The income of the S corporation "flows through" to the shareholders, and each shareholder pays a tax on the individual's prorated share of the corporation's earnings when filing an individual income tax return. All income is taxed the year it is earned, whether or not it is retained or distributed. Rules governing S corporations are similar to partnership rules in that an information return is filed annually on behalf of the corporation.

Thus, corporate earnings in an S corporation are taxed only once—to the shareholder. This avoids the double taxation possibility present with C corporations.

Limited Liability Company

Another option is a Limited Liability Company or LLC. These combine the personal asset protection of a corporation with the flexibility of a partnership. Owners of an LLC are referred to as members, while owners of an S corporation are called shareholders. An LLC member may be another LLC, a corporation, partnership, individual or foreign entity. An LLC may distribute profits in any matter agreed upon by the members of the company.

Federal income taxes may be reduced by incorporation, but not all taxes and costs are necessarily reduced. Rather, a number of increased costs and taxes exist with corporations. All of these must be examined in arriving at the total savings possible by incorporation.

Payroll Taxes

After incorporation, the sole proprietor or partner changes status from employer to employee. The business has at least one additional employee, if not more, which results in increased payroll taxes.

Social Security taxes are increased since the combined employee and employer rates under the corporate structure are higher than for self-employed individuals—partners or sole proprietors.

Stockholders-employees of corporations are also subject to Worker's Compensation charges on their salaries and are entitled to benefits under the act. This is not true of sole proprietors or partners in a partnership. A stockholder-employee's salary may also be subject to the unemployment compensation tax.

Another disadvantage to owner-operators of incorporated businesses is that personal income taxes must be paid through quarterly estimates or withholding, rather than as a lump sum.

Individuals forming businesses should always check with the latest tax information provided by the federal and state governments.

Business Structure Must Fit Objectives

A small-scale family business begins usually as a sole proprietorship. When circumstances surrounding the operation suggest a partnership or corporation, an in-depth analysis needs to be made. An analysis of the organizational characteristics and the objectives of the family is perhaps the most important, but still the most neglected, phase of the process.

Usually, the decision does not need to be rushed. It is a relatively easy and inexpensive process to incorporate or form a partnership, but it may not be so easy and inexpensive to dissolve the corporation or partnership. Those thinking about changing business structure should take enough time to weigh the advantages and disadvantages of each type for their particular situation.

THE COMPUTER IN MANAGEMENT DECISIONS

Agribusiness of any type has never been more dynamic and competitive than it is today. Each decision a manager makes, or fails to make, can significantly impact the business. In some cases, a decision can simply affect a single production cycle of an enterprise. In others, a decision can change the direction of an entire operation.

In this fast-paced, high-risk climate, computers play an important part in helping managers make crucial decisions about their operations (Figure 21–7). Some programs are designed for strategic management, which is concerned with positioning the organization for success by matching its long-range direction with its resources, management capabilities, and the economic environment of the industry. Other programs address tactical management, which focuses on the day-to-day, season-to-season activities needed to carry out long-range strategic plans.

FIGURE 21–7 **Once a luxury, computers are now essential to successful business management.**

The success of strategic or tactical decision making depends to a large degree on managers' access to relevant information and their ability to use that information effectively in making decisions. Today's computer programs can help gather important data, provide a framework for analyzing options, and perform calculations thoroughly and accurately at a fraction of the time it would take to do the same thing with pencil and paper.

Strategic Decisions

An owner's most important strategic management decisions deal with deciding the long-range direction of their businesses. Each must decide what enterprise, or combination of enterprises, offers the best long-term potential, how big the business should be, the type of financing needed, the amount of debt that can be handled, and how to ensure adequate profit from the business now and in the future. The most effective way to approach these and other strategic questions is to identify a wide range of options and then narrow the field to the most feasible plans. The decisions made must be consistent with both business and family goals, available resources, the management ability available, and the risk-bearing capacity of the business and the people involved.

Tactical Decisions

While strategic management addresses long-range plans and objectives, tactical management focuses on the activities that move the organization toward those goals. Computer programs are available to help business managers monitor or analyze production practices, develop financing plans, establish labor schedules, and create marketing plans.

Computer software can help managers develop marketing plans, keep production records, track breeding programs, and make many other tactical decisions. As with **strategic planning**, computers can speed up the decision-making process, reduce mathematical errors, and help the manager think critically about alternative courses of action.

Once a manager develops annual and long-range plans and answers—the how and when questions—the next step is to compare what is actually happening in the business with expectations for production, marketing, and finances. Computers can help carry out the important and time-consuming task of monitoring operations on a daily basis. They can also help managers make adjustments when performance fails to meet expectations.

Having access to such a system depends on what records the manager is willing and able to keep on a day-to-day or week-to-week basis. Whether the records are kept in a hand or a computerized system, they must enable the manager to summarize and analyze them at any time. The computer clearly has the advantage here in terms of quickly recalling structured data, calculating the desired measures, and quickly detailing comparisons of plans to the actual outcomes.

Computers for Decision Making

Of course, the manager must have the right kind of information for each decision, whether strategic or tactical, and the information must be current and accurate. This includes information about the world at large as well as about the business itself.

For strategic decision making, the manager must keep abreast of general economic conditions, world supply and demand, credit policy, and so forth. In the area of tactical planning, the manager must keep up to date on current and future market prices, weather information, and other factors. While much of this information can be gleaned from the general news media, managers can often get information tailored specifically for their concerns through commercial computerized agricultural information networks.

When it comes to information about operations, many managers have been content to keep only the data necessary for income tax preparation. But in today's dynamic and competitive world, that approach is no longer sufficient. At a minimum, the manager must maintain production data in a useful format as well as information on assets, liabilities, and all credit transactions.

As with any technology, the value of the new computerized management tools depends on how conscientiously and wisely they are used. For the system to reach its potential, the manager must record vital data on a regular basis and use the resulting information and analyses in making crucial business decisions.

CREDIT

Sound use of agricultural credit is a two-way street affecting both borrower and lender. The individual seeking credit must be prepared to demonstrate to the lending institution that the proposed financing is feasible.

In any borrower-lender relationship, the borrower supplies up-to-date financial and production records to give the lender an understanding of the business. Financial records include a balance sheet and an income statement, as well as historical and projected cash flows. If possible, 3 to 5 years of financial and production data are desirable. Many lenders today are asking for income tax returns for the past 3 years.

On the other hand, it is the lender's responsibility to logically and systematically analyze these documents. This results in a timely decision on the borrower's creditworthiness. While good financial management is the primary responsibility of the borrower, both lender and borrower must use sound credit practices.

Types of Credit

Borrowers can consider six types of credit depending on their needs:

1. Small Business Administration
2. **Line of credit (LOC)**
3. Loans from friends or family
4. Credit cards
5. Leases
6. **Debt financing**

Small Business Administration (SBA). These loans are made through local banks and can be used to purchase equipment, inventory, furniture, supplies and more. Visit www.sba.gov/financing/sbaloan/snapshot.html for additional information.

LOC (line of credit). These are short-term loans that let borrowers access a specific limit of funds. Borrowers pay interest on the portion of funds used. These can be used to buy inventory or pay operating costs for working capital, but should not be used to buy real estate or equipment. A LOC also has the ability to be accessed quickly. Individuals can then can secure, with proper financing, a long term loan. The advantage to using a LOC is that it is flexible. It can be drawn on as the need arises for the everyday needs of the business. Most lenders require the LOC to be paid down in full or reissued each year.

Loans from friends or family. This type of loan can be very risky and should be detailed in writing to keep feelings from getting hurt or causing family strife.

Credit cards. These should be used to fund short term needs only. They usually carry a very high interest rate and should only be used where you can pay the full amount when due. The advantage to using them is that the borrower can see on a statement the amount that can be borrowed without going through complicated steps.

Leases. Leases are another avenue to investigate for obtaining such items as a vehicle or equipment. The advantages are that the borrower does not have to outlay capital at the beginning of the lease, and the borrower can return the item at the end of lease period. It can also be structured so that the individual or company can purchase the item at the end of the lease for the value of the item. This is valuable because if the item was new when leased, the borrower knows how it has been maintained and can assess the value.

Debt financing. This is the old-fashioned loan, where the borrower has a promissory note which spells out the payments over time, and interest is charged during the term of the loan. Usually the interest payments are a deductible business expense. The borrower is responsible for making loan payments on a pre-set schedule. This type of loan usually requires some sort of collateral to use against the loan, such as a lien against home or property.

SELECTING A LENDER

Selecting a lender or lenders is a critical aspect of financial management. An owner-operator should shop for credit and investigate several sources before making a final decision. The borrower must be prepared to make judgments as well as be judged. Five guidelines to use in rating the quality of a credit service are:

1. Select a knowledgeable lender who understands the equine industry today
2. Select a lender who has experience in equine industry credit and a commitment to agriculture
3. Choose a lender who is willing to discuss lending policies and terms and provide prompt action to credit requests
4. Choose a lender who has the capacity to meet anticipated credit needs
5. Select a lender who has a reputation for honesty and integrity

A lender with a reputation for honesty will judge potential borrowers on the same basis. A strong borrower-lender relationship is one of mutual confidence. Maintaining confidentiality of information and objectively evaluating a situation—being able to say yes or no to a credit request and backing the decision with facts—are strong attributes to seek in selecting a lender.

Preparing for the Lender

Borrowers must provide current, accurate financial statements and supporting records. The following tips will help make negotiating a financial package go more smoothly and ensure a good borrower-lender relationship.

- *Arrange credit in advance.* Lenders do not like surprises. Do not inform the lender of a major decision after the fact. This can destroy trust and credibility and make future credit more difficult or impossible to obtain.
- *Allow your lender time to review your plans and make suggestions.* Major purchase decisions are sometimes made on the basis of emotion rather than profitability. A lender can provide objectivity and counsel in reviewing your credit request. Explaining your **goals** and plans builds the lender's confidence and trust in you, which strengthens the working relationship.
- *Keep your lender informed.* Even the best of businesses face adversity that reduces the ability to repay. Inform your lender as soon as possible of changes in plans or unforeseen problems that will interfere with making loan payments. Communication is the key element in the initial request and throughout the credit process.
- *Maintain a high level of integrity.* If you expect a lender to be honest and aboveboard at all times, then the same will be expected of you. Inaccurate information and failure to honor commitments will jeopardize the borrower-lender relationship.

Analyzing Credit Use

Once credit is obtained, properly managing the credit becomes a major challenge in the business. Three basic financial statements—the balance sheet, income statement, and cash-flow statement—are tools used to monitor the financial strength of the business. When compiled and supported by accurate financial information, these tools can provide the support needed for many of the strategies and financial decisions faced.

Any business—agribusiness firm, farm, corporation, or small business—must meet certain criteria to be successful, particularly if credit is used. A successful business must exhibit strong repayment ability, liquidity and solvency, and profitability and financial efficiency. The lender's cornerstones of sound credit, the five Cs, include the same qualities (Figure 21–8). Both producer and lender can determine the financial status of the business with these criteria:

FIGURE 21–8 The five Cs.

No Plan, No Money

A potential lender or investor wants to see a written business plan. The plan can be used as a guide in developing the business. Business plans can have different formats, depending on the type and source of funding being sought or the general purpose. If funding is already in place, a plan can easily be used as a guide for strategy. Successful business plans contain certain elements.

Title Page. The title page should minimally include four pieces of information: the name of the proposed project, the name of the business, the principals involved, and the address and phone number of the primary contact.

Table of Contents. The table of contents should include the major topics of the body of the business plan and critical tables or figures that the investor should particularly notice.

Statement of Purpose. This section is a brief mission statement of the equine venture: what is to be accomplished, why this project was chosen, and how it is to be done.

Executive Summary. This section presents the key elements of the business plan to prospective lenders and investors. The length should be under five pages to increase its likelihood of being read.

The Business. The next section of the business plan provides details of the venture. The following points should be addressed:

- History
- Description
- Market
- Marketing
- Competition
- Operations
- Management
- Research and development
- Personnel
- Loan application and effects
- Development schedule
- Summary

Financial Plan. This section includes sources and applications for capital, equipment list break-even analysis, balance sheet, income statement, cash-flow budget, historical financial statements, equity capitalization, debt capitalization, and supporting documents.

Still, those who fail to plan, plan to fail—especially without money.

- Character (honesty, integrity, and management ability)
- Capacity (repayment ability and profitability)
- Capital (liquidity and solvency)
- Collateral (minimizing risk to the lender)
- Conditions (for granting and repaying the loan)

Any analysis of the use of credit is only as strong as the quality of financial and other information provided. Circumstances such as size and mix of enterprises, costs, values, commodity prices, collateral values, type of business entity, and time of year can all affect analysis. Do not base final decisions on any one factor, but rather on a balanced, comprehensive approach. Comprehensiveness is the number one factor in developing any valid analytical process.

The Lender's Viewpoint

Many lenders use a systematic approach to analyzing credit. They use some or all of the following guidelines and yardsticks:

- Annual earnings summary
- Earnings-coverage ratio
- Debt-payment ratio

- Business operating efficiency
- Current ratio
- Percentage equity
- Collateral position
- Credit history

Credit Score

Anyone applying for credit should know their FICO score. This is a numerical assessment of credit worthiness developed by Fair Isaac Corporation (FICO), the company that invented the system in 1958. Individuals can get a free copy of their credit report at www.annualcreditreport.com. Credit reports need to be annually reviewed for any errors and have mistakes corrected.

Credit Management

Once the debt and repayment structure is in place, constant monitoring by the lender and management of credit is essential. Debt structure and repayment terms, tracking of security, and marking progress of repayment are frequent problems if numerous creditors are involved.

Sound credit analysis may include periodic review of open accounts with merchants, dealers, and suppliers. A check on personal credit card balances can be used to analyze personal accounts. A sign of strong cash flow and credit management is when accounts payable, after initial billing, average less than 5 percent of revenue. If unpaid bills average more than 10 percent of revenue, it is a sign of pending credit problems. Any sharp increase in accounts payable or a general trend upward will be carefully scrutinized by the lender.

Individual and Business Resources

Evaluating the financial situation and management of an agricultural business frequently involves more than analysis of the basic financial statements. A lender will look at the health and age of the individual requesting credit as well as that of the entire family. The stability of family relationships and evidence of estate planning or transfer of farm assets and short- and long-term goal setting are prime considerations. Education and practical experience should be observed, as well as how management techniques are applied to the operation. A good credit analysis will include on-site investigation of the overall resources—land, buildings, improvements, horses, and equipment—and personal living habits.

Lenders will critically evaluate the effects that economic and market trends have on the business. Forecasts and other projections of costs and expenses related to various enterprises can help determine the overall health of the business and the borrower's needs, desires, and strategies for success.

MANAGEMENT

Expert management is critical to the success of any business venture. Time must be set aside for management, even if the principal laborer is also the manager.

Management involves overlapping activities such as:

- Setting goals and objectives
- Identifying and responding to problems
- Gathering, compiling, analyzing, and applying relevant information
- Making, carrying out, and evaluating results of specific decisions
- Training, directing, and evaluating employees
- Controlling financial decisions and operations
- Monitoring all aspects of the operation

MANAGEMENT FUNCTIONS

At the core of good management is a set of goals and objectives for the business, developed and understood with clarity by the owner, by management, and by labor. Expectations about levels of annual earnings and production, maintenance of buildings and grounds, trade-offs between capital appreciation and current earnings, long-term growth, and achievements must be established. While these goals and objectives are not always formalized in writing, they need to be reasoned and discussed.

Figure 21–9 shows five basic management functions or activities used to achieve the goals and objectives of a business.

Planning

While all five of the basic functions are important, planning is crucial because a good plan involves all the other functions. Planning involves:

- Setting daily priorities and schedules: What should be included in today's to-do list? Who should complete each priority activity?
- Recognizing problem areas and looking for alternative solutions.
- Making a financial plan and cash-flow statement for the year, knowing when and how much credit must be obtained, and where the cash will come from to meet the regular obligations.

FIGURE 21–9 **Five basic management functions or activities used to achieve the goals and objectives of a business.**

- Looking at alternative marketing plans.
- Establishing the overall enterprises for the business.
- Developing the business: How fast should the business grow? Is new staff needed? What professional development is needed for each manager?

Planning cannot be done just once a year. It is an ongoing process. Plans need to be revised when established checks or measures determine that goals are not being reached. Most planning deserves undivided attention. An uninterrupted hour with a banker, at the computer, or in discussion with a trusted neighbor or partner may save a lot of money, time, and energy.

Organizing

Organizing is establishing an internal structure for the roles and activities required to meet the organization's goals. The manager must decide the positions to be filled and the duties, responsibilities, and authority attached to each. Organizing also includes the coordination of efforts among people.

Organizing includes:

- Deciding who reports to whom, often referred to as the chain of command
- Determining the functions of each position (job design), including the degree of authority
- Establishing the work routines and standard operating procedures for each production enterprise

Staffing

Staffing is as crucial to a small or part-time business as it is to a much larger one. Often, the need to figure out how to get all the jobs done on time is even more critical for a small business. No business should try to operate without the possibility of hiring assistance when needed. Assistance can range from hiring a teenager after school to help with a few operations to contracting with an accountant to prepare tax records. Staffing activities include:

- Recruiting and hiring workers
- Training and evaluating workers

Directing

Directing is closely related to staffing. The smaller the business, the more the two are interlocked. Delegating of authority is often one of the most difficult things for the manager of a small business to accomplish. All workers need to know their responsibilities and have a sense of when they can make decisions and when the boss must be involved. The lines of authority become more crucial with more employees.

Motivation is part of directing. Knowing what is going on and listening to employee concerns helps build communication and confidence. Creating a team spirit where every worker feels some responsibility for the success or failure of the operation is desirable. Openness and understanding by a manager are respected in close working relationships.

Controlling

Controlling is another key function. Control is the part of business management that determines what new methods are needed to turn out positive results when an investment decision is proven to be less profitable than planned. Control requires keeping track of expenses and income. It forces a manager to monitor what is happening every day.

PLANNING—THE SECRET OF BUSINESS SUCCESS

What separates a successful business from an unsuccessful one? Many factors—quality of the land, location, managerial skill, and sufficient equity capital—are important. Yet, some businesses that seem to have these basics are less successful than other businesses that are not so well endowed.

An important attribute of good business management is to be able to step away from the immediate concerns to see the future. Strategic planning is analyzing the business and the environment in which it operates to create a broad plan for the future.

For smaller businesses, the most effective planning may take place at the kitchen table. Establishing an appropriate atmosphere for strategic planning requires setting aside time away from the day-to-day problems and interruptions so that the key participants—owners, managers, family members—can reach a common understanding about what they want to do in the next 3 to 5 years, and how they want to do it.

Management needs to take a broad overview of the economy and the industry to determine the major opportunities and threats. Tactical planning is concerned with day-to-day and week-to-week decisions. The results of strategic planning could lead to new enterprises, major capital investments, or perhaps even an exit from the business. This broader focus over a longer time distinguishes strategic planning from tactical planning.

Why Do Strategic Planning?

Strategic planning permits more profits, in the long run, by:

- Establishing a clear direction for management and employees to follow
- Defining in measurable terms what is most important for the firm
- Anticipating problems and taking steps to eliminate them
- Allocating resources (labor, machinery and equipment, buildings, and capital) more efficiently
- Establishing a basis for evaluating the performance of management and key employees
- Providing a management framework that can facilitate quick responses to changed conditions, unplanned events, and deviations from plans

Steps in Strategic Planning

Strategic planning involves the first seven steps shown in Figure 21–10. The eighth step—implementation—is strategic management.

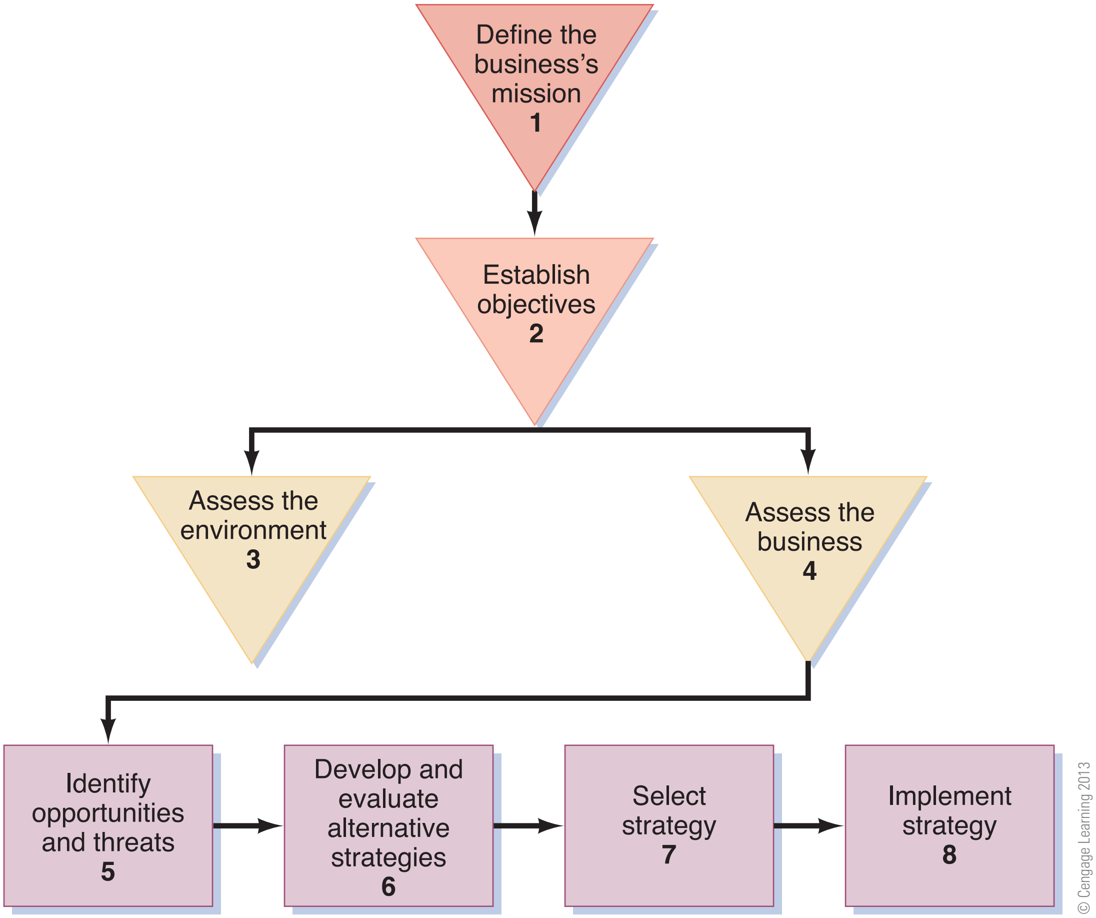

FIGURE 21–10 **Strategic planning involves the first seven steps.**

Step 1. Define the Mission

The mission statement defines the purposes of the organization and answers the question, What business or businesses are we in? Defining the business's mission forces the owner-operator or manager to carefully identify the products, enterprises, and/or services toward which the organization's production is oriented. This statement answers the question, What do we do and why do we do it?

A mission statement is not necessarily a long document. In fact, it should contain fewer than 100 words, and two or three sentences may be sufficient. Answering this question will suggest goals to help clarify objectives in the next step.

Step 2. Establish Objectives

Goals, which are the general, long-term desires of owner-operators or managers, clarify the business's purpose. For example, a goal could be to gain regional recognition. Objectives should translate the goal into concrete terms. Objectives should be measurable and straightforward statements such as the following:

- Increase sales by 100 percent in the next 5 years
- Increase advertising budget by 25 percent in the next 3 years

- Increase foal crop by 30 percent in the next 5 years
- Add 10 more stables in the next 2 years

These objectives should be chosen in such a way that they contribute to reaching the goals identified in step 1. Each objective has two characteristics—it is measurable, and it is time limited. This allows management to evaluate progress in implementing the plan.

Step 3. Assess the External Environment

Every organization faces uncertainties, threats, and opportunities that are beyond its control. Market forces may cause prices to plunge, either in the long run or short run. Overproduction, declining consumer demand, a strong dollar, high interest rates, changes in government policies, and regulation of labor and pesticides are external threats that can cut profits or make business more difficult. New market opportunities are created by demographic changes, changing consumer lifestyles, population growth in selected regions, and technological breakthroughs.

The operator or manager must understand the economic, social, and technological forces that will affect the firm. Then reasonable expectations may be formulated about what will happen to product prices, interest rates, the rate of inflation, labor markets, and input prices over the next 3 to 5 years.

Step 4. Assess the Organization's Strengths and Weaknesses

The quality and quantity of resources within the control of the operator or manager is the first part of this assessment. What are the abilities and limitations of the operator or manager? What skills and abilities do the employees have? How modern and efficient are the facilities? How large is the resource base? How much water is available? What is the cash position of the business? These resources need to be compared to those of competitors.

Step 5. Identify Opportunities and Threats

This step combines the data gathered in steps 3 and 4 to determine the threats and opportunities the business might encounter in the planning period. Difficulties in the external environment can present opportunities in another segment of agriculture. For example, concern about exercise creates a need for horseback riding. Companion animals may provide help for troubled teens. Some firms have avoided problems by creatively turning an external threat into an opportunity.

Step 6. Develop and Evaluate Alternative Strategies

Step 6, along with step 7, is at the heart of the strategic planning process. This is the point at which the business develops the alternative plans that describe the methods for achieving objectives and obtaining greater long-run profits. In what ways can the business gain a competitive advantage?

Some types of strategies operators or managers use to gain a competitive advantage include:

- Become more efficient; increase profits by:
  - — Reducing input use
  - — Using more, or higher-quality, inputs to increase revenue more than costs

- Seek out alternative enterprises
- Exploit quality differences
- Integrate horizontally
- Integrate vertically
- Reduce risks through diversification and hedging
- Identify new markets or narrow current markets—find a niche

Organizations that have some degree of control in the market, because of fewer competitors or the possibility for differentiation of their products and services, have the potential for additional strategies to gain a competitive advantage.

Even though alternatives are developed, step 6 is only half completed. These alternative strategies must be evaluated. In practice, management may develop a long list of possible alternatives. These can usually be whittled down with reason and logic. Once the obvious losers are eliminated, pencil pushing is in order. No single or preferred method is used for evaluating alternatives, but some combination of the following may be used:

- Budgeting alternatives—both profitability and cash flow
- Break-even analysis
- Projections of income, cash flow, and balance sheet statements
- Computerized decision aids

Step 7. Select a Strategy

From the analysis in step 6, the firm selects a strategy—an alternative or a combination of alternatives—that will enable the operator or manager to achieve the desired objectives. Evaluating alternatives may show that the original objectives are not feasible. The operator or manager may have to move back to step 2 and select new objectives or reformulate combinations of alternatives. Selecting a final strategy may involve trade-offs among goals. One alternative is seldom superior to all the other alternatives for attaining each of the goals set by the operator or manager and his or her family. The process of strategic planning should be recognized more as an art than a science.

Step 8. Implementation

The eighth step—implementation—is a crucial link in the strategic management chain. Management must periodically look back on the plan and determine how well the business is doing toward reaching its objectives. Assessing implementation may point to midcourse corrections. Assessment enables planners to understand the planning process. Perhaps objectives were set too optimistically, or perhaps critical threats or opportunities were not recognized. Recognizing and correcting the plan's weaknesses will improve strategic planning the next time the process is undertaken.

Strategic planning should not be viewed as a formidable task resulting in detailed plans. It should be written, but a few pages will suffice. The process should include all the key players participating in the strategic management discussion. All individuals involved in managing the operation must understand where the business is going, how it plans to get there, and what problems or opportunities lie ahead.

SETTING GOALS FOR BUSINESS MANAGEMENT DECISIONS

Almost everyone is enthusiastic about goals. Most people like to discuss goals, and some boast of having goals. People who teach management stress the importance of setting goals. Listen to almost any management guru to hear ideas like these:

- Identify your goals. Manage to reach them.
- Management is goal-directed.
- Take charge of your life and work—set goals and reach them.
- Without goals, you cannot be a manager because you will not know what you want to achieve through your management decisions.

Almost everyone agrees on the importance of goals. The paradox of goals is this: Many people will publicly affirm that they have identified their goals—and that goals are important. But, most cannot or will not record and communicate their vision of desired outcomes in the form of a goal statement that can be communicated to others and used to guide their own management decisions.

Identifying goals has both immediate and long-term payoffs—the quality of daily management outcomes and the focus of long-term decisions are improved.

Those who regularly set and write down goals report benefits such as:

- Communication among family members improved.
- Management decisions and work activities effectively focused on priority concerns.
- Cash-flow management in the production unit and household improved as impulse buying of production inputs and household items declined.
- Borrowing, risk, and interest expense declined.
- Conflict was reduced, and working relationships improved.
- Expenses were kept under control, and profits increased.
- Anxiety and concern over the present and future were reduced.
- A better balance between production activities and family life was achieved.

Goals and commitment—this is a combination that cannot be beaten. It is the combination for ensuring that the business will grow, change, and remain profitable.

HUMAN RESOURCES AND THE BUSINESS

Effective human resource management begins with planning. Using a plan requires that personnel be recruited, hired and then managed effectively (Figure 21–11).

FIGURE 21–11 **Hiring the right person for the job requires great interviewing skills.**

Personnel Planning

Effective personnel planning starts with a self-assessment by managers. Their personal characteristics, attitudes, strengths and weaknesses, and supervisory skills directly affect the working relationships among employees and others in the business.

Personnel needs depend on the work (tasks) to be done, the types of products produced, and the machinery and technology of each operation. An analysis of personnel needs should result in a statement of the kind and amount of work to be done; in turn, this provides a basis for determining the number and types of workers needed.

Matching current personnel—family and nonfamily—with tentative job descriptions is a critical step in developing job descriptions for new employees. Identifying mismatches between job descriptions and current responsibilities may help point out training needs, adjustments in job descriptions, shifts in responsibilities, and—most important—tasks that cannot be adequately handled with existing personnel.

Managing Employees

For a team of family and hired workers to function efficiently and effectively, one or more supervisors must carry out the following five personnel management functions: work scheduling, training, motivation, evaluation, and discipline.

Work Scheduling

The reason for work planning and scheduling is to increase labor efficiency. Waiting for instructions, searching for a supervisor, duplicating the work of another employee, waiting for equipment to be available, and doing maintenance work during critical production periods are examples of inefficiencies caused by poor work scheduling.

Work scheduling should be based on a list of tasks to be accomplished, the machinery and equipment needed for the tasks, the people available to do the tasks, and the time in which the work must be done. A task list identifies what needs to be done within the next period or periods of time. The work schedule accompanying the task list identifies the workers and equipment for the tasks. Providing instructions to workers about the tasks they are to do and when and where they are to do them is the final element of the work schedule. The instructions do not have to be given every day if employees are well trained and well supervised.

Training

Managers who hire workers with little equine work experience must provide extensive training to new employees. The complexity of many farm tasks, the risk of injury to untrained workers, and the labor inefficiencies that result from undirected, on-the-job stumbling make training essential.

Hiring experienced workers is sometimes considered an alternative to carefully planned and implemented training programs. In fact, all employees require training. Experienced employees may require considerable training to change poor work habits, inefficient practices, and lax attitudes toward safety that can endanger themselves and fellow workers. Some employers even prefer to hire inexperienced workers for some tasks because training can focus on the skills that are needed and not on retraining or changing old habits.

Motivation

Employees—family members included—do not change their behavior simply because someone tells them to do so. In fact, threats, bribery, and other types of manipulation may make little difference in an employee's work habits or attitude. The challenge for the manager is to balance workers' needs for job satisfaction with the overall business goals. To do this, the manager must identify employees' most important unsatisfied needs and then determine the feasibility of satisfying those needs through either work itself or conditions at the workplace.

A person working primarily to satisfy a need for social interaction may care little about labor productivity or sales. Can that person satisfy social needs at break times, before and after work, or through casual conversation during work? Or must the worker be disciplined for wasting time on the job?

Evaluation

A formal **evaluation** program lets employees know where they stand on a regular basis and includes guidelines for wage increases. The evaluation should tell employees how they are doing, identify areas where improvement occurred, and offer constructive suggestions for future work improvement. Specific plans for training and job improvement should be discussed. Workers should also have the opportunity to make suggestions, raise questions, and air frustrations and complaints.

In addition to ongoing daily or other regular communication with workers, at least one formal evaluation meeting should be conducted with each employee every year. This meeting provides opportunities to review performance and progress during the past year and to establish performance goals for the coming year.

Compensation should be discussed during the evaluation meeting. Any changes in compensation should be consistent with the strengths and weaknesses discussed in the evaluation meeting. Merit increases should go only to those who have earned them, and employees should understand why they are or are not getting a raise.

Discipline

Workers function best when the rules are clear and they know the consequences of breaking them. Discipline problems can be minimized through careful employee recruitment and training, clear communication of work rules, and proper attention to human needs. When discipline is necessary, the supervisor should not sidestep the responsibility. Failure to provide discipline sends wrong and confusing messages to workers.

MARKETING

Successful marketing helps ensure the success of the business. Owners should know the market and how to market their product. Because of good records, they should know exactly what it costs to produce the services or animals they are marketing. Astute owners know their position in the market.

Once the market position is defined, business owners identify potential customers, who may include professional breeders, trainers, and 4-H and other equine groups. Aggressive businesses explore new markets and develop visible campaigns to interest customers. This can be done by writing articles, conducting clinics and demonstrations, or perhaps placing videos in high-traffic areas such as malls.

The market is determined by supply and demand. Location of a business is important to supply and demand in some operations. Advertising can be used to increase demand and capitalize on or offset some of the effects of location. New business owners should determine the importance of location to the success of the business.

The next step is to place a value or price on products or services. This price should be based on the value of the horse, or the cost to provide the service.

Once the market position is examined, the market strategy should be designed. Market strategy includes advertising and building a positive image.

Marketing Strategy

The marketing challenge is probably at the forefront for many business owners. The boom times when the horse industry was growing at a phenomenal rate appear to be over. Market strategy should include advertising and the building of a positive image.

Advertising

The tendency during pressing times is to stop advertising, cut down on promotion, and eliminate the cost associated with these activities. Advertising and promotion should not be considered a temporary activity.

Advertising takes on many forms, and there is no definite pattern that must be followed to be effective. Some tested techniques can serve as guidelines. For example, the advertising of valuable or expensive horses should be targeted at the broadest possible market. Breed journals and other institutional advertising such as specialty or regional publications may be appropriate.

If national advertising is used, brochures and fliers can be designed for a direct-mail campaign. Using personal letters is often a powerful marketing tool. Videos may also be prepared to promote a service, product, or horse. Web sites on the Internet have become another avenue for marketing.

Web sites. Today, having an attractive, easy-to-use, easy-to-find Web sites is a critical piece of marketing. Web sites can use photos, newsletters, blogs, testimonials,

FIGURE 21–12 **An attractive website that is easy to find and use is an essential piece of marketing.**

and videos to market the services or products of an equine business. Analytical tools provide the business owner with information on the value of the Web site to the business (Figure 21–12)

The Advertisement

A good guideline for developing an advertisement is to plan for the cost to be based on a proportion of anticipated sales. The advertisement should be attractive, direct, and professional. If pictures are included, they should be portrait quality and present the product, service, or horse to its best overall advantage.

All advertisements should have some distinctive style or personalized signature. Include the name of the farm; the owner, manager, or trainer; the phone number; and the mailing address (Figure 21–13). Directions or a small map may also be provided.

Capture the reader's attention with a simple, attractive advertisement. Consistent advertising builds confidence in the stability of a business. Advertising budgets should

FIGURE 21–13 **Advertisements should be distinctive and simple, and contain essential information**

be planned on a yearly basis with a series of advertisements placed in appropriate magazines or journals.

BOARDING AGREEMENTS

In today's business world good contracts are essential. **Boarding contracts** are frequently used in an equine business. These vary, but they should cover at least these five key elements:

1. *Emergencies.* From cuts to colic, emergencies are a part of horse ownership. The boarding contract should address how the facility will handle emergencies, especially if the owner is unavailable. For example, the facility might request a broad authorization to procure veterinary attention should an emergency arise when the owner cannot be reached.

   The owner might want to limit the stable's authorization, give the stable special instructions, or set a dollar limit on emergency veterinary care. The owner might also want to designate someone as a contact person who is authorized to make decisions regarding the horse in the owner's absence. In either situation, the stable would be wise to have the owner acknowledge that he or she will pay the veterinarian's bill.
2. *Insurance.* The horse-boarding facility should know that the horse has **mortality insurance**. Equine mortality insurance companies give an emergency telephone number that the person in possession of a horse must call when the horse becomes injured or ill. Insurance policies typically require that the company be notified promptly of serious health problems while the horse is still alive. With proper notice, the company can evaluate each problem, and it may want to do any number of things such as consult with the attending veterinarian, order an investigation or new course of treatment, get a second opinion, consent to have the horse put down, and/or order a postmortem examination.
3. *Equine Activity Liability Act Language.* Many states have laws that protect their horse industries. Some of these states require that contracts used by equine professionals (such as boarding facility operators) include a specific warning or other language limiting liability for injuries received due to the inherent nature of equine activities. Form contracts sold in stores and found in books usually will not provide this very important information. Horse owners and equine businesses need to check their state's law to determine whether a boarding contract should include this language. (For additional information visit the Animal Legal & Historical Center, http://www.animallaw.info/articles/dduseala.htm.)
4. *Facility-wide Equine Health Programs.* The boarding contract presents a good opportunity to list schedules or disclose the facility's health program and have all boarders consent to it. These provisions will promote the general well-being of all horses on the premises.
5. *Release of Liability* (if allowed under governing law). Many states legally permit parties to sign liability releases. In those states, the releases are well worth the paper they are written on. Boarding facilities that avoid releases are missing out on a good opportunity to try to limit their liability. Releases should be drafted with the assistance of a knowledgeable attorney. Having a release does not eliminate the need for proper insurance.

For the protection of the facility and its customers, the horse-boarding relationship deserves a carefully written contract (Figure 21–14). Details are nothing to be afraid of, and they can benefit everyone. To protect all involved, boarding contracts should be reviewed by a knowledgeable attorney.

AFTER HOURS FARM BOARDING CONTRACT

This Boarding Contract is made and entered into this _____ day of ___________________ 20 ___, by and between Barbara Lee Jensen d/b/a After Hours Farm, hereinafter designated “Manager,” and ___________________________hereinafter designated “Owner,” and if Owner is a minor, Owner’s parent or guardian ___________________________________. Manager agrees to accept Owner’s horse ________________ for boarding and it is the plan and intention of the Owner to board this horse. For and in consideration of the agreements hereinafter set forth, the Owner and the Manager mutually agree as follows:

1) Owner agrees that Manager and employees are not liable for death, sickness, and/or accident including consequential damages caused to the horse, except if caused by the willful and wanton negligence of the Manager; in addition, Owner agrees to hold Manager completely harmless and not liable for any injury whatsoever caused to the Owner, and/or any loss or damage to any personal property.
2) It is the responsibility of the Owner to carry full insurance including coverage on his/her horse and all personal property.
3) Owner shall pay the Manager for boarding services the fee of $ _______ per month plus the applicable sales tax. This shall include the following: stall, bedding, and cleaning, 11 bags of shavings/month, up to 8 pounds of grain/day, hay, regular feedings, daily turnout, use of facilities.
4) The boarding fee is due on the first of the current month. In the event that payment is overdue by fifteen (15) days, Manager is entitled to a lien against the horse for the amount due and shall be entitled to enforce lein and sell the horse for the amount due according to the appropriate laws of New York State.
5) The horse shall be free of infectious, contagious, or transmissible disease. A negative Coggins and proof of current worming and immunizations are required.
6) Manager reserves the right to notify the Owner within seven (7) days of horse’s arrival if horse, in Manager’s opinion, is deemed dangerous or undesirable for aboarding stable. In such case, Owner is responsible for removing horse within seven (7) days and for all fees incurred during horse’s stay. After all fees have been paid, this Contract is concluded.
7) In the event of sickness and/or accident to the horse, after reasonable efforts have failed to contact Owner, Manager has permission to contact a veterinarian for treatment.
8) This contract will be concluded when the Manager or Owner has given thirty (30) days notice to conclude the contract.
9) This Contract is nonassignable and nontransferrable.
10) This Contract represents the entire agreement between the parties. No other agreements or promises, verbal or implied, are included unlesss pecifically stated in this written agreement. This Contract is made and entered into the State of New York and shall been forced and interpreted under the laws of this state. Should any clause be inconflict with State Law, then that clause is null and void. When the Manager and Owner and Owner’s parent or guardian, if Owner is a minor, sign this contract, it will then be binding on both parties, subject to the above terms and conditions.

_____________________________ Manager’s Signature

_____________________________ Owner’s Signature (or Owner’s Parent or Guardian)

Address and Telephone of Owner ____

Description of Horse ____

FIGURE 21–14 **An example of a boarding agreement.**

INSURANCE

Insurance protects an individual, business, or organization against unexpected losses. Common insurance programs in the equine industry include coverage for farm, ranch, and stable operations; commercial equine liability; care/custody control; equine event sponsors; horse club liability; pleasure and show horse owners' liability; and equine mortality insurance.

Farm, Ranch, and Stable Insurance

Farms, ranches, and stables require specialized knowledge and equipment. All require a specialized insurance provider and agent to protect their investments from emotional and financial impact of fires, theft, or litigation.

Coverage options include:

- Dwellings, stables, barns, riding arenas, and other farm buildings
- Guaranteed replacement cost on owner-occupied dwellings
- Replacement cost—actual cash value on other farm structures
- Tack and equipment
- Computer hardware and software
- Named perils on horses
- Spoilage coverage for medicines and vitamins
- Machinery coverage (unspecified, replacement, and newly acquired)
- Personal liability
- Premises/operations liability (boarding, breeding, training, showing, riding instruction)
- Track liability for incidental horse racing
- Care, custody, and control coverage
- Farm/horse operations continuation expense, for example, loss of income or the expenses necessary to carry on normal business after a loss

Commercial Equine Liability Insurance

Commercial horse trainers and instructors should carry liability insurance. This policy provides comprehensive general liability coverage for bodily injury and property damage claims as a result of business activities such as training, instruction, clinics, horse sales, breeding, and boarding.

Under the terms of this type of policy, individuals are protected from a variety of claims that might be brought against them due to their equine business activities.

Care/Custody Control

Individuals caring for or boarding horses can be held responsible if:

- A boarded animal is injured attempting to jump a fence.
- A horse being trained dies in a barn fire.
- An animal ingests a foreign substance in its feed and dies.
- An employee forgets to lock a gate and a broodmare gets loose, is injured, and loses her foal.

Care/custody control insurance coverage protects an individual against liability resulting from death or injury to animals in their custody, not only from fire but also from other causes. The protection provides that if an animal owner makes a negligence claim against a policyholder covered by this type of insurance, the insurance company will defend the policyholder and will be responsible for making payment if it is determined that the loss is due to negligence and the policyholder is legally liable.

Equine Event Insurance

Equine event insurance is for sponsors of horse shows. Any number of show days can be insured. The coverage is designed to provide protection from liability claims that may result from bodily injury or property damage to a spectator attending a show. This insurance can cover:

- Spectator liability
- Products liability, for example, concession stand sales
- Show judges and officials
- Premises owner

In most cases, this policy can extend coverage for the preparation and dismantling of the show, limited to 1 day before and 1 day after the show. The premium is based on the number of show days and the limit of liability selected.

Horse Club Liability Insurance

Horse club liability insurance covers the premises at which meetings, shows, and other activities are held by the club. Meetings, trail rides (noncompetitive), gymkhanas, and other events are automatically covered when they are conducted for the sole benefit of the members.

Liability programs commonly available include spectator liability, personal injury coverage (libel/slander), premises owner's protection, products liability coverage (concession stand), and coverage for show judges and officials. Most basic policy premiums include 2 days of events in which nonmembers participate, as well as up to 100 members.

Pleasure and Show Horse Owner's Liability

Pleasure and show horse liability insurance programs are designed to provide complete liability protection to a person who owns a horse or horses used exclusively for pleasure or show where a homeowner's or tenant's policy will not provide coverage. To qualify, an individual cannot be personally involved in a professional training, breeding, or boarding operation.

A pleasure and show horse owner's liability plan covers an individual against bodily injury claims that may result from the use of the horse and includes property damage claims.

In many instances, this policy can be extended to cover premises owned or leased by an individual when a homeowner's policy will not provide personal liability where the horse is boarded.

EQUINE FULL MORTALITY INSURANCE

Equine full mortality insurance includes theft, transit, and limited emergency colic surgery (Figure 21–15). Subject to the exclusions and conditions contained in the policy, each insured animal is covered against loss by death only. The policy does not cover minor injuries, depreciation in value, failure of the animal to perform the functions for which it is kept, or veterinarian or similar expenses to preserve the animal's life.

The policy also insures against loss resulting from the intentional and voluntary destruction of an insured animal for humane reasons to terminate incurable and excessive suffering arising out of a peril insured against if:

1. The insurance company has agreed to the destruction of the animal or
2. A qualified veterinary surgeon appointed by the insurance company certified that the suffering was so intense that immediate destruction was imperative for humane reasons.

Coverage is limited to specific named perils, for example, fire and/or windstorm, tornado, cyclone, and hail; explosion or earthquakes; flood (meaning the rising of natural bodies of water), drowning; accidental shooting by a person other than the insured or employees of the insured; and transit.

Coverage includes the direct damage caused by theft or attempted theft (but not mysterious disappearance or escape); attack by dogs or wild animals; and collision of an animal with vehicles except those owned by the insured.

Optional coverage may include:

- Equine major medical and surgical, which provides coverage for veterinarian fees that are a direct result of medical and surgical treatment for specified animals.
- Equine loss of use, which provides coverage for specified animals that, during the policy term, become permanently unfit for use specified in the schedule. The animal must first be insured for full mortality and medical/surgical.

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FIGURE 21–15 Some horse owners purchase full mortality insurance.

- Importing costs or international transit
- Gelding surgical coverage, for stallions gelded over the age of 2
- Stallion infertility
- Barrenness

Insurance for Buying or Selling on Contract

Mortality insurance can be purchased for the total sales/purchase or lease/purchase price of a horse and protect both the buyer's and seller's financial interests in the animal. Both buyer and seller receive a copy of the policy and are paid their entire financial interest in the animal should it die before the contract is paid in full.

Rates are based on the breed, use, and age of each horse. All animals must be checked by a veterinarian before coverage is put into effect.

SUMMARY

No one should enter an equine business without first calculating the personal, social, and financial costs. Developing an enterprise budget and record-keeping system is essential to the success of a new business. Accounting systems can be simple or complex, hand-kept or computerized. Besides meeting tax requirements, records provide an effective tool for planning and evaluating the business. When an equine business needs credit, records support the need and the ability to repay the debt.

Obtaining credit is a two-way street. Borrowers look for fair, understanding, and knowledgeable lenders. Lenders lend money to honest, knowledgeable borrowers, who can demonstrate a plan and ability to repay the loan. Both the borrower and the lender manage credit.

Management skills are necessary to operate an equine business successfully. These skills are gaining importance as the economy changes and the workplace changes. Management involves the best use of human resources and the best use of financial resources. Records are essential to good financial management.

Finally, any equine business must consider marketing, the need for insurance, and contracts.

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. A balance sheet is a type of accounting method.
2. Cost of feed represents a fixed cost.
3. Most businesses increase advertising when the business slows down.
4. Equine full mortality insurance insures a horse only against a trailering accident.
5. Cash basis is one accounting method.

Short Answer

6. Give an example of a fixed cost and a variable cost.
7. List five basic management functions used to achieve the goals and objectives of an equine business.
8. List four functions for records.
9. Name the three categories on a balance sheet.
10. Identify four types of credit.
11. List the five C's that are the cornerstone of sound credit.

Critical Thinking/Discussion

12. Describe strategic planning.
13. Discuss the components of a good boarding contract.
14. Give three tips for negotiating a loan.
15. Explain how to market an equine business.
16. Describe how insurance can protect an equine business.

STUDENT ACTIVITIES

1. Visit with a representative of a local small business association. Discuss the types of ownerships for a business—sole proprietorship, corporation, LLC or partnership. Develop a list of advantages and disadvantages of each.
2. Collect case studies of business problems, either financial or managerial. Suggest solutions for these problems. Match your skills against those of local business owners and managers.
3. Visit with several local business owners and discuss the problems encountered in human relations and human resources in the workplace. Discuss the roles of leadership training and managing of people.
4. Collect a variety of marketing material from some equine businesses. Evaluate its effectiveness. For example, compare the quality of photographs, paper, and clarity of writing.
5. Obtain a copy of a boarding contract. Read the contract for clarity. Check it for the five elements of a good contract that are listed in this chapter.
6. Check with local insurance agents and find out the type of insurance coverage they offer for horses and equine businesses. If possible, obtain an insurance policy. Read it and put the major points in your own words.

ADDITIONAL RESOURCES

Books

Bain, M. R. (2007). *The business of horses: Creating a successful horse business*. Parker, CO: Outskirts Press.

Eastwood, S., Jensen, A. R., and Jordon, A. (2006). *Business management for the equine industry*. Ames, IA: Wiley Blackwell.

English, J. E. (2003). *Complete guide for horse business success.* Tempe, AZ: Scholarly Custom Publishing.

Foulk, D. L., Mickel, R. C., Chamberlain, E.A., Margentino, M., and Westendorf, M. (2004). *Agricultural Management Practices for Commercial Equine Operations* . Rutgers, NJ: Cooperative Extension Service, Rutgers University. www.esc.rutgers.edu/downloads/.../FSe296_AgMgmtPractForComEquiOp.pdf

McDonald, M. A. (2009). *Starting and running your own horse business*. North Adams, MA: Storey Publishing.

Pelley, L. (1984). *In one barn: Efficient livestock housing and management.* Woodstock, VT: Countryman Press.

Toby, M. C. (2007). *The complete equine legal & business handbook: Legal insights and practical tips for a successful horse business.* Lexington, KY: Eclipse Press.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing find more information by searching for these words or phrases:

accounting
any words relating to
business
borrowing money
business management
estate planning
finances
horse (equine)
insurance
horse boarding
agreements
horse records
tax records

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

CHAPTER 22

Career Opportunities

The purpose of education and learning is to become employable and stay employable—to get and keep a job. People look for careers and careers look for people. Two broad categories of career opportunities in the equine industry are working for someone else or working for yourself. Success in any career requires some general skills and knowledge as well as some very specific skills and knowledge unique to a chosen occupation in the horse industry.

OBJECTIVES

After completing this chapter, you should be able to:

- List the basic skills and knowledge needed for successful employment and job advancement
- Describe the thinking skills needed for the workplace of today
- Identify the traits of an entrepreneur
- Identify primary, support, show, and rodeo careers in the horse industry
- Describe how to obtain education and experience needed to enter the horse industry
- List six general competencies needed in the workplace
- Describe five ways to identify potential jobs
- List eight guidelines for choosing a job
- List 10 guidelines for filling out an application form
- Describe a letter of inquiry or application
- Identify the role of electronic and social media in finding and obtaining a job
- Describe 10 reasons an interview may fail
- List 10 soft (intangible) skills important in the workplace
- Describe occupational safety from the employer's perspective and from the employee's perspective

KEY TERMS

competencies
creative thinking
cultural diversity
entrepreneur
follow-up letters
information literacy
internship
letter of application
letter of inquiry
resumes
risks
soft skills

BASIC SKILLS AND KNOWLEDGE

In study after study, research indicates that potential employees never acquire some very basic skills and knowledge. Without these basic skills and knowledge, the specific skills and knowledge for employment in the horse industry are of little value. The twenty-first-century workplace demands an even better-prepared individual than in the past. Basic skills include, reading, writing, arithmetic, and listening and speaking.

Basic Skills

Success in the workplace requires that individuals possess skills in reading, writing, arithmetic and mathematics, and listening and speaking, at levels identified by employers nationwide.

Reading

An individual ready for the workplace of today and the future demonstrates reading with the following **competencies**:

- Locates, understands, and interprets written information, including manuals, graphs, and schedules to perform job tasks
- Learns from text by determining the main idea or essential message
- Identifies relevant details, facts, and specifications
- Infers or locates the meaning of unknown or technical vocabulary
- Judges the accuracy, appropriateness, style, and plausibility of reports, proposals, or theories of other writers

Reading skills in the horse industry are necessary to keep up with new information, to understand directions for feeding or treating horses, and to understand the language of a contract (Figure 22–1).

Writing

Individuals ready for the workplace of today and the future demonstrate writing abilities with the following competencies:

- Communicate thoughts, ideas, information, and messages
- Records information completely and accurately
- Compose and create documents such as letters, directions, manuals, reports, proposals, graphs, and flowcharts with the appropriate language, style, organization, and format
- Check, edit, and revise for correct information, emphasis, form, grammar, spelling, and punctuation

In the equine industry, writing skills are necessary for such tasks as keeping stable records, taking a message, describing disease conditions, and requesting a test.

Arithmetic and Mathematics

The workplace of today and the future requires individuals with competencies in arithmetic and mathematics. Arithmetic is the science of computing with numbers by the

FIGURE 22–1 **Reading skills are important to success in life and on the job.**

operations of addition, subtraction, multiplication, and division. Mathematics is the application of arithmetic. Competencies important to those in the equine industry include:

- Perform basic computations
- Use numerical concepts such as whole numbers, fractions, and percentages in practical situations
- Make reasonable estimates of arithmetic results without a calculator
- Use tables, graphs, diagrams, and charts to obtain or convey information
- Approach practical problems by choosing from a variety of mathematical techniques
- Use quantitative data to construct logical explanations of real-world situations
- Express mathematical ideas and concepts verbally and in writing
- Understand the role of chance in the occurrence and prediction of events

Anyone not convinced of the value of arithmetic and mathematics to the horse industry should consider the skills required to figure feed conversion ratios or growth rates.

Listening and Speaking

Individuals working today and in the future must demonstrate an ability to really listen. This means to receive, attend to, and interpret verbal messages and other cues such as body language. Real listening means the individual comprehends, learns, evaluates, appreciates, and supports the speaker.

Speaking skills are used when obtaining and maintaining a job and communicating with coworkers. Career opportunities in sales rely on good speaking and communication skills. Individuals successful in the workplace demonstrate these speaking competencies:

- Organize ideas and communicate oral messages appropriate to listeners and situations
- Participate in conversation, discussion, and group presentations
- Use verbal language, body language, style, tone, and level of complexity appropriate for audience and occasion
- Speak clearly and communicate the intended message
- Understand and respond to listener feedback
- Ask questions when needed

Thinking Skills

Many research studies indicate that contrary to the old workplace, in the new workplace employers want workers who can think. Employers search for individuals showing competencies in these areas: **creative thinking**, decision making, problem solving, mental visualization, knowing how to learn, and reasoning (Figure 22–2).

Creative Thinking

Creative thinkers generate new ideas by making nonlinear or unusual connections and by changing or reshaping goals to imagine new possibilities. These individuals use imagination freely, combining ideas and information in new ways.

Decision Making

Individuals who use thinking skills to make decisions are able to specify goals and limitations to a problem. Next, they generate alternatives and consider all of the pros and cons before choosing the best alternative.

Problem Solving

As silly as it sounds, the first step to problem solving is recognizing that a problem exists. After this, individuals with problem-solving skills identify possible reasons for the problem and then devise and begin a plan of action to resolve it. As the problem is being solved, problem solvers monitor the progress and fine-tune the plan. Being able to recognize a disease condition and look for solutions is a good example of problem solving in equine science.

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FIGURE 22–2 Thinking skills are important for successful employment.

Mental Visualization

This thinking skill requires an individual to see things in the mind's eye by organizing and processing symbols, pictures, graphs, objects, or other information. For example, an individual might use visualization to picture a stable and corral from a diagram or to understand wiring and plumbing from a schematic.

Knowing How To Learn

Perhaps of all the thinking skills, this is most important with the rapid changes in available technology. Successful individuals recognize and can use learning techniques to apply and adjust existing and new knowledge and skills in familiar and changing situations. Knowing how to learn involves awareness of personal learning styles as well as formal (schooling) and informal (experience) learning strategies.

Reasoning

The individual who uses reasoning discovers the rule or principle connecting two or more objects and applies this to solving a problem. For example, physics teaches the theory of mechanical advantage; but the reasoning individual is able to use this information in understanding how the bones, joints, and muscles of the horse work individually and together.

General Workplace Competencies

Besides the basic skills and the thinking skills, the workplace of today and tomorrow demands general competencies in the use of resources, interpersonal skills, information, systems, and technology.

Resources

Resources of a business include time, money, materials, facilities, and people. Individuals in the workplace must know how to manage:

- Time through goals, priorities, and schedules
- Money with budgets and forecasts
- Material and facility resources such as parts, equipment, space, and products
- Human resources by determining knowledge, skills, and performance levels

Interpersonal

Successful people do not act in a vacuum. Most employees are members of a team where they contribute to the group. They teach others in their workplace when new knowledge or skills are needed. More than ever, and at all levels, individuals must remember to serve customers and satisfy customer expectations. Through teams, individuals frequently exercise leadership to communicate, justify, encourage, persuade, or motivate individuals or groups. As part of employment teams, individuals negotiate resources and interests to arrive at a decision. Finally, all interpersonal skills require individuals to embrace **cultural diversity**, a recognition of and sensitivity to the various backgrounds and norms of coworkers and customers.

Information

The Information Age is here. Individuals in the workplace must cope with and use information. Successful individuals will identify the need for information and evaluate information as it relates to a specific job. With the computer, individuals in the workplace must organize and process information in a systematic way. Also, with all this information available, individuals must interpret and communicate information to others using oral, written, or graphic methods. For example, breeding and performance data must be summarized. To manage production information, computer skills are the key (Figure 22–3).

Systems

No longer can any one aspect of a business or industry be viewed as a part that stands alone. Every aspect is part of a system, and successful individuals seek to understand systems—whether they are social, organizational, technological, or biological. With an understanding of the systems in a business, effective predictions and diagnoses can be made. Individuals can then modify systems to improve their products or services. For example, a person who breeds horses must understand the biological systems of reproductive genetics and animal behavior.

FIGURE 22–3
Computers and other technical devices open access to more information in any location than ever before.

Technology

Technology makes life easier only for those who know how to select it, use it, maintain it, and troubleshoot it. Technology is complicated and always changing. Successful individuals learn new technology and learn to apply appropriate technology through all the basic skills, thinking skills, and general workplace competencies.

INFORMATION LITERACY

Do to the advances in communication technology we are bombarded with information in many formats from many sources. **Information literacy** is the ability to:

- Identify what information is needed
- Understand how the information is organized
- Identify the best sources of information for a given need
- Locate the best sources
- Evaluate the sources critically
- Share the information

This process requires the use of the basic skills and the thinking skills.

Not all information is created equal: some is authoritative, current, reliable, but some is biased, out of date, misleading, false. The amount of information available is going to keep increasing. The types of technology used to access, manipulate, and create information will likewise expand—adding to the need for information literacy. This ability to find, evaluate, use and share information is an essential skill on the job. Information literacy is also a needed skill to participate fully in society as an informed citizen.

Many colleges, universities, and organizations offer training on information literacy like this one provided by the University of Idaho as an online, self-help module: http://www.webs.uidaho.edu/info_literacy/.

PERSONAL QUALITIES

Even with all the training in basic skills, thinking skills, and general workplace competencies, some individuals still fail for lack of personal qualities. These include responsibility, self-esteem, sociability, self-management, and integrity or honesty.

Responsible individuals work hard at tasks even when the task is unpleasant. Responsibility shows in high standards of attendance, punctuality, enthusiasm, vitality, and optimism in starting and finishing tasks.

Those possessing self-esteem believe in themselves and maintain a positive view of themselves. These individuals know their skills, abilities, and emotional capacity. They feel good about themselves.

Self-esteem and self-management are qualities that go hand in hand. Successful individuals demonstrate understanding, friendliness, adaptability, empathy, and politeness to other people. They demonstrate these skills in familiar and unfamiliar social situations. Such individuals are sincere people who take an interest in what others say and do.

Along with self-esteem is self-management. Individuals successful in business accurately assess their own knowledge, skills, and abilities while setting well-defined and realistic personal goals. Then, once goals are set, those who manage themselves begin to monitor their progress and motivate themselves through the achievement of goals. Self-management also implies that a person exhibits self-control and responds to feedback unemotionally and nondefensively.

Finally, to be successful in the equine industry, an employee or entrepreneur requires good old-fashioned honesty and integrity. Good ethics are still a part of good business.

INTANGIBLE SKILLS

More and more employers seek employees with intangible skills or **soft skills**, such as balance in a person's life, communicating effectively, problem solving, decision making, resolving conflict, working with others, planning, conducting effective meetings, professional growth, ethics, community service, and volunteerism. These skills are outside of technical skills needed in a job or career. Yet they often are more important in determining a person's success. Employers ask schools and colleges to teach these soft skills. Some schools and colleges have taught these skills, but often not in formalized classroom settings with prepared lessons and assessments. Many of these skills are gained as an individual is raised and reinforced when the student takes an active role in a club or organization such as FFA (https://www.ffa.org/) or National Postsecondary Agricultural Student Organization (PAS, http://www.nationalpas.org/). Leadership roles in an organization are particularly effective in developing these skills. Students who participate in contests such as the FFA Career Development Events

(CDE) or the PAS Career Program Areas (CPA) also seem to develop more of the soft skills important to success in the workplace.

Recognizing the need for these soft skills, many companies have developed formalized lessons, training, and assessment. For example, the National FFA Organization developed educational materials called LifeKnowledge that provide training in four areas of the soft skills—personal, organizational, career, and community. Some examples of soft skill competencies include:

- Work independently and in groups to get things done
- Focus on results and Plan effectively
- Identify and use resources
- Communicate effectively with others
- Take risks to get the job done
- Invest in others by enabling and empowering them
- Evaluate and reflect on actions taken and make appropriate modifications
- Practice human relations skills including compassion, empathy, unselfishness, trustworthiness, reliability, and listening
- Participate effectively as a team member
- Contemplate the future
- Adapt to opportunities and obstacles
- Persuade others to commit
- Live with integrity and make ethical decisions
- Accurately judge my values
- Accept responsibility for personal actions
- Respect others
- Practice self-discipline
- Value service to others
- Use a leadership and personal growth plan
- Practice healthy habits, including, eating, hygiene, and fitness
- Develop and maintain relationships and recognize differences exist among people
- Plan and implement professional ethics, goals, and priorities
- Establish emotional well-being and cope with life's trials

Top Ten Soft Skills

Often people lose their job or fail to get a job because of a soft skill failure and not a failure or lack of technical skills. Industry rates the top ten soft (intangible) skills as:

1. **Strong Work Ethic.** Motivated and dedicated to getting the job done, no matter what while being conscientious and doing the best work.
2. **Positive Attitude.** Optimistic and upbeat, generating generate good energy and good will in the workplace.
3. **Good Communication Skills**. Verbally articulate and a good listener, being able to make a case and express needs in a way that builds bridges with colleagues, customers and vendors.


Courtesy of USDA

FIGURE 22–4 Knowing the technical skills of horsemanship are important, but the soft skills are just as important to employers.

4. **Time Management Abilities.** Know how to prioritize tasks and work on a number of different projects at once to use time on the job wisely.
5. **Problem-Solving Skills.** Resourceful and able to creatively solve problems that will inevitably arise, taking ownership of problems.
6. **Acting as a Team Player.** Work well in groups and teams, being cooperative and taking a leadership role when appropriate.
7. **Self-Confidence.** Belief in ability to do the job, projecting a sense of calm and inspiring confidence in others, but with the courage to ask questions and to freely contribute ideas.
8. **Ability to Accept and Learn from Criticism.** Coachable and open to learning and growing as a person and as a professional.
9. **Flexibility/Adaptability.** Able to adapt to new situations and challenges, embracing change and be open to new idea.
10. **Working Well under Pressure.** Handle the stress that accompanies deadlines and crises, doing best work and coming through in a pinch.

Soft skills refer to a cluster of personal qualities, habits, attitudes, and social graces that make someone a good employee and compatible to work with. Employers value soft skills because research suggests and experience shows that they can be just as important an indicator of job performance as technical skills that relate to the actual job. (Figure 22–4).

ENTREPRENEURSHIP

For individuals working for themselves entrepreneurship is critical. This may also be a good trait for any employee.

The most common view of an **entrepreneur** is one who takes **risks**—a chance of loss—and starts a new business. But some traits of entrepreneurship are desirable at many levels of employment. Within any organization, an entrepreneur may:

- Find a better or more innovative use for resources
- Apply technology in a new way
- Develop a new market for an existing product
- Use technology to develop a new approach to serving an existing market
- Develop an idea that creates a new business or diversifies an existing business

Almost anyone can be an entrepreneur. Entrepreneurship is an attitude more than anything else—an attitude that incorporates many desired traits. The attitude of an entrepreneur includes:

- Taking risks with clear appreciation for the odds
- Focusing on opportunities and not problems
- Placing primary focus on the customer
- Seeking constant improvement
- Being impressed with productivity and not appearances
- Recognizing the importance of example
- Keeping things simple
- Using open-door and personal-contact leadership
- Encouraging flexibility
- Communicating purpose and vision

Entrepreneurs are ready for the unexpected, differences, new needs, demographic shifts, changes in perception, and new knowledge. Entrepreneurs are good employees and good employers. Entrepreneurs keep the equine industry growing.

EMPLOYMENT IN THE HORSE INDUSTRY

Individuals should choose a career based on passion, abilities, and aptitudes. Some people consider the only jobs available in the equine industry to be those in the actual raising or training of horses. But the industry as a whole requires a large number of people to support the infrastructure of suppliers, producers, and marketers.

Specific jobs or employment opportunities in the equine industry can be grouped into general categories. These include primary careers; horse shows and rodeos; the racehorse industry; recreation; equine supplies, support, and services; education; marketing; and research and development. Each area requires some unique skills.

Primary Careers

Primary careers are for those who want daily contact with horses and the horse industry, outside of horse shows, rodeos, and the racehorse industry as shown in the box below (Figures 22–5 and 22–6).

Supplies, Support, and Services

Occupations in the supplies, support, and services area include those that support the horse industry by providing the inputs necessary for an operation to be productive. These careers provide contact with horses and people in the horse industry, though not necessarily on a daily basis as shown in the box below (Figure 22–7).

Courtesy Rick Parker

FIGURE 22–5 **Mounted police officers at a National FFA Convention; a career requiring the knowledge and skills of equine science.**

Courtesy Rick Parker

FIGURE 22–6 **Working cowboys in feedlots and on ranches still use horses.**

Horse Shows and Rodeos

As shown in the box on the next page, for individuals interested in working with horse shows or rodeos, a variety of jobs are available (Figure 22–8). Some offer permanent employment and a steady income. Some require travel to attend horse shows or rodeos in different places

Primary Careers in the Horse Industry

Artificial inseminator	Groom
Breed registry officer	Horse auctioneer
Breeder	Horse buyer
Broodmare manager	Horse camp operator
Cowboy (feedlot or range)	Horse club operator
Equine consultant	Mounted police officer
Equine nutritionist	Ranch or feedlot cowhand
Equine researcher	Rehabilitation therapist
Equine veterinarian	Riding instructor
Exercise rider	Stable manager
Extension horse specialist	Stallion manager
Farm/ranch manager	Trainer
Farrier	Veterinary technician

Careers in Equine Supplies, Support, and Services

Accountant	Horse trailer sales and design
Advertising copywriter	Insurance agent
Architect	Land consultant
Attorney	Photographer
Author/writer	Reporter/journalist
Commercial artist	Saddle maker
Feed manufacturer	Tack and clothing retailer
Feed store operator	Tack and equipment maker
Film production and distribution	Transportation specialist

EDUCATION AND EXPERIENCE

Requirements to begin working in the horse industry vary depending on the level of work. One requirement common to all is practical work experience in the industry. To gain this practical experience, the new employee often begins at an entry-level job and then advances in the organization. Advancement depends on the skills and knowledge the employee brings to the job, the skills and knowledge gained on the job, and productivity on the job.

Entry-level educational requirements vary; but all of the basic skills, thinking skills, soft skills and general workplace competencies discussed earlier are important. These skills should be obtained in high school and reinforced during additional

Courtesy Rick Parker

FIGURE 22–7 **Saddle-making can be a fulfilling career requiring an artistic touch.**

Courtesy Rick Parker

FIGURE 22–8 **Being a course designer is just one of many jobs available in the horse show industry.**

Careers in Horse Shows and Rodeos

Announcer	Rodeo pickup rider
Arena director	Show groom
Course/jump designer	Show manager
Drug inspector	Show receptionist
Fair/exposition manager	Show secretary
Jockey	Show veterinarian
Judge	Steward
Jump builder	Stock contractor
Publicity director	Ticket seller
Rodeo clown	Timekeeper
Rodeo cowboy	

training and schooling. More specialized education in the equine industry is offered at some high schools, community colleges, and universities. Many high school agriscience programs provide the education necessary for lower entry-level positions. Often high school programs in agriscience provide students with supervised work experience in some aspect of agriculture. This is invaluable for getting a job and helping individuals determine if they wish to pursue additional education (Figure 22–9).

Some community colleges and other postsecondary schools provide specialized equine programs with practical experience as a part of the schooling. Programs at community colleges focus on entry-level technician jobs. Universities and colleges offering bachelor's degrees, master's degrees, and doctoral programs provide some highly specialized education in equine science. The HorseSchools.com (http://www.horseschools.com) provides some leads to equine programs at colleges and university and some guidelines on selecting a program.

Courtesy of ARS

FIGURE 22–9 **Supervised work experiences are invaluable to a student's future employment potential.**

EQUINE INDUSTRY—SUPERVISED AGRICULTURAL EXPERIENCE

A supervised agricultural experience (SAE) is designed to provide high school students with an opportunity to gain experience in agricultural areas based on their interests. An SAE represents the actual, planned application of concepts and principles learned in school-based agricultural education. Students experience and apply in real-life situations what is learned in the classroom. Students are supervised by agriculture teachers in cooperation with parents/guardians, employers, and other adults who assist them in developing and achieving of their educational goals. The purpose is to help students develop skills and abilities leading toward an agriculture-related career such as one in the horse industry.

Planning and conducting an SAE for equine science may include areas of career interest such as nutrition, veterinarian, stable manager, trainer, farrier, groom, instructor, sales, tack, saddle-making, and journalism. Students work with their instructors to

- Identify an appropriate SAE opportunity in the community
- Ensure that the SAE represents meaningful learning activities benefiting the student, the agriculture education program, and the community
- Obtain classroom and individual instruction on the SAE program
- Adopt a suitable record-keeping system
- Plan the SAE and acquire needed resources
- Coordinate release time and visits to SAE
- Sign a training agreement along with the employer, teacher, and parent/guardian
- Report on and evaluate the SAE and records resulting from it

Completing an SAE can prove to be an invaluable experience that will help when getting a job or pursuing more education. Additional help and ideas for planning and conducting an SAE can be found through the national FFA Web site at <http://www.ffa.org>.

INTERSHIPS

Students who continue their equine studies at a college or university will want to include one or more internships during their studies, indeed many programs require an **internship** before graduation. Interns work in a temporary position with an emphasis of on-the-job training. An internship is an opportunity to integrate career related experience into an undergraduate education by participating in planned, supervised work.

Characteristics of a good internship include:

- Contributes to the student's personal and professional development through challenging work assignments
- Completed before the student graduates from the college or university although in some cases internships can be completed the summer before graduation
- Planned and scheduled through consultation with the department or college so as to fit into the undergraduate experience

- Involves a supervision component that is mentoring and educational
- Includes career related experiences that complement what is learned in the classroom
- Provides a reflection and evaluation process at the conclusion of the internship
- Builds upon the relationship the department/college/university has with employers
- Successful when the student, the department/college, and the employer all share responsibility in making it a valuable experience

Internships at a college or university may also be called: cooperative education, practicum, externship or apprenticeship.

For the student, internships provide an opportunity to work in a career related environment where the student can try the career field, gain experience for employment, network with individuals in the career, apply knowledge, develop self-confidence, and job searching skills. Additionally, internships tend to make classroom learning more interesting and applicable.

Having a degree is not enough. Acquiring work experience for a resume is crucial. Many internships provide the opportunity to work on real projects for the company. Internship students need to be proactive and show initiative and willingness to be involved in the success of the company. Evidence of any work or projects completed should be saved to show future employers.

IDENTIFYING A JOB

Finding that first job or finding a different job can be difficult. Whole books, videos, and seminars are available on finding jobs. What follows are some suggestions. The Additional Resources section at the end of this chapter provides even more information.

Sources for locating jobs include:

- Classified advertisements in newspapers
- Magazines or trade journals and publications
- Personal contacts
- Placement offices
- Employment or personnel offices of companies
- Public notices
- Online Internet services

Newspapers, magazines, trade journals, and publications can be good resources for locating a job. By reading the advertisements in these publications, the potential employee can determine the demand for his or her job skills. Also, the potential employee can compare his or her skills and training with those listed in the advertisement.

A different twist on the classified advertisement is the “situation wanted” section of newspapers, magazines, and trade journals. Many people secure excellent jobs by advertising their skills.

Personal contacts are still the main source of jobs. Employers do not like to make mistakes. Some feel that the recommendation of a trusted acquaintance lessens the chances of making a hiring mistake. Also, personal contacts may know of job openings before they are publicly announced. This gives the potential employee more time to prepare and research the job. Personal contacts include friends, relatives, teachers, guidance counselors, and employees of the hiring company.

Placement offices provide vocational counseling, give aptitude and ability/interest tests, locate jobs, and arrange job interviews. There are three types of placement offices: public, private, and school. These agencies work to match employers with prospective employees. Often, too, an agency knows how to help potential employees prepare and present themselves.

Public placement offices are supported by federal and state funds. Their services are free. Private placement offices charge for the services they provide. This usually is a percentage of the beginning salary. Individuals using private placement services sign a contract before services are provided. High schools, trade schools, and colleges may maintain a placement service for their students. They also help individuals identify their aptitude or interest for a job and help in preparation for job interviews.

Many companies support their own employment or personnel office. Individuals seeking employment can fill out application forms and/or leave **resumes** in case a job becomes available.

Finally, some companies seeking new employees may issue a public notice of some kind. This includes posters or fliers on bulletin boards around a community. Posters or fliers are sent to related businesses and are posted on their bulletin boards. Schools and colleges often receive public announcements of jobs.

Posting of jobs on the Internet is another kind of bulletin board announcement. Some online information services maintain computerized databases of jobs. Using a computer, interested individuals contact a computerized database to search for jobs that match their qualifications and desires, such as location. This type of job listing can open the door to a wide variety of potential jobs. State or local job services also post jobs on Web sites. Many of these online services post resumes and provide help for writing resumes. AgCareers.com (http://www.agcareers) is a good example of a searchable online database of jobs that allow individuals to post resumes.

Career Clusters

A series of career clusters were developed to help students and instructors identify jobs and careers in 16 broad career areas. Career clusters provide a way for schools to organize instruction and student experiences around categories that encompass virtually all occupations from entry through professional levels. The clusters provide information on the knowledge and skill required. One of the 16 clusters is Agriculture, Food and Natural Resources; within that cluster are the occupations for animal science, which includes equine science. More information on the career clusters can be found at <http://www.careerclusters.org/16clusters.htm> or <http://www.agrowknow.org>.

GETTING A JOB

Once some job possibilities are identified, the work begins. Getting a job is difficult and requires some preparation. ("Finding a job is a full-time job.") Again whole books, videos, and seminars teach how to get a job. A few tips follow.

A Job Is More Than Money

Before taking a job, be certain that it is what you want. While the salary or the wage is important, job satisfaction is something quite different and very important. Jobs quickly become routine and mundane. A job with little fulfillment and challenge can easily become a chore for some people. Before taking a job or even while looking for a job, answer these questions:

1. Does the job description fit your interests?
2. Is this the level of occupation at which you wish to work?
3. Does this type of work appeal to your interests?
4. Are the working conditions suitable to you?
5. Will you be satisfied with the salary and benefits offered?
6. What are the advancement opportunities? Can you advance in this occupation as rapidly as you would like?
7. Does the future outlook satisfy you?
8. Is the occupation in demand now and in the foreseeable future?
9. Do you have or can you get the education needed for the occupation?
10. What type of training is available after taking the job?
11. Can you get the finances needed to get into the occupation?
12. Can you meet the health and physical requirements?
13. Will you be able to meet the entry requirements?
14. Do you know of any reasons you might not be able to enter this occupation?
15. Is the occupation available locally, or are you willing to move to a part of the country where it is available?

Also, before taking a job or looking for a job, do a little personality inventory of yourself. Consider the following:

1. Do I like to be alone or with people?
2. Am I mechanical or artistic?
3. Would I rather work independently or under supervision?
4. Would I prefer to be mentally or physically active?
5. Can I take authority and responsibility for others?
6. Must I have freedom to express creativity?
7. What things do I like to do? (Make a list.)
8. At what time of day do I work best?
9. Can I work under pressure or stress?
10. Make a list of your strong points. Consider skills, hobbies, and leisure-time activities you can offer an employer.

Do your research, and your job will be more rewarding. You will also feel better about yourself.

Research

Before applying for a position, it is a good idea to do a little research on the company and the job. Important things to learn about a job and/or company include:

- Name of the company
- Name of personnel manager or person who will conduct the interview
- Company address and phone number
- Position's minimum requirements and job responsibilities
- Geographic scope of the company—local, county, state, regional, national
- Company's product(s) and demand for the product(s)
- Recent company developments

Most companies maintain a Web site and much of the company information can found online.

Application Forms

If the company requires an application form, remember you are trying to sell yourself with the information you give. Review the entire application form before you begin. Pay particular attention to any special instructions to print or write in your own handwriting. When answering ads that require potential employees to apply in person, be prepared to complete an application form on the spot. Take a pen and a list with the information you will need to complete the application form. This information may include your Social Security number; the addresses of schools you have attended; names, phone numbers, and addresses of previous employers and supervisors; and names, phone numbers, and addresses of references.

These guidelines will provide you with some direction when completing application forms.

- Follow all instructions carefully and exactly.
- When your application is handwritten, write neatly and legibly. Handwritten answers should be printed unless otherwise directed.
- Application forms should be written in ink unless otherwise requested. If you make a mistake, mark through it with one neat line.
- Be honest and realistic. Give all the facts for each question but keep your answers brief.
- Fill in all the blanks. If the question does not pertain to you, write "not applicable" or "NA." If there is no answer, write "none" or draw a short line through the blank.
- Many application forms ask what salary you expect. If you are not sure what is appropriate, write "negotiable," "open," or "scale" in the blank. Before applying, try to find out the going rate for similar work at other locations. Give a salary range rather than exact figure.

Letters of Inquiry and Application

The purpose of a **letter of inquiry** is to obtain information about possible job vacancies. The purpose of a **letter of application** is to apply for a specific position that has been publicly advertised. Both letters indicate your interest in working for a particular company, acquaint employers with your qualifications, and encourage the employer to invite you for a job interview.

Letters of inquiry and application represent you. They should be accurate, informative, and attractive. Your written communications should present a strong, positive, professional image of you, both as a job seeker and future employee.

The following list should be used as a guide when writing letters of inquiry and letters of application.

1. Use 8½ × 11 inch white paper, not personal or fancy paper, and use an attractive, simple format. The letter and envelope should be neatly typed using a word processor and free of errors.
2. Write to a specific person. Use "To Whom It May Concern" only if you are answering a blind ad.
3. Make your letter short and specific, one or two pages at most; leave details to the resume.
4. Set a positive tone and use logical, organized paragraphs with ideas that are expressed in a clear, concise, direct manner.
5. Use carefully constructed sentences that are free of spelling or grammatical errors. Avoid slang words and expressions and excessive use of the word "I."

6. Avoid mentioning salary and fringe benefits.
7. Write a first draft and then make revisions.
8. Proofread the final letter yourself, and have someone else proofread it. Be sure you have addressed it and signed it correctly.

A letter of inquiry should:

1. Specify the reasons you are interested in working for the company and ask if any positions are available now or anticipated to open up in the near future.
2. Explain how your personal qualifications and work experience would help meet the needs of the company. (Since you are not applying for a particular position, you cannot relate your qualifications directly to job requirements.) Mention and include your resume.
3. Express your interest in being considered a candidate for a position when one becomes available, and state your willingness to meet with a company representative to discuss your background and qualifications. (Include your address and a phone number where you can be reached.)
4. Obtain the name of the personnel manager and address the letter of inquiry to him or her.

A letter of application should:

1. Indicate your source of the job lead (newspaper ad, etc.). Specify the particular job you are applying for and the reason for your interest in the position and the company.
2. Explain how your personal qualifications meet the needs of the employer and explain how your work experience relates to the job requirements. Mention and include your resume.
3. Request an interview and state your willingness to meet with a company representative to discuss your background and qualifications. (Include your address and a phone number where you can be reached.)
4. Obtain the name of the personnel manager and address the letter of application to him or her.

Resume

Many jobs require a resume. Everyone should have a resume and keep it up to date. Plenty of templates are online that can be used to get started. Resumes should be viewed in terms of layout and design and content. They should be visually pleasing and state accomplishments, not just previous job descriptions without any grammatical errors. A resume may express an individual's personality, but should be clear and concise, so it's not difficult for the potential employer to read. (Figure 22–10). The following information should be included:

- Name, address phone number, and email address
- Brief, specific statement of career objective
- Educational background—names of schools, dates, major field of study, degrees or diplomas—listed in reverse chronological order
- Leadership activities, honors, and accomplishments
- Work experience, listed in reverse chronological order

RESUME
Roger Brown

Contact Information
PO Box 1238
Anywhere, ID 00000
Phone: 000/888-8888
E-mail: rbrown@mail.com

Career Objective
Obtain a satisfying job in the equine industry that provides advancement opportunities during my career.

Education
College of Southern Idaho, Twin Falls, ID, 2010–2012: A.A.S., Equine Science.
Local High School, Anywhere, ID: Graduated 2010.

Activities and Honors
- Member Block and Bridle Club, 2010–2012.
- Advisor to local 4-H Club.
- Member 4-H Club with equine emphasis; learned judging and equitation.
- Member FFA for three years and was elected president during senior year.

Employment and Work Experiences
January 2009 to Present: Sun Valley Stables, Sun Valley, ID; general help; cleaned stalls and exercised horses.

July 2007 to December 2009: ABC Grocery, Anywhere, ID; restocked shelves; boxed groceries; promoted to checker position.

References
Available on request.

FIGURE 22–10 **A good resume shows information quickly and clearly.**

- Special technical skills and interests related to job
- References, if requested

Limit your resume to one page if possible. Make sure it is neatly word processed, error free, and logically organized. Be honest when listing qualifications and experiences, and make sure your strong points will stand out clearly at a glance. Employers look for a quick overview of who you are and how you might fit into their business. On the first reading, the employer will spend only 10 to 15 seconds reading a resume, so be sure to present relevant information clearly and concisely in an eye-catching format.

Before the Interview

In today's highly connected, electronic world some things can occur before the interview that will jeopardize an individual's chances of securing a job. Some of this comes under the heading of social media, like email and online networking. Make sure that your email address, your user name, is not offensive or vulgar. Go to your Web page or social network space (for example, on Facebook or MySpace), and remove any information and pictures that are embarrassing, vulgar, or crude. Frequently, human resources departments will check such sites.

Show up on time. Allow yourself a time margin such that if anything goes wrong. Do not be too early either. You should be no more than 10 minutes early for the appointment. Arriving early also allows time for a trip to the bathroom where among other activities you can check your hair, teeth, and face.

Your appearance is the first impression. You should be dressed appropriately and professionally for an interview and your clothes should be clean and pressed and your shoes polished. Make sure your fingernails are clean. Also tattoos and facial piercings should not be visible.

Turn off your cell phone and begin the interview with a firm handshake.

The Interview

The next step in the job-hunting process is the interview. Many sources of good information exist on how to do well in an interview. Perhaps the best advice comes from the interviewer's side of the desk. This is a list of reasons interviewers give for *not* placing applicants in a job.

- Poor attitude; not really eager to work, or interested only in the salary and benefits of the job
- Unstable work record; lacks direction or goals
- Lack of confidence and self-selling ability
- Lack of skill and experience; bad references
- "Bad mouthing" former employers
- Too demanding (wanting too much money or to work only under certain conditions)
- Unavailable for interviews; late for or cancels an appointment
- Poor appearance, poor grammar, use of slang
- Lack of manners and personal courtesy; chewing gum, smoking, or fidgeting
- No attempt to establish rapport; not looking the interviewer in the eye; being evasive
- Showing up with a friend (always go alone to an interview)

Both the FFA CDEs and the PAS CPAs provide opportunities for students to hone their interviewing skills.

Follow-up Letters

Follow-up letters are sent immediately after an interview. The follow-up letter demonstrates your knowledge of business etiquette and protocol. Always send a follow-up letter regardless of whether you had a good interviewing experience and even if you are no longer interested in the position. When employers do not receive follow-up letters from job candidates, they often assume the candidate is not aware of the professional courtesy they will need to demonstrate on the job.

The major purpose of a follow-up letter is to thank those individuals, by name, who participated in your interview. In addition, a follow-up letter reinforces your name, eagerness, and qualifications to the employer and indicates if you are still interested in the job position. It also offers you an opportunity to restate your reasons for wanting the job and explain why you think you are a strong candidate.

OCCUPATIONAL SAFETY

Employees in the equine industry should expect a safe and healthy workplace. Still, individuals may encounter such hazards as:

- Toxic chemicals in cleaning products
- Slippery floors
- Heavy lifting
- Stress
- Unsafe equipment
- Sharp objects
- Harassment
- Poor workstation design

To prevent or minimize exposure to occupational hazards, employers are expected to give employees safety and health training, including providing information on chemicals that could be harmful to an individual's health. If an employee is injured or becomes ill because of a job, many employers pay for medical care; sometimes employers provide lost wages.

Not only are equine industry employers responsible for creating and maintaining a safe workplace, but employees must do their part as well. Employee responsibilities include:

- Following all safety rules and instructions
- Recognizing and understanding the dangers of working around horses
- Using safety equipment and protective clothing when needed
- Looking out for coworkers
- Keeping work areas clean and neat
- Knowing what to do in emergency situations
- Reporting any health and safety hazards to the supervisor

For additional information about personal and occupational safety practices in the workplace, contact the Occupational Safety and Health Administration (OSHA) online at <http://www.osha.gov>, the National Institute for Occupational Safety and Health (NIOSH) at <http://www.cdc.gov/niosh/homepage.html>, or the U.S. Department of Labor at <http://www.dol.gov>.

SUMMARY

The goal of education and training is primarily to become employable and stay employable—to get and keep a job or run a successful business. The world of work requires people who can read, write, do math, and communicate. Rapidly advancing technology has made these skills even more critical. The modern workplace requires people who possess thinking skills. In addition to possessing a solid set of basic skills, future employees also need to relate well to other people, be able to use information, understand the concept of systems, and use technology.

Personal qualities such as responsibility, self-esteem, sociability, self-management, and integrity are not outdated concepts.

(*continues*)

Jobs in the equine industry range from those very closely tied to the industry to those that support the equine industry. In general, potential job areas include supplies and services, training, production, marketing, research, and development. Education and training for jobs in the equine industry vary from on-the-job training to high school and college degrees.

After training and education, finding and getting the right job may still be a challenge. Several good resources exist for locating a job. Still, the best one is personal contact. Well-written letters of inquiry and application, a clear, eye-catching resume, and being prepared for the job interview help secure a job (Figure 22–11).

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FIGURE 22–11 **Nothing can be quite as satisfying as to obtain the job that you really want and then enjoying time "in the saddle."**

REVIEW

Success in any career requires knowledge. Test your knowledge of this chapter by answering these questions or solving these problems.

True or False

1. Reading skills are not important for employees who feed horses.
2. Good ethics are still a part of conducting a horse business.
3. A veterinary technician does not require a science background.
4. General appearance is important in a job interview.
5. The horse industry includes much more than just riding and training horses.

Short Answer

6. List three traits of an entrepreneur.
7. Name four general competencies needed in the workplace.
8. Give three sources of information for finding a job.
9. List five types of work available in the horse show industry and five types in the support and services area of the horse business.
10. Name 10 primary careers in the horse industry.
11. List three options for an SAE in the equine industry.

Critical Thinking/Discussion

12. What is the purpose of knowledge and education?
13. Explain the differences between a letter of application, a letter of inquiry, and a follow-up letter.
14. What kinds of information are listed in a resume?
15. Describe five reasons that an interview may fail.
16. Discuss the importance of the soft skills to getting and keeping a job.
17. Describe an employee's responsibility to promoting occupational safety.

STUDENT ACTIVITIES

1. Gather sample resumes from local sources. Develop your own resume.
2. Collect position announcements and classified ads for jobs in the horse industry. Write a letter of inquiry and a letter of application for two selected jobs using this information.
3. Develop a list of questions frequently asked during job interviews. Use the questions in role-playing job interviews and video the interviews.
4. Visit a public or private placement office. Following the field trip, discuss the office's policies and how they affect job searchers and employers. Alternatively, invite a representative from a state employment agency to explain how employment agencies can help students gain employment.
5. Attend a career field day. Locate individuals currently employed in the horse industry to discuss career opportunities.
6. Select one career in the horse industry of interest, and prepare a research paper on the career using a computer and word processing software. The paper should identify the knowledge and skills required and the employment opportunities.
7. Collect pictures or photographs of people engaged in various careers with horses, and prepare a presentation of opportunities.
8. Meet with a resource person such as a business owner or personnel manager to discuss what he or she looks for in resumes, application letters and forms, and during interviews.
9. Visit with local agribusiness people to discuss the importance of employee work habits, basic skills, and attitudes, and how these affect the entire business.
10. Select one of the intangible (soft) skills and develop a example of that skill that can be shown to classmates.
11. Using the Web sites listed in this chapter, develop a presentation on occupational safety from the employer's or employee's perspective.

12. Using the Internet, visit some Web sites that post jobs, such as:

<http://www.agcareers.com>
<http://www.thingamajob.com>
<http://www.equimax.com/>
<http://www.monster.com>

Search for jobs in the equine/horse industry and look for any aids the site provides to those applying for a job.

ADDITIONAL RESOURCES

Books

Almos, A. (2007). *Horse Schools: The international guide to universities, colleges, preparatory and secondary schools, and specialty equine programs*. North Pomfret, VT: Trafalgar Square Publishing.

American Horse Council. (2010). *Horse industry directory.* Washington, DC: Author.

Aslett, D. (1993). *Everything I needed to know about business I learned in the barnyard.* Pocatello, ID: Marsh Creek Press.

Bain, M. R. (2007). *The business of horses: Creating a successful horse business*. Parker, CO: Outskirts Press.

Business Council for Effective Literacy. (1987). *Job-related basic skills: A guide for planners of employee programs.* New York: Business Council for Effective Literacy.

Eastwood, S., Jensen, A. R., and Jordon, A. (2006). *Business management for the equine industry*. Ames, IA: Wiley Blackwell.

English, J. E. (2003). *Complete guide for horse business success.* Tempe, AZ: Scholargy Custom Publishing.

Farr, M. & Shatkin, L. (2007). O*NET Dictionary of Occupational. St. Paul, MN: JIST Works, <http://www.onetonline.org/>

Ferguson. (2010). *Encyclopedia of Careers and Vocational Guidance* (5 Volume Set), 15th edition. New York, NY: Ferguson, an imprint of Infobase Publishing.

Hogue-Davies, V. (2004). *Careers with horses: The comprehensive guide to finding your dream job*. Irvine, CA: BowTie Press.

Kreitler, B. (1996). *50 careers with horses—from accountant to wrangler.* Ossining, NY: Breakthrough Publications.

Mandino, O. (1970). *The greatest salesman in the world.* New York: Fredrick Fell Publishers.

McDonald, M. A. (2009). *Starting and running your own horse business*. North Adams, MA: Storey Publishing.

Peters, T. (1994). *The pursuit of wow!* New York: Vintage Books.

U.S. Department of Education. (1991). *America 2000: An education strategy.* Sourcebook. Washington, D.C.: Author.

INTERNET

Internet sites represent a vast resource of information, but remember that the URLs (uniform resource locator) for World Wide Web sites can change without notice. Using one of the search engines on the Internet such as Google or Bing, find more information by searching for these words or phrases:

applying for a job	entrepreneurship	workplace competencies
career planning	finding jobs	workplace skills
creating a resume	horse industry careers or jobs	

Table A–18 in the appendix also provides a listing of some useful Internet sites that can serve as a starting point for further exploration.

APPENDIX

Due to its location in a book, and because of its name, an appendix is often ignored by the reader. But an appendix can contain valuable information that can enhance a reader's understanding and learning. Further, information in an appendix is quick and easy to find.

The information in this appendix includes a variety of useful conversion factors, feed standards and facts, a feeding worksheet, a gestation calculator, several health checklists and schedules, and the addresses for breed registries and equine organizations. Armed with this information, the reader can understand more, plan more, and learn more.

TABLE A–1 Conversion Tables for Common Weights and Measures

COMMON MEASURES	CONVERSION AMOUNTS
1 pound	454 grams
2.2 pounds	1 kilogram
1 quart	1 liter
1 gram	15.43 grains
1 metric ton	2,205 pounds
1 inch	2.54 centimeters
1 centimeter	10 millimeters or .39 inches
1 meter	39.37 inches
1 acre	.406 hectare

TABLE A–2 Weight Conversions

COMMON MEASURES	CONVERSION AMOUNTS
8 tablespoons	¼ pound
3 teaspoons	1 tablespoon
1 pint	1 pound
2 pints	1 quart
4 quarts	1 gallon or 8 pounds
2,000 pounds	1 ton
16 ounces	1 pound
27 cubic feet	1 cubic yard
1 peck	8 quarts
1 bushel	4 pecks
OTHER CONVERSIONS	
1 percent	.01
1 percent	10,000 parts per million
1 megacalorie (mcal)	1,000 calories
1 calorie (big calorie)	1,000 calories (small calorie)
1 megacalorie	1 therm

TABLE A–3 Standard Weights of Farm Products per Bushel

PRODUCT	POUNDS
Alfalfa	60
Apples (average)	42
Barley (common)	48
Beans	60
Bluegrass (Kentucky)	14–28
Bromegrass, orchardgrass	14
Buckwheat	50
Clover	60
Corn (dry ear)	70
Corn and cob meal	45
Corn (shelled)	56
Corn kernel meal	50
Corn (sweet)	50
Cowpeas	60
Flax	56
Millet (grain)	50
Oats	32
Onions	52
Peas	60
Potatoes	60
Ryegrass	24
Rye	56
Soybeans	60
Spelt	30–40
Sorghum	56
Sudangrass	40
Sunflower	24
Timothy	45
Wheat	60
Milk, per gallon	8.6

TABLE A–4 Storage and Feeding Dry Matter—Losses of Alfalfa

STORAGE METHOD	STORAGE LOSS (PERCENT)	FEEDING LOSS (PERCENT)
Small bales, stored inside	4	5
Round bales, stored inside	4	14
Hay stacks, stored inside	4	16
Round bales, stored outside	12	14
Hay stacks, stored outside	16	16
Haylage, vertical silo	7	11
Haylage, bunk silo	13	11

TABLE A–5 Bushel Weights and Volumes

ITEM	POUNDS/CUBIC FEET	CUBIC FEET/TON
Oats = 32 lb/bu	26	77
Barley = 48 lb/bu	38.4	53
Shelled corn = 56 lb/bu	44.8	45
Wheat = 60 lb/bu	48	42
Corn & cob meal = 70 lb/bu	28	72
Soybeans = 60 lb/bu	48	42
Rye = 56 lb/bu	44.8	45
Soybean oil meal = 54 lb	–	37
Dairy feed = 35 lb	–	57

TABLE A–6 Measurement Standards, Hay and Straw

ITEM	AVERAGE CUBIC FEET/TON	RANGE CUBIC FEET/TON
Hay, baled	275	250-300
Hay, chopped—field cured	425	400-450
Hay, chopped—mow cured	325	300-350
Hay, long	500	475-525
Straw, baled	450	400-500
Straw, chopped	600	575-625
Hay, loose	480	370-390
Straw, loose	800	750-850

TABLE A–7 Fahrenheit to Centigrade Temperature Conversions[1]

°F	°C	°F	°C	°F	°C
100	37.8	77	25.0	54	12.2
99	37.2	76	24.4	53	11.7
98	36.7	75	23.9	52	11.1
97	36.1	74	23.3	51	10.6
96	35.6	73	22.8	50	10.0
95	35.0	72	22.2	49	9.4
94	34.4	71	21.7	48	8.9
93	33.9	70	21.1	47	8.3
92	33.3	69	20.6	46	7.8
91	32.8	68	20.0	45	7.2
90	32.2	67	19.4	44	6.7
89	31.7	66	18.9	43	6.1
88	31.1	65	18.3	42	5.6
87	30.6	64	17.8	41	5.0
86	30.0	63	17.2	40	4.4
85	29.4	62	16.7	39	3.9
84	28.9	61	16.1	38	3.3
83	28.3	60	15.6	37	2.8
82	27.8	59	15.0	36	2.2
81	27.2	58	14.4	35	1.7
80	26.7	57	13.9	34	1.1
79	26.1	56	13.3	33	0.6
78	25.6	55	12.8	32	0.0

[1] Formulas used: $°C = (°F - 32) \times 5/9$ or $°F = (°C \times 9/5) + 32$

TABLE A–8 Conversion Factors for English and Metric Measurements

TO CONVERT THE ENGLISH	TO THE METRIC MULTIPLY BY	TO CONVERT METRIC	MULTIPLY BY	TO GET ENGLISH
acres	0.4047	hectares	2.47	acres
acres	4047	square meters	0.000247	acres
BTUs	1055	joules	0.000948	BTUs
BTUs	0.0002928	kilowatt hours	3415.301	BTUs
BTU/hours	0.2931	watts	3.411805	BTU/hours
bushels	0.03524	cubic meters	28.37684	bushels
bushels	35.24	liters	0.028377	bushels
cubic feet	0.02832	cubic meters	35.31073	cubic feet
cubic feet	28.32	liters	0.035311	cubic feet
cubic inches	16.39	cubic centimeters	0.061013	cubic inches
cubic inches	1.639×10^{-5}	cubic meters	61012.81	cubic inches
cubic inches	0.01639	liters	61.01281	cubic inches
cubic yards	0.7646	cubic meters	1.307873	cubic yards
cubic yards	764.6	liters	0.001308	cubic yards
feet	30.48	centimeters	0.032808	feet
feet	0.3048	meters	3.28084	feet
feet/minute	0.508	centimeters/second	1.968504	feet/minute
feet/second	30.48	centimeters/second	0.032808	feet/second
gallons	3785	cubic centimeters	0.000264	gallons
gallons	0.003785	cubic meters	264.2008	gallons
gallons	3.785	liters	0.264201	gallons
gallons/minute	0.06308	liters/second	15.85289	gallons/minute
inches	2.54	centimeters	0.393701	inches
inches	0.0254	meters	39.37008	inches
miles	1.609	kilometers	0.621504	miles
miles per hour	26.82	meters/minute	0.037286	miles per hour
ounces	28.349	grams	0.035275	ounces
fluid ounces	0.02947	liters	33.93281	fluid ounces
liquid pints	0.4732	liters	2.113271	liquid pints
pounds	453.59	grams	0.002205	pounds
quarts	0.9463	liters	1.056747	quarts
square feet	0.0929	square meters	10.76426	square feet
square yards	0.8361	square meters	1.196029	square yards
tons	0.9078	tons	1.101564	tons
yards	0.0009144	kilometers	1093.613	yards
yards	0.9144	meters	1.093613	yards

TABLE A–9 Gestation Calculator for Horses[1]

DATE OF SERVICE	ESTIMATED DATE OF BIRTH	DATE OF SERVICE	ESTIMATED DATE OF BIRTH	DATE OF SERVICE	ESTIMATED DATE OF BIRTH
01 Jan.	06 Dec.	30 May	05 May	27 Oct.	02 Oct.
06 Jan.	11 Dec.	04 June	10 May	01 Nov.	07 Oct.
11 Jan.	16 Dec.	09 June	15 May	06 Nov.	12 Oct.
16 Jan.	21 Dec.	14 June	20 May	11 Nov.	17 Oct.
21 Jan.	26 Dec.	19 June	25 May	16 Nov.	22 Oct.
26 Jan.	31 Dec.	24 June	30 May	21 Nov.	27 Oct.
31 Jan.	05 Jan.	29 June	04 June	26 Nov.	01 Nov.
05 Feb.	10 Jan.	04 July	09 June	01 Dec.	06 Nov.
10 Feb.	15 Jan.	09 July	14 June	06 Dec.	11 Nov.
15 Feb.	20 Jan.	14 July	19 June	11 Dec.	16 Nov.
20 Feb.	25 Jan.	19 July	24 June	16 Dec.	21 Nov.
25 Feb.	30 Jan.	24 July	29 June	21 Dec.	26 Nov.
01 Mar.	04 Feb.	29 July	04 July	26 Dec.	01 Dec.
06 Mar.	09 Feb.	03 Aug.	09 July	31 Dec.	06 Dec.
11 Mar.	14 Feb.	08 Aug.	14 July	05 Jan.	11 Dec.
16 Mar.	19 Feb.	13 Aug.	19 July	10 Jan.	16 Dec.
21 Mar.	24 Feb.	18 Aug.	24 July	15 Jan.	21 Dec.
26 Mar.	01 Mar.	23 Aug.	29 July	20 Jan.	26 Dec.
31 Mar.	06 Mar.	28 Aug.	03 Aug.	25 Jan.	31 Dec.
05 Apr.	11 Mar.	02 Sep.	08 Aug.	30 Jan.	05 Jan.
10 Apr.	16 Mar.	07 Sep.	13 Aug.	04 Feb.	10 Jan.
15 Apr.	21 Mar.	12 Sep.	18 Aug.	09 Feb.	15 Jan.
20 Apr.	26 Mar.	17 Sep.	23 Aug.	14 Feb.	20 Jan.
25 Apr.	31 Mar.	22 Sep.	28 Aug.	19 Feb.	25 Jan.
30 Apr.	05 Apr.	27 Sep.	02 Sep.	24 Feb.	30 Jan.
05 May	10 Apr.	02 Oct.	07 Sep.	01 Mar.	04 Feb.
10 May	15 Apr.	07 Oct.	12 Sep.	06 Mar.	09 Feb.
15 May	20 Apr.	12 Oct.	17 Sep.	11 Mar.	14 Feb.
20 May	25 Apr.	17 Oct.	22 Sep.	16 Mar.	19 Feb.
25 May	30 Apr.	22 Oct.	27 Sep.	21 Mar.	24 Feb.

[1] Assumes a 340-day gestation.

TABLE A–10 Vaccination Schedules for Different Classes of Horses

	PREGNANT MARES										
MONTH OF GESTATION	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Pneumabort-K (rhinopneumonitis)			X		X		X		X		
Flu (influenza)			(X)							X	
E & W (encephalitis: Eastern & Western)			(X)							X	
Tetanus toxoid			(X)								
Strangles*											
Potomac horse fever (PHF)*											
E-Se (Great Lakes states)**											
Equine viral arteritis (EVA)*											

* Depends on region, incidence, past history of disease.

** 1 cc/100 lb of mare; e.g., 10 cc/1,000-lb mare.

(X) = optional

	FOALS					
AGE	**AT BIRTH**	**2 MONTHS**	**3 MONTHS**	**4 MONTHS**	**5 MONTHS**	**6 MONTHS**
Rhinopneumonitis		X* then every 2 months				
Flu		X* then every 2 months				
E & W		X*				
Tetanus toxoid	X					
Strangles						X
Nonvaccination injection of vitamin E-selenium (equine product)	X**					

* Initial 4-way, booster 3 weeks later (the time when passive, colostral immunity decreases).

** 1 cc/100 lb (for Great Lakes, selenium-deficient states), most foals: 1 ccIM at birth.

	BARREN AND MAIDEN MARES
4-way	1 to 2 times per year (depends on traffic, exposure to a larger population)
Rhinopneumonitis	Rhinomune if separated from pregnant population; otherwise Pneumabort-K (more frequent administration)
Strangles	As above
PHF	As above

(*continues*)

TABLE A–10 (*continued*)

	STALLIONS
EVA	3 weeks prior to breeding to a known shedding stallion if the mare has a negative titer (i.e., no prior exposure to the virus)
Rhinopneumonitis	Rhinomune 2×/year, before breeding and at the end of the season
Flu	Contained in 4-way, 2×/year, then alone at alternate 2-month periods
E & W	Within 4-way, 2×/year
Tetanus toxoid	Within 4-way, or once a year
Strangles	If endemic
PHF	If endemic
EVA	If endemic, prior history, outbreak on farm; one month prior to breeding season
	YEARLINGS
Assuming prior boosters as foals/weanlings, continue with 4-way 2×/year and strangles vaccine. Rhinomune 2×/year.	

TABLE A–11 Vaccination Schedules

TYPE OF VACCINATION	SUGGESTED SCHEDULE
Tetanus toxoid	1 booster per year or when lacerated (cut) or injured.
Influenza	1 booster per year unless there is a special situation.
Rhinopneumonitis	1 booster per year unless there is a special situation. (Pregnant mares require a separate vaccination schedule.)
Eastern equine encephalomyelitis (EEE)	1 booster per year in endemic areas after initial vaccination series.
Potomac horse fever	1 booster per year after initial vaccination series in endemic areas.
Strangles	1 booster per year. This vaccine should be used only if necessary, based on past history of the horse or farm.
Equine viral arteritis	Special situation.
Rabies	Special situation.
Leptospirosis	Special situation.

Notes: Horses 1 year and older will be considered adults for scheduling vaccinations.

Special situations, such as erratic outbreaks of a given disease, heavy exposure to a variety of horses at shows or racetracks, or increased traffic into the farm or stable, will require a different vaccination schedule from the average program.

Consult your veterinarian about special situations. Clear combination vaccines (3- and 4-way products) vaccinate against several diseases simultaneously, check with your veterinarian before use.

Never vaccinate a sick horse until you check with your veterinarian—severe complications can result.

This schedule is based on proper use of vaccinations (foals given the initial injections in a vaccination series) up to 1 year of age.
Some vaccine products use one injection as a booster while others require a two-injection series repeated every year. Check with your veterinarian.

TABLE A–12 Checklist for Internal Parasites

Controlling internal parasites (worming) requires treating at certain intervals during the year with appropriate worming agents. This program should be designed in consultation with your veterinarian, who will consider:

- Number and type of horses
- Arrangement of pastures
- Traffic of horses
- Resistance of parasites to worming agents
- Use of tube worming vs. paste wormers
- Breeding program—pregnant mares and foals
- Use of fecal tests to determine effectiveness of treatment

The average adult horse should be wormed at least four times a year (every 3 months) or more frequently if your veterinarian advises. Even an effective program will not eliminate all parasites, but it will keep them at a tolerable level so they will not affect the health of the horse.

TABLE A–13 Checklist for External Parasite Control

External parasites include flies, mosquitoes, lice, etc. The three primary reasons to control external parasites are for the comfort of the horse, to prevent certain skin diseases, and to lower the incidence of some diseases that are transmitted by insects.

The two most effective methods of external parasite control are cleanliness and appropriate use of chemical repellents.

Caution: Check with your veterinarian if the horse is exhibiting any of the following symptoms:

- Hair loss other than normal shedding
- Excessive itching
- Sores on the skin

Always follow the label directions on insecticides carefully.

TABLE A–14 Checklist for Equine Dental Program

Each horse that is a yearling or older should have a dental examination by a veterinarian at least once per year. Other examinations might be necessary if symptoms occur.

Symptoms that warrant examination:

- Difficulty chewing
- Reluctance to drink cold water
- Quidding—dropping food out of the mouth
- Excessive unchewed grain in the manure
- Constipation colics
- Weight loss
- Swelling or tenderness in jaw region
- Reluctance to accept a bit

During the examination, the horse's teeth can be floated—filed down to remove any sharp edges that can interfere with proper chewing. In the younger horse, other procedures might also be required, such as removal of wolf teeth or dental caps.

TABLE A–15 Feed Requirement Worksheet

Class of Horse ___________

Owner's Name ________________________________ | _________ Mature horse at rest
Address ___________________________________ | _________ Mature horse at moderate work
Breed of Horse ________________________________ | _________ Mare in last 90 days of pregnancy
Weight of Horse _________________ Age _________ | _________ Mare in peak of lactation (first 3 months)
| _________ Growing foal ________ Mature weight

		Dig. Energy	Dig. Protein	Ca	P	Vit. A 1,000
A. Your horse's daily requirements		_____ mcal	_____ lb	_____ g	_____ g	_____ IUs
I		II	III	IV	V	VI
B. Ration lbs. of						×(1,000
		×(mcal/lb) =mcal	×(C P/lb) =lb C P	×(Ca/lb) = g Ca	×(P/lb) = g P	IUs/lb) = 1,000 IU
Feedstuff	each					
_____	_____	×(___)=___	×(___)=___	×(___)=___	×(___)=___	×(___)=___
_____	_____	×(___)=___	×(___)=___	×(___)=___	×(___)=___	×(___)=___
_____	_____	×(___)=___	×(___)=___	×(___)=___	×(___)=___	×(___)=___
_____	_____	×(___)=___	×(___)=___	×(___)=___	×(___)=___	×(___)=___
_____	_____	×(___)=___	×(___)=___	×(___)=___	×(___)=___	×(___)=___
C. Total lb supplied by ration		____mcal	____lb	____g	____g	_____1,000 IUs
D. Horse's requirement		____mcal	____lb	____g	____g	_____1,000 IUs
E. Needed nutrients		____mcal	____g	____g	____g	_____1,000 IUs

F. Instructions

1. Determine the class of horse and record requirements in line A.
2. List ration ingredients and pounds of each in the appropriate columns.
3. Be sure ration ingredients in B do not exceed 2 to 2.5 percent of body weight.
4. Obtain feed compositions and record in cols. II, III, IV, V, and VI.
5. Multiply pounds of each feed (col. I) times each value in cols. II, III, IV, V, and VI.
6. Total the nutrients from each source to get total in ration (line C values).
7. Copy nutrient requirements from line A to line D.
8. Subtract line C values from line D values and record any deficiencies in line E.

TABLE A–16 Breed Registry Associations

Akhal Teke Registry of America
21314 129th Avenue SE
Snohomish, WA 98296-7843
vniik@ryazan.rinf.ru
http://www.akhal-teke.org/

American Baskir Curly Registry
PO Box 151029
Ely, NV 89315
http://www.abcregistry.org/

American Buckskin Registry Association
PO Box 493850
Redding, CA 96049-3850
Georgijones@aol.com
http://www.americanbuckskin.org

American Connemara Pony Society
2360 Hunting Ridge
Winchester, VA 22603
secretary@acps.org
http://www.acps.org/

American Cream Draft Horse Association
PO Box 2065 Noble Avenue
Charles City, IA 50616-9108
http://www.imh.org/imh/bw/cream.html

American Dartmoor Pony Association
15870 Pasco-Mantra Road
Anna, OH 45302

American Dominant Gray Registry
10980 “8” Mile Road
Battle Creek, MI 49017-9560

American Exmoor Pony Registry
PO Box 477
Pittsboro, NC 27312-0477
exmoor@bmts.com
http://www.imh.org/imh/bw/exmoor.html
http://www.exmoorponysociety.org.uk/address.php

American Hackney Horse Society
4059 Iron Works Parkway, Suite 3
Lexington, KY 40511-8462
http://www.hackneysociety.com/

American Haflinger Registry
1685 East Waterloo Road
Akron, OH 44306-4103
ahaflinger@sbcglobal.net
http://www.haflingerhorse.com/

American Half Quarter Horse Registry
PO Box 1198
Apache Junction, AZ 85217-1198
lzmqhorses@earthlink.net
http://halfquarterhorseregistry.com/

American Hanoverian Society
4059 Iron Works Pike
Lexington, KY 40511
AHSoffice@aol.com
http://www.hanoverian.org/

American Holsteiner Horse Association
222 East Main Street, Suite 1
Georgetown, KY 40324-1712
ahhambr@bellsouth.net
http://www.holsteiner.com/

American Horizon Horse Registry
Box 1923
Edgewood, NM 87015

American Indian Horse Registry
9028 State Park Road
Lockart, TX 78644
http://www.indianhorse.com/

American Miniature Horse Association
5601 South Interstate 35 W
Alvarado, TX 76009
http://www.amha.org

American Miniature Horse Registry
PO Box 3415
Peoria, IL 61614-3415
http://www.shetlandmini.com/

American Morgan Horse Association
4066 Shelburne Rd Ste 5
Shelburne VT 05482-6908
info@morganhorse.com
http://www.morganhorse.com/

TABLE A–16 (*continued*)

American Mustang and Burro Association
P.O. Box 608
Greenwood, DE 19950

American Mustang Association
PO Box 338
Yucaipa, CA 92399

American Paint Horse Association
PO Box 961023
Fort Worth, TX 76161-0023
http://www.apha.com/

American Quarter Horse Association
PO Box 200
Amarillo, TX 79168
http://www.aqha.com/

American Quarter Pony Association
PO Box 30
New Sharon, IA 50207
http://www.aqpa.com/

American Saddlebred Horse Association
4093 Iron Works Parkway
Lexington, KY 40511-8434
http://www.american-saddlebred.com/

American Shetland Pony Club
81 B Queenwood Road
Morton, IL 61550
info@shetlandminiature.com
http://www.shetlandmini.com/

American Shire Horse Association
2354 315 Court
Adel, IA 50003
Secretary@Shirehorse.org
http://www.shirehorse.org/

American Suffolk Horse Association
4240 Goehring Road
Ledbetter, TX 78946-9707
http://www.suffolkpunch.com/

American Tarpan Studbook Association
150 Joan Street
Medford, WI 54451

American Trakehner Association
1536 West Church Street
Newark, OH 43055
atahorses@alltel.net
http://www.americantrakehner.com/

American Walking Pony Registry
PO Box 5282
Macon, GA 31208-5282

American Warmblood Society
24516 Taylor Road
Lincoln, MO 65338
http://www.americanwarmblood.org/

American Welara Pony Society
PO Box 401
Yucca Valley, CA 92286-0401
http://www.welararegistry.com

Appaloosa Horse Club
2720 West Pullman Road
Moscow, ID 83843
http://www.appaloosa.com

Arabian Horse Association
10805 E. Bethany Drive
Aurora, CO 80014
http://www.arabianhorses.org/default2.asp

Belgian Draft Horse Corporation of America
125 Southwood Drive, PO Box 335
Wabash, IN 46992-0335
belgian@belgiancorp.com
http://www.belgiancorp.com/

Caspian Horse Society of the Americas Corporate Offices
PO Box 1589
Brenham, TX 77834-1589
chsregistrar@aol.com
http://www.caspian.org/

Chilean Corralero Registry International
230 East North Avenue
Antigo, WI 54409

(*continues*)

TABLE A–16 (*continued*)

Cleveland Bay Horse Society of North America
PO Box 483
Goshen, NH 03752
cbhsna@aol.com
clevelandbay@mesnetworks.net
http://www.clevelandbay.org

Clydesdale Breeders of the U.S.A.
17346 Kelley Road
Pecatonica, IL 61063
secretary@clydesusa.com
http://www.clydesusa.com/

Draft Cross Breeders & Owners Association
PO Box 543
Fishers, IN 46038
Admin@draftcrossbreedersandowners.com
http://www.dcboa.com/

Falabella Miniature Horse Association
33222 N Fairfield Rd
Round Lake, IL 60073
falabellafmha@aol.com
http://www.falabellafmha.com/

Florida Cracker Horse Association
2992 Lake Bradford Rd South
Tallahassee, FL 32310
hardeemail@cox.net
http://www.floridacrackerhorses.com/

Friesian Horse Association of North America
4037 Iron Works Parkway, Suite 160
Lexington, KY 40511-8488
fhana@fhana.com
http://www.fhana.com/

Galiceno Horse Breeders Association
Box 219
Godley, TX 76044-0219

Golden American Saddlebred Horse Association
4237 30th Avenue
Oxford Junction, IA 52323-9724
http://www.american-saddlebred.com/

Haflinger Association of America
14570 Gratiot Rd
Hemlock, MI 48626
http://www.equinepost.com/resources/breeds/showBreed.asp?ID=131

Half Quarter Horse Registry of America
29264 Bouquet Canyon Road
Saugus, CA 91350

Half Saddlebred Registry of America
4093 Iron Works Parkway
Lexington, KY 40511
http://www.asha.net/ASR-HSHA-Registration

International Arabian Horse Association
10805 E. Bethany Drive
Aurora, CO 80014
iaha@iaha.com
http://www.iaha.com

International Arabian Horse Registry of North America
PO Box 325
Delphi Falls, NY 13501-0325

International Buckskin Horse Association
PO Box 268
Shelby, IN 46377-0268
IBHA@netnitco.net
http://www.ibha.net/

International Colored Appaloosa Association
PO Box 4424
Springfield, MO 65808-4424

International Curly Horse Organization
North American Curly Horse Registry
HC 31 Box 102A
Williamsburg, NM 87942
office@curlyhorses.org
http://www.curlyhorses.org/

International Morab Breeders Association
24 Bauneg Beg Road
Sanford, ME 04073
imba@morab-imba.com
http://www.morab.com/

(*continues*)

TABLE A–16 *(continued)*

International Plantation Walking Horse Association
908 N Hollywood
Burbank, CA 91505
http://www.walking-horse.com/state/address.html

International Sport Horse Registry, Inc.
Oldenburg Registry, North America
517 DeKalb Ave
Sycamore, IL 60178
ISREG@aol.com
http://www.isroldenburg.org/

International Trotting and Pacing Association (Trottingbred/Harness Racehorse)
60 Gulf Road
Gouverneur, NY 13642
Phone: (315) 287-2294
Fax: (317) 287-5010
Office Manager Kathy Denesha
ldenesha@twcny.rr.com
http://www.trottingbreds.homestead.com

Lippizan Association of North America
PO Box 1133
Anderson, IN 46015-1133
lana@lippizan.org
http://www.lipizzan.org/

Missouri Fox Trotting Horse Breed Association
PO Box 1027
Ava, MO 65608-1027
BeckyHuff@mfthba.com
http://www.mfthba.com/

The Purebred Morab Horse Association.
W2802 Emons Road, Appleton WI 54915
pmha@puremorab.com
http://www.puremorab.com/

Mountain Pleasure Horse Association
PO Box 33
Wellington, KY 40387
jamurphy@mrtc.com
http://www.mountainpleasurehorse.org/

National Half Quarter Horse Registry
539 Tsatsawassas Lake Road
East Nassua, NY 12062
Taz1919@aol.com

National Pinto Arabian Registry
9706 CR 2440
Royse, TX 75189

National Pinto Horse Registry
2812 Velvarde Drive
Thousand Oaks, CA 91360
pintoregistry@msn.com
http://www.pintohorseregistry.com/

National Spotted Saddle Horse Association
PO Box 898
Murfreesboro, TN 37133-0898
nssha898@aol.com
http://www.nssha.com/

New Forest Pony Association
PO Box 206
Pascoag, RI 02859
http://www.newforestpony.net/

North American District of the Belgian Warmblood Breeding Association
5749 General Hunton Road
Broad Run, VA 22014-4877

North American Exmoors
RR 4 Box 273
Amherst, Nova Scotia, B4H 3Y2
CANADA

North American Morab Horse Association
W, 3174 Faro Springs Road
Hilbert, WI 54129

North American Mustang Association and Registry PO Box 850906
Mesquite, TX 75185-0906

(continues)

TABLE A–16 (*continued*)

North American Peruvian Horse Association
3095 Burleson Retta Road, Suite B
Burleson, TX 76028
info@NAPHA.net
barbara@leaperuvianhorses.com
http://www.pphrna.org/
or
PO Box 2187
Santa Rosa, CA 95405
db@igait.com

North American Selle Francais Horse Association
PO Box 646
Winchester, VA 22604-0646

North America Shagya (Arabian) Society
PO Box 225
Delphi Falls, NY 13051
kadavis@abcs.com
http://www.shagya.net/

North American Single-Footing Horse Association
4055 Villa Creek Road
Cayucos, CA 93430
contact@singlefootinghorse.com
http://www.singlefootinghorse.com/

North American Trakehner Association
1536 West Church Street
Newark, OH 43055
atahorses@alltel.net
http://www.americantrakehner.com/

Norwegian Fjord Assn of North America
24570 W Chardon Road
Grayslake, IL 60030

Palomino Horse Association
10171 Nectar Avenue
Nelson, MO 65347
http://www.palominohorseassoc.com/

Palomino Horse Breeders of America
15253 E Skelly Drive
Tulsa, OK 74116-2637
http://www.palominohba.com/

Palomino Ponies of America
160 Warbasse Junction Road
Lafayette, NJ 07848-9408

Paso Fino Horse Association, Inc.
4047 Iron Works Parkway, Suite 1
Lexington, KY 40511
http://www.pfha.org/

Percheron Horse Association of America
PO Box 141, 10330 Quaker Rd.
Fredericktown, OH 43019-0141
percheron@percheronhorse.com
http://www.percheronhorse.org/

Performance Horse Registry
United States Equestrian Registry
4047 Iron Works Parkway
Lexington, KY 40511
kball@usef.org
http://www.phr.com/

Peruvian Part Blood Registry
2027 Cribbens Street
Boise, ID 83704

Peruvian Paso Horse Registry of North America
3077 Wiljan Court, Suite A
Santa Rosa, CA 95407
db@igait.com
http://www.pphrna.org

Pintabian Horse Registry
PO Box A
Karlstad, MN 56732
http://www.pintabians.org/

Pinto Horse Association of America, Inc.
7330 NW 23rd Street
Bethany, OK 73008
http://www.pinto.org/

Pony of the Americas Club
3828 South Emerson Avenue
Indianapolis, IN 46203-5990
http://www.poac.org/

(*continues*)

TABLE A–16 (*continued*)

Purebred Morab Horse Association, Inc.
W2802 Emons Road
Appleton, WI 54915
http://www.puremorab.com/

Quarter Sport Horse Registry
1463 Country Lane
Bellingham, WA 98225-8515

Racking Horse Breeders Association of America
67 Horse Center Road, Suite B
Decatur, AL 35603
RHBAA67HORSE@aol.com
http://www.rackinghorse.com/

Ridden Standardbred Association
1578 Fleet Road
Troy, OH 49373

Rocky Mountain Horse Association
4037 Iron Works Parkway, Suite 160
Lexington, KY 40511
information@rmhorse.com
http://www.rmhorse.com/

Royal Warmblood Studbook of the Netherlands
North American Department
PO Box 0
Sutherlin, OR 97479
office@kwpn-na.org
http://www.nawpn.org/

Spanish Mustang Registry
323 County Road 419
Chilton, TX 76632
dildine@hot1.net
MAT@vtc.net
http://www.spanishmustang.org/

Spanish-Barb Breeders Association International
PO Box 1628,
Silver City, NM
or
12284 Springdale Road
Terry, MS 39170

Spanish-Norman Registry, Inc.
PO Box 985
Woodbury, CT 06798
http://www.spanish-norman.com/

International Sport Horses of Color
PO Box 1567
Cottage Grove, OR 97424
info@shoc.org
http://www.shoc.org/

Standardbred Pleasure Horse Organization
31930 Lambson Forest Road
Galena, MD 21653

Swedish Gotland Breeders' Society
c/o Livestock Breeders Conservancy
PO Box 477
Pittsboro, NC 27312

Swedish Warmblood Association
PO Box 1587
Coupeville, WA 98239
or
515 Stageline Road
Hudson, WI 54016

Swedish Warmblood Association of North America
PO Box 788
Socorro, NM 87801
Office@swanaoffice.org
http://www.swanaoffice.org/

Tennessee Walking Horse Breeders' and Exhibitors' Association
PO Box 286
Lewisburg, TN 37091-0286
http://www.twhbea.com/

The Jockey Club
821 Corporate Drive
Lexington, KY 40503-2794
http://home.jockeyclub.com/

Thoroughbred Horses for Sport
PO Box 160
Great Falls, VA 22066

(*continues*)

TABLE A–16 (*continued*)

Thoroughbred in Sport Association 964 Gale Drive Wisconsin Dells, WI 53965	Universal Perkehner Society PO Box 1874 Cave Creek, AZ 85331
United Quarab Registry 31100 NE Fernwood Road Newberg, OR 97132 or Box 12754 Ogden, UT 84412	Walkaloosa Horse Association PO Box 3170 Carefree, AZ 85377 contact@walkaloosaregistry.com http://www.walkaloosaregistry.com/
United States Icelandic Horse Congress 38 Park Street Montclair, NY 07042 http://www.icelandics.org/ http://www.icelandichorsebreeders.org/	Walking Horse Owners' Association of America P.O. Box 4007 Murfreesboro, TN 37129 whoa@walkinghorseowners.com http://walkinghorseowners.com/
United States Lipizzan Registry 8480 O'Hare Road Las Vegas, NV 89143-1235 USLRoffice@aol.com http://www.uslr.org	Welsh Pony and Cob Society of America 720 Green Street Stephens City, VA 22655 registrar@welshpony.org http://www.welshpony.org/
United States Trotting Association 750 Michigan Avenue Columbus, OH 43215-1191 customerservice@ustrotting.com http://www.ustrotting.com	Westfalen Warmblood Association of America 18432 Biladeau Lane Penn Valley, CA 95946

TABLE A–17 National and International Horse Organizations

American Driving Society
PO Box 278
1837 Ludden Dr., Suite 120,
PO Box 278
Cross Plains, WI 53528
mailto:susie.koos-acker@americandrivingsociety.org
http://www.americandrivingsociety.org/

American GrandPrix Association
1301 6th Avenue West, Suite 406
Bradenton, FL 34205
http://www.stadiumjumping.com

United States Hunter-Jumper Foundation
3870 Cigar Lane
Lexington, KY 40511
ahjf@earthlink.net
http://www.ahjf.org/

American Paint Horse Association
PO Box 961023
Fort Worth, TX 76161-0023
askapha@apha.com
http://www.apha.com/

American Polocrosse Association
PO Box 158
Bonneau, SC 29431
info@americanpolocrosse.org
http://www.americanpolocrosse.org/

American Quarter Horse Assn
1600 Quarter Horse Drive
Amarillo, TX 79168-0001
http://www.aqha.com/

American Royal Association
1701 American Royal Court
Kansas City, MO 64102
http://www.americanroyal.com/

American Saddlebred Association, Inc
4093 Iron Works Pike
Lexington, KY 40511
saddlebred@asha.net
http://www.asha.net/

American Vaulting Association National Office
8205 Santa Monica Blvd., #1-288
West Hollywood, CA 90046
AmericanVaulting@aol.com
http://www.americanvaulting.org/

American Warmblood Society
24516 Taylor Road
Lincoln, MO 65338
aws@americanwarmblood.org
http://www.americanwarmblood.org/

Appaloosa Horse Club
2720 West Pullman Road
Moscow, ID 83843
http://www.appaloosa.com

Appaloosa Horse Club of Canada
4189-3rd St. SE, PO Box 904
Claresholm, AB TOL 0T0
CANADA
aphcc@appaloosa.ca
http://www.appaloosa.ca/

Arabian Horse Association
10805 E Bethany Dr.
Aurora, CO 80014
http://www.arabianhorses.org
info@arabianhorses.com

Asian Racing Federation Secretariat Office
Andrew Harding
Australian Racing Board
7/51 Druitt Street
Sydney N.S.W 2000
AUSTRALIA
arb@australian-racing.net.au
http://www.asianracing.org/contact_main.html

International Azteca Horse Association
RR #2
Paris, ON N3L 3E2
CANADA
jdc@aztecana.com
http://www3.sympatico.ca/azcc/IAzHA.html

(continues)

TABLE A–17 (*continued*)

Back Country Horsemen of America
PO Box 1367 Graham, WA 98338
info@backcountryhorse.com
http://www.backcountryhorse.com/

Barrel Futurities of America, Inc.
Secretary/Treasurer
Main Office:
Cindy Arnold
Rt. 2 Box 120 K
Vian, OK 74962
cindy@barrelfuturitiesofamerica.com
http://www.barrelfuturitiesofamerica.com/

Canadian Belgian Horse Association
17150, Conc. 10
Schomberg, ON L0G 1T0
CANADA
cbha@csolve.net
http://www.canadianbelgianhorse.com/

Canadian Buckskin Association
PO Box 135
Okotoks, AB T0L 1T0
CANADA

Canadian Cutting Horse Association
RR 3
Innisfail, AB T4G 1T8
CANADA
cchasec@ccha.ca
http://www.ccha.ca/

Canadian Dressage Owners & Riders Association
RR 2
Millbrook, ON L0A 1G0
CANADA
info@cadora.ca
http://www.cadora.ca/

Canadian Driving Society
Drive Canada
PO Box 2062
Vancouver, BC V6B 3S3
CANADA
drivecanada@shaw.ca
http://www.norwestcontrols.com/cds/index.html

Canadian Fjord Horse Association
Box 1335
Killarney, MB R0K 1G0
CANADA
joankemp@mts.net
http://www.cfha.org/

Canadian Hackney Society
RR 1
Linsay, ON K9V 4R1
CANADA
banness@sympatico.ca
http://www.hackney.ca/

Canadian Haflinger Association
6004 Sixth Line E
Ariss, ON N0B 1B0
CANADA
mweeden@hsfx.ca
http://www.haflinger.ca/

Canadian Horse Breeders Association/ Société des Éleveurs de Chevaux Canadiens
59 rue Monfette Local 108,
Victoriaville, QC G6P 1J8
Phone: (418) 268-3443
Fax: (418) 268-3599
http://www.clrc.on.ca/canadian.html

Canadian Icelandic Horse Federation Secretary
Box 189
Ari de Lint
2647 Stonecroft Dr.
Abbotsford, BC
V3G 1K8
CANADA
lauscher@can.rogers.com
http://www.cihf.ca/

Canadian Percheron Association
Box 1504
Vernon, BC V1T 8C2
CANADA
canadapercheron@uniserve.com
http://www.canadianpercherons.com/

(*continues*)

TABLE A–17 (*continued*)

Canadian Professional Rodeo Association
272245 RR 2
Airdrie AB T4A 2L5
CANADA
cpra@rodeocanada.com
http://www.rodeocanada.com/

Canadian Shire Horse Association
1882 Conc. Road 10
Blackstock, ON L0B 1B0
CANADA
quinteshire@bel.auracom.com
mhousejb@telusplanet.net
cshawebmaster@sympatico.ca
http://www.canadianshirehorse.com/

The Carriage Association of America, Inc.
3917 Jay Trump Road
Lexington, KY 40511
info@caaonline.com
http://www.caaonline.com/

Clydesdale Horse Association of Canada
RR 2
Hopewell, NS B0K 1C0
CANADA
mlangille@auracom.com
http://www.canadianclydes.com

Del Mar National Horse Show
2260 Jimmy Durante Blvd
Del Mar, CA 92014
http://www.sdfair.com/horseshow/

Foundation Quarter Horse Association
11418 Shiloh Church Rd, Mena,
AR 71953
fqha@hughes.net
http://www.fqha.com/

Gladstone Equestrian Association
PO Box 119
Gladstone, NJ 07934
GladstoneEq@gladstonedriving.org
http://www.gladstonedriving.org/

Golden American Saddlebred Horse Association
4237 30th Avenue
Oxford Junction, IA 52323-9724
smamrose@usmicro-solutions.com
http://www.gasha.org/

Hanoverian Breeders Club of Eastern Canada
580 Goodwood Rd, RR 4
Uxbridge, ON L0P 1R4
CANADA
ursula@sympatico.ca
http://www.hanoverianbreedersclub.com/

Hanoverian Horse Society
RR 2
Elora, ON N0B 1S0
CANADA

Intercollegiate Horse Show Association
webcommittee@ihsainc.com
JimArrigon@hotmail.com
http://www.ihsa.com/

International Arabian Horse Association
10805 E Bethany Drive
Aurora, CO 80014
iaha@iaha.com
http://www.iaha.com/

International Buckskin Horse Association
PO Box 268
Shelby, IN 46377-0268
http://www.ibha.net/

International Halter-Pleasure Horse Association
256 N Highway 377
Pilot Point, TX 76258-9624

International Hunter Futurity
PO Box 13244
Lexington, KY 40583-3244
inthf1@windstream.net
http://www.inthf.org/

International Jumper Futurity & Young Jumper Championships
International Jumper & Dressage Futurity
yjcoffice@youngjumpers.com
or
Young Jumper Championships
PO Box 1445
Georgetown, KY 40324
ijfoffice@youngjumpers.com
http://www.youngjumpers.com/

(*continues*)

TABLE A–17 (*continued*)

The International Side-Saddle Organization PO Box 161 Stevensville, MD 21666 ISSOAside@aol.com http://www.sidesaddle.com/	National Snaffle Bit Association 4845 S Sheridan, Suite 515 Tulsa, OK 74145 http://www.nsba.com/
Japan Racing Association New York Office 1010 Washington Blvd., 9th Floor Stamford, CT 06901-2202 info@nyjra.com http://japanracing.jp/	North American Riding for the Handicapped Association PO Box 33150 Denver, CO 80233 narha@narha.org http://www.narha.org/
Masters of Foxhounds Association of America PO Box 363 Millwood, VA 22646 office@mfha.com http://www.mfha.com/	Palomino Horse Association HC 63 Box 24 Dornsife, PA 17823 http://www.palominohorseassoc.com/ srebuck@mail.tds.net
National Barrel Horse Association PO Box 1988 Augusta, GA 30903-1988 http://www.nbha.com/	Palomino Horse Breeders of America 15253 East Skelly Drive Tulsa, OK 74116 http://www.palominohba.com/mareswopapers.htm
National Cutting Horse Association 260 Bailey Ave Fort Worth, TX 76107 jdavis@nchacutting.com http://www.nchacutting.com/	Palomino Horse Breeders of America 15253 E Skelly Drive Tulsa, OK 74116-2637 yellahrses@aol.com http://www.palominohba.com/
National Grand Prix League 2508 Keller Pkwy. St. Paul, MN 55109	Professional Horsemen's Association of America 2009 Harris Road. Penfield, NY 14526 http://www.nationalpha.com/
National Horse Show Commission PO Box 167 1021 Colloredo Boulevard Shelbyville, TN 37162 http://www.nationalhorseshowcommission.org/	The Pyramid Society 4067 Iron Works Parkway, Suite 2 PO Box 11941 Lexington, KY 40579 info@pyramidsociety.org http://www.pyramidsociety.org/
National Reining Horse Association 3000 NW 10th Street Oklahoma City, OK 73107 http://www.nrha.com/	The Ride and Tie Association 8215 E White Oak Ridge #41 Orange, CA 92869 RideandTieDon@aol.com http://www.rideandtie.org/

(*continues*)

TABLE A–17 (*continued*)

Side-Saddle International
Pittern Hill House
Kineton, Warwick
CV35 OJF ENGLAND
info@sidesaddleinternational.com
http://www.sidesaddleinternational.com/

Societe Des Eleveurs De Checaux Canadiens
68 rue Deslauriers
Pierrefonds, PQ H8Y 2E4
CANADA

Special Olympics International
1133 19th St. NW
Washington, DC 20036
info@specialolympics.org
http://www.specialolympics.org/Special+Olympics+Public+Website/default.htm

Team Pen America, Inc.
1302 Dinkle Rd
Stanley, NM 87056
tpanews@teampenamerica.com
http://www.teampenamerica.com/index.html

Tennessee Walking Horse National Celebration
PO Box 1010
Shelbyville, TN 37162
cnixon@twhnc.com
http://www.twhnc.com/

United Professional Horsemen's Association
4059 Iron Works Parkway, Suite 2
Lexington, KY 40511
uphakgr@aol.com
http://www.uphaonline.com/

United States Dressage Federation
4051 Iron Works Parkway
Lexington, KY 40511
Secretary@usdf.org
http://www.usdf.org/

United States Equestrian Team
1040 Pottersville Road
PO Box 355
Gladstone, NJ 07934
bjenkins@uset.org
http://www.uset.com/

United States Eventing Association
525 Old Waterford Road, NW
Leesburg, VA 20176
info@useventing.com
http://www.eventingusa.com/

United States Hunter Jumper Association
3870 Cigar Lane
Lexington, KY 40511
sdotson@ushja.org
http://www.ushja.org/

United States Olympic Committee
1 Olympic Plaza
Colorado Springs, CO 80909
media@usoc.org
http://www.teamusa.org/

United States Polo Association
771 Corporate Drive, Suite 430
Lexington, KY 40503
uspa@uspolo.org
http://www.uspolo.org/

United States Team Penning Association
PO Box 4170
Fort Worth, TX 76164
angie.grizzell@ustpa.com
http://www.ustpa.com/

United States Team Roping Championships
PO Box 1198
Stephenville, TX 76401
ustrc@ustrc.com
http://www.ustrc.com/Home/

United States Vaulting Federation
RD 1, Box 235
Pittstown, NJ 08867-9722

USA Equestrian Federation
4047 Iron Works Parkway
Lexington, KY 40511
webmaster@usef.org
http://www.usef.org/

TABLE A–18 Equine Science Resources on the Internet

NAME/TOPIC	URL
About.com (Horse Page)	http://animals.about.com/cs/mammals/a/blwl070903.htm
Agriculture Online	http://www.agriculture.com/
Alberta Agriculture	http://www.agric.gov.ab.ca/app21/seltopic?cat1=Livestock&cat2=Horses
American Association of Equine Practitioners (AAEP)	http://www.aaep.org/
American Horse Council	http://www.horsecouncil.org/
American Veterinary Medical Association (AVMA)	http://www.avma.org/
Animal Health Products	http://www.ahp-vet.com
Center for Animal Health	http://www.aphis.usda.gov/vs/ceah/ncahs/index.htmMonitoring
Certified Horsemanship	http://www.cha-ahse.org
Colleges—Equine	http://www.uscollegesearch.org/equestrianequine-studies-horse-management-colleges.html
Cornell Veterinary Medicine	http://www.vet.cornell.edu/publicresources/animalhealth/
Discover Horses	http://www.discoverhorses.com/
Equestrian Conservation	http://www.elcr.org/
Equijournal	http://www.equijournal.com/
Equimax	http://www.equimax.com/
Equine Affaire	http://www.equineaffaire.com/
Equine Canada	http://www.equestrian.ca/ http://www.equinecanada.ca/
Equine Info	http://www.equineinfo.com/
Equine Law	http://www.kentuckylaw.com/
Equine Massage/Muscle	http://www.equinemmt.com
Equine Research	http://www.csupomona.edu~erc/ http://www.equineguelph.ca/ http://www.ca.uky.edu/agcollege/vetscience/ukerf1.htm http://www.sandhillsonline.com/equestrian/research.htm http://vet.osu.edu/282.htm
Equine Science Center	http://www.esc.rutgers.edu/
Equine Studies	http://www.equinestudies.umd.edu/ http://www.equinestudies.org/ http://www.equinecollege.org/ http://www.animalscience.uconn.edu/
Equine Veterinary Network	http://www.equinevetnet.com/
EquiSearch	http://www.equisearch.com
Equiworld	http://www.equiworld.net/
Extension	http://www.cals.ncsu.edu/an_sci/extension/horse/hhmain.html http://extension.missouri.edu/main/displayCategory.aspx?C+15 http://www.ansi.okstate.edu/library/equine.htm http://www.utextension.utk.edu http://www.vgl.ucdavis.edu/

TABLE A–18 (*continued*)

NAME/TOPIC	URL
Farriers' Information	http://www.farriers.com/area7.htm http://www.uscollegesearch.org/oklahoma-farriers-college-inc.html http://www.horseshoes.com/
Horse Books	http://www.horsebooksonline.com/ http://www.horseinfo.com/ http://www.abebooks.com/home/HORSEBOOKSPLUS/ http://www.equibooks.com/bookstore.html http://www.equine-research-inc.com http://www.horse.com/depts/dept.aspx?dept=246&maindept=242 http://www.halfhaltpress.com/asp/home.asp
Horse Breeds of the World	http://www.imh.org/imh/bw/home2.html
Horse Farm Net	http://www.horsefarm.net/
Horse Forum	http://horseforum.com/
Horse Genetics	http://www.vgl.ucdavis.edu
Horse Health	http://www.sohahorses.org/
Horse Information Center	http://www.horseinfo.com/
Horse Net	http://www.horsenet.com/
Horse Sanctuary	http://www.equus.org/
Horse Training Info	http://www.kbrhorse.net/pag/train.html
Horse World Club	http://www.horseworld.net/
Horse Worldwide	http://www.horseworldwide.com/
HorseWeb	http://www.horseweb.com/
International Museum of the Horse	http://www.imh.org/
Kentucky Equine Research	http://www.ker.com/
Kentucky Horse Park	http://www.kyhorsepark.com/
Morris Animal Foundation	http://www.morrisanimalfoundation.org/
National Sporting Library	http://www.nsl.org/
NetVet	http://netvet.wustl.edu/
Pasture and Hay for Horses	http://www.noble.org/Ag/Forage/HorsePasture/index.htm
Publications	http://www.americanhorsepubs.org/communication/newsletter_archive/news_97_05.htm http://www.fqha.com/ http://www.westernhorseman.com/ http://www.thoroughbredtimes.com/ http://horsepages.com/ http://www.horseadvice.com/advisor/ http://www.webpony.com/ http://www.hunterandsporthorsemag.com/ http://www.virtualhoss.com/

(*continues*)

TABLE A–18 (*continued*)

NAME/TOPIC	URL
	http://www.horsecountry.com/ http://www.thearabianmagazine.com/ http://www.horsemagazine.com/ http://www.youngrider.com/youngrider/ http://www.rockymountainrider.com/
The Horse.com	http://www.thehorse.com/
Tillers International	http://www.tillersinternational.org/
U.S. Cavalry Association	http://www.uscavalry.org/
USDA	http://www.usda.gov/
Yahoo! Equine Page	http://dir.yahoo.com/Recreation/sports/equestrian/

TABLE A–19 Alignment of Textbook with Agriculture, Food And Natural Resources (AFNR) Career Clusters Career Pathway for Animal Systems (AS) and National Standards[1]

ANIMAL SYSTEMS (AS)[2]: PERFORMANCE ELEMENT	ANIMAL SYSTEMS (AS)[2]: PERFORMANCE INDICATOR	NATIONAL STANDARDS[3]	*EQUINE SCIENCE* CHAPTER
AS.01. Examine the components, historical development, global implications and future trends of the animal systems industry.	AS.01.01 Evaluate the development and implications of animal origin, domestication and distribution.	Science C3: Develop and understanding of biological evolution Social Studies 7h: Apply economic concepts and reasoning when evaluating historical and contemporary social developments and issues;	1, 2, 3
AS.02. Classify, evaluate, select and manage animals based on anatomical and physiological characteristics.	AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.	Science C3: Biological evolution	1, 2, 7, 8, 9, 16
	AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.	Science: Develop an understanding of: C1: The Cell C5: Matter, energy and organization in living systems F2: Population growth	4, 5, 6, 9
	AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.	Science C5: Develop an understanding of matter, energy and organization in living systems.	3, 6, 7, 8, 9, 12
AS.03. Provide for the proper health care of animals.	AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites and other disorders.	Science: Develop and understanding of: C4: Interdependence of organisms F1: Personal and community health F5: Natural and human-induced hazards	14, 15, 16, 17, 18
	AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.	Science: Develop an understanding of: F5: Natural and human-induced hazards F6: Science and technology in local, national and global challenges Social Studies 9d: Analyze the causes, consequences, and possible solutions to persistent, contemporary, and emerging global issues, such as health, security, resource allocation, economic development, and environmental quality.	14, 18

(*continues*)

TABLE A–19 (*continued*)

ANIMAL SYSTEMS (AS)[2]: PERFORMANCE ELEMENT	ANIMAL SYSTEMS (AS)[2]: PERFORMANCE INDICATOR	NATIONAL STANDARDS[3]	*EQUINE SCIENCE* CHAPTER
AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction and economic production of animals.	AS.04.01. Indicator: Formulate feed rations to provide for the nutritional needs of animals.	Math 1C: Compute fluently and make reasonable estimates. Math 6B: Solve problems that arise in mathematics in other contexts. Science A4: Develop the ability to recognize and analyze alternative explanations and models. Science C5: Develop an understanding of matter, energy, and organization in living systems.	12, 13
	AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.	Science C5: Develop and understanding of matter, energy, and organization in living systems.	12, 13
AS.05. Evaluate and select animals based on scientific principles of animal production.	AS.05.01. Evaluate the male and female reproductive systems in selecting animals.	Science: Develop and understanding of: C1: The cell C3: Biological evolution	11
	AS.05.02. Evaluate animals for breeding readiness and soundness.	Science C6: Develop and understanding of the behavior of organisms.	11, 8
	AS.05.03. Apply scientific principles in the selection and breeding of animals.	Math 6C: Apply and adapt a variety of appropriate strategies to solve problems. Science: A4: Develop the ability to Formulate and revise scientific explanations and models using logic and evidence. C2: Develop an understanding of the molecular basis of heredity. E2: Develop an understanding about science and technology.	8. 9, 10
AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.	AS.06.01. Demonstrate safe animal handling and management techniques.	Science C6: Develop an understanding of the behavior of organisms.	16, 18, 19, 20

(*continues*)

TABLE A–19 (*continued*)

ANIMAL SYSTEMS (AS)[2]: PERFORMANCE ELEMENT	ANIMAL SYSTEMS (AS)[2]: PERFORMANCE INDICATOR	NATIONAL STANDARDS[3]	*EQUINE SCIENCE* CHAPTER
	AS.06.02. Indicator: Implement procedures to ensure that animal products are safe.	Science: Develop and understanding of: F1: Personal and community health F5: Natural and human-induced hazards	19, 20
AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing and handling of animals.	AS.07.01. Design animal housing, equipment and handling facilities for the major systems of animal production.	Science: Develop and understanding of: C6: The behavior or organisms F6: Science and technology in local, national, and global challenges	18
	AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.	Science F5: Develop an understanding of natural and human-induced hazards.	18
AS.08. Analyze environmental factors associated with animal production.	AS.08.01. Reduce the effects of animal production on the environment.	Science: Develop an understanding of: C4: The interdependence of organisms F4: Environmental quality	18
	AS.08.02. Evaluate the effects of environmental conditions on animals.	Science: Develop an understanding of: C6: Behavior of organisms F4: Environmental quality	16, 18, 19, 14
Agribusiness Systems (ABS) Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.[4]			21, 22
Cluster Content Standard (CS): The student will demonstrate competence in the application of leadership, personal growth and career success skills necessary for a chosen profession while effectively contributing to society.[4]			22

[1]National AFNR Career Cluster Content Standards were developed by a committee of the National Council for Agricultural Education (The Council) as part a National FFA project to provide state agricultural education leaders and teachers with a forward-thinking guide for what students should know and be able to do through the study of agriculture in grades 9 through 14. A complete copy of these standards is available online at: http://www.teamaged.org/council/images/stories/pdf/finalafnrstandardsv324609withisbn_000.pdf

[2]Definition of Animal Systems (AS)—the study of animal systems, including life processes, health, nutrition, genetics, management and processing, through the study of small animals, aquaculture, livestock, dairy, horses and/or poultry

[3]National Council of Teachers of Mathematics, National Science Education Standards and Expectations of Excellence: Curriculum Standards for Social Studies

[4]Refer to complete National AFNR Career Cluster Content Standards online at: http://www.teamaged.org/council/images/stories/pdf/final afnrstandardsv324609withisbn_000.pdf

Notes: The Cluster Skills serve as the foundation for all pathways. They involve skills that apply to all pathways within the AFNR Career Cluster. Such concepts as leadership, communication, teamwork and general safety are included in the Cluster Skills.

(*continues*)

TABLE A–19 (*continued*)

Within each pathway, the standards are organized as follows:

- Pathway Content Standard—This is a general statement indicating the broad area of knowledge covered in each pathway. For Animal Systems (AS) the Pathway Content Standard: is that the student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.
- Performance Elements—These represent the major topical areas within each pathway.
- Performance Indicators—These are more precise statements that serve as an indication of the knowledge/ability the student should possess.
- The content standards as developed and published by The Council include measurements. These are not included in this table. Measurements are sample measurable activities that students might carry out to indicate attainment of each Performance Indicator. The measurements are broken into three levels as follows:
  - Level I—These are fundamental activities/abilities students possess at roughly the 9th- and 10th-grade levels upon which all other activities are built.
  - Level II—These are activities/abilities that will build on the first-level knowledge and are skills that students possess at roughly the 11th- and 12th-grade levels.
  - Level III—These are activities/abilities that will build in complexity from the first two levels and are skills students possess at roughly the 13th- and 14th-grade levels. These skills may be obtained at the end of the high school level in more focused programs, in which case articulation agreements with postsecondary institutions are encouraged.

These measurement levels can be found online at http://www.teamaged.org/council/images/stories/pdf/finalafnrstandards v324609withisbn_000.pdf

Correlations by state available upon request. Contact your sales representative for more information.

GLOSSARY

Like a foreign language, terms unique to equine science can be baffling to the newcomer. When individuals travel to a foreign country and want to do business, they are expected to know the language of the country. The same is true for the individual wanting to learn about horses. Indeed, the term glossary means obscure or foreign words of a field. Successful individuals use the glossary and learn the language. Words not found in the glossary may be listed in the index or defined within a chapter of the book.

A

abdomen—The part of the body between the thorax and the pelvis (the belly region).

abdominal worm—Nematode parasite that lives in the abdominal cavity.

abductors—Muscles that move a limb away from the center plane of the horse.

abortion—Premature termination of a pregnancy.

abscess—A localized collection of pus in a cavity formed by disintegration of tissues.

absorption—To take in by various means.

accounting—A system of recording, classifying, and summarizing commercial transactions in terms of money.

accrual accounting—An accounting system in which expenses are considered expenses when they are committed and income is counted as income when it is earned. This includes changes in inventory.

acid solution—A solution with pH less than 7 (for example, a mixture of equal parts of vinegar and water).

active immunity—A long-lasting immunity that is achieved when an animal is challenged and stimulated to produce its own antibodies.

acute—Refers to a disease that runs a short, severe course.

additive genes—The members of a gene pair that have equal ability to be expressed.

adductors—Muscles that pull a limb toward the center plane on the horse.

adenosine triphosphate (ATP)—The universal energy-transfer molecule.

adhesion—The abnormal union of surfaces normally separated by the formation of new fibrous tissue resulting from inflammation.

adipose—Fat tissue.

adrenal cortex—Outer portion of the adrenal gland producing corticosteroids.

adrenal medulla—Center portion of the adrenal gland producing epinephrine and norepinephrine.

aerobic—Occurring only in the presence with oxygen.

afferent—Nerves that carry impulses toward the central nervous system.

agglutination—A clumping together of living cells caused by an antibody.

aglactic mare—A mare not producing milk in adequate quantities.

agonistic behavior—Combative behavior.

aids—The means by which a rider communicates with a horse (e.g., hands, legs, voice, and seat).

air requirements—Refers to the ventilation necessary for the size and number of animals in a building.

albino—A horse with the dominant W allele, which lacks pigment in skin and hair at birth. The skin is pink, the eyes brown (sometimes blue), and the hair white. Such a horse is termed white.

alkaline solution—A solution with pH greater than 7 (for example, a spoonful of baking soda in a pint of warm water).

allantois—Embryonic/fetal membrane.

alleles—The alternative form of a gene having the same place in a homologous chromosome, or genes on the same location of a pair of homologous chromosomes.

allelomimetic behavior—Mimicry behavior.

allergy—Heightened sensitivity to a particular substance that does not affect the majority of the group.

alveoli—The sac in the lung where the exchange of oxygen and carbon dioxide occurs.

amble—A lateral gait, distinguished from the pace by being slower and more broken in cadence. It is not a show gait.

amino acids—The building blocks that make up the body's protein.

amniotic fluid—Fluid contained within the innermost of the fetal membranes, just outside the fetus.

anaerobic—Occurring without oxygen.

anaphylactic shock—An extreme antigen-antibody reaction.

anatomical—Refers to the structural parts of the body and the relation of its parts.

androgens—Hormones that maintain and control masculine characteristics.

anemia—A condition in which blood is deficient in red blood cells.

anestrus—The time when a mare does not cycle or have a heat period; usually occurs in the winter.

aneurysm—When a blood vessel is dilated and then fills with blood.

angle of incidence—Refers to the angle at which the incisor teeth meet.

angulation—The amount of angle.

ankle—The joint connecting foot and the leg.

annuals—Plants that complete their life cycle from seed in one growing season.

anoplocephaliasis—A disease of yearlings at pasture caused by tapeworms.

anterior—Forward (in space) or toward the head.

anthelmintics—Drugs used to treat worms in horses.

antibiotics—Substances with the capacity to inhibit the growth of or kill microorganisms.

antibodies—Large protein molecules that destroy bacteria, yeast, some viruses, and toxins.

antigens—Substances that, when introduced into an organism, induce an immune response consisting of the production of a circulating antibody.

anti-inflammatory—Drugs that can be used to lessen pain and decrease inflammation.

antiseptic—An agent used in the treatment of wounds or disease to prevent the growth and development of germs.

anus—The exterior posterior opening of the digestive tract.

anvil—A heavy block of iron or steel on which metal may be forged.

aorta—The main vessel that carries blood to all bodily organs except the lungs.

apprenticeship—A job that involves working under the supervision of a professional for a variable amount of time. This type of job may or may not include a salary.

Archeohippus—One of the early ancestors of the modern horse.

arteries—Vessels that carry blood from the heart.

arthritic—Inflammation of a joint.

articulation—Where the joints come together.

artificial insemination (AI)—Introducing sperm cells into the female reproductive tract by means other than natural service.

ascarids—Part of the large groups of parasites known as roundworms.

as-fed basis—Indicates that the amount of nutrients in a feed or diet is expressed in the form in which it is fed.

assets—The property or resources owned and controlled by a business.

assimilation—The transforming of digested foods into an integral and homogenous part of the solids or fluids of the organism.

atrophy—A wasting away or shrinking of muscle.

atropine—An alkaloid compound used as an antispasmodic.

auditory—The sense of sound.

autonomic nervous system—The system that is concerned with control over the digestive system, eyes, blood vessels, glandular products, and other automatic functions.

axon—A nerve cell that conducts impulses away from the cell body.

azoturia—A disease common to draft horses and characterized by the passing of red or brown urine.

B

Babesia—Small protozoan parasites that occur in red blood cells. Ticks are the intermediate hosts.

baby teeth—Temporary teeth.

back—Trotting in reverse.

bacterial spore—A microscopic form of a bacterium that is very resistant to damage.

bad mouth—A malocclusion where the top and bottom teeth do not meet.

bag up—A term used to describe the development of the mammary glands near the time of parturition.

balance—The ability of a horse to coordinate action, go composed, and be in form.

balance sheet—Statement of the assets owned and liabilities owed in dollars. It shows equity or net worth at a specific point in time.

bald face—A wide white marking that extends beyond both eyes and nostrils.

banding—A style of manes seen in Western show horses. Manes are sectioned and fastened with rubber bands.

Bang's—Another name for brucellosis.

barn sour—A horse that will run back to the barn.

barren mare—A mare that has not had a foal.

bars—(1) The structure that keeps the hoof wall from overexpanding. It is a support structure that angles forward from the hoof wall. (2) The gap between a horse's incisors and molars. (3) Side points on the tree of a saddle.

basal metabolism—Minimal energy requirements to maintain vital body processes.

base-narrow toe-in—Narrow at the feet.

base-wide toe-out—Wide at the feet.

beat—Refers to the time when a foot—or two feet simultaneously—strike the ground. Beats may or may not be evenly spaced in time.

bedding—A cushioning material for an animal.

bench knees—Lateral deviation of the cannon bone.

benzimidazole—A classification of antiparasitic drug.

birth date—For racing or showing events, the foal's birthday is considered as January 1, regardless of the actual month it was born.

bishoping—Artificial altering of the teeth of an older horse to make it sell as a young horse.

bit—The part of the bridle that is put in the horse's mouth and used to control the animal.

biting—Horses have several reasons for biting; for example, when too much pressure is applied in grooming or during cinching the saddle girth. They may also bite in self-defense.

blacksmith—A person who trims and puts shoes on horses' feet.

blastula—A hollow ball of cells, one of the early stages in embryological development.

blaze—A type of coloring on the face of the horse.

blemish—A blemish differs from an unsoundness in that it is unattractive, but does not and is not apt to interfere with the horse's performance. It is usually an acquired physical problem that may not make the horse lame but may interfere with the action of the horse. A blemish does not have to be an unsoundness.

blindness—This is characterized by cloudiness of the cornea or complete change of color to white. Pale blue, watery eyes may indicate periodic ophthalmia (moon blindness).

blistering—Application of an irritating substance as treatment for a blemish or unsoundness. Blistering increases the blood supply to the site of the blister and induces more rapid healing.

bloom—A shiny coat for show horses.

boarding contract—Agreement between the owner of a horse and the owner of the stable.

bobtailed hackney—A large horse used to pull carriages.

bog spavin—A soft fluctuating enlargement located at the upper part of the hock and due to a distention of the joint capsule.

bolt—To eat rapidly; to startle.

bomb calorimetry—The method used to determine the heat of combustion of feedstuffs and calculate the caloric content.

bone spavin (jack spavin)—A bony enlargement at the base and inside back border of the hock. It may fuse bones and render joints inarticulate.

boot—A device that can be applied to the foot to prevent it from injuring the elbow.

bots—The larvae of an insect, the botfly.

bowed tendon—A serious discrimination involving any or all of a group of tendons and ligaments, but usually the superflexor tendon, the deep flexor tendon, and the suspensory ligament. It is caused by severe strain and wear and shows up as a thickened enlargement of the tendon that occupies the posterior space in the cannon region between the knee and ankle or between the hock and ankle.

bowline knot—A type of knot that will not slip.

braid puller—A piece of baling wire bent to form a long, narrow loop.

braiding—A style of manes seen in hunters and jumpers. Manes are sectioned and braided into small, neat braids.

break-even analysis—Determining where income is equal to the total of the fixed costs and variable costs of doing business.

breast collar—A collar sometimes used to keep the saddle in place.

breeching—The part of a harness that passes around the rump of a draft horse.

breed—(1) To produce young; a particular sort or kind of animal. (2) A group of horses selected for their common ancestry and common characteristics.

breed registries—Organizations that track horses breeding true or with a common ancestry.

breeding true—This means the offspring will almost always possess the same physical characteristics as the parents.

bridle path—A trail or path designated for use by horses and riders. Also, a space clipped in the mane just behind the ears for the crownpiece of a bridle or halter. The bridle path should be 2 to 8 inches long, depending on the breed of the horse.

bronchi—The two main branches of the trachea going to the lungs.

bucked shins—Temporary unsoundness characterized by inflammation of the bone covering along the front surface of the cannon bone.

buck-kneed—Standing with knees too far forward.

bulk—Excessive amounts of fiber or water.

C

calcification—Replacement of the original hard parts of an animal by calcium carbonate.

calf-kneed—When the knees tend to bow inward.

Calippus—One of the early ancestors of the modern horse.

calks—Grips on the heels and the outside of the front shoes of horses, designed to give the horse better footing and prevent slipping.

camped-out—A condition where the leg is too far back and behind the plumb line. Usually the whole leg is involved and the plumb line is at or in front of the toe instead of behind the heel.

camped-under—The opposite of camped out.

canines—The pointed teeth beside the incisors.

cannon bone—The bone extending between the knee or hock and the fetlock joint in horses.

canter—A slow, restrained, three-beat gait in which the two diagonal legs are paired, thereby producing a single beat that falls between the successive beats of the other unpaired legs.

capillary—The smallest blood vessel that connects the arteries and veins.

capillary refill—The number of seconds it takes for the color to return to an area of the horse's gum that has been pressed with the thumb once the thumb is removed. One to 2 seconds is normal.

capital—The amount of money that can be obtained through borrowing or selling assets; it is used to promote the production of other goods.

capped elbow—A blemish at the point of the elbow, also called shoe boil. It is caused by injury from the shoe when the front leg is folded under the body while the horse is lying down.

capped hocks—An enlargement at the point of the hock; it is usually caused by bruising.

carbohydrates—Any of a group of neutral compounds composed of carbon, hydrogen, and oxygen including the sugars and starches. They are used immediately for growth or stored for future use.

carnivores—Animals feeding or preying on animals, eating only animal food.

carotene—A compound from which vitamin A is synthesized.

carriage traces—Straps, chains, or ropes of a harness, extending from the collar (specifically the hames) to the vehicle or load.

cartilage—A translucent elastic tissue that composes most of the skeleton of embryos and very young vertebrates. Most cartilage is replaced by bone.

cash-basis accounting—An accounting system in which income is recorded as income when it is received and expenses are recorded as expenses when they are paid.

cash flow—Actual cash levels for a business.

caslick—A procedure in which the vulva is sutured to prevent infection.

catalyzed—When the chemical reaction rate is increased.

catheter—A slender tube inserted into a body cavity for drawing off or administering fluids.

caudal—Posterior.

cavalry—Originally, a military force mounted on horseback; its main duties include observing and reporting information about the enemy, screening movements of its own force, pursuing and demoralizing a defeated enemy, maintaining a constant threat to an enemy's rear area, striking suddenly at detected weak points, turning exposed sides, and exploiting a break in the enemy's lines.

cecum—The blind pouch that forms the beginning of the large intestine.

cell—The smallest unit of life.

centaurs—Mythical Greek creatures that were imagined to be men with the bodies of horses.

center of gravity—The centered mass of the horse, most commonly located in the middle of the rib cage just caudal to the line separating the cranial and middle thirds of the body. The forelimbs bear 60 to 65 percent of the body's weight because the center of gravity is located more cranially.

centers—Another name for centrals.

centrals—First incisor teeth.

centrioles—Two cylindrical bodies, located near the nucleus, that play a part in cell division.

cerebellum—The part of the brain responsible for control of voluntary muscular movement.

cerebrum—The part of the brain, anterior to the brain stem, responsible for memory, intelligence, and emotional responses.

cervix—The outer end of the uterus.

chestnuts—Horny, irregular growths on the inside of the horse's legs. On the front legs, they are just above the knee. On the rear legs, they are toward the back of the hock. Chestnuts are like human fingerprints—no two are alike, and they do not change in size or shape throughout the horse's adult life.

chiggers—The larval stage of harvest mites; they affect horses' feet and muzzles.

chip fractures—Occur in several different places but are most common at the knee. They are small fractures that break off one of the bones in the knee. They are usually caused by high amounts of concussion and stress on the knee and are seen most frequently in racing horses.

chromatids—Because of the syntheses during the interphase stage of mitosis, each chromosome consists of two sister chromosomes (chromatids) that are identical in their structural and genetic organization. They become visible when mitosis begins.

chromosomes—Microscopic structures, found in the nucleus of cells, that carry the genes.

chronic—Continuing a long time.

cinch—The part of a Western saddle used to hold it on to the horse under the girth area.

citric acid cycle—Also known as the tricarboxylic acid cycle (TCA cycle) or the Krebs cycle; is a series of enzyme-catalysed chemical reactions, which is of central importance in all living cells, especially those that use oxygen as part of cellular respiration.

classes of horses—The classification of horses according to their use.

clinch cutter—Tool used to remove used horseshoes.

clinching block—A tool used to remove old horseshoes.

club foot—In this condition, the foot axis is too straight and the hoof is too upright.

cob—A close-knit horse, heavily boned, short coupled and muscular, but with quality; not so heavy or coarse as to be a draft animal. A cob is usually small, standing under 15 hands.

cocked ankles—These may appear in front but are more common in hind legs. Severe strain or usage may result in inflammation or shortening of the tendons and a subsequent forward position of the ankle joints.

coffin bone—The bone of the foot of a horse, enclosed within the hoof.

coldblood—A horse of draft horse breeding.

cold-fitted—Horseshoes that are applied to the feet without heat.

colic—A broad term that describes a horse showing abdominal pain. Has a number of causes but generally indicates pain in the digestive tract.

collar—Part of a draft horse harness fitted over the shoulders that helps to take the strain when a load is pulled.

collateral—Property, savings, stocks, and so forth deposited as security additional to one's personal or contractual obligations.

collected—Describing a horse that has full control over its legs at all gaits and is responsive to the cues of its rider.

color breed—Color breeds do not breed true colors, for example, albinos, paints, Appaloosas, buckskins, white, cream, or spotted.

colostrum—The first milk secreted by a mare just before and the first day after foaling. It is high in antibodies that protect the newborn against infectious diseases.

colt—A male horse up to 3 years of age.

combined immunodeficiency disease—A condition in which an animal is deficient in cells of the immune system.

commissures—A band of nerve fiber connecting the two halves of the brain or spinal cord or paired ganglia.

competencies—Abilities or capabilities of employees.

compost—Piling organic matter in a way that encourages decay and decomposition.

concentrates—Classification of feedstuffs that are high in energy and low in crude fiber.

conception—The act of becoming pregnant.

condition score—A subjective score given to a horse based on its overall body fat.

conditioned response—Response to a stimulus that is learned.

confinement—Refers to a situation in which a horse lives in an enclosed stall, versus free in a paddock or pasture.

conformation—How the horse is shaped according to type and/or breed.

congenital—Condition that exists at birth; acquired during the prenatal period.

Conquistadors—Early Spanish explorers and warriors.

conservative treatment—A more reserved treatment for bone fractures in horses. The treatment consists of stall confining, hand walking, and anti-inflammatory drugs to reduce pain and swelling.

constrict—To draw together or render narrower.

contouring—Being able to shape something to fit the contours of something else.

contracted feet—This is caused by continued improper shoeing, prolonged lameness, or excessive dryness. The heels lose their ability to contract and expand when the horse is in motion.

contracted heels—An abnormal contraction of the hoof wall at the heels.

contraction—A complex interaction of many parts of the nervous system and the muscular system. It is controlled by the nervous impulses received by the muscle cells.

cooler—A large square of wool or acrylic material used to cover a horse from head to tail. A cooler is useful for cooling out a horse.

cornea—The transparent part of the coat of the eyeball that covers the iris and pupil.

corners—The third incisor.

corns—Reddish spots in the horny sole, usually on the inside of the front feet, near the bars. Advanced cases may ulcerate and cause severe lameness.

coronary band—Area where the hoof meets the leg; it produces the hoof wall.

coronary vessels—The blood vessels that provide nourishment to and encircle the heart like a crown at the juncture of the atria and the ventricles and send branches to both structures.

coronet—The dividing line between the hoof and the leg of a horse.

corporation—A body of people recognized by law as an individual person having a name, rights, privileges, and liabilities distinct from the individual members.

corpus hemorrhagicum—The bloody spot on the ovary immediately after ovulation that becomes a corpus luteum.

corpus luteum—The gland formed on the ovary following ovulation that produces the hormone progesterone.

corticosteroids—Hormones from the adrenal glands.

cowlicks—Permanent hair whorls that cannot be brushed or clipped out. They are located mainly on the forehead and neck.

cracks (quarter, toe, heel)—Associated with a hoof wall that is too long and has not been trimmed frequently enough. They can also develop with horses that are in rain and mud for long periods of time. The mud draws water out of the hoof wall and when the hoof dries it often cracks.

cradle—A device useful in preventing an animal from licking or biting an injured area.

cranial—Relating to the cranium, the part of the skull that encloses the brain.

creative thinking—Ability to generate new ideas by making nonlinear or unusual connections or by changing or reshaping goals to imagine new possibilities; using imagination freely to combine ideas and information in new ways.

creep feeding—Feed supplied to the foal in an area unavailable to adult horses.

crescent—Shaped like the moon in its first quarter.

crestfallen—A heavy neck that breaks over and falls to one side.

cribbing—When horses grasp an object (e.g., a feed box edge or manger) between their teeth and apply pressure, gradually gnawing the object away if it is not metal.

cristae—One of the inward projections or folds of the inner membrane of a mitochondrion.

cross-firing—The same as forging in a pacer; occurs when the inside of the near fore and hind leg (or the reverse) strike in the air as the stride of the hind leg is about completed and the stride of the foreleg is just beginning.

cross-tying—A method of using two ropes to secure a horse so the head is level.

croup—The rump of a horse.

crude protein (CP)—Total amount of protein in a feed.

crupper strap—A leather strap with a padded semicircular loop. The loop end goes under the tail and the strap end is affixed at the center of the back band of a harness or the cantle of a saddle to prevent the saddle from slipping over the withers.

cryptorchid—The condition where one or both testicles (more commonly one) do not descend into the scrotum as they should shortly before birth; *see* **ridgling**.

cue—The stimulus used to train horses.

cultural diversity—Term used to describe the American workplace representing people from different backgrounds.

cups—The deep indentures in the center of the surfaces in young permanent teeth.

curb—An enlargement on the back of the leg, just below the hock. It is caused by trauma to the plantar ligament that causes the ligament to become inflamed and then thickened.

curb bit—A bit that works with leverage action on a horse's mouth. A curb bit must have shanks and a curb strap or chain.

curb chain—Used in combination with a curb bit. It acts against the chin groove to produce a painful pressure.

cut-back—A saddle cut back at the withers.

cytoplasm—The material that lies within the cell and contains several organelles and granules in suspension.

D

dam—The female parent of a horse.

dam's produce—Offspring from a particular dam.

data sheet—Similar to a resume; contains pertinent information about a potential employee.

debt financing—Loan, where the borrower has a promissory note that spells out the payments over time, and interest is charged during the term of the loan.

deciduous—Temporary teeth.

deep flexor tendon—The inner part of the leg, responsible for extension of the foot as it progresses through a stride.

defecation—Release of feces from the bowel.

degree of finesse—Determined with gaited and parade horses by how well they "move" off their hocks.

dehydration—An abnormal depletion of body fluids.

demographic—Having to do with vital and social statistics.

dental stars—Marks on the incisor teeth appearing first as narrow, yellow lines in front of the central enamel ring, then as dark circles near the center of the tooth in advanced age.

dentition—The process of cutting teeth.

deoxyribonucleic acid (DNA)—A nuclein of complex molecular structure that is the major component of genes; it plays an important role in the gene action of chromosomes.

depressed—A state when the horse is extremely relaxed and muscles are flaccid.

dermatitis—Inflammation of the skin.

detoxification—The act of removing poison or of the effect of poison.

diaphragm—A body partition of muscle and connective tissue. Separates the thoracic cavity from the abdominal cavity.

diestrus—A period of sexual inactivity between two estrous cycles.

diffusion—The spreading out of molecules in a given space.

digesta—The food, fluids, and nutrients moving through the digestive system.

digestible energy (DE)—That portion of the gross energy in a feed that is not excreted in the feces.

digestion—The breakdown of foods in the digestive tract to simple substances that may be absorbed by the body.

digestive disturbances—Any abnormal digestive activity that causes discomfort in the animal.

dilation—Expansion of an opening, becoming wider or larger.

diluters—Any of several types of fluids used to dilute and increase the volume of semen.

direct life cycle—A parasite that requires no other organism except the final host to complete its life cycle.

directness—Also known as trueness. The line in which the foot is carried forward during the stride.

discrimination—A prejudice or partiality of unsoundness.

disease—Any condition of a horse that impairs normal physiological functions.

disinfectant—A chemical that destroys harmful microorganisms.

distal spots—Dark spots on a white coronet band.

distended—Enlarged or swollen.

domesticated—Tamed or gentled for use by man.

dominant allele—A gene that is expressed.

dorsal—Back; opposite of ventral.

draft—An animal or team of animals used to pull a load; something that is drawn or pulled; or the force required to pull a load.

draft horse—A large breed of horses used for work.

dressage—A method in which, through body movements and without using hands, feet, or legs, a rider can guide a trained horse through natural maneuvers.

driving—Horses harnessed and controlled from behind.

dry matter—Indicates the part of the feed that is not water.

dry-matter basis—Method of expressing the concentration of a nutrient.

dun—Body color yellowish or gold with a mane and tail that may be black, brown, red, yellow, white, or mixed. Usually dun has a dorsal stripe, zebra stripes on the legs, and transverse stripes over the withers.

duodenum—The first part of the small intestine.

dwelling—A perceptible pause in the flight of the foot, as though the stride has been completed before the foot strikes the ground. It may occur either front or rear and is particularly common in heavy harness horses, heavy show ponies, and some saddlers.

dystocia—A retained placenta in the mare.

E

easy keepers—Horses that are easy to feed.

ectoparasites—Parasites that live on the outside of their hosts.

edema—Excessive accumulation of fluid in tissue spaces.

efferent—Nerves that carry impulses away from the central nervous system.

ejaculation—When the semen is expelled through the urethra.

electrolytes—Any molecular substance that, in solution, will dissolve into its electronically charged components called ions.

eliminative behavior—Behavior demonstrated by horses during defecation or urination.

embryo—The earliest stages in the development of an organism before it has assumed its distinctive form.

embryo transfer—Removal of developing embryos from one mare and their transfer to the uterus of another.

endoparasites—Internal parasites; those living inside the animal.

endurance fibers—These are type IIa muscle fibers used during periods of aerobic work such as jogging or long-distance riding. These fibers can use carbohydrates, fat, or protein for energy.

English—A type of riding dictated by the saddle, tack, clothing, and riding method used.

enterprise—A specific process or activity that requires a certain amount of risk to make a profit.

enterprise budget—A look at the costs and risks involved with producing one commodity or making one product.

entrepreneur—One who starts and conducts a business assuming full control and risk.

enzyme—A substance that increases the rate of a chemical reaction.

Eocene epoch—A division of geologic time following the Paleocene and ending about 37 million years ago.

Eohippus—The earliest known ancestor of the modern horse.

epimeletic behavior—Behavior indicating desire for care and attention.

epiphysitis—Swelling or inflammation around the growing points of the long bones.

epithelial—The tissues that form one or more layers of cells that cover most internal and external surfaces of the body.

Epona—An ancient Gaul goddess of horses who lovingly protected the horse and stable and also kept watch over the grooms and carters.

equine encephalomyelitis—An inflammatory disease of the brain and spinal cord.

equity—The value remaining in a business in excess of any liability or mortgage.

esophagus—A muscular tube extending from the pharynx down the left side of the neck and through the thoracic cavity and diaphragm to the stomach.

essential amino acids—Those amino acids that cannot be synthesized by the body and must be supplied in the diet.

estate—One's entire property or possessions.

estrogen—Steroid hormone produced by the ovary responsible for estrus behavior.

estrous cycle—The reproductive cycle; the period of time between recurring periods when the female is fertile and sexually receptive, or "in heat."

estrus—The period of sexual excitement (heat) during which the female will accept the male in the act of mating.

euthanasia—The act of painlessly putting to death animals suffering from incurable conditions or diseases.

evaluation—Determining worth, performance, value, or conformation; appraisal.

event—A competition including dressage, stadium jumping, and cross-country jumping.
evolution—Refers to a process of continuous change from a lower, simpler state to a higher, more complex state.
expiration—Expulsion of air effected by a relaxation of muscles and a contraction of rib and abdominal muscles.
exploratory behavior—Learning from, investigating, and being attentive to the environment.
extenders—Any diluter with additives to extend the lifespan of sperm cells.
extensor—Structure used to stretch limbs out straight. The extensor tendon is attached to the front of the coffin bone.
external respiration—Consists of two movements—inspiration and expiration.
extracellular—Outside the cell.
eye worm—A parasite that lives in the tear duct and conjunctival sac of the horse's eye.

F

farrier—A person who cares for horses' feet, including trimming and nailing on horseshoes; a horseshoer.
fatigued—Exhausted, wearied with labor or exertion.
fat-soluble vitamins—Vitamins A, D, E and K; found in the fat portion of the feed and stored in the fatty tissues of the horse.
feather fetlocks—Long hair growth on the fetlocks of a horse.
feathering—A fringe of hair around the horse's foot just above the hoof. Some breeds naturally have more feathering or a heavier fetlock than others.
feral—Horses that were once domesticated and have become wild.
fermentation—Decomposition of organic substances, especially carbohydrates, under anaerobic conditions. These conditions are often created by the enzymes produced by microorganisms such as yeast, molds, and bacteria.
fertilization—When a sperm fuses with an egg.
fetlock—The joint above the hoof of a horse.
fetus—The later stage of foal development within the uterus.
fibrosis—Thickening of affected skin.
filly—The name for a female horse until the age of 3.
firing—Making a series of skin blisters with a hot needle over an area of lameness.
firing marks—Where one leg strikes another.
fistulous withers—An inflammation of the withers affecting this region in much the same way as poll evil affects the poll. Source may be a bruising or bacterial infection.
fixed costs—Costs that usually do not fluctuate with an increase or decrease in production.
flanks—The fleshy part of the side between the ribs and the hip.
flat foot—Conformation that lacks the natural concave curve to the sole. Instead, the sole is flat and predisposed to more contact with the ground. Flat foot increases the chance for sole bruises and resulting lameness.
flehmen response—A particular type of curling of the lips in stallions, and many other mammals, that facilitates the transfer of odor-producing chemicals into the vomeronasal organ in the nose.
flexing at the poll—To give its head to the bit.
flexion test—Helps to determine the extent and location of a fracture or other problem of the leg.
flexor—The tendons that cause the fetlock joint to flex or bend; located behind the cannon bone.
flight—The horse's primary defense mechanism.
flighty—A nervous horse.
floating—Filing off the sharp edges of a horse's teeth.
flukes—Trematode parasitic worms that are flat and leaf-shaped.
flushing—The process of removing the embryo from a mare in preparation for embryo transfer.
foal—A young, unweaned horse of either sex.
foal heat—The heat that occurs directly after parturition. It is often not fertile.
follicle—A saclike structure within the ovary that gradually enlarges and, with one burst, releases an egg into the oviduct. Following this rupture, the corpus luteum forms.
follicle stimulating hormone (FSH)—A hormone secreted by the anterior pituitary and responsible for follicular growth and ovulation.
follow-up letter—Letter written immediately after a job interview.
Food and Agriculture Organization (FAO)—An agency of the United Nations that conducts research, provides technical assistance, conducts education programs, maintains statistics on world food, and publishes reports with the World Health Organization.
forage—Feedstuffs from the leaves and stocks of plants.

foramen magnum—The skull is attached to the first vertebra of the spine and has a large opening, the foramen magnum, through which the spinal cord passes.

forbs—Any nongrasslike plant that is relatively free of woody tissue that an animal consumes.

forecasts—Calculations done beforehand.

forging—Striking the end of the branches or the undersurface of the shoe of the forefoot with the toe of the hind foot. This is the diagonal foot in pacers and the lateral foot in trotters.

foundation sires—All registered foals must have their ancestry traced back to the founding stallions.

foundation stock—Refers to the original animals of the breed.

founder—Also called laminitis. An inflammation of the sensitive laminae under the horny wall of the hoof. All feet may be affected, but the front feet are most susceptible.

fox trot—A slow, short, broken type of trot in which the head usually nods. In executing the fox trot, the horse brings each hind foot to the ground an instant before the diagonal forefoot.

fracture—A break or crack in a bone.

free fatty acids—Major components of lipids and fats.

free radicals—A molecule with one or two unpaired electrons that do not interact with each other; they are often very reactive and unstable.

freeze brand—An identifying mark made with copper stamps or marking rods that are cooled in liquid nitrogen or dry ice. This unalterable system of angular symbols was developed by Dr. Keith Farrell, a USDA veterinary medical officer.

frog—A triangular-shaped formation in the sole of the horse's foot. It should be full and elastic and help to bear the weight of the horse.

fulcrum—The support around which a lever turns.

full-mouthed—Refers to a horse having all of the permanent teeth and cups present.

G

gait—A horse's way of going, or the way of moving its legs during progression. The horse is more versatile in selecting gaits than any other four-legged animal. It uses several gaits unique to the species in a distinctive rhythmic movement of the feet and legs. A gait is characterized by distinctive features, regularly executed.

gaited horses—Horses that perform gaits other than the four natural gaits (walk, trot, canter, and gallop).

gallop—The gallop, also called the run, is a fast, four-beat gait where the feet strike the ground separately, first one hind foot, then the other hind foot, then the front foot on the same side as the first hind foot, then the other front foot, which decides the lead.

Galvayne's groove—A mark on the tooth used to determine the age of the horse.

gametes—Sex cells.

ganglia—Secondary nerve centers located chiefly along the spinal cord. They receive and dispatch nerve impulses that do not have to reach the brain (including such stimuli as heat, pain, excessive pressure, and others) but are immediately switched over to motor filaments and cause certain muscles to react instantaneously.

gaskin—The area of the horse's rear leg just below the thigh and stifle area and above the hock. They are usually heavily muscled.

gastric digestion—Chemical breakdown of foodstuffs by the stomach.

gastric juice—Digestive fluid secreted by glands in the mucous membrane of the stomach.

gastrulation—The beginning process of cell differentiation when the ectoderm, mesoderm, and endoderm are being formed.

gelding—A castrated male horse.

genes—The fundamental units of genetics that determine all the hereditary characteristics of animals.

genetic—The interaction of the genes in producing similarities and differences in individuals related by descent.

genetic variation—Differences in genetic makeup.

genome—A complete set of chromosomes.

genomics—The study of genes and their function, aiming to understand the structure of the genome, including mapping genes and sequencing the DNA. It examines the molecular mechanisms and the interplay of genetic and environmental factors in disease.

genotype—The genetic makeup of an animal.

geologic time scale—An arbitrary chronologic sequence of geologic events, used as a measure of the age of any part of geologic time, usually presented in the form of a chart showing the names of the various rock layers, time layers, or geologic time units.

gestation—The period during which a female is pregnant.

get of sire—Offspring from a particular sire.

gingivitis—Inflammation of the gums.

girth—*See* **heart girth**.

glomeruli—Ball-shaped tiny filters, of which each kidney has several million, located in the outer portion or cortex that filter approximately 200 gallons of liquid a day, rejecting blood cells and proteins but permitting fluid salts and other chemicals, including nitrogenous wastes, to pass through.

glycolysis—The breakdown of glucose by enzymes, releasing energy and pyruvic acid; part of the metabolic process.

goals—The end objectives or terminal points of a business.

goiter—An enlargement of the thyroid area.

Golgi apparatus (Golgi body)—A special type of membrane mixture found near the nucleus. In cells that synthesize and secrete products, the Golgi is the site of the material that is accumulated.

grade—An animal that is not registered with a specific breed registry.

granule—One of the small bodies in the cytoplasm of cells.

grease heel—*See* **scratches**.

grooming behavior—Behavior exhibited when horses care for their hair coat.

gross energy (GE)—The heat of combustion, the energy (calories) released by burning a feed sample in a bomb calorimeter.

grullo—Body color that is smoky or mouse-colored. Each hair is mouse-colored. The mane and tail are black, usually the lower legs are black, and often there is a dorsal stripe.

gum disease—*See* **gingivitis**.

gymkhana—A meet for various athletic contests or games for horses, or the place where they are held.

H

hack—An enjoyable, good riding or driving horse, sometimes considered a small Thoroughbred in Europe or a saddlebred in North America.

hackamore—A bitless bridle used in the West for training horses.

half-stocking—A white marking from the coronet to the middle of the cannon.

halter pulling—A habit that develops when a horse pulls at whatever it is being tied to.

halters—Sometimes called head collars. They are used for leading and tying a horse.

hammer—One of the tools used for horseshoeing.

hand—The height of a horse. The measurement is taken from the top of the withers to the ground; a hand is 4 inches.

hand mating—Breeding that is monitored closely by the handler.

hard at the heels—When elastic cartilages under the skin that serve as part of the shock-absorbing mechanism ossify they are firm but movable inward and outward by the fingers.

hard keepers—Horses that need more feed per unit of body weight.

hard-keeping—A horse that has a very hard time putting or keeping weight on its body.

hard mouth—Term used when the membrane of the mouth where the bit rests becomes toughened and the nerves deadened because of continued pressure from the bit.

heart girth—Also called girth. The circumference of the chest just behind the withers and in front of the back.

heart rate—The number of times the heart beats in a minute.

heat—Another word for estrus, or when a mare is receptive to a stallion. This time period is also when follicles develop and a mare ovulates.

heat increment (HI)—The energy (heat) loss associated with the consumption, digestion, absorption, and metabolism of the nutrients for maintenance and productive functions.

heaves—An incurable respiratory disease of horses.

heaving—Caused by a loss of elasticity in the lungs, resulting from a breakdown in the walls of a portion of the air cells. There is an extra contraction of the flank muscles during expiration. It is often heard.

heel calk—Grips on the heels of the front shoes of horses, designed to give the horse better footing and prevent slipping.

hemostasis—The stoppage of bleeding; the arrest of bleeding.

herbivores—Animals that subsist primarily on the available vegetation and decayed organic material in the environment.

herd obedience—The tendency of horses to do what the group does.

heredity—Passing, or capable of passing, genetically from parents to offspring.

hernia—A protrusion of the internal organs through an opening in the body wall.

heterozygous—Having different genes for the same trait.

hierarchy—The dominance hierarchy requires that each horse recognize the other horse and determine through some initial aggressive acts (biting or kicking) and submissive acts (running away) which horse is dominant and which is subordinate.

high ringbone—A bony enlargement on the pastern bones. It occurs at the pastern joint.

hinny—A cross between a male horse, or stallion, and a female donkey (called a jennet or jenny). A hinny is similar to the mule in appearance but smaller and more horselike, with shorter ears and a longer head.

Hippocamp—One of the early ancestors of the modern horse.

hippomane—Soft, dark brown body of tissue that may be floating among the membranes of the passed placenta.

histogenesis—The process of tissue formation.

hitching post—A rail to which horses are tied.

hobble—A type of restraint used on horses in which either the front feet or hind feet (at the pastern or fetlock joints) are placed in straps to keep them from kicking or walking or wandering too far.

hock—The large joint halfway up the hind leg of a horse. Analogous to the heel of a human.

homeostasis—Maintaining a balance between all the parts.

homozygous—Having identical genes.

hoof leveler—The tool used to determine the angle of the hoof wall and check that the hoof is level to the ground.

hoof pick—A tool used for cleaning the sole, frog, and hoof wall.

hoof testers—A tool that picks up increased sensitivity, commonly over the toe, in the horse's foot.

hoof wall—A horny substance made up of parallel fibers that should be dense, straight, and free from ridges and cracks.

hormone—A product of living cells that affects the activity of cells.

horseshoeing—The process of putting shoes on horses.

hosts—The animals from which a parasite obtains food. Different parasites require different numbers and types of hosts.

hot-fitted—Horseshoes that are applied with heat.

humoral immunity—The component of the immune system involving antibodies that are secreted by B cells and circulate as soluble proteins in blood plasma and lymph.

hunters—Horses that are subjectively judged while jumping fences, or horses ridden in fox hunts.

hunter seat—A division of equitation competition judged on the ability and the style of the rider. The riders can be judged both over fences and on the flat. In over-fences classes the riders are judged not only on their ability to negotiate a course of jumps on their horses, but also on their style and position while they do it.

hybrids—Animals produced from the mating of two different breeds.

hydration—The quality or condition of having adequate fluid in the body tissues.

hydrolyzes—Splitting a compound with the introduction of water.

hydrotherapy—The application of cold water to the affected area, usually hosing the leg.

hypercalcemia—High levels of calcium in the blood.

hyperparathyroidism—Overactive parathyroid.

hypochloremia—Low levels of chloride in the blood.

hypothalamus—An area in the brain that controls visceral activities, regulates body temperature and many metabolic processes, and influences certain emotional states.

hypothyroid—An underactive thyroid gland.

Hyracotherium—Another name for *Eohippus.*

I

ileum—The part of the small intestine that connects the jejunum to the cecum.

immune system—The system in the body that protects and fights diseases.

immunity—A condition in which an animal is resistant to a disease.

immunocompromised—Having the immune system impaired or weakened by age, drugs, or illness; making the individual more susceptible to infectious diseases.

immunoglobulins—Antibodies that are members of a related group of gamma globulin molecules.

impaction—Constipation.

implants—Devices used to repair a fracture in a long bone.

imprinting—Imposing a behavior pattern in a young animal by exposure to stimuli; for example, exposure to humans.

incisors—Any one of the 12 front teeth.

income—Amount of money received periodically in return for goods, labor, or services.

indirect life cycle—A parasite requiring several hosts for the parasite to reproduce.

infectious—Diseases caused by pathogenic organisms present in the environment or carried by other animals.

infective—Capable of producing an infection.

inflammation—Redness, swelling, pain, heat, and disturbed function of an area of the body.

influenza—A contagious viral disease characterized by respiratory inflammation, fever, muscle soreness, and often a loss of appetite.

information literacy—A combination of skills: the ability to articulate one's information need; the ability to identify, locate, and access appropriate sources of information to meet the information need; the ability to effectively use information resources, regardless of format; the ability to critically and ethically apply the information; and the ability to determine if the need has been adequately met.

infundibulum—(1) The end of the oviduct nearest the ovary. (2) The funnel-shaped inside of the tooth.

ingestive behavior—Behavior exhibited by a horse during feeding.

inherited—Received genetically from parents.

inorganic—Something composed of substances of other than plant or animal origin.

input costs—Money required to begin production.

inspiration—Inhalation brought about by a contraction of the diaphragm and an outward rotation of the ribs.

insulin—Hormone that lowers the blood glucose and gets glucose across the cell membrane where it can be metabolized.

interdental space—The space behind the incisors and ahead of the six lower molars in each branch of the mandible.

interest—Payment for the use of money or credit.

interfering—Striking the supporting leg, usually at the fetlock, with the foot of the striding leg. Interference commonly occurs between the supporting front leg and a striding front leg or between a supporting hind leg and a striding hind leg.

intermediate host—Host of a parasite before the last host.

intermediates—Second incisor teeth.

internal respiration—The interchange of gases between the blood and the body tissues.

internship—Any official or formal program to provide practical experience for beginners in an occupation or profession.

interphase—A long phase in the process of mitosis.

interval training—The use of multiple bouts of work interspersed with a relief interval when partial recovery is allowed.

involution—The process during which the uterus returns to normal following parturition.

ivermectin—A drug used to control parasites.

J

jack—Male donkey.

jejunum—The middle part of the small intestine.

jennet—A female donkey; also called a jenny.

jockeys—Professional riders of horses in races.

joint—A union of two bones.

joint capsule—The fibrous sac that encloses the entire joint.

K

karyotype—The entire set of stained chromosomes photographed through a microscope and then cut apart and arranged in pairs.

knocked-down hip—A fracture of the external angle of the hip bone (ilium) resulting in a lowering of the point of the hip.

L

laceration—A cut with jagged edges.

lactation—Producing milk.

lactic acid—The chemical produced in the body when glucose or glycogen are used for energy in the absence of oxygen.

lactose—The sugar found in milk.

laminae—The flat tissue in the sole or base of the hoof.

laminitis—An inflammation of the sensitive laminae under the horny wall of the hoof. All feet may be affected, but the front feet are most susceptible. It is characterized by ridges running around the hoof. (Also known as founder.)

large colon—The part of the digestive tract (large intestine) that is enlarged in the horse to allow time for the digestion of cellulose.

large intestine—Includes the cecum, large colon, small colon, rectum, and anus.

larvae—Newly hatched, wormlike stage in the life cycle of an insect.

larynx—The area of the respiratory tract between the pharynx and the trachea.

lateral cartilages—Elastic cartilages just under the skin and extending above the hoof on each side of the heel that serve as part of the shock-absorbing mechanism.

laterally—Toward the side.

laxative—Medicine administered to the horse to produce evacuation of the bowels.

leg cues—Signals given through the rider's legs to the horse.

legumes—Plants with the characteristic of forming nitrogen-fixing nodules on their roots, in this way making the use of atmospheric nitrogen possible.

lesions—Abnormal changes in the structure of an organ due to disease or injury. Can be internal or external.

letter of application—Sent with resume or data sheet when applying for a job.

letter of inquiry—Sent to a potential employer inquiring about possibility of employment.

liabilities—Just or legal responsibilities.

libido—Sexual drive.

lice—External parasites; they may be biting or sucking. Very host specific, they can cause serious skin irritation or anemia.

ligament—Tough, fibrous tissue that connects bones or cartilages at a joint. Ligaments can also support an organ.

light horses—Horses used primarily for riding, driving, showing, racing, or utility on a farm or ranch. A light horse is capable of more action and greater speed than a draft horse.

limited liability company (LLC)—a business structure allowed by state statute: similar to a corporation, owners have limited personal liability for the debts and actions of the LLC. Other features of LLCs are more like a partnership, providing management flexibility and the benefit of pass-through taxation.

line of credit (LOC)—An arrangement between a financial institution, usually a bank, and a customer that establishes a maximum loan balance that the bank will permit the borrower to maintain; the borrower can draw down on the line of credit at any time, as long as he or she does not exceed the maximum set in the agreement.

liniment—A preparation (mostly alcohol-based) used in treatment of mild strains, sprains, etc., as a counterirritant to increase blood flow.

Lipizzan stallions—Stallions of the Lipizzan breed, located at the Spanish Riding School, formerly in Vienna, now located in Wels, Austria.

liquidity—A business's ability to meet short-run obligations when due without disrupting the normal operation of the business.

lochia—A brown fluid found in the uterus during uterine involution following pregnancy.

longe—The act of exercising a horse on the end of a long rope, usually in a circle.

longitudinally—Running or placed lengthwise.

lope—A smooth gait, that is slower than a gallop but faster than a trot. *See* **canter.**

low ringbone—A bony enlargement on the pastern bones. It occurs at the pastern-coffin bone joint at about the level of the coronet band.

lumbar—The portion of the lower back near the loin area.

lungworm—A roundworm parasite that lives in the lung. More common in donkeys than in horses.

luteal phase—Period of time during the estrous cycle when the corpus luteum is producing progesterone.

lymph—Fluid that assists in carrying food from the digestive tract to the tissues and waste products back to the bloodstream.

lymph nodes—The gland-like bodies found in the lymphatic vessels that produce lymphocytes and monocytes.

lymph vessels—Ducts that transport lymph.

lysosomes—Small bodies that store large numbers of enzymes.

M

macrominerals—Minerals found in the body in large quantities, for example, calcium and phosphorus.

maiden mare—A female horse that has not been bred or had a foal.

malignant—Tending to produce death or deterioration.

malocclusion—Where the top and bottom teeth do not meet.

mandible—Lower jaw.

mange—An itching skin disease caused by parasitic mites.

mare—The name for a female horse after the age of 3.

market value—Refers to the price for which an animal might sell at auction.

mastication—The processing of chewing.

mastitis—Inflammation of the mammary glands.

maxilla—Upper jaw.

meconium—The soft, dark greenish-brown accumulation of digested amniotic fluid, glandular secretions, mucous, bile, and epithelial cells in the digestive tract during development of the foal.

megacalorie—One thousand kilocalories, or 1 million calories.

meiotic cycle—Also called meiosis. The division of egg and sperm cells. This cycle produces the gametes or sex cells. The steps in the cycle are prometaphase, metaphase, anaphase, and interphase.

***Merychippus*—**An early ancestor of the modern horse.

mesentery—Where the small intestine lies in folds and coils near the left flank, being suspended from the region of the loin by an extensive fan-shaped membrane.

***Mesohippus*—**An early ancestor of the modern horse.

messenger ribonucleic acid (mRNA)—The protein-coding instructions from the genes are transmitted indirectly through mRNA.

metabolic—Pertaining to the normal biochemical processes of the body.

metabolic alkalosis—Condition in the body when the pH increases to above the normal levels.

metabolic disorder—Any abnormalities in normal body functions.

metabolism—The physical and chemical processes in an organism by which living matter is produced, maintained, and destroyed, and by means of which energy is made available.

metabolites—The products of metabolism.

metabolizable energy (ME)—Energy in the feed that is useful to the animal for growth, production, and reproduction. It is the portion of the gross energy that is not lost in the feces, urine, and gas.

metritis—Inflammation of the uterus.

microbial action—Digestion by very minute organisms.

microchip—A small silicon chip the size of a grain of rice; contains the horse's registration number or identification number. A specially designed needle and syringe are used to implant the microchip.

microfilaments—Long, thin, contractile rods that appear to be responsible for the movement of cells, both external and internal.

microminerals—Minerals found in the body in small quantities, for example, iron and zinc.

microsatellites—Composed of simple repeats of DNA subunits, primarily in chromosomal regions not used as templates for protein synthesis. These genes are chosen as effective for identifying individuals and verifying parentage, not for their value in making horse-breeding decisions.

microtubules—Hollow, cylindrical groupings of tubelike structures that help give the cell shape and form. They are also involved in other cell processes.

midges—Blood-sucking arthropods used as an intermediate host to the nematode onchocerciasis. This parasitic infection usually occurs in the connective tissue, flexor tendons, and suspensory ligaments of the horse.

milk teeth—The first teeth that an animal develops.

mimicry behavior—Imitating the behavior of another animal.

minerals—Essential nutrients for horses, for example, calcium and phosphorus.

miniature—A very small horse; not taller than 34 inches.

Miocene epoch—A division of geologic time beginning about 23 million years ago.

mites—Various small parasitic arachnids; closely related to ticks. They are a secondary host for tapeworms.

mitochondria—Cell structures composed of an outer membrane and a winding inner membrane. A series of chemical reactions that occur on the inner membrane convert the energy of oxidation into the chemical energy of ATP. Almost all of the energy passes through this molecule before being used in cell function.

mitosis—Cell division that occurs in plants and animals. The steps in mitosis are early prophase, late prophase, metaphase, anaphase, telophase, and interphase.

molars—Permanent teeth.

Monday morning disease—Another term for azoturia.

monkey mouth—Where the lower jaw and tooth structure extend beyond the top teeth.

monodactyl—Having a single toe.

moon blindness—Periodic ophthalmia or moon blindness is an inflammation of the inner eye. It is due in part to a vitamin B deficiency. It usually impairs vision and treatment is usually unsuccessful.

morbidity—The incidence of disease or illness; the rate of sickness.

morphogenesis—The process of development during which cells differentiate into specialized types of cells.

Morrill Land Grant Act—Federal law beginning 1862 that established land grant institutions in each state.

mortality insurance—Insurance covering financial losses due to the death of a horse.

motile—Exhibiting or capable of movement.

motion behavior—Predictable behavior exhibited by an animal in normal movement.

mouth speculum—An instrument used to hold a horse's mouth open.

mucous membranes—A membrane that lines the cavities in the body and connects the inside of the cavity to the outside.

mucous secretions—Viscous, slippery secretions produced by mucous glands.

mule—A cross between a female horse and a male donkey.

muscle tone—Development of strength and firmness of muscles.

mustangs—Wild horses; native horses of the Western plain; feral horses.

mutagen—An agent that can induce or increase the frequency of a mutation in an an organism.

myelin—The substance that covers certain axons and nerve fibers.

myofibrils—Long, thin tissues that are the contractile elements within muscle cells.

myosin—A protein present in muscle tissue.

myxoviruses—A type of virus that attacks the entire respiratory track.

N

nasal—Pertaining to the nose.

National Research Council (NRC)—Examines literature and current practices in the nutrition and feeding of horses and publishes recommendations on horse nutrition.

navicular bone—A small bone located in the horse's foot.

navicular disease—Inflammation of the navicular bone. It causes horses to go lame.

neck—In teeth, the joining of the root and gum; body part of horse.

necrosis—Death of tissues.

nematodes—Parasitic worms—called roundworms—with unsegmented, cylindrical bodies. They have complete digestive systems.

neonatal—Relating to or affecting the newborn shortly after birth.

nephrons—Part of the kidney; a renal tubule.

nerves—Bands of white tissue emanating from the central nervous system and ganglia and extending to all parts of the body.

net energy (NE)—The energy fraction of the feed remaining after fecal, urinary, gas, and heat losses are subtracted from the gross energy. Net energy more precisely measures the real value of feed.

net worth—Financial condition of a business listing all assets, values of assets, and liabilities of a business.

neurotransmitter—A biochemical used to transmit a nerve impulse at a synapse, for example, actecholine or epinephrine.

nippers—(1) First incisors; also called centrals. (2) In horseshoeing, a tool used to remove extra hoof wall.

nomenclature—A set or system of names.

nonadditive gene—The members of the gene pairs are not equally expressed when nonadditive gene pairs control a trait.

noninfectious—Diseases caused by environmental problems, nutritional deficiencies, or genetic defects.

nonruminant—Monogastric, or without a functional rumen; such as a horse or pig.

nonruminant herbivore—A single-stomached animal that eats primarily plant material.

nucleotides—Basic building blocks of DNA, each composed of one sugar, one phosphate, and a nitrogenous base.

nucleus—Each cell contains this structure, which directs the activity of the cell.

nutrients—Substances that provide nourishment for the body.

nutrigenomics—The study of how different feeds may interact with specific genes to increase the risk of common chronic diseases. It also seeks to provide a molecular understanding of how common chemicals in the diet affect health by altering the expression of genes and the structure of an animal's genome.

nutritional deficiencies—Deficiency of any necessary substance that provides nourishment for the body.

O

off side—Right side of the horse.

olfactory—Sense of smell.

Oligocene epoch—A division of geologic time beginning about 37 million years ago.

omnivores—Eating both plant or vegetable and animal food.

onagers—Relatives of the horse.

open mare—A mare that was either not bred or did not conceive in the previous season.

ophthalmia—Inflammation of the eyeball or conjunctiva. *See* **moon blindness**.

orbit—The eye socket.

organ—Any part of an animal that performs a specific function.

organelles—The inside parts of a cell such as the Golgi apparatus, nucleus, ribosomes, centrioles, microfilaments, microtubles, lysosomes, and storage particles.

organic—Chemical compounds of carbon combined with other chemical elements and generally manufactured in the life processes of plants and animals. Most organic compounds are a source of food for bacteria and are usually combustible.

osmotic pressure—The pressure needed to prevent water from flowing across a semipermeable membrane into a more concentrated solution from a less concentrated one.

osselets—Soft, warm swellings over the front and sometimes sides of the fetlock joint.

ossify—Cartilage being made into bone.

osteochondrosis—A metabolic disease of cartilage resulting in bone and joint defects.

osteomalacia—A disease in which the bones become softer. Occurs in adult animals.

ovaries—Endocrine glands in the female that produce the egg (ovum) at ovulation.

over-at-the-knee—The same as calf-kneed or buck-kneed.

overo—Either dark or white in color, with no white crossing the back. The spotting is usually roan and extends downward from the back. The tail is usually of one color. Overo horses usually have bald faces, and glassy eyes are common.

overreach—The hitting of the forefoot with the hind foot.

oviducts—The tubes through which the ovum passes to the uterus.

ovulation—The release of egg from the mature follicle on the ovary.

ovum—Egg.

oxidative phosphorylation—A series of chemical reactions occurring on the inner membrane that convert the energy of oxidation into the chemical energy of ATP. In this process the predominant energy transfer molecule is ATP.

oxidize—To combine with oxygen to release energy.

P

pace—A fast, two-beat gait in which the front and hind feet on the same side start and stop at the same time.

paddling—To throw the front feet outward as they are picked up.

paddock—A small fenced area.

palatability—Acceptability of taste.

palatable—Appealing to the palate or taste.

Paleocene epoch—A division of geologic time beginning about 65 million years ago.

palpate—To examine by touch.

parasites—Organisms that live in or on another organism of a different species for the purpose of obtaining food.

parotid—The largest saliva gland.

parrot mouth—A result of the upper and lower incisors not meeting because the lower jaw is too short.

partnership—A form of business organization with multiple owners.

parturition—The act of foaling or giving birth.

passive immunity—Acquired by the transfer of antibodies from another individual; for example, colostrum.

passive transfer—The process by which antibodies are passed from mare to foal in the colostrum.

pastern—That part of the horse's leg between the fetlock and the coronet.

pasture mating—Natural mating.

pasturing—Grazing horses on grass or other forage.

patella—The flat, moveable bone at the front of the stifle joint of a horse.

pathogenic—Disease-causing.

pedal osteitis—Caused by chronic inflammation to the coffin bone, usually of the front feet. Persistent pounding of the feet, chronic sole bruising, or laminitis are causes.

pedigree—A record of the ancestry of an animal.

Pegasus—A mythological flying horse.

penis—The stallion's reproductive organ that is used to deposit semen or sperm into a mare's vagina.

perennials—Plants that normally continue to grow for three or more seasons.

performance record—The record tracking the actual ability and production of an animal or its offspring.

pericardium—The sac that encloses the heart.

periople—A varnish-like coating that holds moisture in the hoof and protects the hoof wall.

periosteum—A dense connective tissue that covers the surface of each bone.

peristalsis—Successive waves of involuntary muscle contraction passing along the walls of the intestine or other hollow muscular structures that force the contents onward.

permanent pastures—Pastures on which horses graze all the time.

perpendicular—Being or set at right angles to a given line or plane.

phantom—An object used for a stallion to mount instead of a mare.

pharynx—A short, somewhat funnel-shaped muscular tube between the mouth and the esophagus that also serves as an air passage between the nasal cavities and the larynx.

phenotypes—The visual characteristics of an animal.

photoperiod—Refers to the number of hours of light in a day.

photorefractory—A time when an animal fails to respond to changes in light.

pig-eyed—Those horses with sunken eyes, seeing less in front and behind than others do.

pincers—Also called centrals. First incisor teeth.

pincher—A tool used to remove horseshoes.

pineal gland—The gland in horses and most other mammals that is responsible for melatonin synthesis.

pinworms—Parasites that cause intense itching around the anus, from the females laying eggs there; the horse then rubs its hindquarters, resulting in the hair being rubbed off over the tailhead.

pitch—Jumping action of a horse in its attempt to unseat its rider.

placenta—The organ that develops in the female during pregnancy, lining the uterus and holding the fetus and attached by the umbilical cord.

plantar cushion—The part of the foot that expands and contracts to absorb shock and pumps blood from the foot back toward the heart.

plantar ligament—The ligament that runs behind the rear cannon bone in a horse.

plasma—The fluid portion of blood, as distinguished from corpuscles. Plasma contains dissolved salts and proteins.

plasma membrane—A very thin membrane of lipid (fat) and protein separating the cell from the environment and from other cells. It controls the transport of molecules in and out of the cell.

plates—Referring to a type of horseshoe.

Pleistocene epoch—A division of geologic time beginning about 2 million years ago.

Pliocene epoch—A division of geologic time beginning about 5 million years ago.

Pliohippus—An early ancestor of the modern horse; the first true monodactyl.

plumb line—When a weight is placed on the end of a string to measure the perpendicularity of something, such as the straightness of the leg of a horse.

pointing—A stride in which extension is more pronounced than flexion. A horse guilty of a pointed stride breaks or folds its knees very slightly and is low-gaited in front. Also indicates the standing position a horse frequently takes when afflicted with navicular bone disease or injury to the foot or leg, standing on three legs and pointing with the fourth.

points—Black coloration from the knees and hocks down as in bays and browns. Sometimes includes tips of ears.

poll—Having to do with the head area of the horse.

poll evil—A fistula—lesion or sore—on the poll; it is difficult to heal and caused by injury. This is an acquired unsoundness resulting from a bruise or persistent irritation in the region of the poll.

polyestrous—Having many heat cycles during the year. Mares have more regular cycles at the peak of breeding season when there is more light and no cycles at all during the winter months.

polyvinylchloride (PVC)—A type of plastic used in building materials.

pommel—Upper front part of a saddle; a saddlebow.

pony—A breed of very small horse that is not over 14 hands high.

posterior—Backward (in space).

postpartum—The time immediately after birth.

poultice—A moist, mealy mass applied hot to a sore or inflamed part of the body.

pounding—Heavy contact with the ground, usually accompanying a high, laboring stride. Faults in conformation that shift the horse's center of gravity forward tend to create pounding.

precipitates—To separate out from a solution.

premaxilla—The area of the jaw that contains cavities for the six upper incisor teeth.

premolar—Temporary teeth.

prepuce—Foreskin.

principal—Property or capital.

profitability—Money remaining after all fixed and variable costs are deducted from net income.

progeny—Offspring or descendants of one or both parents.

progesterone—A hormone that is released by the ovary before the fertilized egg is implanted.

proglottids—The segments of a worm.

prolactin—A hormone involved in lactation produced by the anterior pituitary.

proprioceptors—The joint proprioceptors give the horse a sense of the positions of its limbs. A sensory receptor situated within the body that is responsive to internal stimuli.

prostaglandins—A group of hormones that are unsaturated fatty acids and responsible for control of the estrous cycle and timing of parturition.

proteomics—The study of the complete set of proteins (directed by DNA) produced by a species, using the technologies of large-scale protein separation and identification; includes how proteins are modified, when and where proteins are expressed, how they are involved in metabolic pathways, and how they interact with one another.

protozoal—Any of a subkingdom or phylum of animals containing microscopic, single-celled organisms that reproduce typically by binary fission.

protozoans—Single-celled animals that occur in the bloodstream and intestinal tract of horses.

proud flesh—Excess scar tissue on an injured area.

proximal—Situated closer to the origin.

Przewalski's horse—The oldest species of horse still in existence. This horse was only discovered in the late nineteenth century.

puberty—Sexual maturity; the age when an animal becomes capable of reproduction.

puff—*See* **road puffs**.

puller—Tool used to remove worn horseshoes.

pulse—Expansion and contraction of the arteries.

Punnett Square—A tool used to predict genetic combinations from matings; numbers of row and columns for the male and female genes depend on the number of genes being studied.

pupae (pl.), pupa (sing.)—Stage of insect development between larvae and adult during which the insect is quiescent.

Q

qualitative traits—Traits usually controlled by a few genes showing sharp distinction between phenotypes, for example, coat color.

quantitative traits—Traits controlled by many pairs of genes with no sharp distinction between phenotypes, for example, growth rate and speed.

quick-release knot—A knot that unties quickly or breaks loose for the safety of the animal or the handler.

quidding—A condition in which horses drop food from the mouth while in the process of chewing. It is usually caused by bad teeth or bad gums (stomatitis or gingivitis). It can also be caused by paralysis of the tongue.

quittor—A festering of the foot anywhere along the border of the coronet. It may result from a calk wound, neglected corn, gravel, or nail puncture.

R

rack (single foot)—A fast, flashy, unnatural, four-beat gait in which each foot meets the ground separately at equal intervals; originally known as the "single-foot," a designation now largely discarded.

radius—The shorter and thicker of the two bones of the forearm.

random segregation—The random transfer of chromosomes and their genes to form gametes.

rasp—A tool used for leveling the horse's foot.

rate of passage—The time required for something to move through an area; for example feed through the digestive tract.

ration—The feed allowed an animal during a 24-hour period.

reactive behavior—Activities horses use to maintain themselves in harmony with their environment and adjust to sudden, potentially harmful changes.

receptors—The part of the neuron that receives internal and external stimuli such as sight, taste, smell, or hearing.

recessive allele—A gene that is not expressed in a heterozygote.

rectum—The terminal part of the intestine.

red blood cells—Originate in the red bone marrow, liver, and spleen, and carry oxygen from the lungs to the tissues.

reflex—A nervous action that occurs without conscious thought in response to a stimulus; for example: a kick in response to a surprise.

registered—A horse whose name, along with the name and number of its sire and dam, has been recorded in the records of its breed association.

relaxation—Controlled by the nervous impulses received by the muscle cells, a muscle either contracts or relaxes.

relaxin—A hormone from the ovaries that causes relaxation of the pelvic ligaments and possibly relaxation of the cervix at parturition.

respiration rate—The number of times an organism breathes in a minute.

résumé—Summary of an individual's employment and educational history.

reward training—Positive reinforcement.

RFID—Stands for radio frequency identification; an automatic identification method relying on storing and remotely retrieving identifying data about a horse, animal, or product; devices called chips, tags, or transponders are attached to or incorporated into a product, animal, or person for the purpose of identification using transmitted radio waves; tags or chips can be active (power source required) or passive.

ribonucleic acid (RNA)—A substance found in the cytoplasm and nuclei of cells that promotes the synthesis of cell proteins.

ribosomes—Tiny particles within the cell made of RNA and protein; present in large numbers in most cells. They are the site of protein synthesis.

rickets—A bone disease in young horses; caused by a deficiency of calcium.

ridgling—Also called a cryptorchid. A horse with one or both testes maintained in the body cavity; the horse is sterile if both testes are undescended, but fertile if one testis is suspended.

rigging—The part of the saddle involved in securing the cinch around the horse.

ringbone—A bony enlargement on the pastern bones, front or rear. It is caused by bony development around these joints due to tearing and damage of the ligaments and tendons at these bones.

rings—Ridges.

risks—A chance of encountering harm or loss.

road puffs—Soft enlargements located at the ankle joints and due to enlargement of the synovial (lubricating) sacs; also called windgalls.

roadsters—Horses used for driving; includes heavy and fine harness horses and ponies.

roan—More or less uniform mixture of white with black hairs on the body, but usually darker on head and lower legs; can have a few red hairs in mixture.

roaring—The sound made when air is inhaled into the lungs; also called whistling.

rodeo—A public event in which the more exciting features of a roundup are presented, as the riding of broncos, branding, lariat throwing, etc.

rolling—Excessive side-to-side shoulder motion. Horses wide between the forelegs and lacking muscle development in that area tend to roll their shoulders. The toe-narrow fault in conformation can also cause rolling.

romal reins—A rein style from the vaquero (cowboy) tradition that incorporates a closed rein with a long quirt (whip) at the end.

rotational grazing—The practice of changing the pasture areas of horses for better utilization.

rotavirus—Any of a group of wheel-shaped, RNA-contained viruses that cause gastroenteritis in newborn animals.

roughage—Feedstuffs with a high fiber content.

roundworms—Nematode worms having no segments.

run—*See* **gallop**.

run up—The process of sliding an English stirrup iron up the inside of the stirrup leather so that it does not bounce on the horse's side or get caught on a projection.

running martingale—A strap that terminates with two rings that when properly adjusted has the effect of preventing the elevation of the head beyond a certain level.

running walk—A slow, four-beat gait, intermediate in speed between the walk and rack. The hind foot oversteps the front foot from a few to as many as 18 inches, giving the motion a smooth gliding effect. It is characterized by a bobbing or nodding of the head, a flopping of the ears, and a snapping of the teeth in rhythm with the movement of the legs.

R value—The level of insulating ability of a material. The higher the number the better the insulative factor.

S

saddle seat—A style of horseback riding within the category of English riding that is designed to show off the high trotting action of certain horse breeds.

saliva—Fluid that moistens and lubricates the mass of food for swallowing and, as a digestive juice, acts on the starches and sugars.

sarcolemma—The outer envelope of skeletal muscles.

scalping—Occurs when the hind foot hits above or at the line of the hair (coronet) against the toe of a breaking-over (beginning the next stride) forefoot.

scapula—The shoulder blade.

scars—Marks left on the skin after the healing of a wound or sore. They may appear on any part of the body.

scratches (grease heel)—A low-grade infection or scab in the skin follicles around the fetlock.

scrotum—The pouch containing the testicles.

secretory—Products produced by glands in the body that aid in digestion.

selenium—A mineral required in the diet.

semen—Sperm cells plus fluid from the accessory glands.

seminiferous tubules—Small coiled tubules in the testes where spermatozoa are produced.

sensitization—Allergic.

serviceability—The usefulness of a horse for its intended function.

sesamoid bones—The two pyramid-like bones that form a part of the fetlock or ankle joints on the front and rear legs of a horse.

sesamoiditis—A condition that consists of a fracture of one or both of the pyramid-like bones that form a part of the fetlock or ankle joints and join with the posterior part of the lower end of the cannon bone.

settle—Breeding successfully.

settling percentage—The percent of mares bred that conceive.

sex determination—Where females carry the XX chromosome and the males carry the XY chromosome.

sexed semen—X-bearing sperms cells separated from Y-bearing sperms cells so insemination can produce either all male (XX) or all female (XY) offspring.

shareholders—Owners of a share of a company; stockholders.

sheath—The double fold of skin that covers the free portion of a male horse's penis.

shock—A state of profound depression of the vital processes of the body.

shod—Refers to a horse with horseshoes.

shoe boil—Also called capped elbow. A soft, flabby swelling at the point of the elbow; it is usually caused by contact with the shoe when the horse is lying down.

shoe boil roll—Same as a boot.

shoeing apron—A piece of heavy clothing used to protect the horseshoer.

short cycle—A cycle that runs shorter than a normal estrous cycle.

sidebones—When the lateral cartilages ossify, making the horse hard-at-the-heels.

silage—Fermented roughage.

silent heat—An estrous period with no outward signs of receptivity to the male.

singeing lamp—An apparatus used to burn the long hairs off a horse's body.

sire—The male parent of a horse.

small colon—Part of the large intestine where the moisture in the food is reabsorbed.

small intestine—The site of most nutrient absorption.

smooth mouth—Refers to a horse that has no cups present in the permanent teeth.

snaffle bit—A bit that works with direct action on a horse's mouth. A snaffle bit may have a jointed or a solid mouthpiece.

snip—A white or beige mark over the muzzle between the nostrils.

soft skills—Cluster of personality traits, social graces, facility with language, personal habits, friendliness, and optimism possessed by individual to varying degrees; for example, work ethics, teamwork, courtesy, self-discipline, self-confidence, and language proficiency.

soil test—Used to determine contents of soil and whether fertilizer or some other substance is needed to increase yield.

sole—The bottom of the hoof.

sole proprietorship—Form of business organization where one individual owns the business.

solvency—Having sufficient means to pay all debts.

space requirements—Refers to the area needed for the size, type of operation, and number of animals in a building.

speedy-cutting—Occurs when a trotter or pacer traveling at speed hits the hind leg above the scalping mark and against the shoe of a breaking-over forefoot.

spermatozoa—Male reproductive cells.

spinal cord—One of the most important parts of the central nervous system. This system supplies the body with information about its internal and external environment. It conveys sensation impulses to the brain or spinal cord and other parts of the body.

splint—An inflammation of the interosseous ligament that holds the splint bones to the cannon bone causing swelling. Usually associated with conformation problems.

splint boots—Protective covering for the front legs, extend from below the knee to just above the fetlock.

spooky—A horse that is easily frightened.

sprain—Any injury to a ligament usually occurring when a joint is carried through an abnormal range of motion.

spring—The manner in which weight settles back on the supporting leg at the end of the stride.

sprung—The appearance of the ribs when the mare develops a wider stride to compensate for the increased weight she is carrying during pregnancy.

stall—A compartment or cubicle for horses.

stall walking—When a horse walks too much in its stall. It reduces condition and induces fatigue.

stallion—A male horse over 4 years of age.

stamina—Ability to endure.

star—A solid white mark on the forehead. The shape may range from oval to diamond to a narrow vertical, diagonal, or horizontal star.

stay apparatus—Consists of ligaments and tendons that stabilize all the joints of the forelimb and the lower joints (the fetlock and pastern) of the hind limb so minimal muscular activity is needed to hold tension on these ligaments and tendons, which in turn prevent flexing of the joints and collapsing of the leg; allows the horse to balance its weight on its legs almost like legs of a chair.

step—The distance between imprints of the two front legs or the two back legs.

steppes—Vast semiarid, grass-covered plains, as found in southeast Europe, Siberia, and central North America.

stepping pace—Also known as slow pace. A modified pace in which the objectionable side or rolling motion of the true pace is eliminated because the two feet on each side do not move exactly together. Instead, it is a four-beat gait with each of the four feet striking the ground separately.

sterile—Free from living microorganisms; unable to reproduce.

sternum—Breastbone.

steroids—Fat-soluble organic compounds. These inactivated hormonal substances are water soluble and are readily eliminated through the urine.

stifled—Refers to a horse crippled by a displaced patella of the stifle joint.

stillbirth—When a foal is born dead.

stimuli—Any factors or environmental changes producing activity or response.

stock—Livestock domesticated for farm use.

stocking—A white marking from the coronet to the knee.

stocking plus—A white marking like the stocking, but the white extends onto the knee or hock.

stocking rate—Number of animals per acre of pasture.

stomach hairworm—A tiny nematode parasite, very thin and hairlike.

stomach worm—A parasite that produces fibrous tumors or numerous nodules that, if close together, form a tumor. They cause gastric and cutaneous habronemiasis. Source of summer sores.

stomatitis—Inflammation of the mouth.

straight shoulders—A conformation problem that will give a horse a hard gait and possibly cause trouble keeping a saddle in place.

strategic planning—Analyzing the business and the environment in which it operates to create a broad plan for the future.

stress—A demand for adaptation. There are four categories of stress—behavioral, immunological, metabolic, and mechanical.

stride—The distance between successive imprints of the same foot.

stride stance—The weight-bearing phase of the stride.

stride suspension—The non–weight-bearing phase of the stride.

stringhalt (stringiness, crampiness)—An ill-defined disease of the nervous system characterized by sudden lifting or jerking upward of one or both of the hind legs; most obvious when the horse takes the first step or two.

strip—Also called stripe. A white mark starting at eye level or below and ending on or above the upper lip. The size and shape of a stripe may vary widely and must be described in detail as to width, length, and relationship (whether it is connected or unconnected) to a star.

stripe—*See* **strip**.

strongyles—Part of the large groups of parasites known as roundworms.

stud books—Permanent books of breeding records.

summer sores—Parasitic infections caused by stomach worms where lesions ooze serum, are very itchy, and disappear in cold weather. They occur where horses cannot reach them.

supplement—A feed or mixture richer in a specific nutrient than the basic feedstuffs in a ration.

sweeney—A wasting away of the shoulder muscle overlying the scapula of the horse.

swing—The non–weight-bearing phase of the stride.

synapses—The connections between nerve cells.

synovitis—Inflammation of a synovial membrane.

systemic—Affecting the whole.

T

tack—Equipment used in riding and driving horses, such as saddles, bridles, etc.

tail board—Used in the prevention of tail rubbing.

tail rubbing—Constant rubbing of the tail from irritation of parasites. Sometimes develops into a habit.

tandem—A type of trailer in which the horses ride side by side.

tapeworms—Large worms that have a head and proglottids or segmented bodies that attach to the intestine of the horse.

tattoo—An identifying mark, on the mucous membrane on the upper lip, made by rubbing ink into perforations made by a tattoo gun.

teased—To provoke sexually with no intention of mating.

temporary pastures—Pastures on which horses graze part of the time.

tendon—Part of the bands of tough, fibrous connective tissue forming the end of a muscle that serves to transmit its force to another part.

territorialism—Gives the horse space for its basic functions and for care of its home and feeding.

testes—The male reproductive organs producing sperm cells and hormones.

tetanus—(1) The prolonged contraction of a muscle caused by rapidly repeated stimuli; (2) A disease marked by rigidity and spasms of the voluntary muscles, caused by the bacterium *Clostridium tetani.*

tetanus shot—An injection that helps protect an animal from developing the disease tetanus (lockjaw).

thoracic—Of or pertaining to the thorax (the area between the neck and the abdomen).

thoroughpins—A distention of the synovial bursa, and considered a discrimination. They can be pressed from side to side.

threadworm—An intestinal parasitic worm that is unique because only the adult female is parasite, it can exist outside the host; also contributes to foal heat diarrhea.

throatlatch—The part of the bridle under the horse's throat that connects the bridle to the head.

thrombin—A biochemical in the blood partially responsible for the process of clotting.

thrush—An inflammation of the fleshy frog of the foot caused by a fungus. It is blackish in color, foul smelling, and associated with filthy stalls. It may cause lameness.

thyroid—The gland that secretes thyroxin, the hormone that controls the rate of metabolism.

ticks—Blood-sucking parasites; often an intermediate host; can cause death in foals.

tie down—A strap that, when properly adjusted, has the effect of preventing the elevation of the head beyond a certain level without cramping the horse.

tie stall—A stall in which a horse is fastened by a halter.

tissue—The structured groupings of cells specialized to perform a common function necessary to the survival of the horse.

titer—The strength of a solution as determined by titration.

tobiano—A white horse in which regular, distinct spots extend down over the neck and chest. All four legs are white, and the face is usually marked the same as in other color patterns found in horses.

total digestible nutrients (TDN)—Indicates the energy density of a feedstuff. TDN takes into account the amount of fat, protein, and carbohydrate in the feed.

toxin—Poison.

trace-mineralized salt—Salt containing a mixture of the microminerals.

trailer sour—Horses that become fearful of trailers and are difficult to haul.

trappy—A gait that is a short, quick, choppy stride. Horses with short and steep pasterns and straight shoulders tend to have a trappy gait.

trauma—An injury or wound to a living body.

traverse or side step—The traverse or side step is a lateral movement of the animal to the right or left as desired without moving forward or backward.

tree—Basic unit of a saddle; the tree determines the shape of the saddle and may be made of plastic, fiberglass, aluminum, or wood covered with rawhide.

Triple Crown winners—Three-year-old horses winning all three of these races in one season: Kentucky Derby at Churchill Downs, Preakness at Pimlico in Baltimore, and Belmont Stakes at Elmont, New York.

Trojan Horse—A classic legendary horse in which Greek soldiers hid to gain entry into the ancient city of Troy.

troponin—A special protein involved in muscular contraction.

trot—A natural, rapid, two-beat, diagonal gait in which the front foot and the opposite hind foot take off at the same split second and strike the ground at the same time.

turbinates—Soft, bony structures in the head. These structures are supplied with a great deal of blood.

twitch—(1) The contraction of small muscle units, manifested as a quick, simple, spasmodic contractions; (2) a device used in the restraint of horses.

tying-up syndrome—A metabolic disorder of the muscles that is associated with forced exercise after a period of rest during which the animal has access to feed; thought to be a mild form of azoturia.

U

ulcerate—To break skin or mucous membranes.

umbilicus—The navel.

unconditioned response—A response that occurs without practice.

unicorn—A mythological horselike animal that had a single large horn in the middle of its forehead.

unnerve—Cutting or removing a nerve from the body.

unsoundness—Any condition that interferes or is apt to interfere with the function and performance of the horse.

unthriftiness—Unhealthy or inefficient condition; lacking vigor or bloom.

upright pasterns—straight, vertical pastern bone—a conformation problem.

ureters—Part of the urinary system that passes urine to the bladder.

urethra—The canal through which urine in the female and urine and semen in the male are discharged.

urine—The fluid that contains nitrogenous waste and any excess salts or sugars not required by the body.

uterus—Part of the female reproductive tract; it consists of a body, cervix, and two horns, one of which receives the fertilized ovum for development.

V

vaccine—A substance that is either inactivated killed organisms or modified live organisms prepared for inoculation. It stimulates the immune response and/or produces durable immunity with a single dose.

vacuoles—Large liquid-filled areas in cells.

vagina—The part of the female reproductive tract that receives the sperm during mating and functions as a passageway during parturition.

variable costs—Costs that increase or decrease in relation to an increase or decrease in production.

veins—Vessels that carry blood from the tissues to the heart.

venae cavae—The large veins entering the heart.

ventilation—Air movement in and out of a building.

ventral—Surface opposite the backbone; opposite of dorsal.

vertebrae—Any of the bones or segments in the spinal column.

vertebral column—The backbone.

vesicle—A small, thin-walled cavity.

veterinarian—An animal doctor; a DVM.

vices—Habits acquired by some horses that are subjected to long periods of idleness. Hard work and freedom from close confinement are distinct preventives.

viral—Of, pertaining to, caused by, or the nature of a virus.

visceral—Smooth muscle is sometimes called visceral muscle.

vital signs—Indications of an animal's health: heart rate, temperature, and respiration rate.

W

walk—A natural, slow, flat-footed, four-beat gait; each foot takes off from and strikes the ground at a separate interval.

warmblood—Refers to the overall temperament of light to medium horse breeds. Warmblood horses are fine boned and suitable for riding.

water-soluble vitamins—B-complex vitamins and vitamin C; not stored in the body and must be replaced each day.

waxed teats—When drops of sticky, clear, or amber-colored fluid excreted prior to parturition become dried and hard, coating the ends of the teats and giving them a waxy appearance.

way of going—How a horse moves.

weanling—A foal that has been weaned from its mother.

weaving—A rhythmical shifting of the weight from one front foot to the other. It is not a common vice, but when carried to extremes, it renders a horse almost useless.

wet mare—A mare that has foaled during the current breeding season and is nursing the foal.

whistling—A paralysis or partial paralysis of the nerves that control the muscles of the vocal cords; also called roaring.

white blood cells—The active agents in combating disease germs in the body.

white on knee or hock—A separate white mark on the knee or hock.

white spots—White spots on the front of the coronet band or on the heel.

wind puffs—Soft enlargements located at the ankle joints and due to the enlargement of the synovial (lubricating) sacs.

windgalls—Soft enlargements located at the ankle joints due to enlargement of the synovial (lubricating) sacs. Also called road puffs.

winding—Twisting the front leg around in front of the supporting leg as each stride is taken. Sometimes it is called threading, plaiting, or rope-walking. Wide-chested horses tend to walk in this manner. Winding increases the likelihood of interference and stumbling.

wind-sucking—When a horse identifies an object on which it can press its upper front teeth while pulling backward and sucking air into the stomach, usually accompanied by a prolonged grunting sound. The habit is practiced while eating, thus causing loss of food.

winging outward—An outward deviation in the direction of the stride of the foreleg. It is the result of a narrow or pigeon-toed standing position. Winging is exaggerated paddling and very noticeable in high-stepping horses.

winking—When the mare raises her tail to urinate, and the labia open to expose the clitoris, while she assumes a mating position.

withers—The highest part of the back located at the base of the neck in a horse.

wolf teeth—The first permanent premolars.

wound—A disruption in the integrity of living tissue, caused by physical means.

wry muzzle—A distortion of the muzzle.

Y

yearlings—Horses between 1 and 2 years of age.

Z

zebra hybrid—An all-encompassing term for a zebra crossed on any other equine species.

zoonosis—A disease that can be transmitted to humans from animals.

zygote—Cell formed by the union of the male and female gametes (the sperm and egg) and the individual developing from this cell.

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