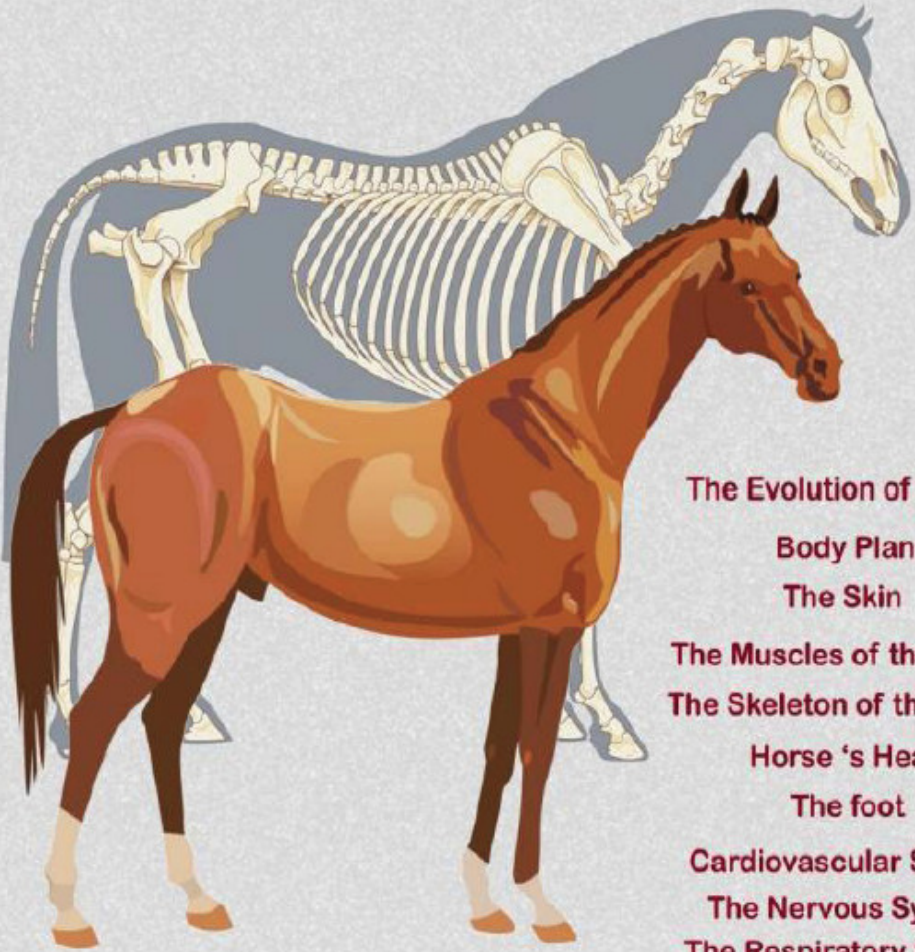


# **HORSE ANATOMY**

## **Coloring Book**



**Veterinary  
Workbook and Coloring**

**The Evolution of Horse**

**Body Plan**

**The Skin**

**The Muscles of the Horse**

**The Skeleton of the Horse**

**Horse 's Head**

**The foot**

**Cardiovascular System**

**The Nervous System**

**The Respiratory System**

**The Urinary System**

**The Reproductive System**

**The Digestive System**

**More than 200 illustration images of anatomy**





# Horse Anatomy

## Coloring Book





**COPYRIGHT © 2020**

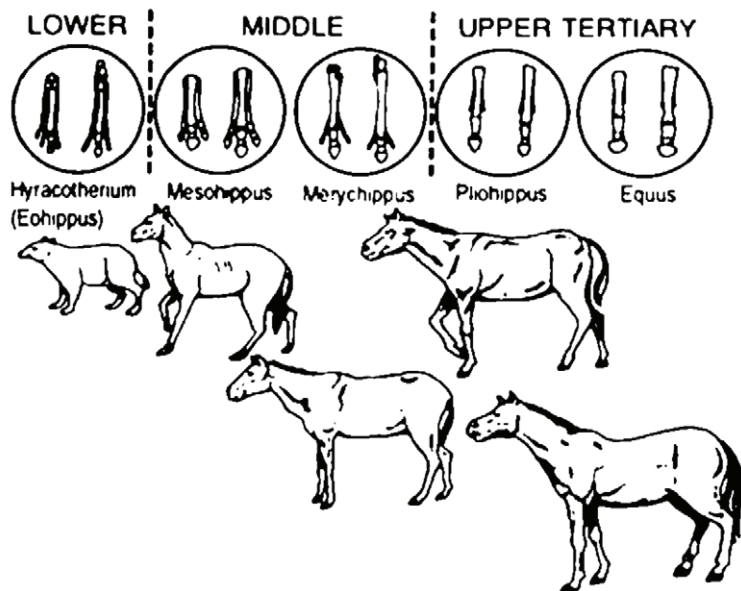
ALL RIGHTS RESERVED. THIS BOOK OR PARTS THEREOF MAY NOT BE REPRODUCED IN ANY FORM, STORED IN ANY RETRIEVAL SYSTEM, OR TRANSMITTED IN ANY FORM BY ANY MEANS—ELECTRONIC, MECHANICAL, PHOTOCOPY, RECORDING, OR OTHERWISE—WITHOUT PRIOR WRITTEN PERMISSION OF THE PUBLISHER, EXCEPT AS PROVIDED BY UNITED STATES OF AMERICA COPYRIGHT LAW.

# The Evolution of The horse

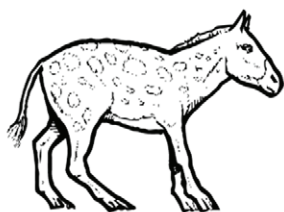


The horse as we know it today is the product of a long evolutionary chain stretching back millions of years. The chain begins with eohippus, or "dawn horse," a small animal which flourished over fifty million years ago. Eohippus was equipped with four toes on its forefeet and three toes on its hind feet, all terminating in thick horn. Behind the toes was a pad, which persists in the modern horse as a small, horny callosity on the point of the fetlock, called the "ergot." Scientists know what eohippus looked like because a nearly complete skeleton was discovered in Wyoming in 1931.

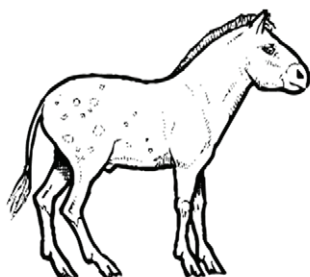
Over millions of years, the multiple toes on the horses' feet gradually evolved into a single toe as the size of the digits decreased until only the central one played any part in running. The first one-toed horses were grazers, like their three-toed ancestors. Over time, horses also increased in size, from the hare-sized eohippus, to the large animals we know today. As horses adapted to their environment, changes in the skull and limbs also took place. The first horses were domesticated around 3,000 B.C., probably in Asiatic Russia.



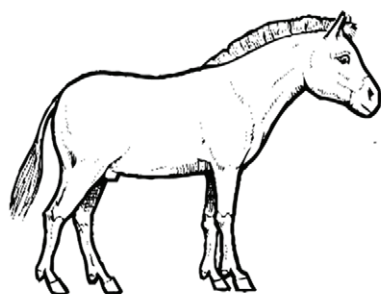




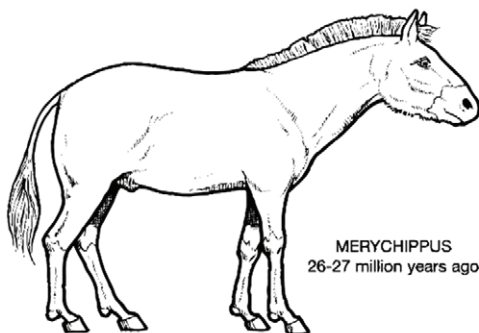
EOHIPPIUS  
50 million years ago



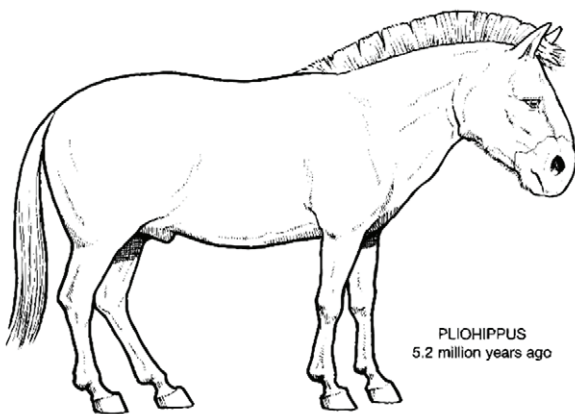
MESOHIPPUS  
26-38 million years ago



MIOHIPPIUS  
30 million years ago



MERYCHIPPUS  
26-27 million years ago



PLIOHIPPIUS  
5.2 million years ago

# Body Plan

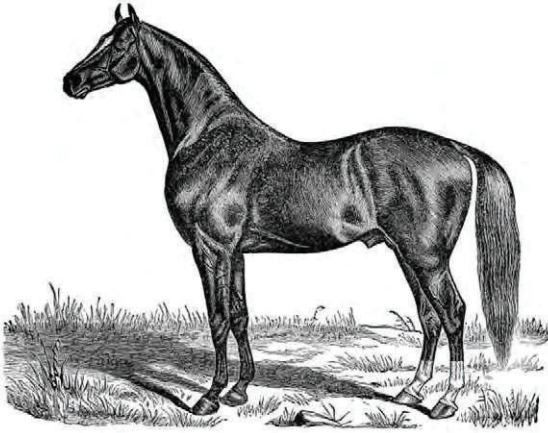


Figure 1

## Median plane

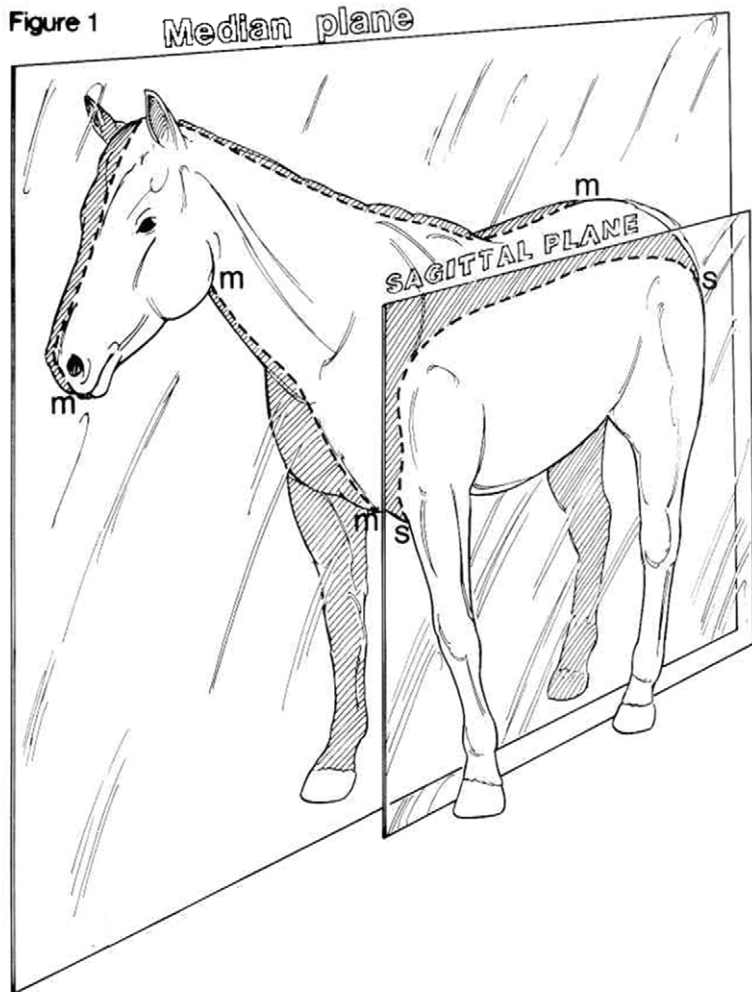


Figure 1. The **median plane** (L., medianus = in the middle), indicated by the dashed lines between the m's, divides the horse's body into right and left halves. A **sagittal plane** (L., sagitta = arrow), indicated by the dashed line from s to s, is any plane parallel to the median plane.

Figure 2  
Median plane

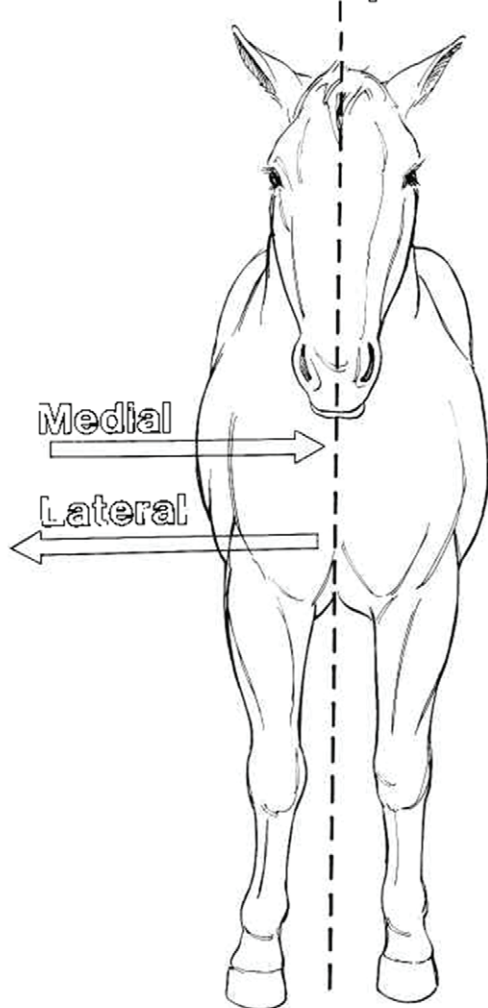


Figure 2. The **median plane** is indicated by the dashed line. **Medial and lateral** (L., latus = side) are directional terms relative to the median plane. Medial structures are located closer to the median plane. Lateral structures lie away from the median plane, that is, toward the side.



Figure 3

### Transverse plane

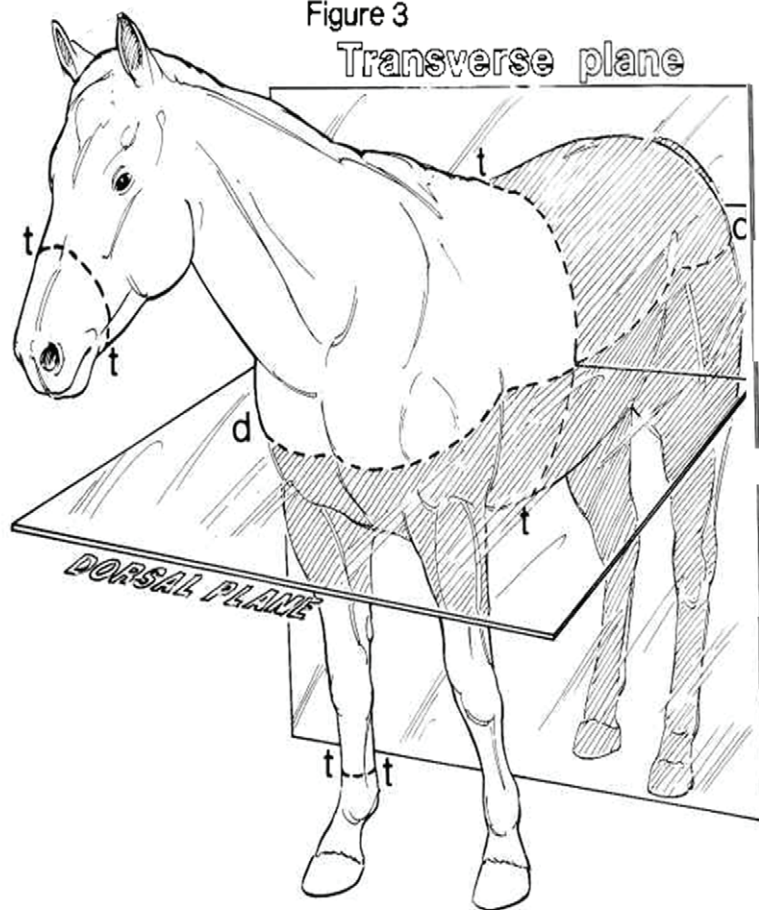
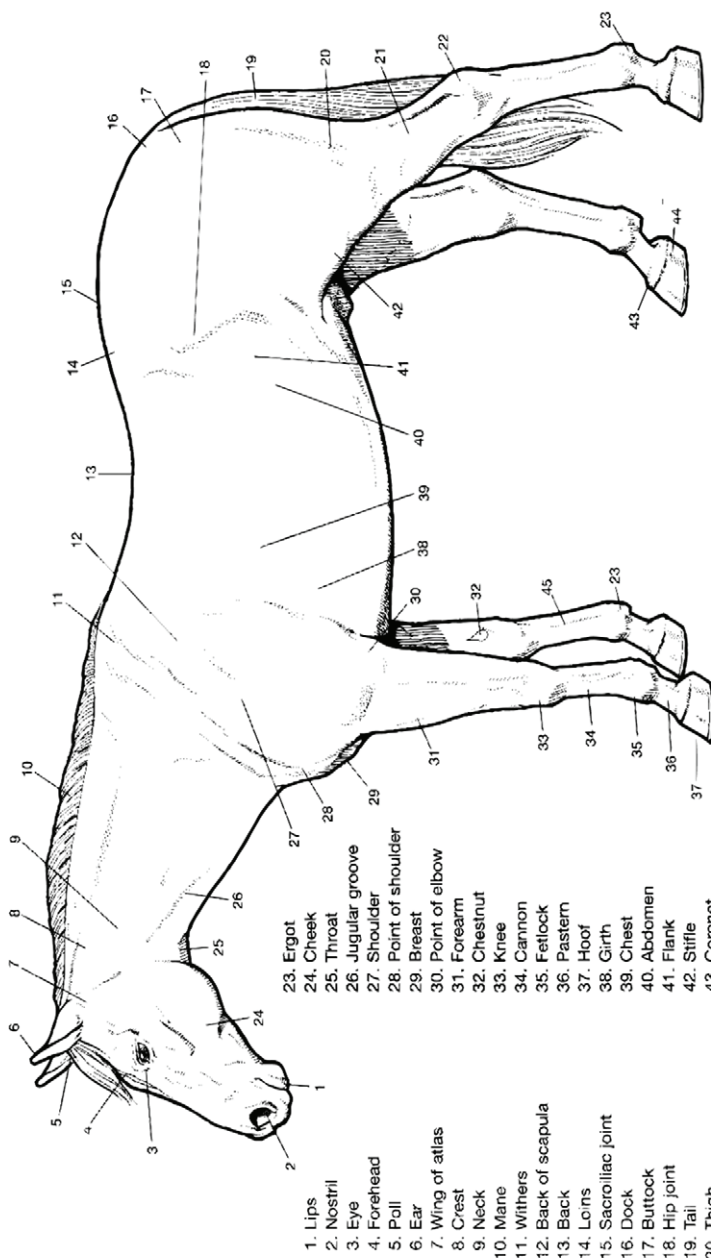


Figure 3. A **transverse plane**, indicated by the dashed lines between the t's, passes through the head, trunk or limb perpendicular to the part's long axis. A **dorsal plane** (frontal plane), indicated by the dashed line from d to d, passes through a body part parallel to its dorsal surface.

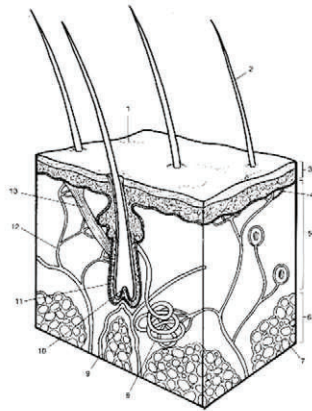
## Points of the Horse



The points of the horse are the external features that make up the horse's conformation, or shape. Knowledge of the points of the horse is vital for a real understanding of the animal. Experts acquire this knowledge by visual examination and physical touch. By feeling the point of the shoulder and

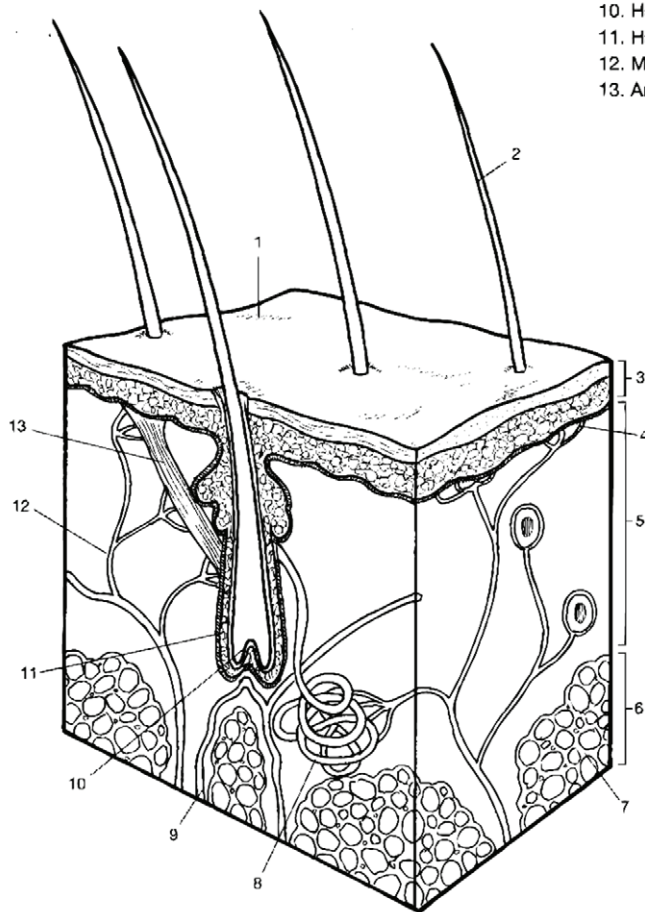
other associated features, for instance, it is possible to establish what the angle of the shoulder is and whether it is correctly conformed. No one feature should be out of proportion with the others.

# The Skin



The skin is the largest organ of the horse's body. It is made up of tissue known as the epithelium, which consists of two distinct layers. The uppermost is the epidermis, an avascular, keratin-rich layer of protective covering, divided into two sub-layers: the outer, called the stratum corneum, and the inner, called the stratum germinativum. The deeper skin layer is the dermis, or corium, the flexible, nourishing source of the epidermis. It is an intricately woven layer of collagen strands, elastic fibers, and fat, including hair follicles, sweat and sebaceous glands, and the udder in the female. Blood and lymph vessels, muscles, and nerves are embedded at various levels.

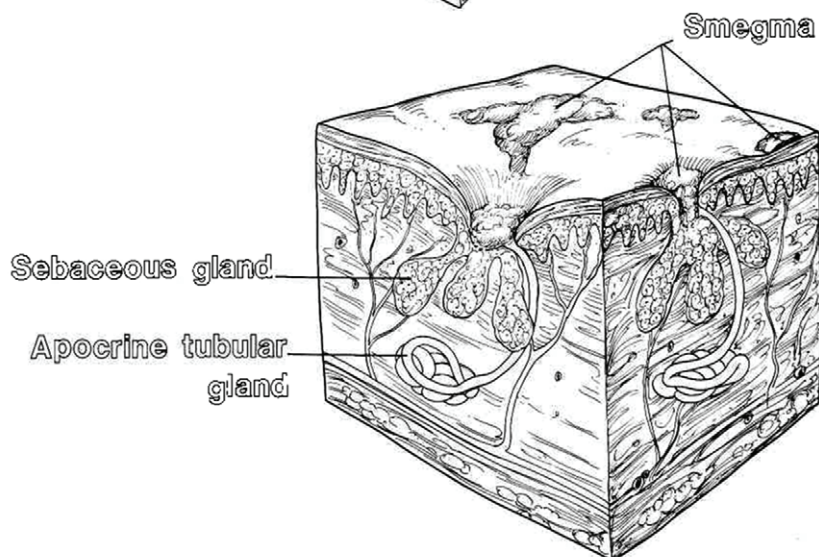
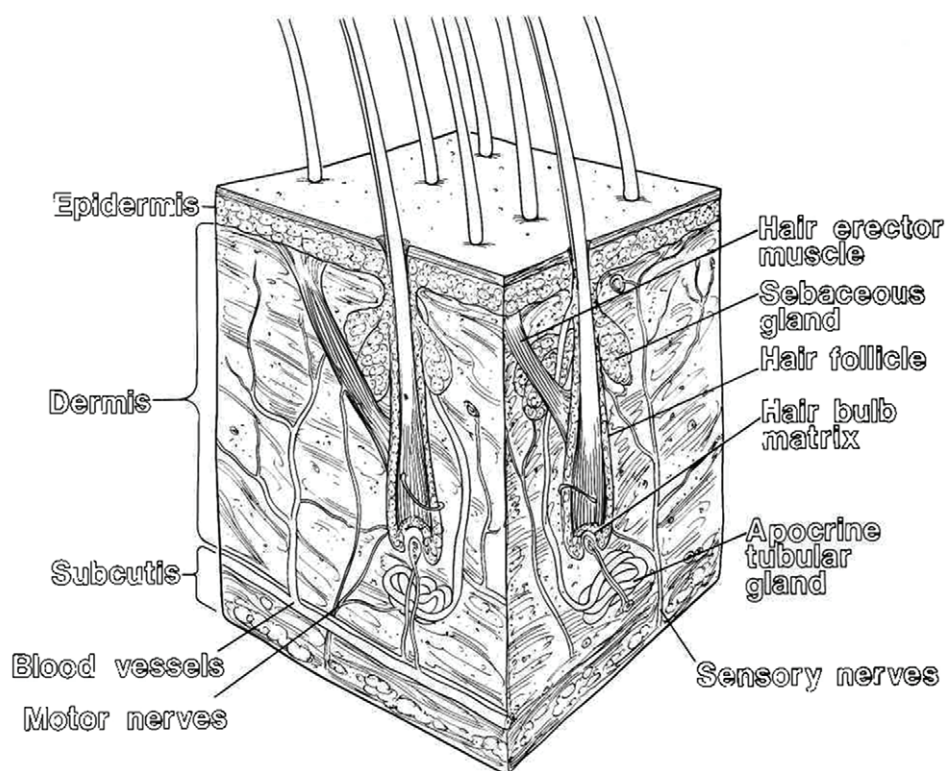
1. Pore
2. Hair
3. Epidermis
4. Nerve ending
5. Dermis
6. Hypodermis
7. Subcutaneous fat
8. Apocrine sweat gland
9. Blood vessel
10. Hair bulb
11. Hair follicle
12. Motor nerve
13. Arrector pili muscle



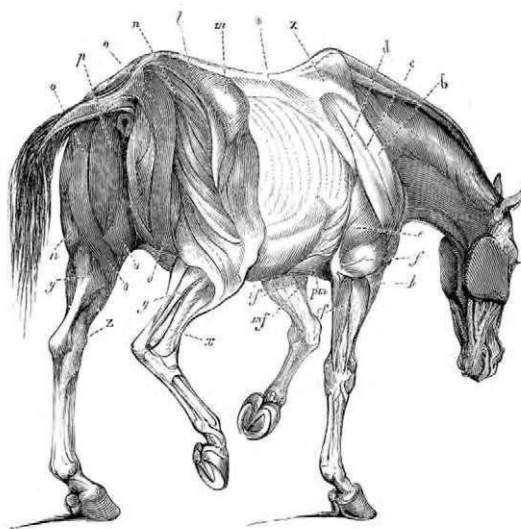
Among the many functions of the skin, two are especially important: it is a barrier to harmful microorganisms, and it offers protection from the elements. The hair over much of its surface grows in "streams" that help repel rain and sweat. In addition, the skin of the horse contains

sebaceous glands, which produce an oily material that waterproofs the skin. Horses are quite susceptible to skin problems, however, especially in unhygienic conditions, and good stable and field management are essential.



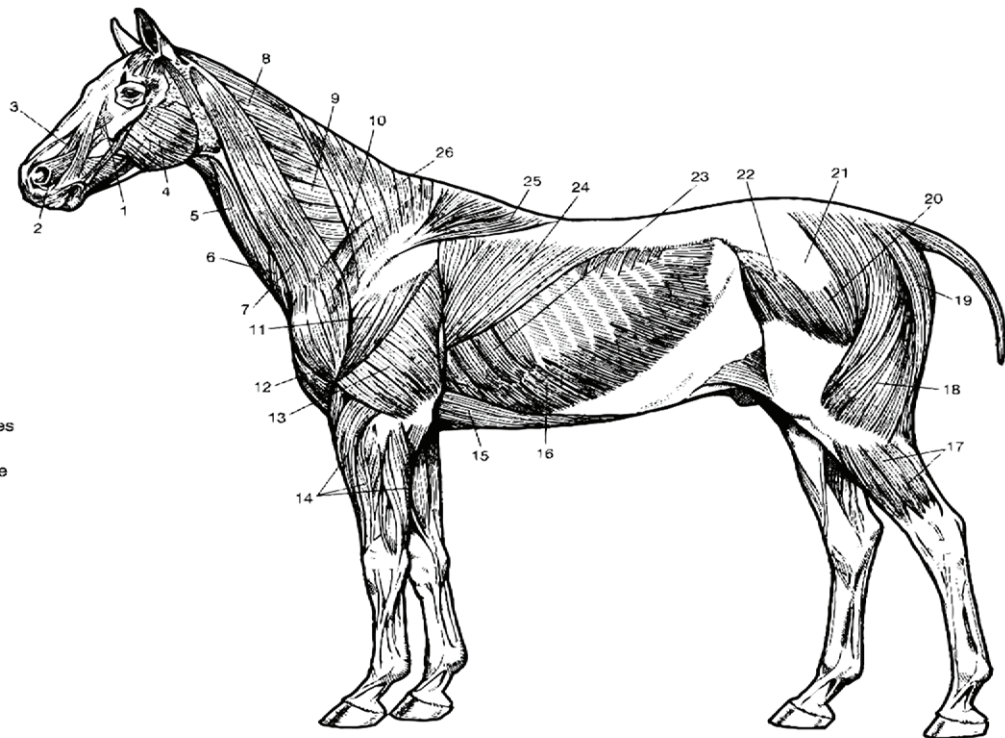


# The Muscles of the Horse



## The Muscles of the Horse

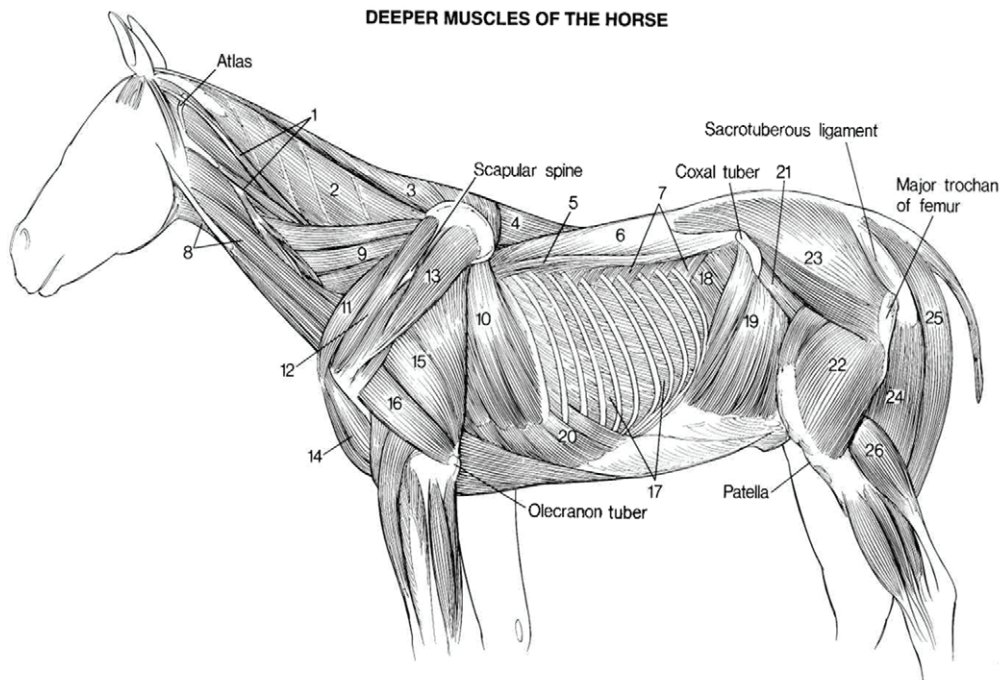
1. Superior labial levator muscle
2. Canine muscle
3. Nasolabial levator muscle.
4. Masseter muscle
5. Sternomandibular muscle
6. Cervical cutaneous muscle
7. Brachiocephalic muscle
8. Splenius muscle
9. Cervical ventral serrated muscle
10. Subclavian muscle
11. Deltoid muscle
12. Descending pectoral muscle
13. Brachial triceps
14. Carpal and digital extensor muscles
15. Ascending pectoral muscle
16. External abdominal oblique muscle
17. Digital extensor muscles
18. Femoral biceps muscles
19. Semitendinous muscle
20. Superficial gluteal muscle
21. Gluteal fascia
22. Tensor muscle
23. Thoracic ventral serrated muscle
24. Latissimus dorsi muscle
25. Thoracic trapezius muscle
26. Cervical trapezius muscle



There are approximately 700 separate muscles in a horse's body. All movements, from a flick of the tail to the most difficult maneuver, are brought about by a complicated system of skeletal muscles. Motion is produced by the contraction and relaxation of alternating, opposing groups of muscles acting reciprocally on skeletal layers and eventually on the hooves as fulcrums on the ground.

Centuries of selective breeding have led to enhanced muscular development in some breeds and types. For example, the quarter horse, bred to sprint, has highly developed, muscular forelimbs and hindquarters, while the *steeplechasing* thoroughbred, bred to race over courses with hurdles and water jumps, has a less muscular physique than the *sprinting* thoroughbred.

## DEEPER MUSCLES OF THE HORSE



m. = muscle, mm. = muscles

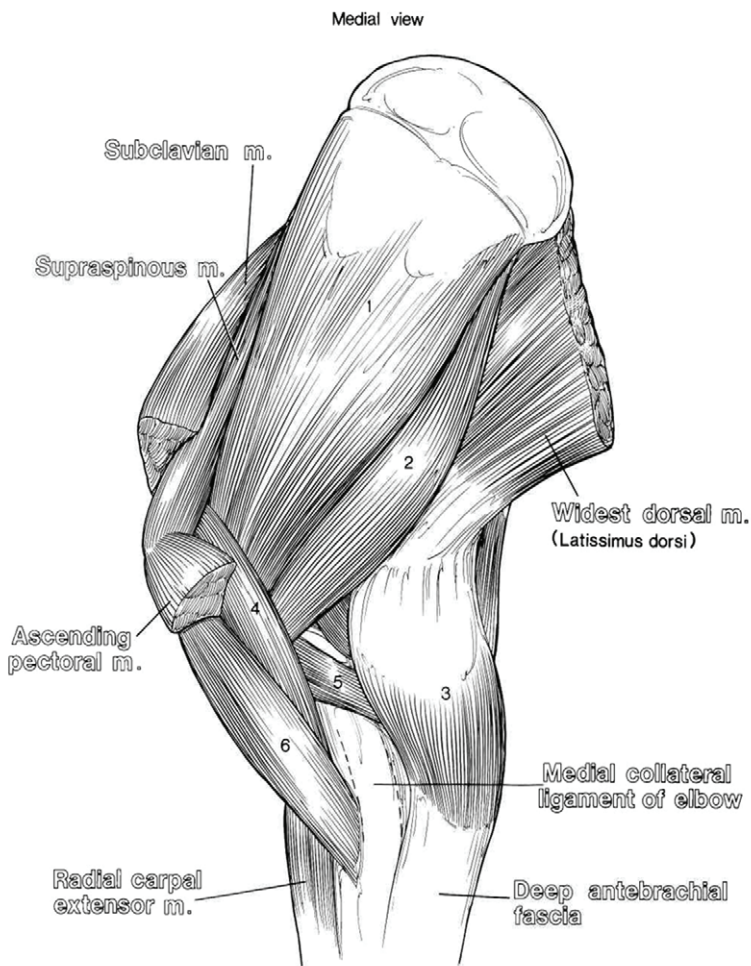
1. Longest capital and atlantal m.
2. Complex m.
3. Rhomboid m.
4. Thoracic spinal m.
5. Iliocostal m.
6. Longest dorsal m.
7. Caudal dorsal serrated m.
8. Omohyoid m.
9. Cervical ventral serrated m.
10. Thoracic ventral serrated m.
11. Subclavian m.
12. Supraspinatus m.
13. Infraspinatus m.

14. Brachial biceps m.
15. Long head of brachial triceps m.
16. Lateral head of brachial triceps m.
17. External intercostal mm.
18. Transverse abdominal m.
19. Internal abdominal oblique m.
20. External abdominal oblique m.
21. Iliac m.
22. Femoral quadriceps m.
23. Middle gluteal m.
24. Semimembranosus m.
25. Semitendinosus m.
26. Gastrocnemius m.

The tying-up syndrome is a muscular disease that follows prolonged, hard exercise. The condition occurs in certain horses apparently due to depletion of muscle energy. Affected horses are very stiff and do not want to move. They should not be forced to move! Electrolytes (salts) and glucose (simple sugar) given orally and intravenously have been used to treat tying-up. Injection of an immunomodulator has had dramatic results in alleviating tying-up syndrome. Prevention includes better conditioning, less strenuous exercise and giving the horse more water and extra electrolytes.



## DEEP SHOULDER AND ARM MUSCLES

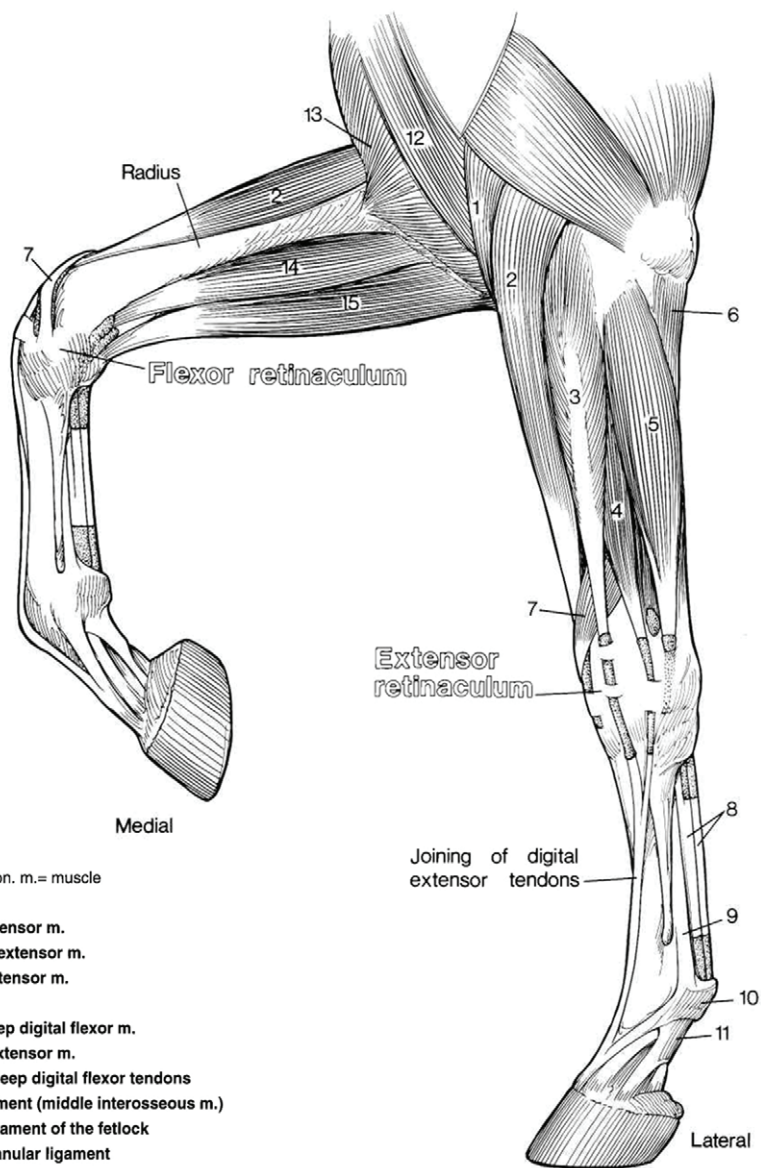


Medial view of dissected right shoulder and arm. m.= muscle

1. Subscapular m.
2. Major teres m.
3. Tensor m. of antebrachial fascia
4. Coracobrachial m.
5. Medial head of brachial triceps m.
6. Brachial biceps m.

In addition to flexion and extension, movements of the limbs include adduction - movement toward the median plane, abduction - movement away from the median plane, and a limited amount of rotation about the limb's axis.

## DISTAL FORELIMB MUSCLES



Right forelimb in flexion. m.= muscle

1. Brachial m.
2. Radial carpal extensor m.
3. Common digital extensor m.
4. Lateral digital extensor m.
5. Lateral ulnar m.
6. Ulnar head of deep digital flexor m.
7. Oblique carpal extensor m.
8. Superficial and deep digital flexor tendons
9. Suspensory ligament (middle interosseous m.)
10. Palmar annular ligament of the fetlock
11. Proximal digital annular ligament
12. Descending pectoral m.
13. Transverse pectoral m.
14. Radial carpal flexor m.
15. Ulnar carpal flexor m.

## DORSOSCAPULAR LIGAMENT AND NUCHAL LIGAMENT

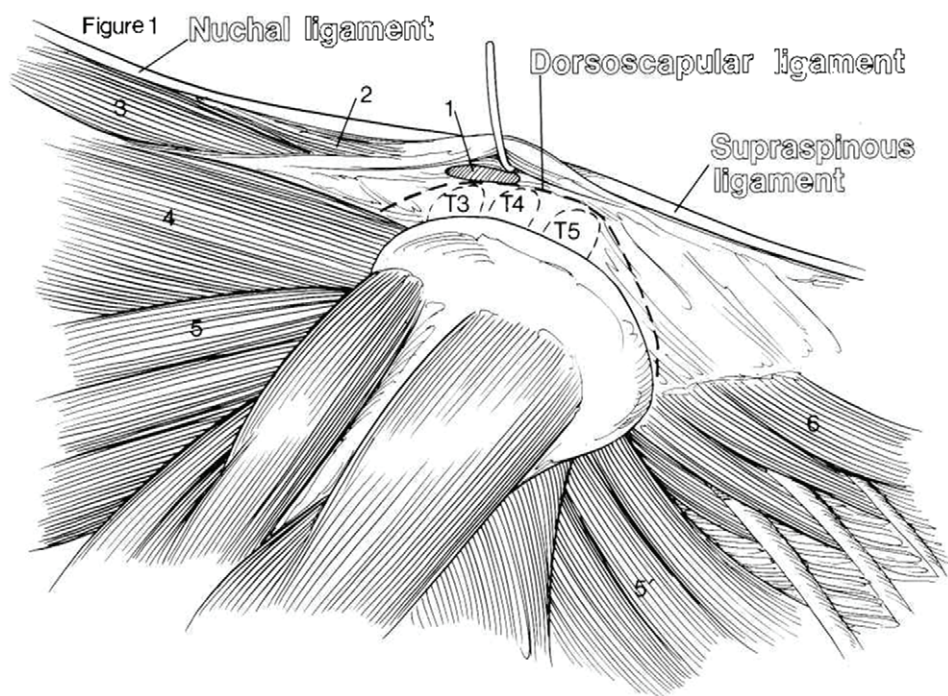


Figure 1. Lateral view of a dissection of the left withers. The trapezius muscle has been removed. The **thoracic rhomboid muscle** and **nuchal ligament** have been pulled away from the superficial surface of the **dorsoscapular ligament**, a thickened part of the thoracolumbar fascia that helps to attach the trunk to the shoulder. The dorsal part (seen here) arises from the spines of T3, T4 and T5 vertebrae. Elastic bands from the ventral part (not seen here) attach to the medial surface of the **scapula** between attachments of the **ventral serrated muscles**. Identify and color the dorsoscapular ligament (outlined by a dashed line and over the thoracic spines) and the structures associated with it.

1. **Supraspinous bursa**

2. **Rhomboid muscle**

3. **Capital semispinal muscle**

4. **Splenius muscle**

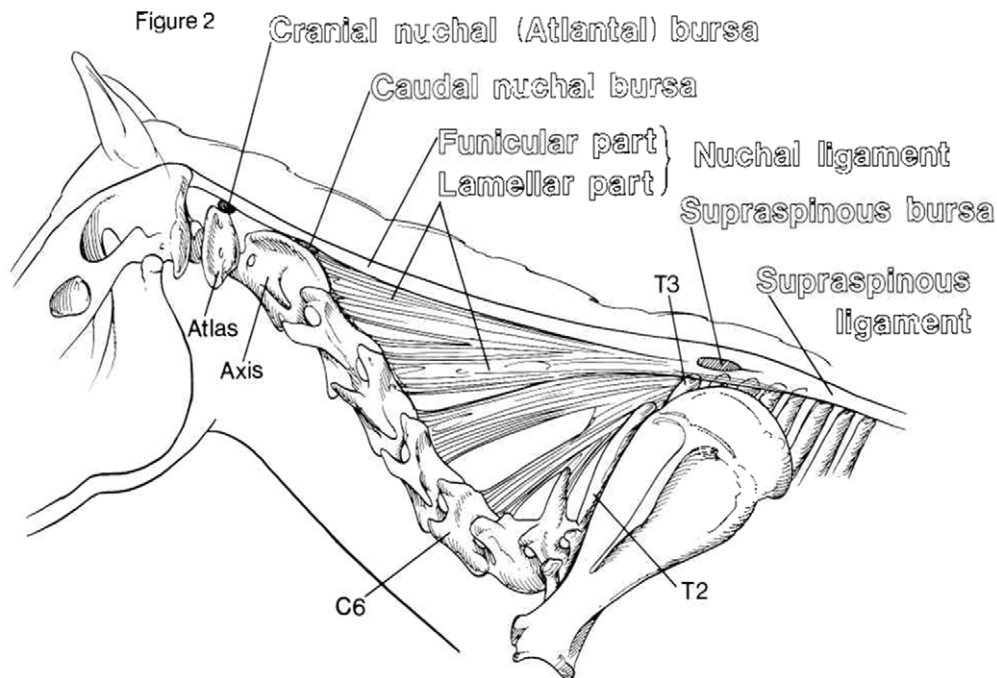
5,5'. **Ventral serrated muscles**

6. **Dorsal serrated muscle**

Figure 2. Lateral view of dissected **nuchal ligament**. The **funicular part of the nuchal ligament** consists of two parallel cords that attach to the skull and flatten caudally where they merge with the **supraspinous ligament**. Elastic bands of the **lamellar part** extend from the funicular part and the second and third thoracic spines to spines of the axis and C3 to C5 or C6.

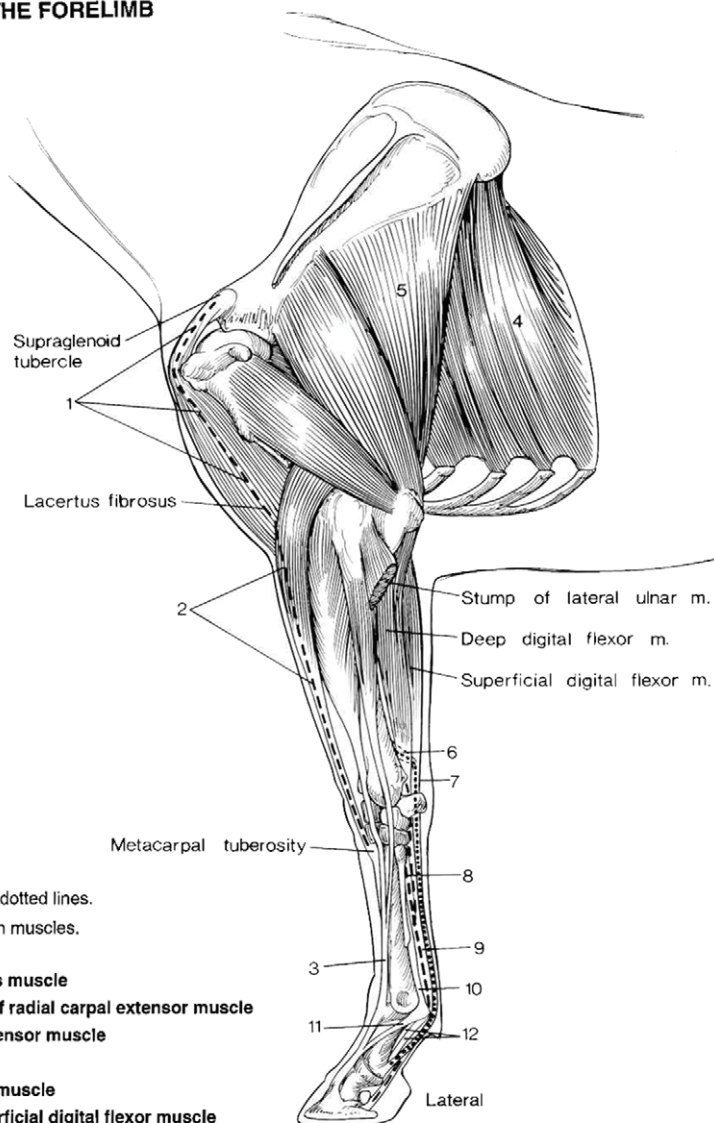
Elasticity of the nuchal ligament minimizes muscular exertion when the horse lowers or raises its head during grazing.

#### Lateral views





## STAY APPARATUS OF THE FORELIMB

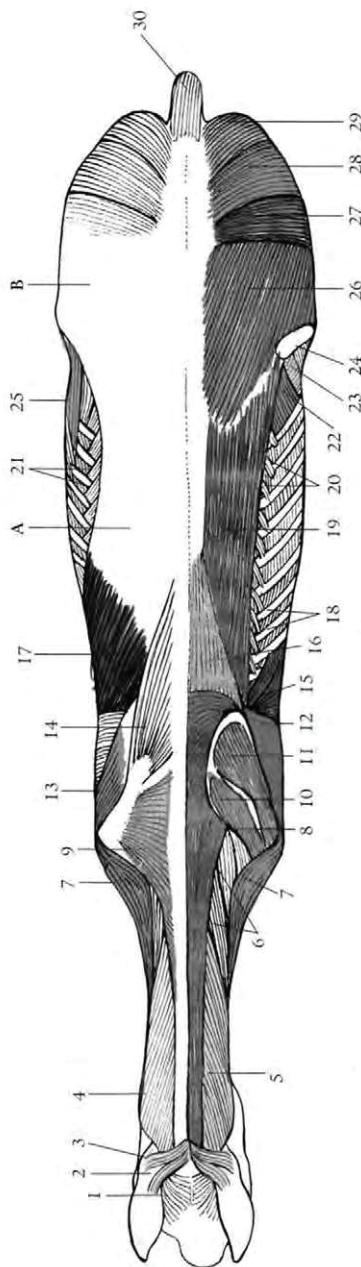


Tendons are indicated by dashed or dotted lines.

Parts of some tendons pass through muscles.

1. Tendons of the brachial biceps muscle
2. Fascial covering and tendon of radial carpal extensor muscle
3. Tendon of common digital extensor muscle
4. Thoracic serrated muscle
5. Long head of brachial triceps muscle
6. Radial check ligament of superficial digital flexor muscle
7. Tendon of superficial digital flexor muscle
8. Carpal check ligament of deep digital flexor muscle
9. Tendon of deep digital flexor muscle
10. Suspensory ligament
11. Extensor branch of suspensory ligament
12. Three distal sesamoidean ligaments

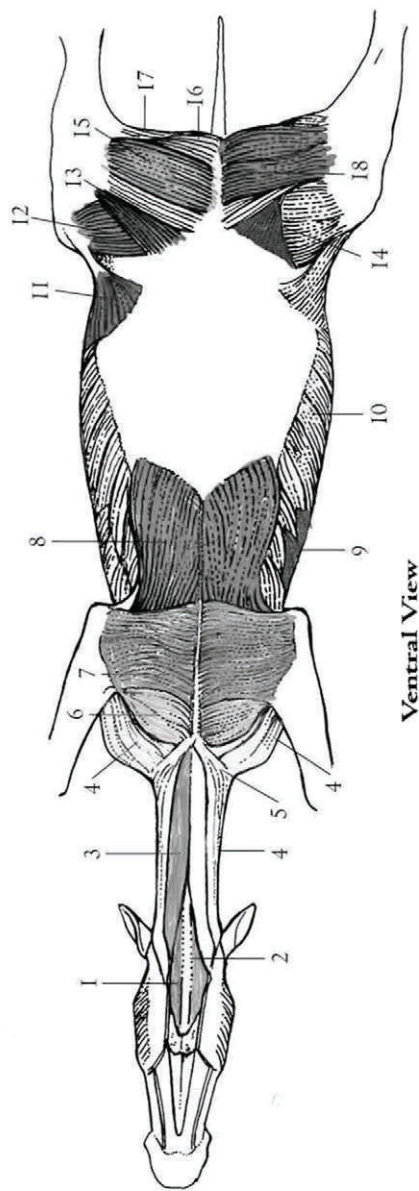
# MUSCLES – Dorsal and Ventral



Dorsal View

- 1 Scutularis muscle
- 2 Auricular levator muscle
- 3 Auricular abductor muscle
- 4 Splenius muscle
- 5 Complexus muscle
- 6 Cervical part of ventral serrate muscle
- 7 Brachiocephalic muscle
- 8 Rhomboid muscle
- 9 Cervical part of trapezius muscle
- 10 Supraspinous muscle
- 11 Infraspinous muscle
- 12 Triceps muscle
- 13 Deltoid muscle
- 14 Thoracic part of trapezius muscle
- 15 Thoracic part of ventral serrate muscle
- 16 Spinalis dorsi
- 17 Latissimus dorsi muscle
- 18 External intercostal muscle
- 19 Longissimus dorsi muscle

- 20 Iliocostal muscle
- 21 Caudal part of dorsal serrate muscle
- 22 Costal retractor muscle
- 23 Transverse abdominal muscle
- 24 Internal abdominal oblique muscle
- 25 External abdominal oblique muscle
- 26 Medial gluteal muscle
- 27 Superficial gluteal muscle
- 28 Biceps femoris muscle
- 29 Semitendinosus muscle
- 30 Tail levator muscle



Ventral View

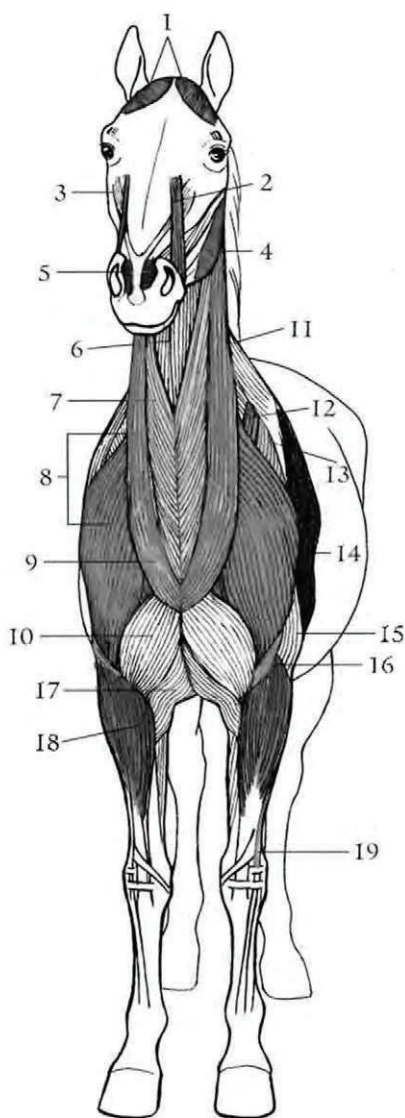
- |   |   |   |                        |
|---|---|---|------------------------|
| ① | Omohyoid muscle                                 | ⑬ | Sartorius muscle       |
| ② | Sternohyoid muscle                              | ⑭ | Iliopsoas muscle       |
| ③ | Sternomandibular part of sternoccephalic muscle | ⑮ | Gracilis muscle        |
| ④ | Brachiocephalic muscle                          | ⑯ | Semimembranosus muscle |
| ⑤ | Cervical subcutaneous muscle                    | ⑰ | Semitendinosus muscle  |
| ⑥ | Cranial superficial pectoral muscle             | ⑱ | Adductor muscle        |
| ⑦ | Caudal superficial pectoral muscle              |   |                        |
| ⑧ | Caudal deep pectoral muscle                     |   |                        |
| ⑨ | Ventral serrate muscle                          |   |                        |
| ⑩ | External abdominal oblique muscle               |   |                        |
| ⑪ | Abdominal subcutaneous muscle                   |   |                        |
| ⑫ | Femoral quadriceps muscle                       |   |                        |



## Cranial and Caudal

### Cranial View

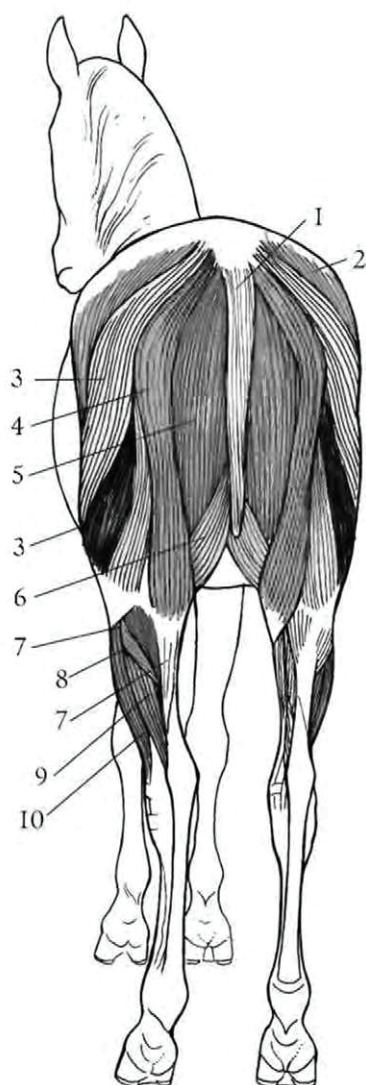
- ① Interscutular muscle
- ② Levator muscle of upper lip and nostril wing
- ③ Levator muscle of upper lip
- ④ Masseter muscle
- ⑤ Transverse nasal muscle
- ⑥ Sternothyrohyoid muscle
- ⑦ Sternomandibular part of sternocephalic muscle
- ⑧ Brachiocephalic muscle
- ⑨ Remains of skin muscle in neck (cutaneous colli)
- ⑩ Cranial superficial pectoral muscle
- ⑪ Cervical part of trapezius muscle
- ⑫ Cranial deep pectoral muscle
- ⑬ Supraspinatus muscle
- ⑭ Long head of triceps muscle
- ⑮ Lateral head of triceps muscle
- ⑯ Brachialis muscle
- ⑰ Caudal superficial pectoral muscle
- ⑱ Radial carpal extensor muscle
- ⑲ Oblique carpal extensor muscle and tendon



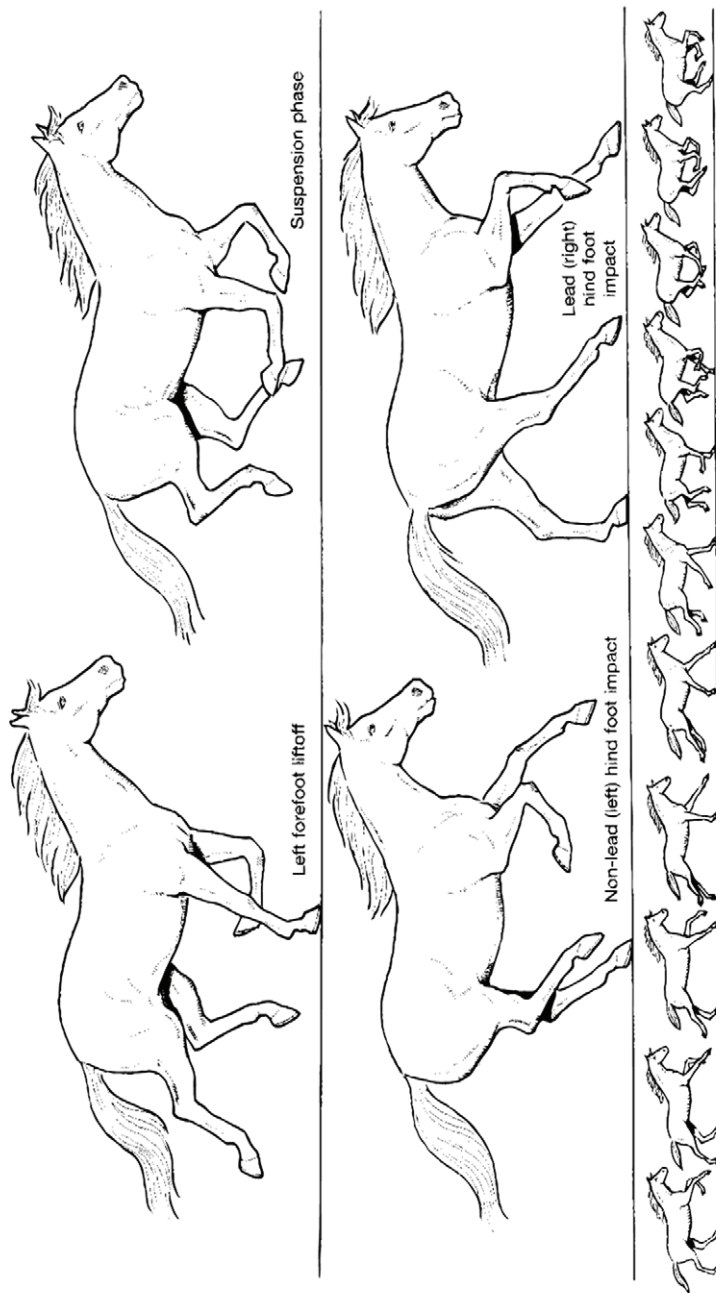
# Caudal View

- ① Levator muscle of tail
- ② Superficial gluteal muscle
- ③ Biceps femoris muscle
- ④ Semitendinosus muscle
- ⑤ Semimembranosus muscle
- ⑥ Gracilis muscle
- ⑦ Gastrocnemius muscle
- ⑧ Soleus muscle
- ⑨ Deep digital flexor muscle
- ⑩ Lateral digital extensor muscle

} components of  
hamstring group  
of muscles



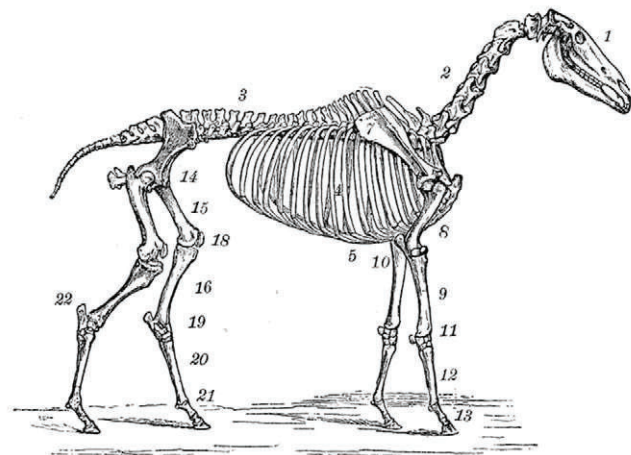
## The Horse in Motion

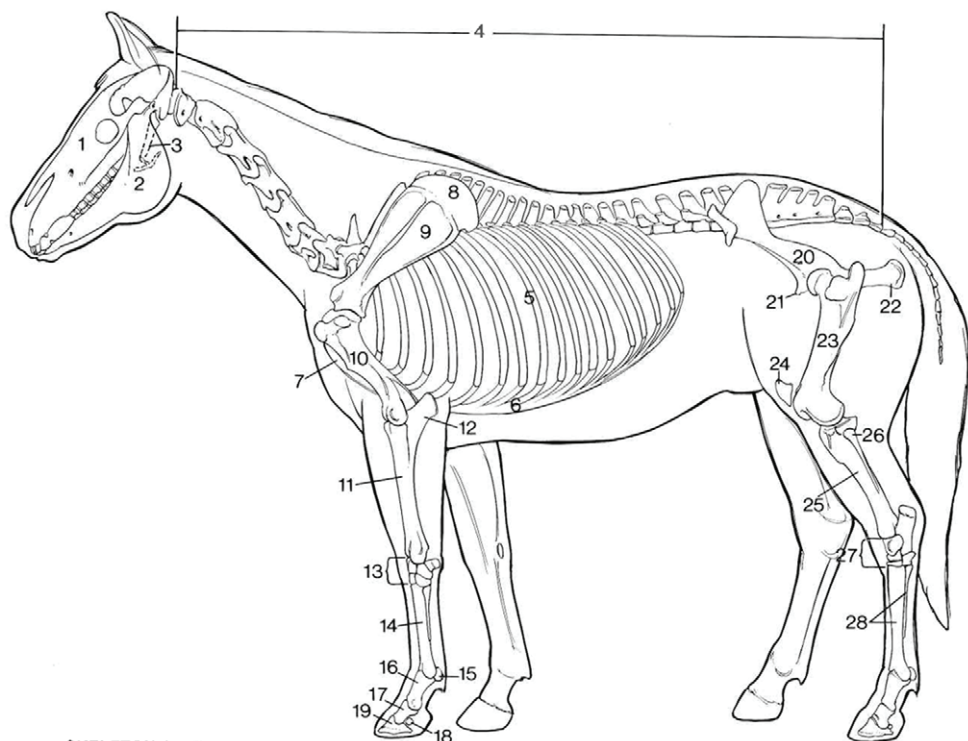


The horse has four natural gaits: walk, trot, canter, and gallop. The illustration shows the final and fastest gait—the gallop. The gallop consists of a rapid four-time step sequence, which varies according to the horse's speed. The left and right sides move in different manners, with one side leading, and the other side trailing. The four limbs move individually and in the following sequence of footfalls: non-lead hind foot; lead hind foot; non-lead forefoot; lead forefoot. One feature of the gallop is the suspension phase, when all

four legs are off the ground. For years, people weren't sure if this actually happened, until a series of photographs taken in the nineteenth century by Edward Muybridge proved conclusively that the horse was completely airborne for an instant during its stride. The suspension phase allows the horse to recover its equilibrium and to get its hind feet under the body. During the gallop there is one suspension phase per stride.

# The Skeleton of the Horse





**SKELETON OF THE HORSE**

**AXIAL SKELETON**

1. Skull
2. Mandible
3. Hyoid bone

4. Vertebral column
5. Ribs

6. Costal cartilages
7. Sternum

**APPENDICULAR SKELETON**

**FORELIMB**

8. Scapular cartilage
9. Scapula
10. Humerus
11. Radius
12. Ulna
13. Carpal bones - 7 or 8

14. Metacarpal bones - 3  
(3rd Mc = cannon bone)
15. Proximal sesamoid bones - 2
16. Proximal phalanx  
(First phalanx or P1)  
(Plural = phalanges)

17. Middle phalanx  
(Second phalanx or P2)
18. Distal sesamoid bone  
(Navicular bone)
19. Distal phalanx  
(Third phalanx or P3)  
(Coffin bone or pedal bone)

**HINDLIMB**

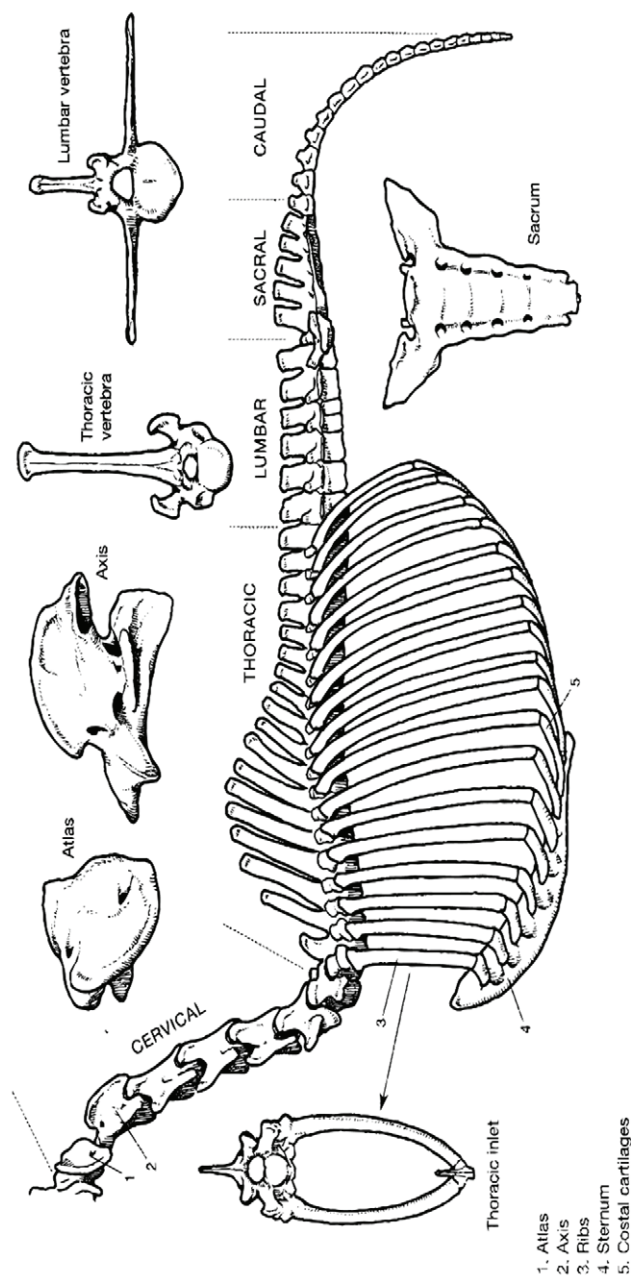
20. Ilium
  21. Pubis
  22. Ischium
- } Fused to form  
the hip bone  
(os coxae)
23. Femur

24. Patella
25. Tibia
26. Fibula
27. Tarsal bones - 6
28. Metatarsal bones - 3

Digital bones of the hindlimb are named the same as those of the forelimb, nos. 16 - 19.

There are 205 bones in the horse's skeleton. Thirty-four, including 3 auditory (hearing) ossicles in each temporal bone, are in the skull. The twenty bones in each forelimb and the twenty in each hindlimb are of great importance in health and disease, since they form the basis for locomotion.

## The Vertebral Column

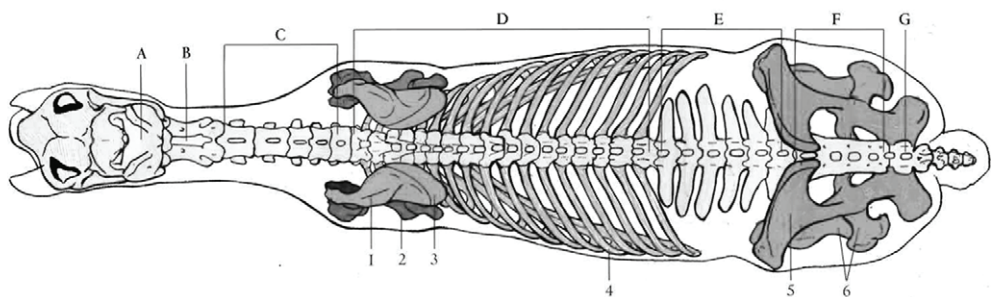


The horse has fifty-four bones in the vertebral column, arranged as follows: cervical, or neck vertebrae (7); thoracic, or chest vertebrae (18); lumbar, or loins vertebrae (6); sacrum, or croup bone (5) vertebrae fused to form a single bone; coccygeal, or tail vertebrae (18). However, the tail vertebrae can vary from fifteen to twenty-one. In addition, the horse has eighteen ribs on each side. Eight ribs are attached directly to the sternum by individual cartilaginous

extensions. Ten false ribs are attached by cartilage to the posterior sternum. Cervical stenotic myelopathy (wobbler syndrome) causes spinal cord compression and is a common and devastating disease in horses. Most prevalent in thoroughbred and quarter horse males, it produces a loss of control in the hindquarters when the horse is walking or turning.



# SKELETON AND SURFACE FEATURES FROM ABOVE



A – Atlas (1<sup>st</sup> cervical vertebra)

B – Axis (2<sup>nd</sup> cervical vertebra)

C – Cervical vertebrae 3-7

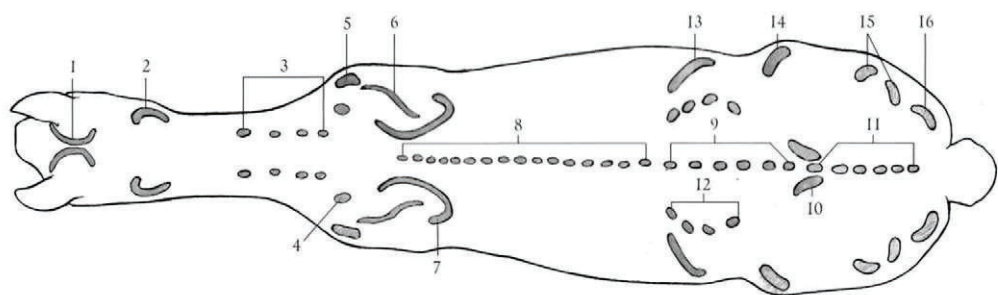
D – Thoracic vertebrae 1-8

E – Lumbar vertebrae

F – Sacrum (5 fused vertebrae)

G – 1st caudal vertebrae

1. Scapula
2. Humerus
3. Scapular cartilage
4. Ribs
5. Pelvic bone
6. Femur



1. External parietal crest
2. Wing of atlas
3. Transverse process of cervical vertebrae
4. Lesser tubercle of humerus
5. Cranial part of greater tubercle of humerus
6. Scapular spine
7. Scapular cartilage
8. Spinous processes of thoracic vertebrae
9. Spinous processes of lumbar vertebrae
10. Sacral tuber of ilium
11. Sacral Spinous processes
12. Transverse processes of lumbar vertebrae
13. 18<sup>th</sup> rib
14. Coxal tuber of ilium
15. Greater trochanter of femur
16. Ischiatic tuber of ischium

## THE VERTEBRAL COLUMN

Figure 1. Regions of the vertebral (spinal) column.

Identify the regions and the number of vertebrae in each region:

**7 cervical, 18 thoracic, 6 lumbar, 5 sacral** (fused to form the sacrum), **and 15-21 caudal (coccygeal) vertebrae.**

The vertebral formula of the horse is **C<sub>7</sub>T<sub>18</sub>L<sub>6</sub>S<sub>5</sub>Ca<sub>15-21</sub>**

There may be one more or one less thoracic vertebra or one less lumbar vertebra.

The latter condition has been noted mainly in Arabian horses.

Figure 2. Vertebrae are irregular bones of various shapes.

Identify and color the following parts:

- 1. Transverse processes (Wings)** on the atlas and sacrum
- 2. Vertebral foramen** (Combined foramina form the vertebral canal which contains the spinal cord and its coverings.)
- 3. Body**
- 4. Arch**
- 5. Spinous process(es)**
- 6. Articular processes (Dens of the axis)**
- 7. Articular surfaces of sacrum (Articulate with each ilium)**

Figure 1

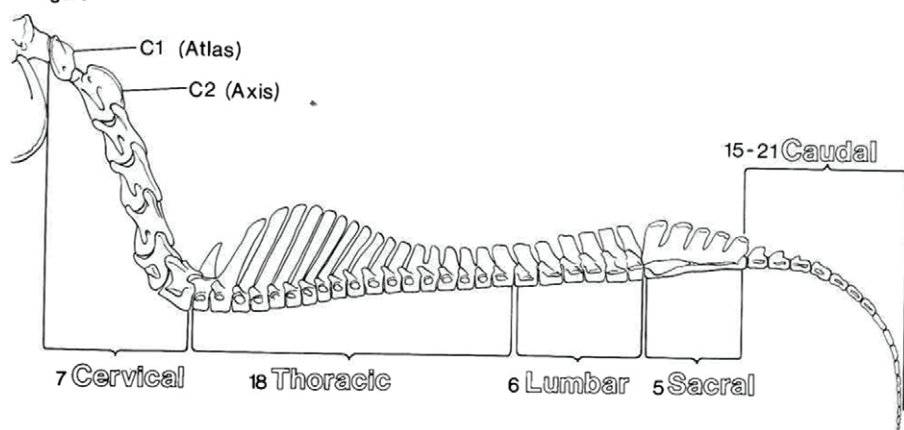
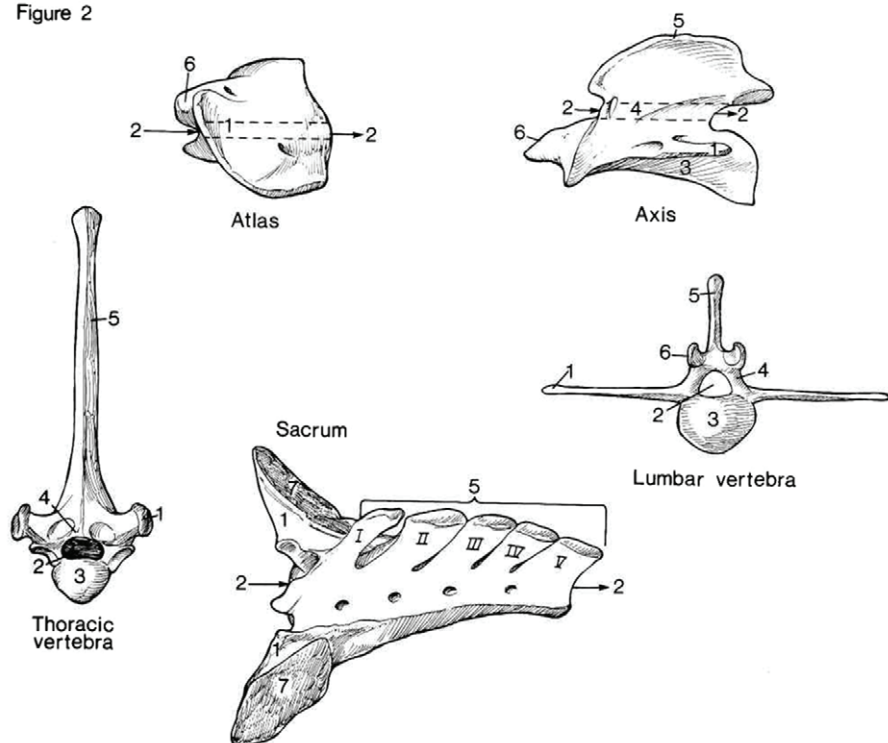


Figure 2



## RIBS AND STERNUM

The horse has 18 (occasionally 19) pairs of ribs. **Costal cartilages** of the first 8 pairs of true ribs articulate with the **sternum**; the rest are false (asternal) ribs. Final ribs which lack costal cartilage attachment to adjacent cartilages are floating ribs. Fused costal cartilages form the costal arch. (L., costa = rib).

The **head** of each rib articulates with the bodies of adjacent thoracic vertebrae, the first rib articulating with the 7th cervical and 1st thoracic vertebrae. The **tubercle** on most ribs articulates with the transverse process on the caudal vertebra of the two with which the head articulates. On the caudal ribs in the series, the tubercle approaches the head and eventually fuses with it.

Figure 1. Craniocaudal view of first ribs, first thoracic vertebra and sternum.

- |                             |            |
|-----------------------------|------------|
| 1. Left 1st rib             | 4. Neck    |
| 2. Transverse process of T1 | 5. Head    |
| 3. Tubercle                 | 6. Sternum |

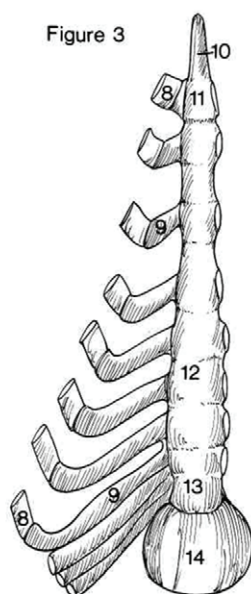
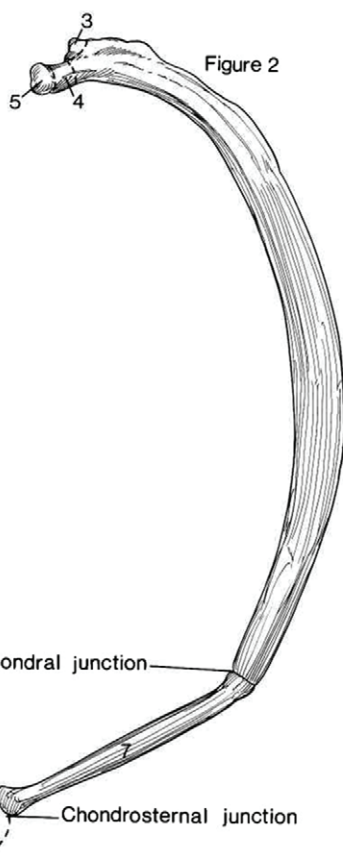
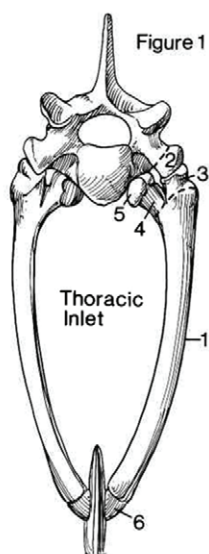
Figure 2. Medial view of right 7th rib. Notice the costochondral and chondrosternal junctions (Greek, chondros = cartilage).

- |             |                               |
|-------------|-------------------------------|
| 3. Tubercle | 6. Sternum                    |
| 4. Neck     | 7. Right 7th costal cartilage |
| 5. Head     |                               |

The **sternum** consists of 7 **sternebrae** which never become completely bony. The cranial segment, the **manubrium**, presents a cartilage as does the caudal segment, the **xiphoid process**, from which the **xiphoid cartilage** projects.

Figure 3. Dorsal view of the horse's sternum.

- |                                |                       |
|--------------------------------|-----------------------|
| 8. First 8 ribs                | 12. Sternebrae 2 to 6 |
| 9. Costal cartilages           | 13. Xiphoid process   |
| 10. Cartilage of the manubrium | 14. Xiphoid cartilage |
| 11. Manubrium                  |                       |





## THE PELVIC GIRDLE – Dorsal and Lateral Views

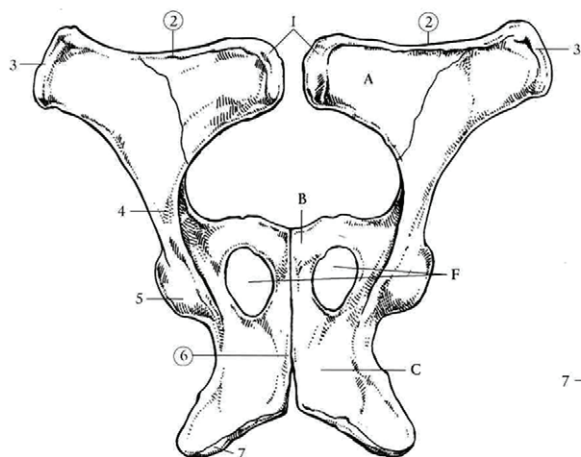


Fig. 1 (a) Dorsal view

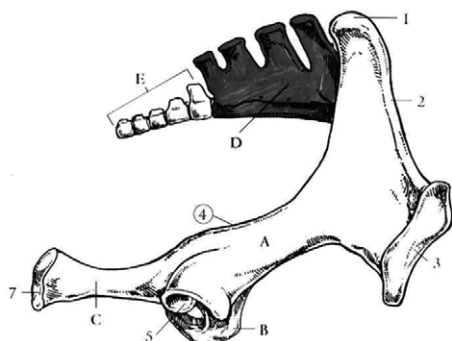


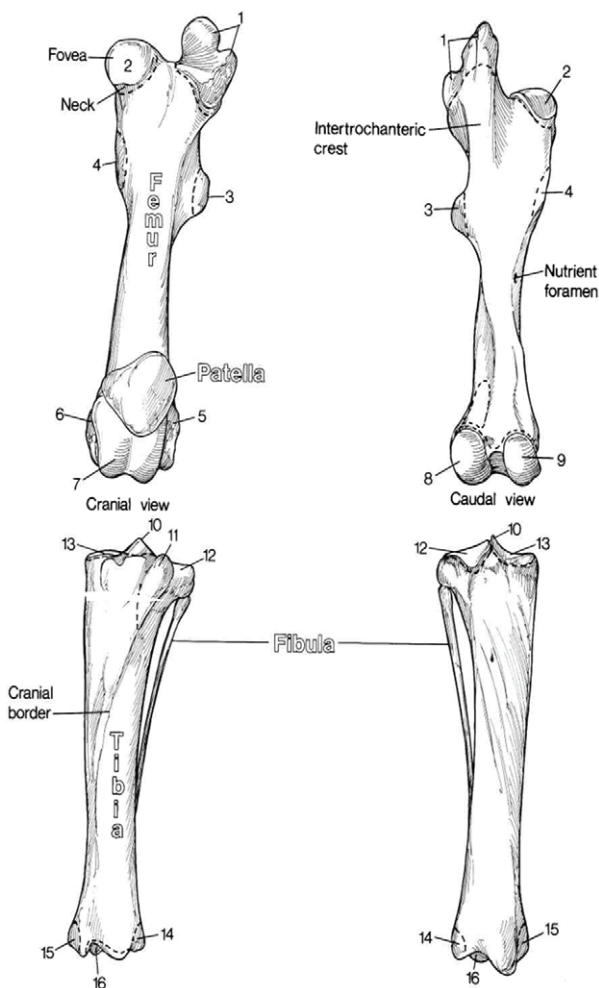
Fig. 1 (b) Lateral view

### The pelvic girdle – dorsal and lateral view (figure 1)

A – Ilium  
B – Pubis  
C – Ischium  
D – Sacrum  
E – Caudal vertebrae  
F – Obturator foramen

1. Tuber sacrale
2. Crest of ilium
3. Tuber coxae
4. Ichiadic spine
5. Acetabulum
6. Symphysis pelvis
7. Tuber ischii

## BONES OF THE THIGH AND LEG

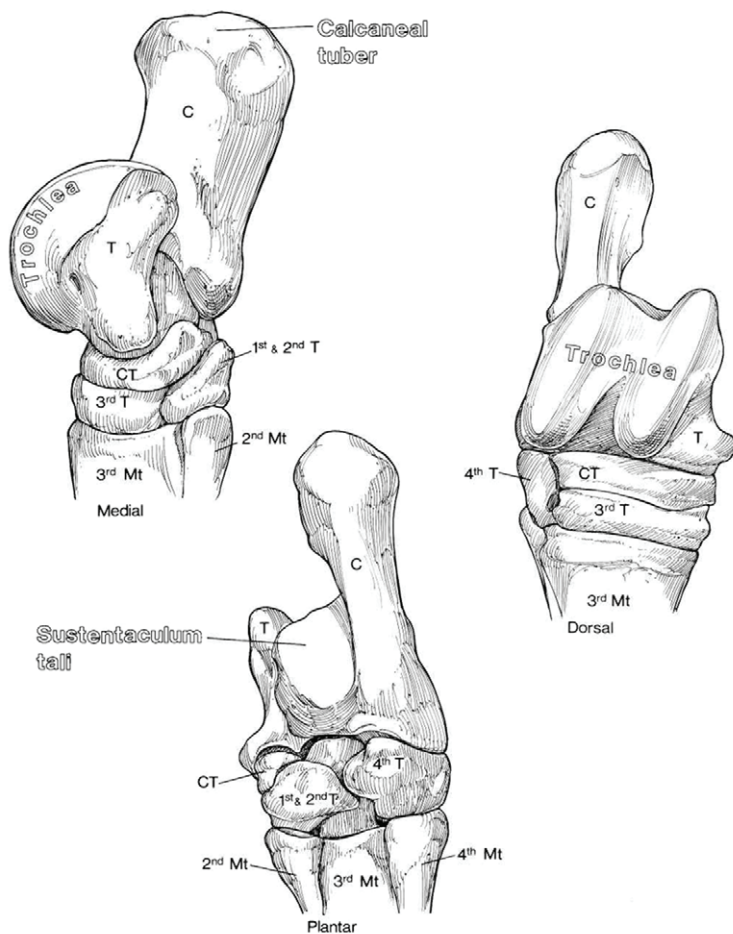


Bones of the thigh and leg:

**femur, patella, tibia, fibula.**

1. Major (greater) trochanter
2. Head
3. Third trochanter
4. Minor (lesser) trochanter
5. Lateral epicondyle
6. Medial epicondyle
7. Trochlea
8. Lateral condyle
9. Medial condyle
10. Intercondylar eminence
11. Tibial tuberosity
12. Lateral condyle
13. Medial condyle
14. Lateral malleolus
15. Medial malleolus
16. Articular surface (tibial cochlea)

## BONES OF THE HOCK



**C. Calcaneus**

**T. Talus**

**CT. Central tarsal bone**

**1st & 2nd T. First and second tarsal bones - fused**

**3rd T. Third tarsal bone**

**4th T. Fourth tarsal bone**

**2nd Mt. Second metatarsal bone**

**3rd Mt. Third metatarsal bone**

**4th Mt. Fourth metatarsal bone**

## **METACARPAL AND DIGITAL BONES**

In the dorsal and palmar views of the right metacarpal and digital bones, the bones are disarticulated so that the articular surfaces may be seen.

**2 Mc Second (medial small) metacarpal bone (splint bone)**

**3 Mc Third (large) metacarpal bone (cannon bone)**

**1. Metacarpal tuberosity**

**2. Ridge on distal articular surface**

**4.Mc Fourth (lateral small) metacarpal bone (splint bone)**

**PSm Medial proximal sesamoid bone**

**PSl Lateral proximal sesamoid bone**

**PP Proximal phalanx (first phalanx, P1, long pastern bone)**

**3. Extensor process**

**MP Middle phalanx (second phalanx, P2, short pastern bone)**

**DS Distal sesamoid bone (navicular bone)**

**4. Articular surface      5. Flexor surface**

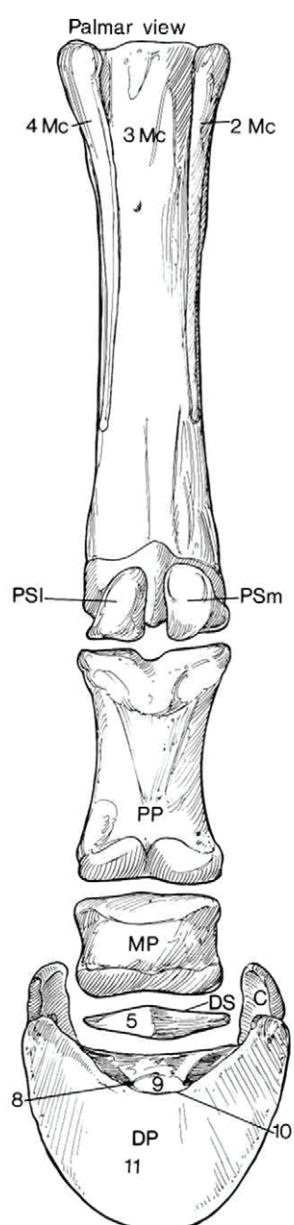
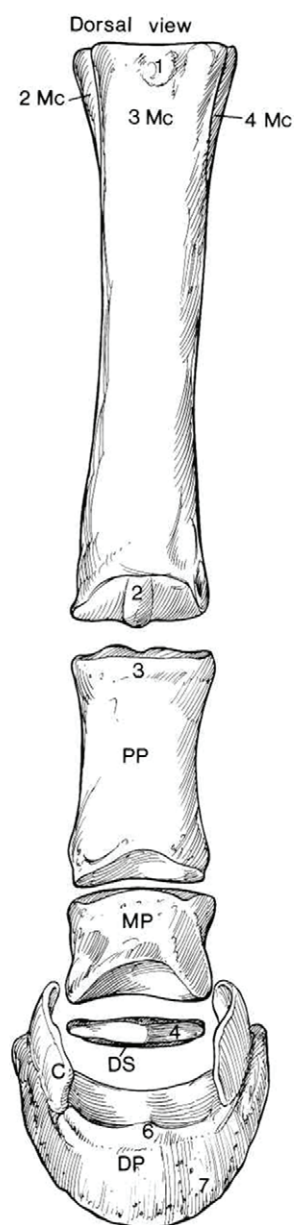
**DP Distal phalanx (third phalanx, P3, coffin bone)**

**6. Extensor process      9. Flexor surface**

**7. Parietal surface      10. Semilunar line**

**8. Solar foramen      11. Solar surface**

**C Cartilages of the distal phalanx**



## STRUCTURE OF JOINTS

Figure 1. Fibrous Joints - Immovable; fibrous tissue unites; ossify with age

**Suture** - Most joints of the skull

**Syndesmosis** - Between shafts of some long bones

Figure 2. Cartilaginous Joints - Limited movement; midline

**Symphysis** - Fibrocartilage; symphysis pelvis ossifies with age; intervertebral discs do not normally ossify

**Growth plate (physis)** (arrows) - Hyaline cartilage grows and ossifies, increasing a bone's length. It completely ossifies at maturity.

Figure 3. Synovial Joint - Drawn here in longitudinal section. Synovial (diarthrodial) joints are movable. Parts of a typical synovial joint:

**Articular cartilages** - Hyaline cartilage

**Synovial membrane** - Produces lubricating synovial fluid ("joint oil")

**Fibrous joint capsule**

**Collateral ligaments** - Extra-articular



Figure 1. Fibrous joints

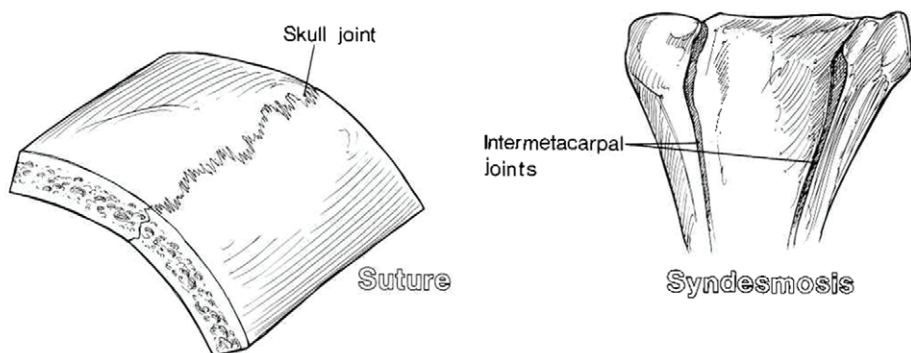


Figure 2. Cartilaginous joints

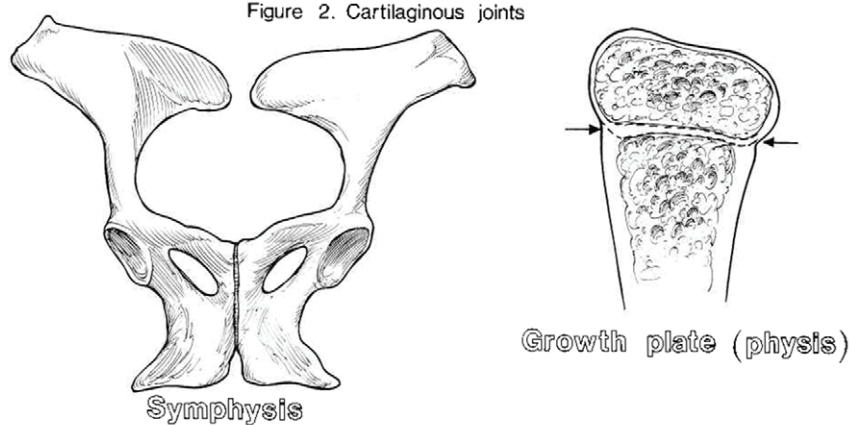
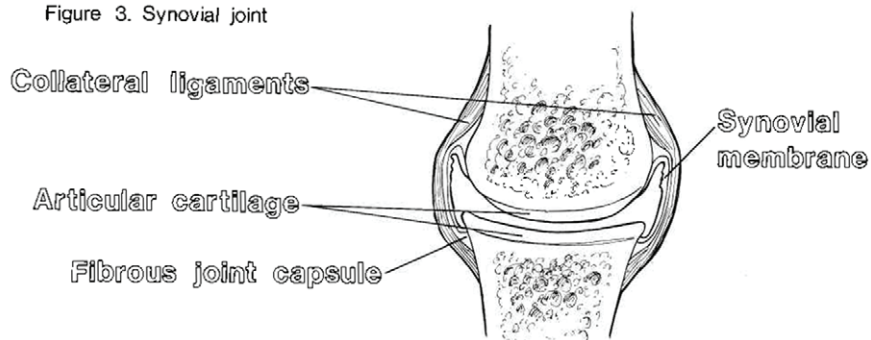


Figure 3. Synovial joint



## JOINTS OF THE FORELIMB

**Shoulder (humeral) joint** - Glenoid cavity of scapula and head of humerus.  
Surrounding muscles act as ligaments.

**Elbow (cubital) joint** - Condyle of humerus, proximal end of radius and trochlear notch of ulna. A thin joint capsule extends a pouch into the olecranon fossa.

**Radioulnar joint** - Shafts of radius and ulna. Interosseous ligament of the forearm forms a syndesmosis in foals that later ossifies distal to the interosseous foramen.

**Carpal joints** - Common collateral ligaments, fibrous joint capsule and palmar ligament

**Antebrachiocondylar joint** - Distal end of radius and proximal row of carpal bones

**Midcarpal joint** - Proximal row of carpal bones and distal row of carpal bones

**Carpometacarpal joint** - Distal row of carpal bones and proximal ends of metacarpal bones

**Intercarpal joints** - Between adjacent carpal bones

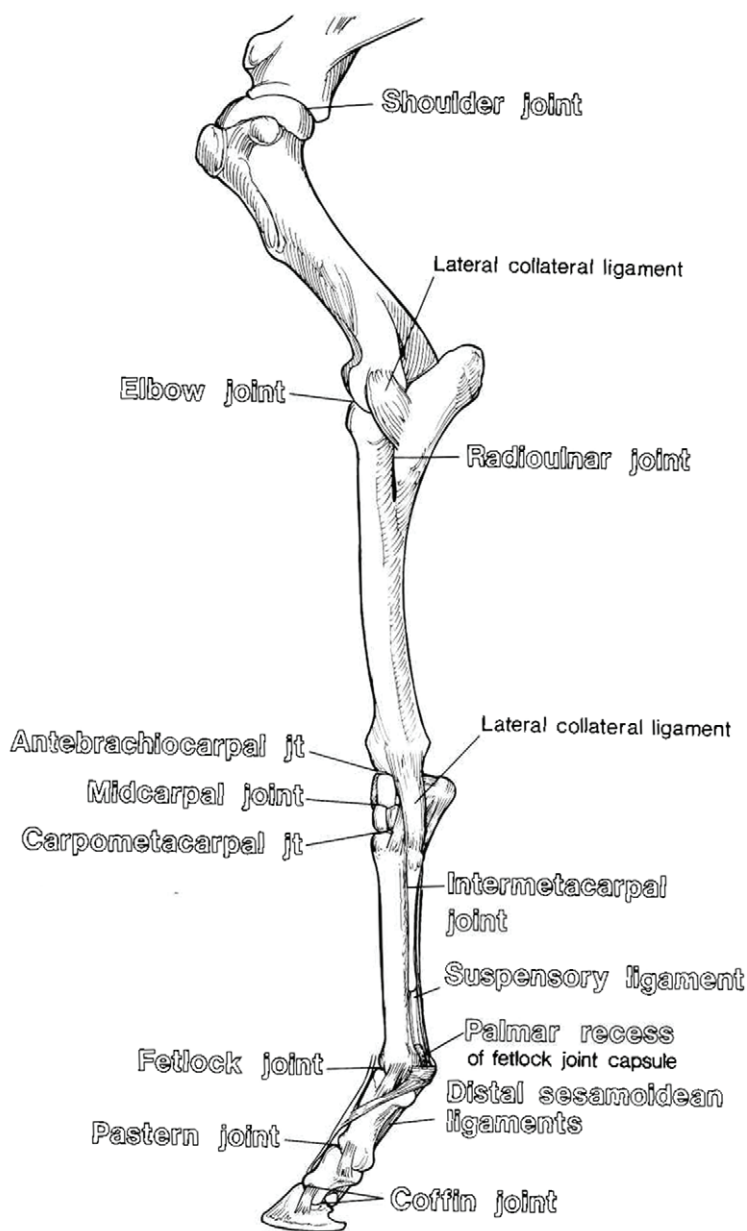
**Intermetacarpal joints** - Syndesmoses that ossify with age

**Fetlock joint (metacarpophalangeal joint)** - Distal end of third metacarpal bone, proximal end of proximal phalanx and the two proximal sesamoid bones. Several sesamoidean ligaments connect with and support the proximal sesamoid bones. The **palmar recess of the joint capsule** extends proximad between the third metacarpal bone and the suspensory ligament.

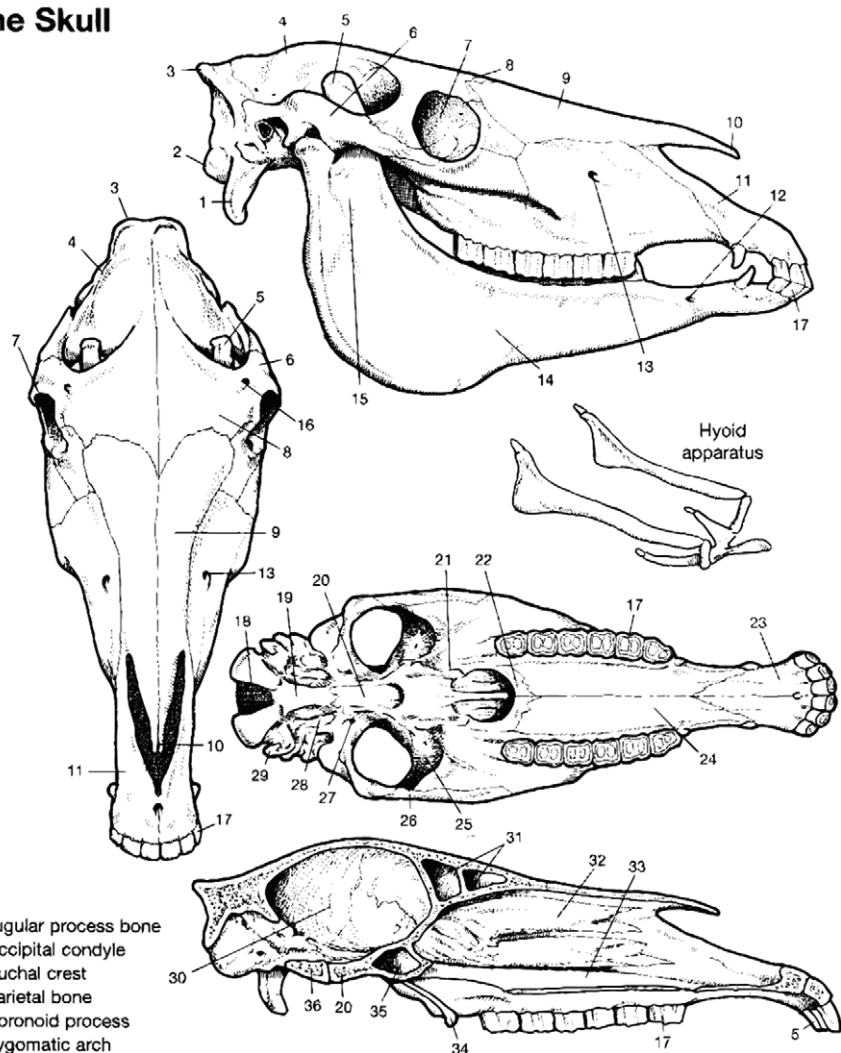
**Proximal interphalangeal joint (pastern joint)** - Distal end of proximal phalanx and proximal end of middle phalanx

**Distal interphalangeal joint (coffin joint)** - Distal end of middle phalanx, proximal end of distal phalanx and the distal sesamoid (navicular) bone

Wind-puffs are swellings of the palmar recess of the fetlock joint capsule. They are due to an excessive amount of synovial fluid produced by the synovial membrane of the fetlock joint. The condition occurs most commonly in hard-worked horses and may or may not result in lameness.



# The Skull



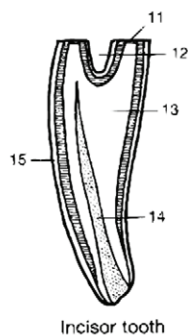
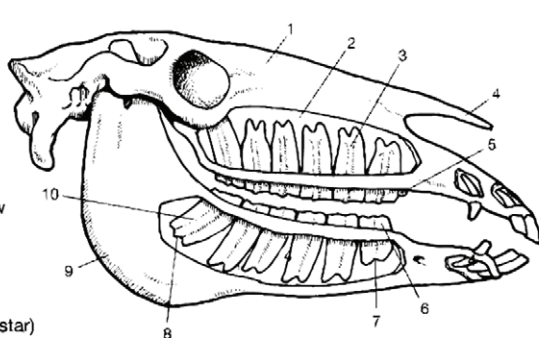
1. Jugular process bone
2. Occipital condyle
3. Nuchal crest
4. Parietal bone
5. Coronoid process
6. Zygomatic arch
7. Orbit
8. Frontal bone
9. Nasal bone
10. Nasal peak
11. Incisive bone
12. Mental foramen
13. Infraorbital foramen
14. Mandible
15. Ramus of the mandible
16. Supraorbital foramen
17. Teeth

18. Foramen magnum
19. Occipital bone
20. Basisphenoid bone
21. Hamulus of pterygoid bone
22. Palatine bone
23. Incisive bone
24. Maxilla
25. Orbital fissure
26. Zygomatic bone
27. Caudal alar foramen
28. Foramen lacerum

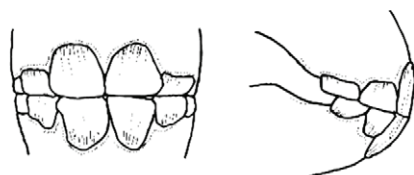
29. Jugular process bone
30. Cranial cavity
31. Conchofrontal sinus
32. Nasal cavity, middle nasal meatus and ventral nasal meatus, ventral nasal concha, and ethmoturbinates
33. Vomer
34. Pterygoid bone
35. Sphenopalatine sinus
36. Occipital bone

## The Teeth

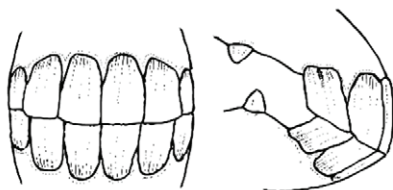
1. Maxilla, upper jaw
2. Sinuses
3. Reserve crown
4. Nasal bone
5. Wolf tooth
6. Crown
7. Apical foraminae
8. Apex
9. Mandible, lower jaw
10. Reserve crown
11. Table
12. Infundibulum
13. Dentine
14. Pulp cavity (dental star)
15. Peripheral Cement



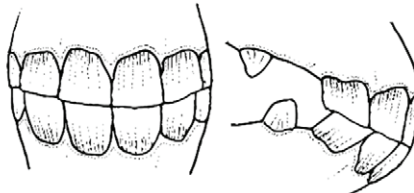
Incisor tooth



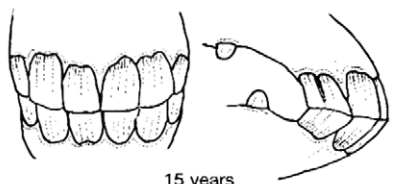
3 years



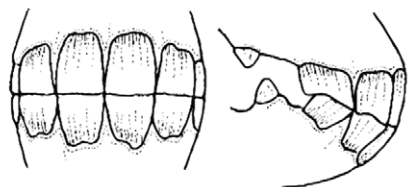
10 years



5 years



15 years



7 years



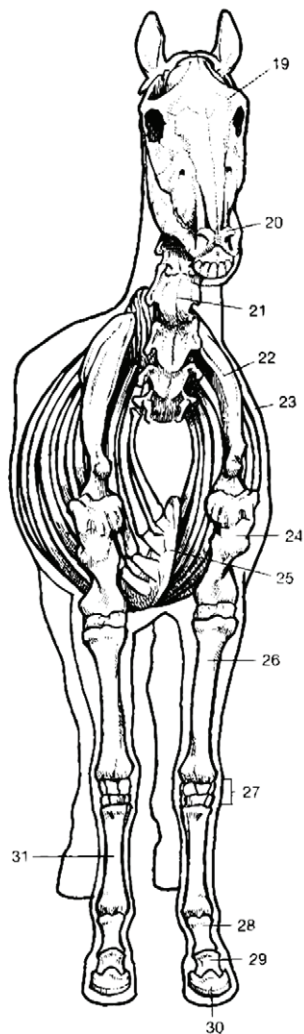
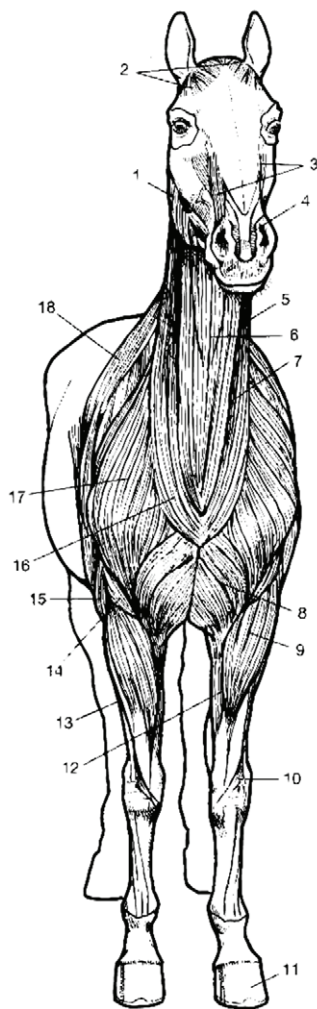
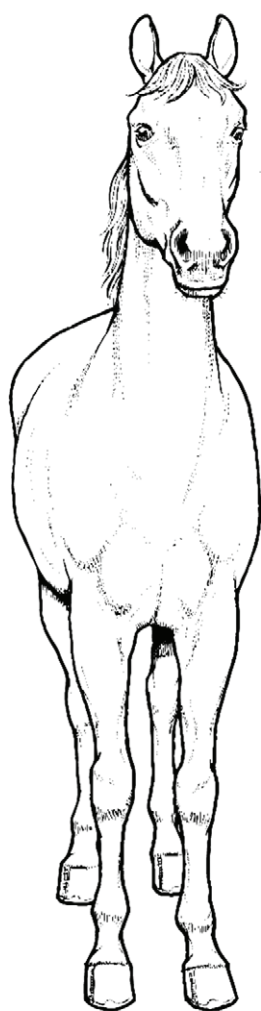
20 years

An adult horse has a total of forty teeth, which have long roots. The molar "sets" are very close to one another, with no gaps. This tight structure helps the teeth withstand the considerable forces placed upon them. As a result of continual friction in the upper and lower jaws during grinding of food, the surface or "table," is worn down by approximately 3mm (1/5 inch) each year. The articulation between the equine jaws permits considerable lateral movement,

as well as forward and backward movement of the lower jaw, enabling the molars to grind food thoroughly. The appearance of the incisor teeth, their profiles and tables can be used to estimate the age of a horse. This can be done with some accuracy up to the age of seven; beyond this only an approximate estimate is possible. Horses over the age of six are often described as "aged."



## The Horse from the Front



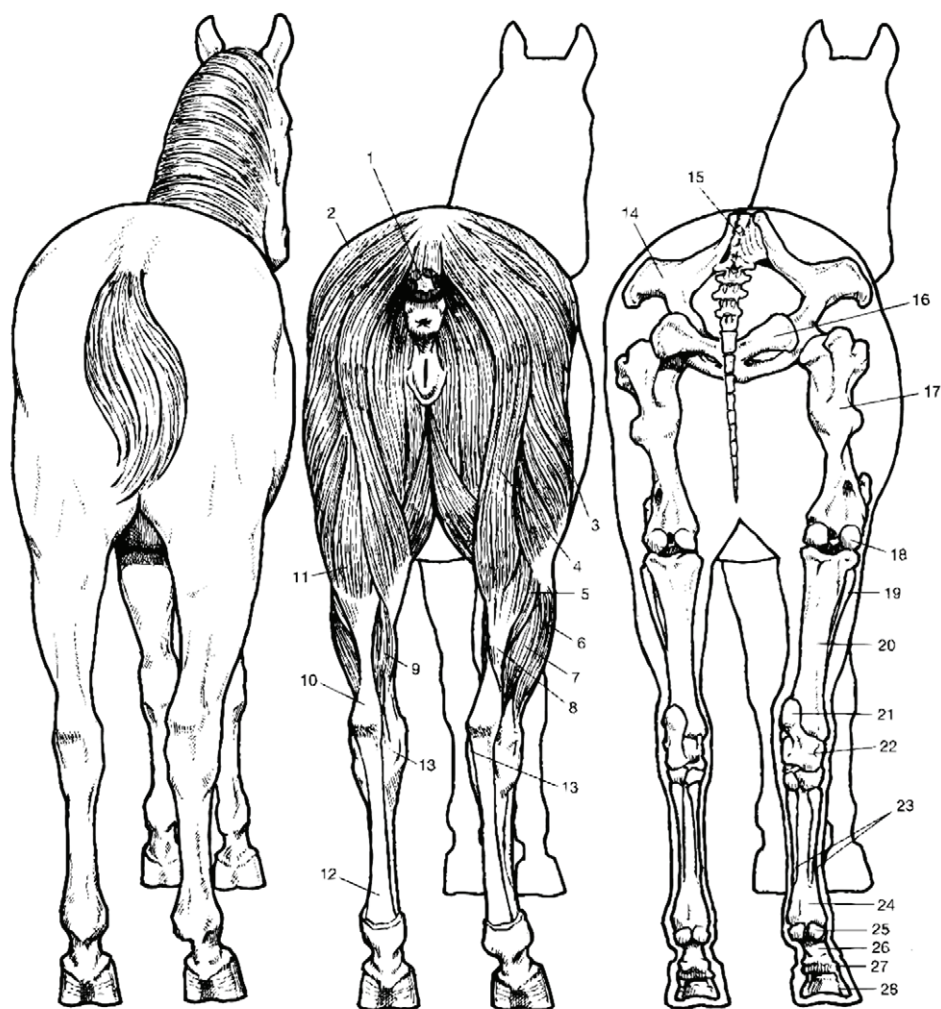
1. Masseter muscle
2. Rostral auricular muscles
3. Nasolabial levator muscles
4. Dorsal and ventral parts of the lateral nasal muscle
5. Jugular vein
6. Sternothyroid muscle
7. Sternomandibular muscle
8. Pectoral muscle
9. Radial carpal extensor muscles
10. Tendon of oblique carpal extensor

11. Hoof
12. Radial carpal flexor
13. Common digital extensor muscle
14. Brachial muscle
15. Deltoid muscle
16. Cutaneous superficial pectoral muscle
17. Brachiocephalic muscle
18. Trapezius muscle
19. Skull
20. Nasal cartilage

21. Cervical vertebrae
22. Scapula
23. Ribs
24. Humerus
25. Sternum
26. Radius
27. Carpal bones
28. Proximal phalanx (long pastern)
29. Middle phalanx (short pastern)
30. Distal phalanx (pedal bone)
31. Metacarpal bone (cannon)



# The Horse from the Rear (Mare)

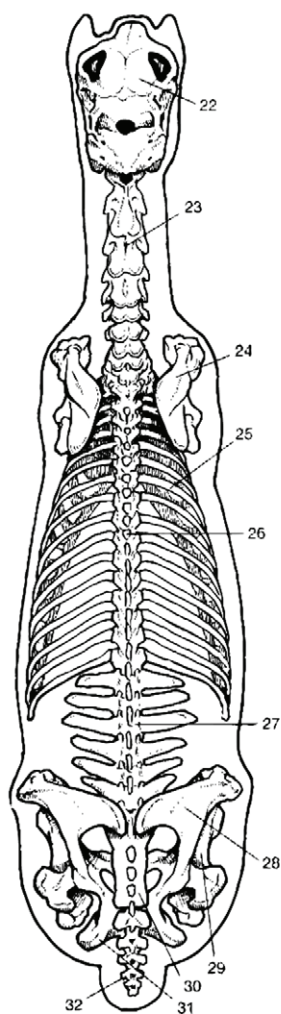
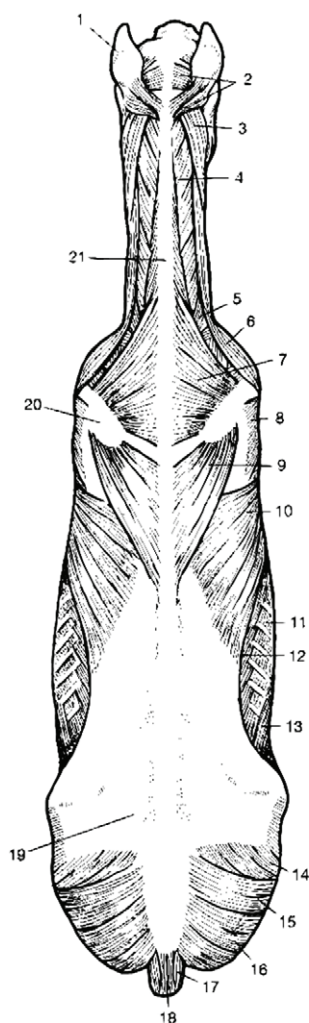
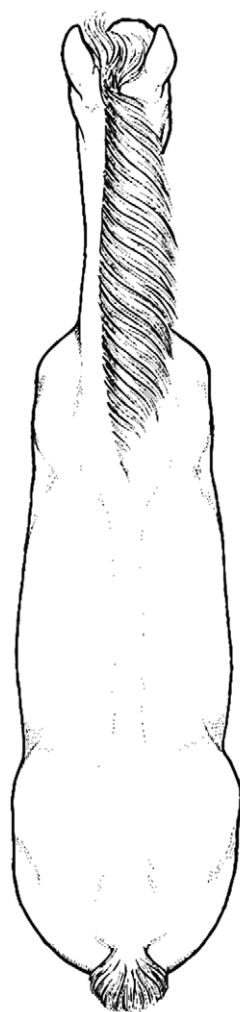


1. Tail muscles
2. Superficial gluteal muscle
3. Biceps femoris muscle
4. Semitendinosus muscle
5. Soleus muscle
6. Lateral digital extensor muscle
7. Lateral head of deep digital flexor muscle
8. Tendon of gastrocnemius muscle
9. Superficial digital flexor muscle

10. Tendon of superficial digital flexor
11. Gastrocnemius muscle
12. Superficial and deep digital flexor tendons
13. Flexor retinaculum at hock
14. Wing of ilium
15. Sacral spinous process
16. Ischiatic arch
17. Femur
18. Lateral condyle of femur

19. Fibula
20. Tibia
21. Calcaneal tuber (point of hock)
22. Os calcis
23. Splint bones
24. Metatarsal (hind cannon)
25. Sesamoid bones
26. Proximal phalanx (long pastern)
27. Middle phalanx (short pastern)
28. Pedal bone

## The Horse from Above

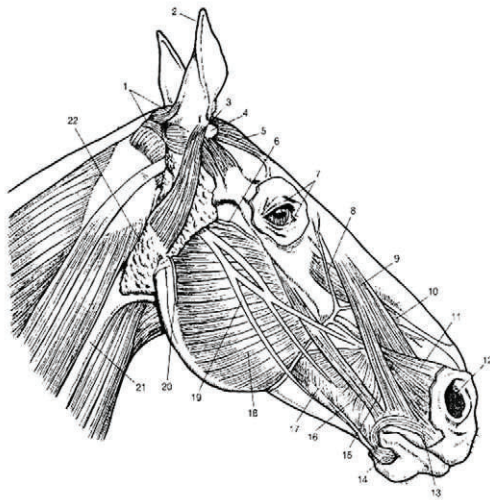


1. Auricular cartilage
2. Auricular muscles
3. Brachiocephalic muscle
4. Splenius muscle
5. Cervical part of ventral serrate muscle
6. Omotransverse muscle
7. Cervical trapezius muscle
8. Deltoid muscle
9. Thoracic trapezius muscle
10. Latissimus dorsi muscle

11. External intercostal muscles
12. Iliocostal muscles
13. External abdominal oblique muscle
14. Superficial gluteal muscle
15. Biceps femoris muscle
16. Semitendinous muscle
17. Short tail levator muscle
18. Long tail levator muscle
19. Thoracolumbar fascia
20. Scapular spine
21. Nuchal ligament

22. Skull
23. Cervical vertebrae
24. Scapula
25. Ribs
26. Thoracic vertebrae
27. Lumbar vertebrae
28. Ilium
29. Femur
30. Sacrum
31. Ischium
32. Caudal vertebrae

# Horse's Head



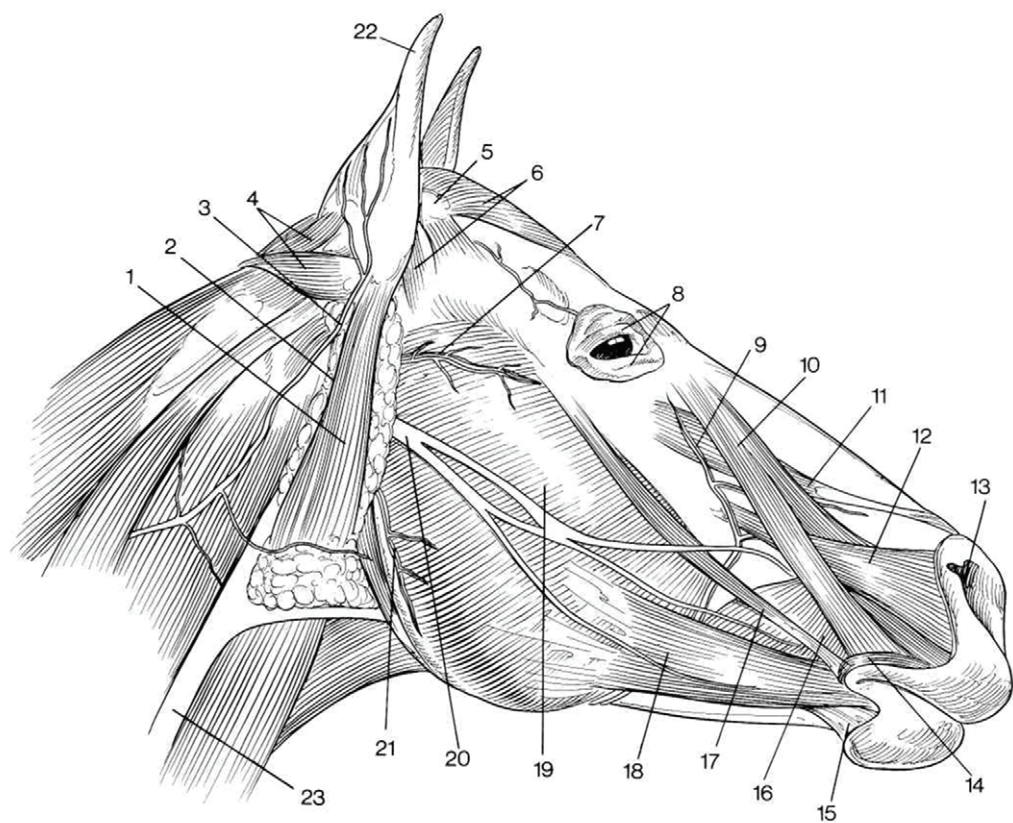
## SUPERFICIAL LATERAL STRUCTURES OF THE HEAD

Superficial dissection of right side of head.

1. **Parotidoauricular muscle**
2. **Parotid salivary gland**
3. **Great auricular nerve**
4. **Caudal auricular muscles**
5. **Scutiform cartilage**
6. **Rostral auricular muscles**
7. **Transverse facial artery, vein and nerve**
8. **Eyelids**
9. **Angular artery and vein of the eye**
10. **Nasolabial levator muscle**
11. **Superior labial levator muscle**
12. **Canine muscle**
13. **Nostril**
14. **Oral orbicular muscle**
15. **Inferior labial depressor muscle**
16. **Buccinator muscle**
17. **Zygomatic muscle**
18. **Facial cutaneous muscle**
19. **Masseter muscle**
20. **Facial nerve**
21. **Masseteric artery and vein**
22. **Auricular (conchal) cartilage**
23. **External jugular vein**

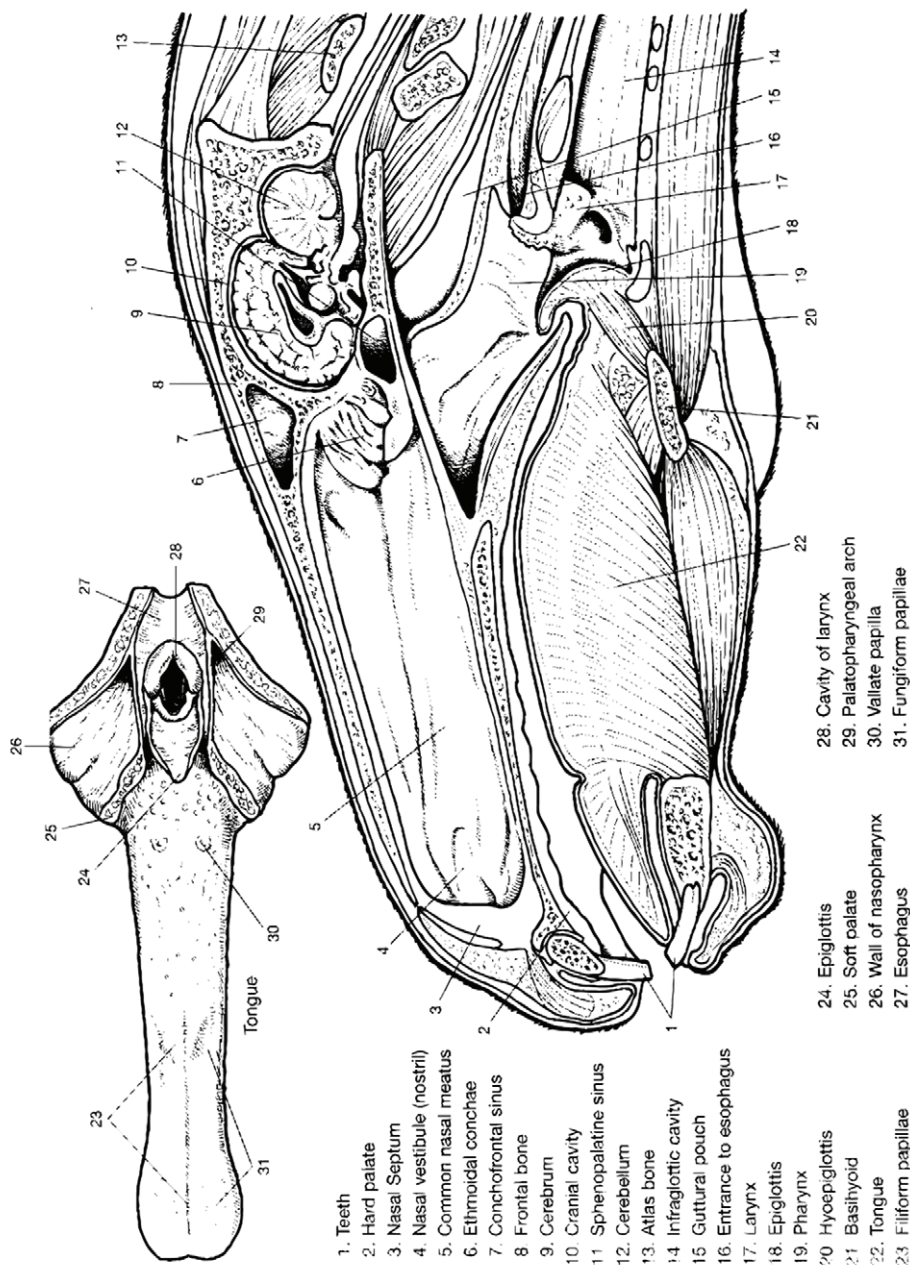
Right and left **superior labial levator muscles** join in a common tendon that spreads out in the upper lip. Contraction of these muscles raises the upper lip.

The superficially located **facial nerve** can be injured by a blow to overlying halter parts, resulting in paralysis of facial muscles on that side. The muzzle is then pulled to the opposite side by the functioning muscles there.



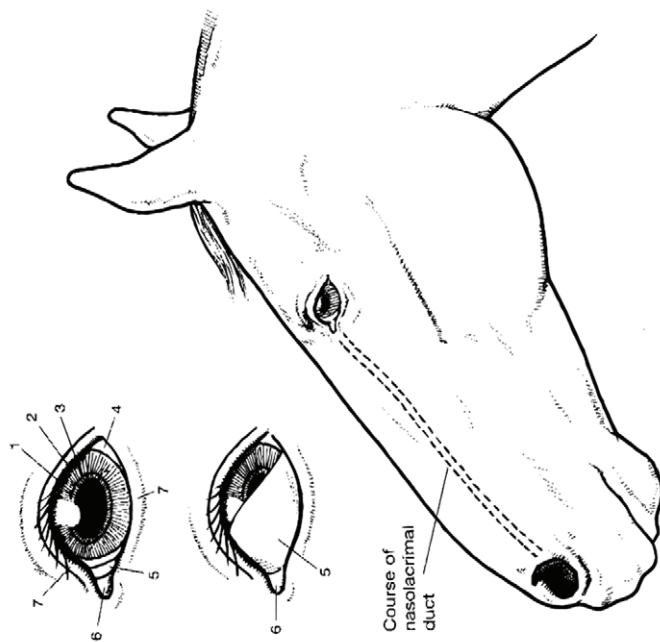


# The Internal Structures and Cavities of the Head

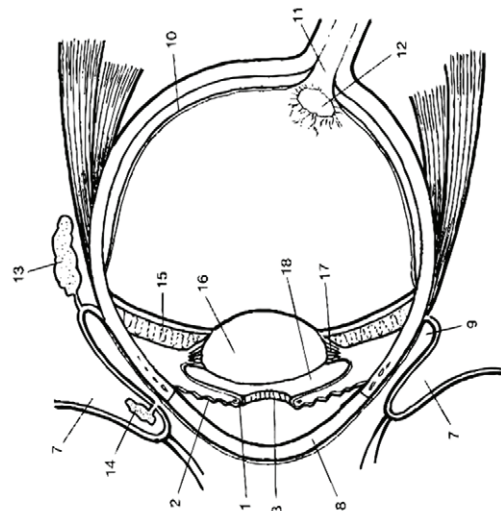




## The Eye



The eye should be clear, with salmon-pink mucous membranes indicating a healthy blood supply. Tears secreted by the lacrimal gland and the gland of the third eyelid wash over the surface of the eye, collecting at the junction of the lids. Tears then flow through the two lacrimal puncta and lacrimal canals into the lacrimal sac and continue into the nasolacrimal duct.



- |                      |                       |
|----------------------|-----------------------|
| 1. Cornea            | 10. Retina            |
| 2. Iris              | 11. Optic nerve       |
| 3. Pupil             | 12. Optic disc        |
| 4. White of eye      | 13. Lacrimal gland    |
| 5. Third eyelid      | 14. Tarsal gland      |
| 6. Lacrimal caruncle | 15. Ciliary ring      |
| 7. Eyelids           | 16. Lens              |
| 8. Cornea            | 17. Ciliary muscle    |
| 9. Conjunctiva       | 18. Posterior chamber |

## GUTTURAL POUCHES

Figure 1. Caudal part of sagittal section of head.

Arrow indicates **pharyngeal opening of auditory tube** under a ridge of cartilage.

Figure 2. Ventral view of guttural pouches. Lower jaw, tongue, larynx, and most of the pharynx removed.

a.= artery; n.= nerve; Inn.= lymph nodes

- |   |   |
|---|---|
| 1. <b>Right guttural pouch</b><br>(ventral wall removed)                                  | 9. <b>Lateral compartment of guttural pouch</b>         |
| 2. <b>Left guttural pouch</b>   | 10. <b>External carotid a.</b>                          |
| 3. <b>Med. retropharyngeal Inn.</b>   | 11. <b>Hypoglossal n.</b>                               |
| 4. <b>Cranial laryngeal n.</b>  | 12. <b>Opening of auditory tube into guttural pouch</b> |
| 5. <b>Vagosympathetic nerve trunk</b>   | 13. <b>Glossopharyngeal n.</b>                          |
| 6. <b>Ventral straight muscles of head</b>  | 14. <b>Lingual a.</b>                                   |
| 7. <b>Common carotid a.</b>   | 15. <b>Stylohyoid bone</b>                              |
| 8. <b>Internal carotid a.</b><br>(dashed lines against dorsal wall of medial compartment) |   |

A **guttural pouch** is a large, caudoventral outpocketing (diverticulum) of the **auditory tube**, a tube extending from the pharynx to the middle ear in the temporal bone and serving to equalize pressure on the inside of the eardrum. Guttural pouches occur only in equids - horses, donkeys, zebras. Caudoventrally the guttural pouch is folded around the stylohyoid bone, forming communicating medial and lateral compartments.

Lymph nodes, blood vessels and nerves lying against a guttural pouch can be damaged by fungal or bacterial infections spreading from the pouch. Erosion of an arterial wall with hemorrhage into the guttural pouch can be fatal. Discharges of pus or blood from a nostril when the horse lowers its head may indicate such a condition. Abnormal filling of a guttural pouch with air (tympany) can occur in a foal. A distended guttural pouch causes swelling in the parotid region.

Notice the position of the soft palate as it has moved from the breathing position at the base of the epiglottis toward the caudal wall of the pharynx.

Figure 1

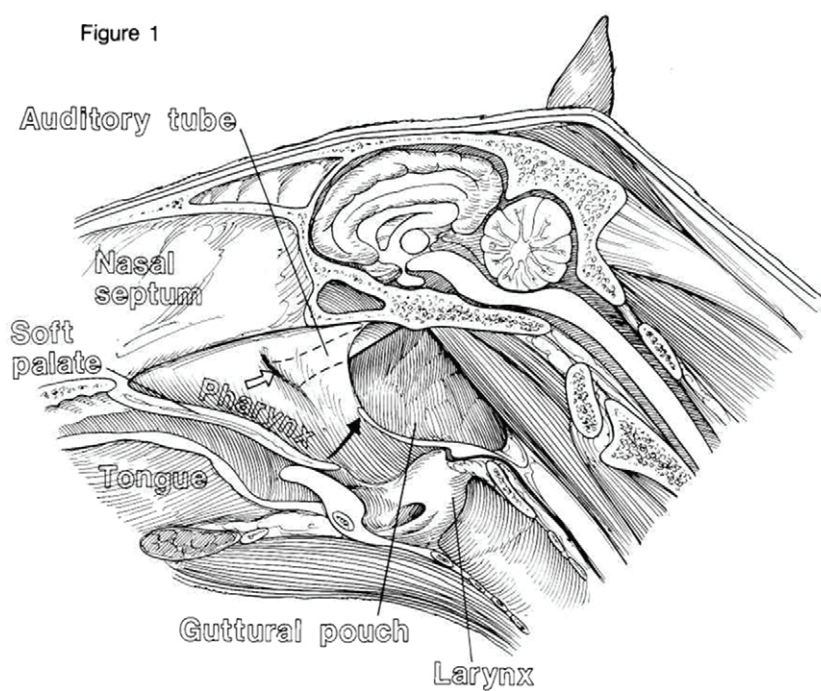
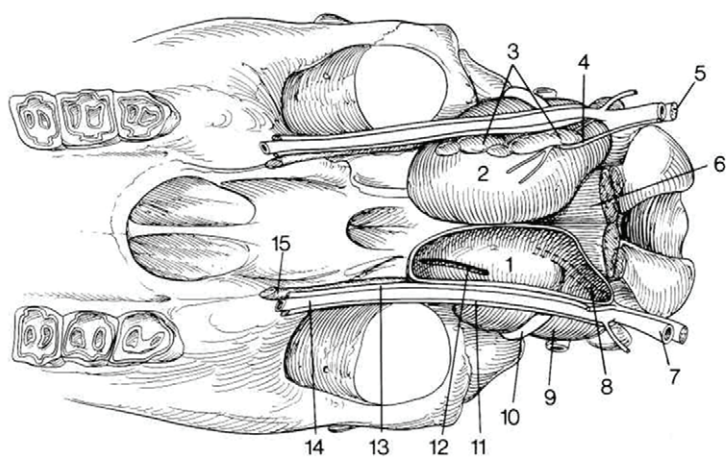


Figure 2



## VENTRAL STRUCTURES OF THE HEAD

Figure 1. Ventral view of head. Superficial dissection. Facial cutaneous muscle removed on left side.

Figure 2. Deeper dissection with mandible split at symphysis and halves displaced laterad. Most of mylohyoid muscles removed.

- |  |                                      |
|--|--------------------------------------|
| 1. Parotid gland   | 11. Inferior labial depressor m.     |
| 2. Parotid duct  | 12. Mandibular gland                 |
| 3. Facial vein   | 13. Mandibular duct                  |
| 4. Facial artery   | 14. Sublingual gland                 |
| 5. Left ramus of mandible  | 15. Sublingual caruncle              |
| 6. Body of mandible  | 16. Basihyoid bone                   |
| 7. Sternohyoid and omohyoid mm.  | 17. Hypoglossal n. - motor to tongue |
| 8. R. facial cutaneous muscle<br>(removed on left side to expose<br>masseter muscle) | 18. Lingual n. - sensory to tongue   |
| 9. R. mandibular lymphocenter  | 19. Styloglossus muscle              |
| 10. Mylohyoid muscle   | 20. Geniohyoid muscle                |
|  | 21. Genioglossus muscle              |
|  | 22. Oral mucous membrane             |
|  | 23. Apex (tip) of tongue             |

The palpable lymph nodes of the two **mandibular lymphocenters** enlarge and may abscess in a case of strangles (viral + streptococcal infection).

Saliva enters the oral cavity at the following locations:

1. The **parotid duct** opens on a papilla of mucous membrane opposite the third upper cheek tooth (P4).
2. Numerous small ducts from buccal glands open on the mucous membrane of the cheek.
3. Each **mandibular duct** opens on a flattened **sublingual caruncle**.
4. Many short, twisted ducts from each **sublingual gland** open on small papillae on a sublingual fold of mucous membrane on the floor of the oral cavity.

Figure 1

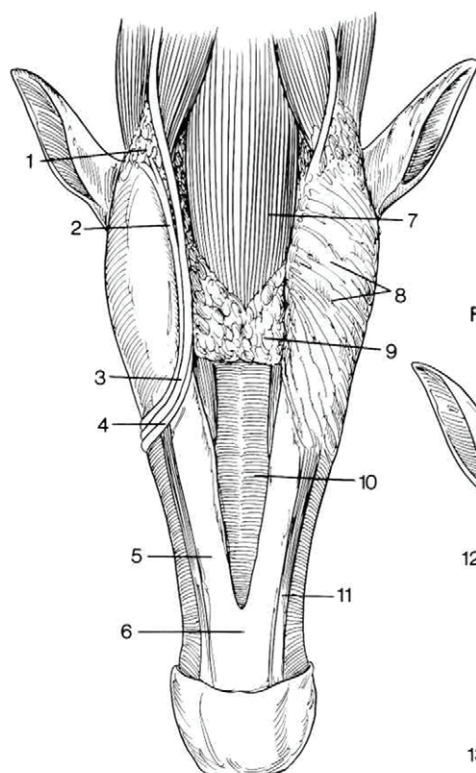
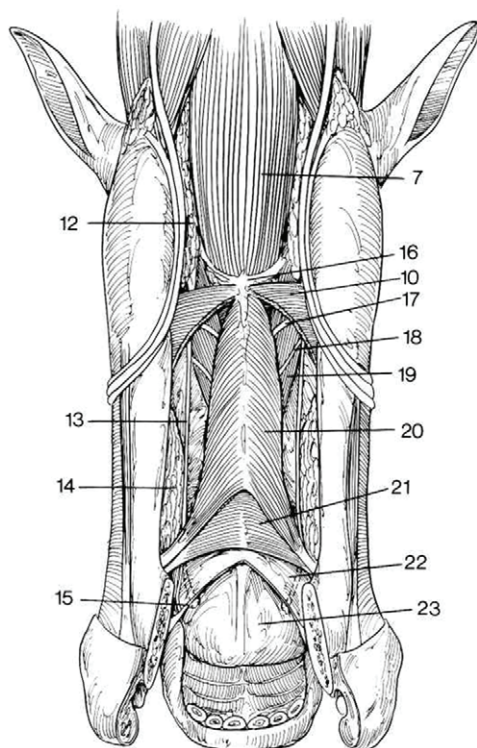


Figure 2





## EQUINE TEETH

Figure 1. Sagittal section (right) and occlusal surfaces (left) of a permanent lower first incisor tooth.

Figure 2. Complete permanent dentition.

Abbreviations and dental formulae:

I = incisor, C = canine, P = premolar, M = molar teeth

Di = deciduous incisor, Dp = deciduous premolar (No Dc or Dm's)

Deciduous teeth:  $2(Di3/3 Dp3/3) = 24$

Permanent teeth:  $2(I3/3 C1/1 P3/3 M3/3) = 40 \text{ or } 42$

Canine teeth are absent or rudimentary in the mare.

A **wolf tooth** is a small, inconstant first upper premolar. It may interfere with the bit and is usually extracted.

Caps are deciduous teeth that remain attached to erupted permanent teeth. They may have to be extracted.

A yellowish layer of cement covers the crown and fills in the **infundibulum** of central enamel. The **cup** is the dark cavity in the early infundibulum. With time, cement wears away over the crown, exposing the white enamel. Cement is maintained over the root.

The hypsoodont teeth of the horse have long reserve crowns that permit the teeth to continue to grow out for 12 to 14 years following eruption. As they wear down, the shapes of the occlusal (meeting, grinding) surfaces change. The infundibulum of an incisor tooth wears down to an **enamel spot** that is soon worn away. The appearance of an elongated, yellowish-brown **dental star** to the lip side of the infundibulum indicates wear into the tip of the **pulp cavity** that has been filled in with **secondary dentin**. At first elongated, the dental star changes to circular as the tooth wears down.

Wear in the upper incisors lags behind that of the lowers.

The enamel ridges of the infundibula of the cheek teeth (premolars and molars) provide enamel ridges for grinding feed through the lateral motion of the narrower lower jaw. Due to this slightly narrower lower jaw, sharp ridges called **points** develop on the buccal (cheek) side of the upper cheek teeth (molars and premolars) and the lingual (tongue) side of the lowers. Sharp points can cut the cheek or tongue and have to be cut off or floatd (filed down).



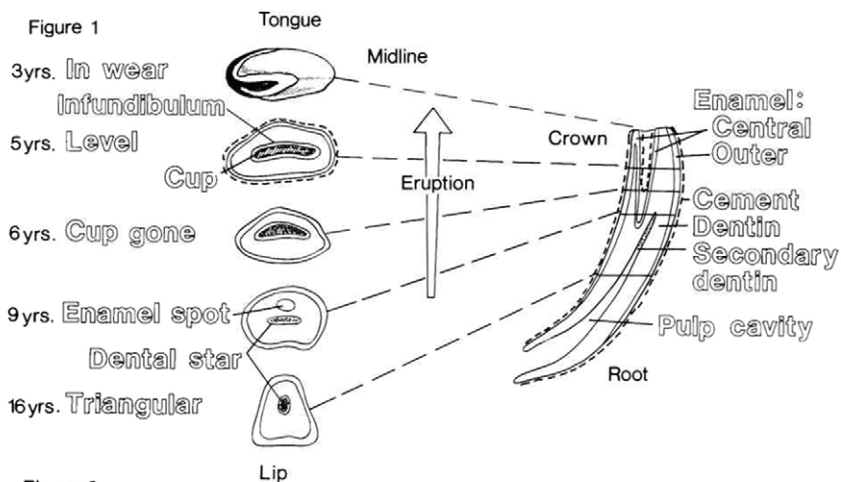
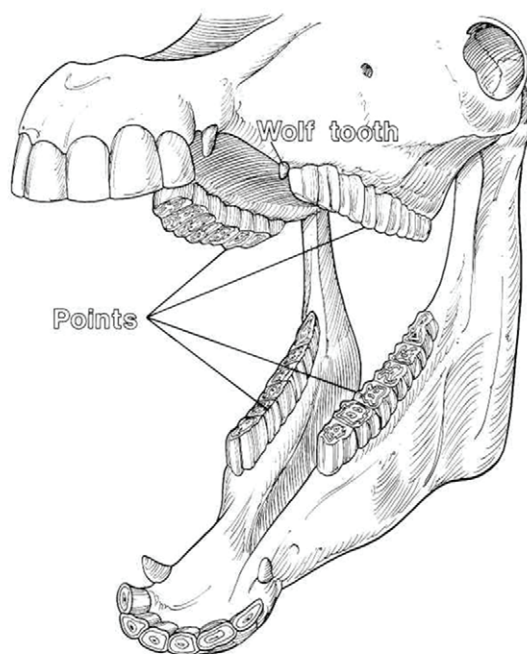
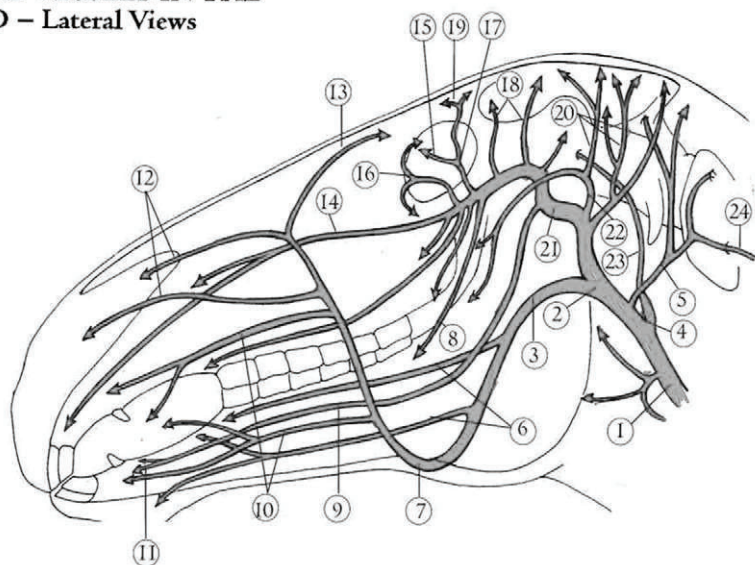


Figure 2

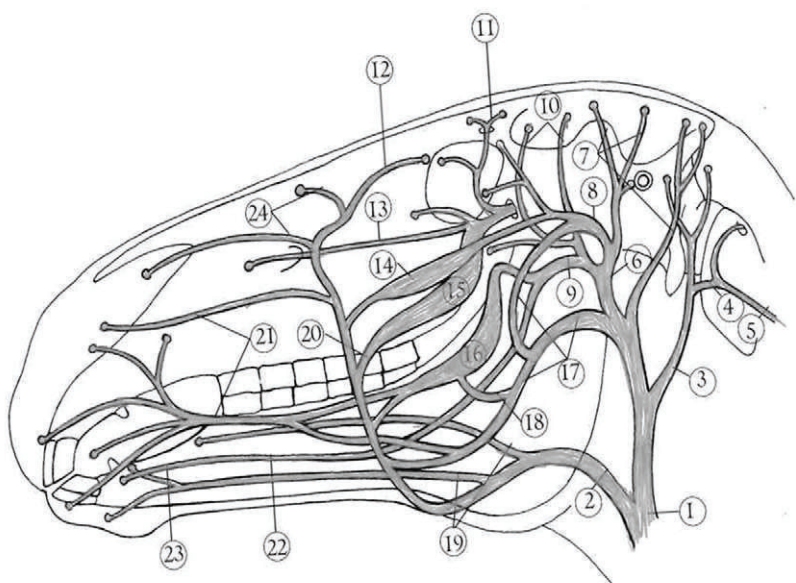


## BLOOD VESSELS IN THE HEAD – Lateral Views



Arteries

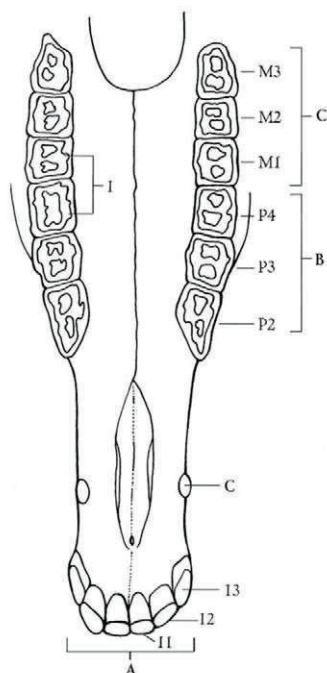
- |  |   |
|--|---|
| ① Common carotid artery  | ②③ Rostral, lateral and caudal auricular arteries |
| ② External carotid artery  | ②④ Maxillary artery                               |
| ③ Linguofacial trunk   | ②⑤ Superficial temporal artery                    |
| ④ Carotid body (slightly swollen initial part of internal carotid artery containing stretch receptors responsive to changes in blood pressure) | ②⑥ Internal carotid artery (to brain)             |
| ⑤ Occipital artery   | ②⑦ Vertebral artery                               |
| ⑥ Lingual and sublingual arteries  |   |
| ⑦ Facial artery  |   |
| ⑧ Buccal artery  |   |
| ⑨ Mandibular (inferior) alveolar artery  |   |
| ⑩ Mandibular and maxillary labial arteries   |   |
| ⑪ Mental artery  |   |
| ⑫ Dorsal and lateral nasal arteries  |   |
| ⑬ Angularis oculi artery   |   |
| ⑭ Infraorbital artery  |   |
| ⑮ External ethmoidal artery  |   |
| ⑯ Malar artery   |   |
| ⑰ External ophthalmic artery   |   |
| ⑱ Rostral and caudal deep temporal arteries  |   |
| ⑲ Supraorbital arteries  |   |



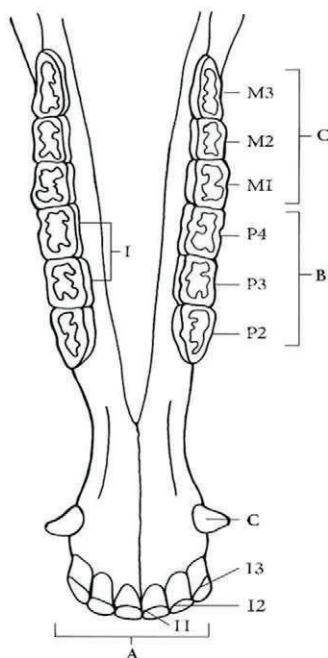
## Veins

- |  |  |
|--|--|
| ① External jugular vein                      | ②⑩ Deep facial vein  |
| ② Linguofacial vein                          | ②① Mandibular (inferior) and maxillary (superior) labial veins |
| ③ Occipital vein                             | ②② Mandibular alveolar vein                                    |
| ④ Vertebral/occipital vein anastomosis       | ②③ Mental vein   |
| ⑤ Vertebral vein                             | ②④ Dorsal and lateral nasal veins                              |
| ⑥ Superficial temporal vein                  |  |
| ⑦ Rostral, middle and caudal auricular veins |  |
| ⑧ Transverse facial vein                     |  |
| ⑨ Maxillary vein                             |  |
| ⑩ Deep temporal veins                        |  |
| ⑪ Supraorbital vein                          |  |
| ⑫ Angular vein of eye                        |  |
| ⑬ Infraorbital vein                          |  |
| ⑭ Sinus of transverse facial vein            |  |
| ⑮ Sinus of deep facial vein                  |  |
| ⑯ Sinus of buccal vein                       |  |
| ⑰ Masseteric veins                           |  |
| ⑱ Lateral branch of buccal vein              |  |
| ⑲ Lingual and sublingual veins               |  |

# CHEEK TEETH; CENTRAL INCISOR AND ESTIMATION OF AGE



Upper dental arcade – plan view



Lower dental arcade – plan view

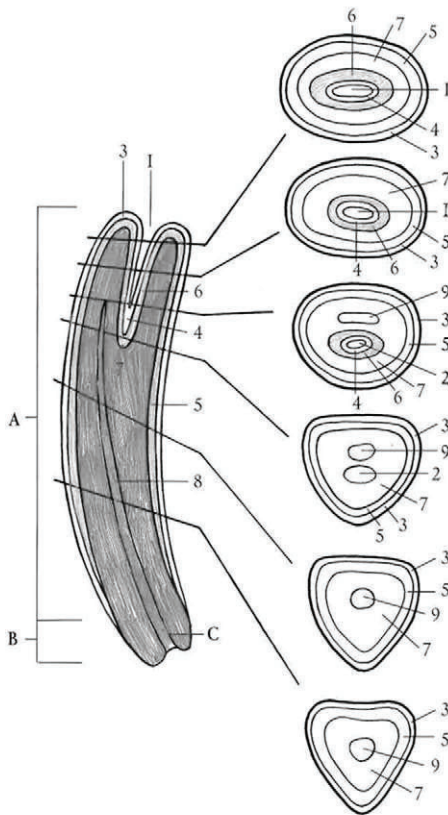
On both drawings, label:

- A Incisor teeth
- B Premolar teeth
- C Molar Teeth

## Upper and Lower Dental Arcades – Plan Views

On both drawings, identify and colour:

- ① Central incisor tooth
- ② Intermediate incisor tooth
- ③ Corner incisor tooth
- ④ Canine tooth (rudimentary and only erupt in stallions)
- ⑤ 1st cheek tooth (P1 of upper dental arch – wolf tooth – often absent)
- ⑥ 2nd cheek tooth
- ⑦ 3rd cheek tooth
- ⑧ 4th cheek tooth
- ⑨ 5th cheek tooth
- ⑩ 6th cheek tooth



Central incisor tooth – longitudinal and transverse sections

### Central Incisor – Longitudinal and Transverse Sections

Labels:

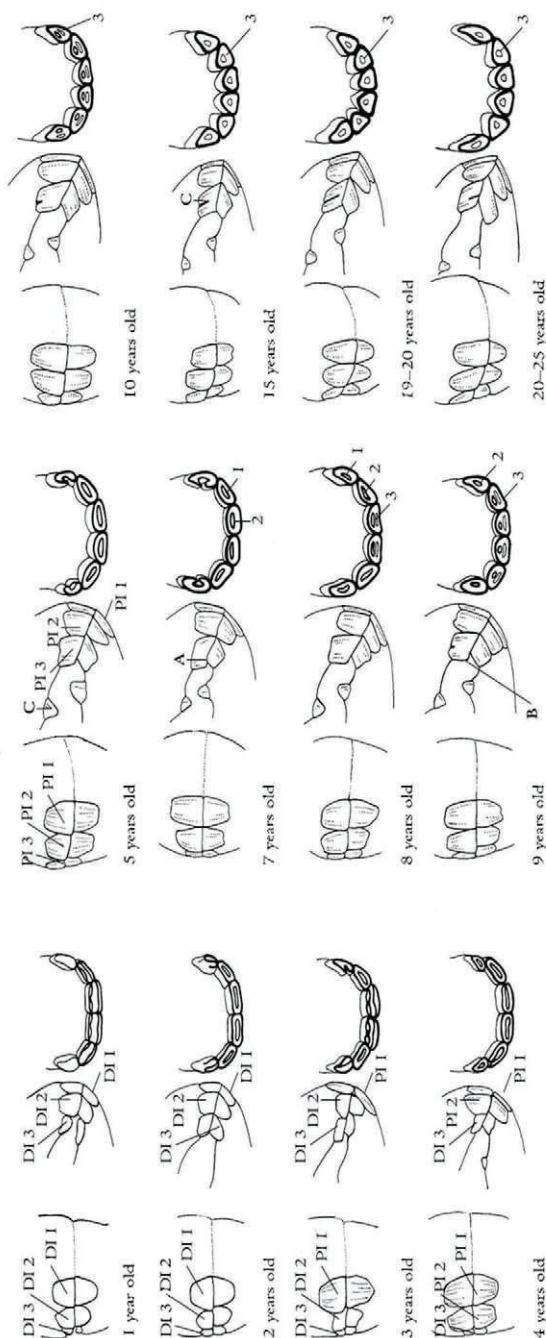
A Crown

B Root

C Root canal (entry into pulp cavity, constricted as root forms)

- ① Infundibulum ('cup': central depression in tooth table)
- ② Remains of infundibulum ('mark': central depression occupied initially by central cement and subsequently by central enamel only)
- ③ Peripheral cement (covering entire crown and root: providing attachment for fibres of periodontal membrane holding tooth in socket)
- ④ Central cement (lining infundibulum: continuous with peripheral cement over unworn tooth table)
- ⑤ Peripheral enamel (hard crystalline surface coating over entire tooth)
- ⑥ Central enamel (infolded enamel producing infundibulum)
- ⑦ Dentine (bone-like substance forming bulk of tooth)
- ⑧ Pulp cavity containing nerves and blood vessels of tooth (dental pulp)
- ⑨ 'Dental star' (secondary dentine deposited in pulp cavity)

# : INCISOR TEETH AND ESTIMATION OF AGE



Series of drawings showing incisor teeth of horses of varying ages. Each set of drawings shows, from left to right, (i) incisor teeth from in front, (ii) from the right and (iii) a plan view of the tables of the lower incisors.

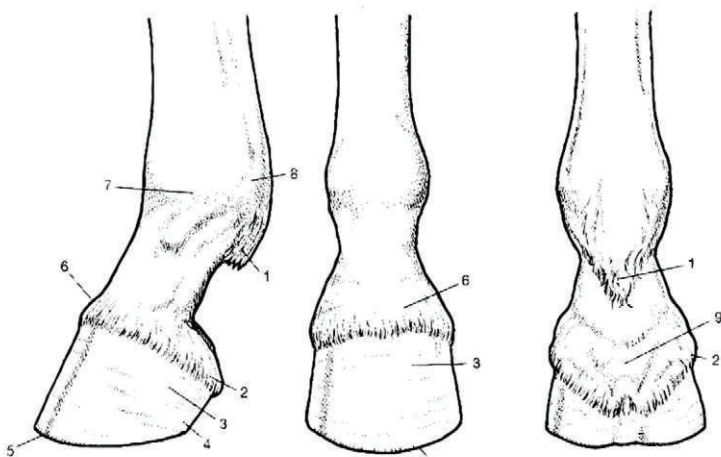
Label:

- A Seven-year hook
- B Nine-year hook
- C Galway's groove

- (i) Central temporary (or deciduous) incisor
- (ii) Intermediate temporary incisor
- (iii) Corner temporary incisor
- (iv) Central permanent incisor
- (v) Intermediate permanent incisor
- (vi) Corner temporary incisor
- (vii) Canine
- (viii) Cup
- (ix) Mark
- (x) Dental star



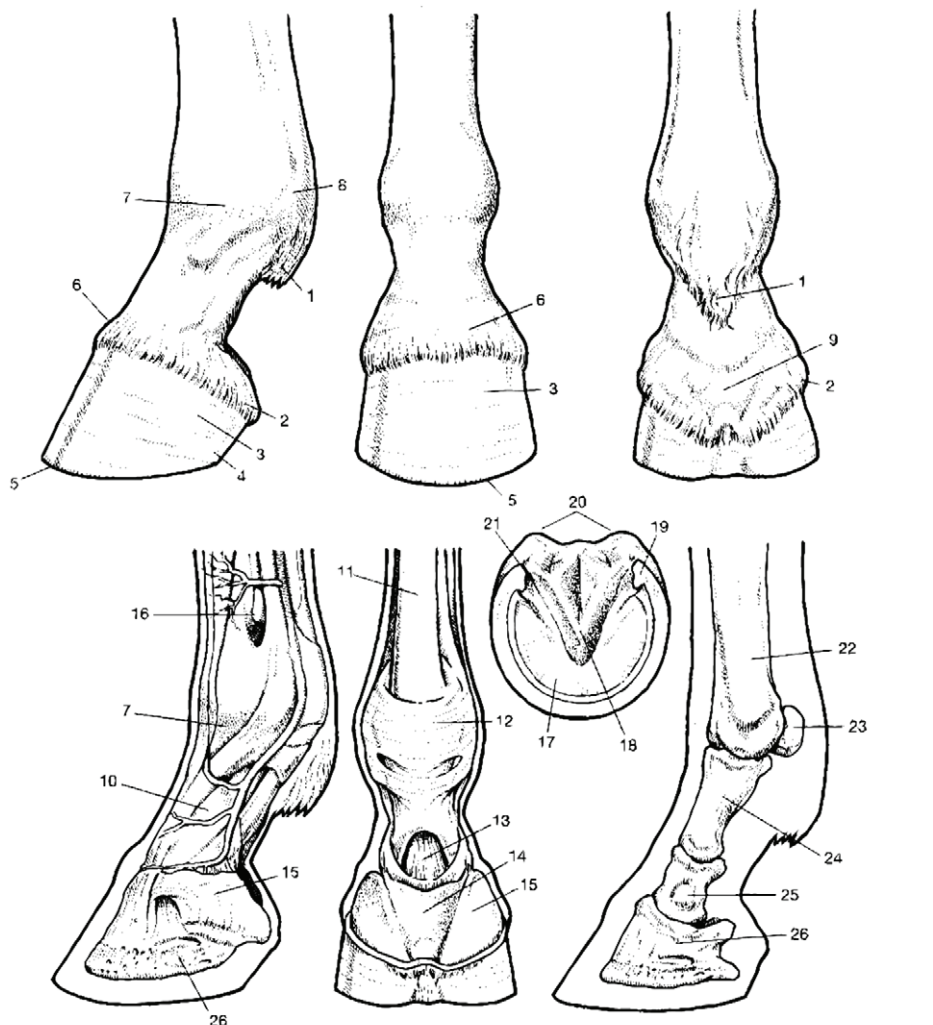
# The Foot



## The Foot

Proper condition of the legs and feet are crucial to the health and soundness of a horse, for major problems can

develop in these parts of the horse's anatomy. It is essential to regularly check the condition of the horse's feet.



1. Fetlock tuft
2. Peripole
3. Wall
4. Heel
5. Toe
6. Coronet
7. Fetlock joint
8. Site of lateral digital vein and artery

9. Interbulbar furrow
10. Sesamoid bone
11. Flexor tendon
12. Ligament of fetlock
13. Deep flexor tendon
14. Plantar cushion
15. Lateral cartilage
16. Metacarpal bone
17. Sole

18. Frog
19. Angle of wall
20. Bulb of heels
21. Collateral groove
22. Metacarpal bone (cannon)
23. Sesamoid bone
24. Proximal phalanx (large pastern)
25. Middle phalanx (small pastern)
26. Distal phalanx (pedal bone)

## SURFACE OF THE HOOF

Figure 1. Side of the hoof

**Coronet**

**Skin**

**Periole**

**Toe**

**Quarter**

**Heel**

} Regions  
of the  
hoof wall

The **coronet** is the junction of the skin and the soft horn of the **periole**. The coronary band is a deeper region. Notice that the **periole** widens over the **heel**. Hoof and foot are not the same! The hoof (like your fingernail) is a highly cornified (horny) epidermal structure lacking in blood vessels and nerves. The foot includes the hoof and underlying corium (dermis), skin between the bulbs of the heels, digital cushion, distal phalanx and its cartilages, distal end of the middle phalanx, navicular bone, coffin joint, ligaments, tendons, vessels and nerves.

Figure 2. Ground (solar) surface of the hoof

Notice that the hoof of the hindfoot, B., is narrower and more pointed than the hoof of the forefoot, A.

Half of the ground surface of the wall of the hoof of the forefoot has been trimmed. On the untrimmed half, the **epidermal ("insensitive") laminae, el**, of the **internal layer** of the wall blend with the thick **middle layer**. These layers may also be seen on the trimmed half.

Identify the **white line**, the soft white horn at the junction of the wall and the sole. Leave the white line uncolored.

The **angle of the wall** continues into the **bar**.

On the **frog** identify the **apex**, a., and the **central groove**, c. The **frog** blends with the **bulbs of the heels**.

On each side, a **collateral groove** separates the frog from the bar and the sole.

Figure 1

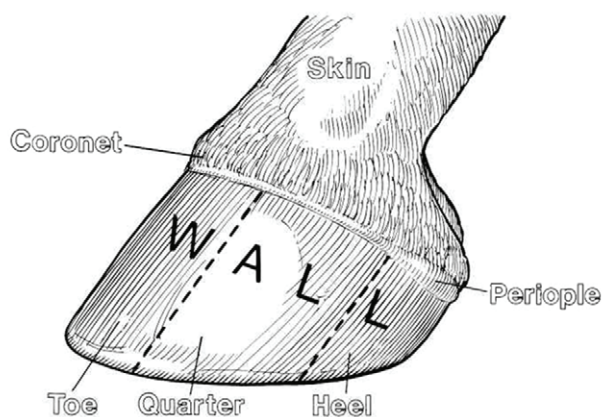
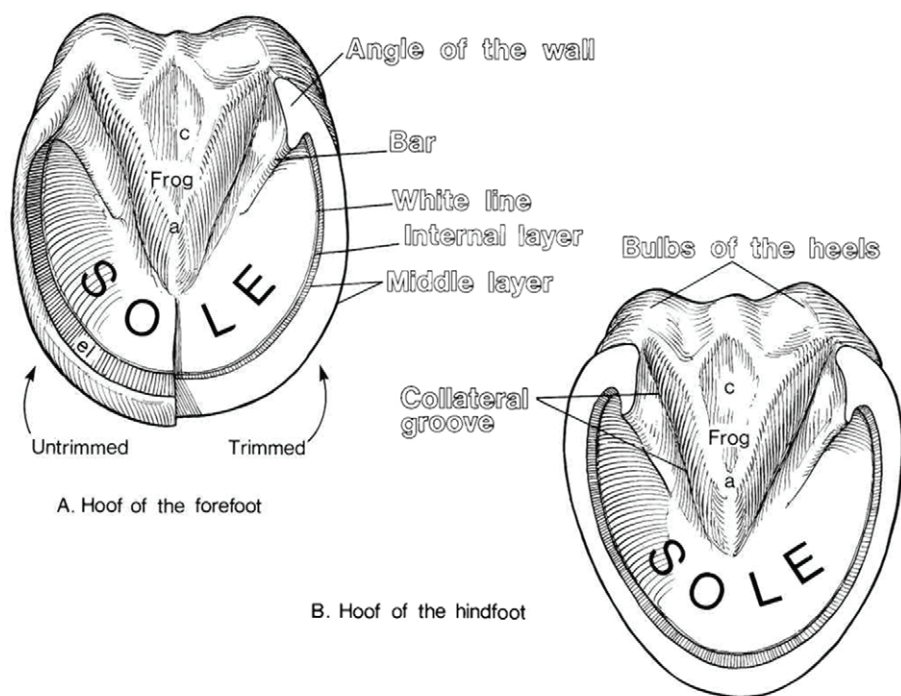


Figure 2



## GROWTH AND NOURISHMENT OF THE HOOF

Figure 1. Hoof pulled away from underlying corium.

Adjacent regions of corium (dermis) and hoof (epidermis):

- 1. Perioplic corium** - - - fits into **6. Perioplic groove**
- 2. Coronary corium** - - - fits into **7. Coronary groove**
- 3. Laminar corium** - - - - **dermal ("sensitive") laminae** interlock with  
**8. Epidermal ("insensitive") laminae of wall**
- 4. Corium of sole** - - - fits against **9. Internal surface of sole**
- 5. Corium of frog** - - - - fits over **10. Frog stay**

The **corium** is collagenous connective tissue containing many nourishing blood vessels and nerve endings. It blends into the periosteum of the distal phalanx. Over-eating in lush pastures, grain overloads causing circulation of endotoxins (poisons) and hard concussion on the foot may cause blood to be shunted away from small arteries in dermal laminae, resulting in laminitis (founder). Shunting of blood from dermal laminae at first causes swelling and then death of tissue possibly followed by loosening and downward rotation of the distal phalanx.

Figure 2. Growth of the hoof. The stippled line from **1 to 1'** indicates the layer of **basal epidermal cells** that proliferate (multiply) to form the hoof. The dashed line from **2 to 2'** indicates the underlying **dermis**.

A. higher magnification of:

- 3. papillae (projections) of coronary corium** covered by
- 4. basal cells of the coronary epidermis.**

Epidermal cells over the papillae form -

- 5. horn tubules;** epidermal cells in between form -
- 6. intertubular horn.**

Tubular and intertubular horn move toward the ground, forming the

- 7. middle layer of the hoof wall.** The cells cornify (become horny) as they are pushed toward the ground.

**Arrow** indicates direction of growth: 1/4 to 1/2 inch per month.

Notice **8, interlocking of dermal and epidermal laminae**, then go to B. Higher magnification of:

- 9. Dermal lamina.** Notice the small blood vessels.
- 10. Epidermal lamina.** Cells not yet cornified.

Figure 1

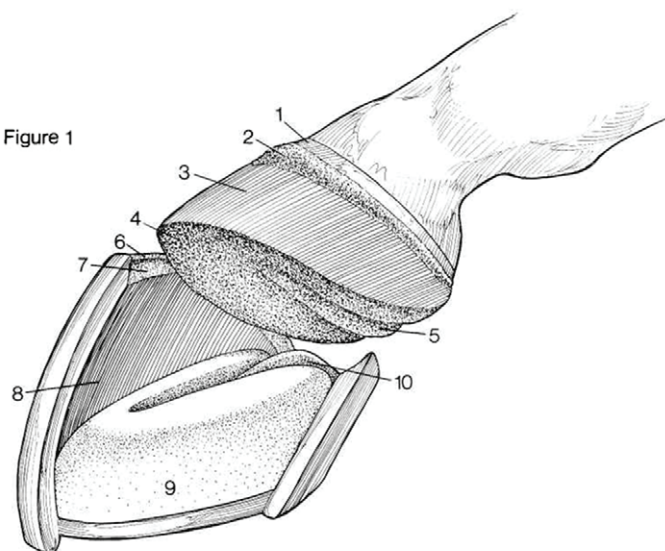
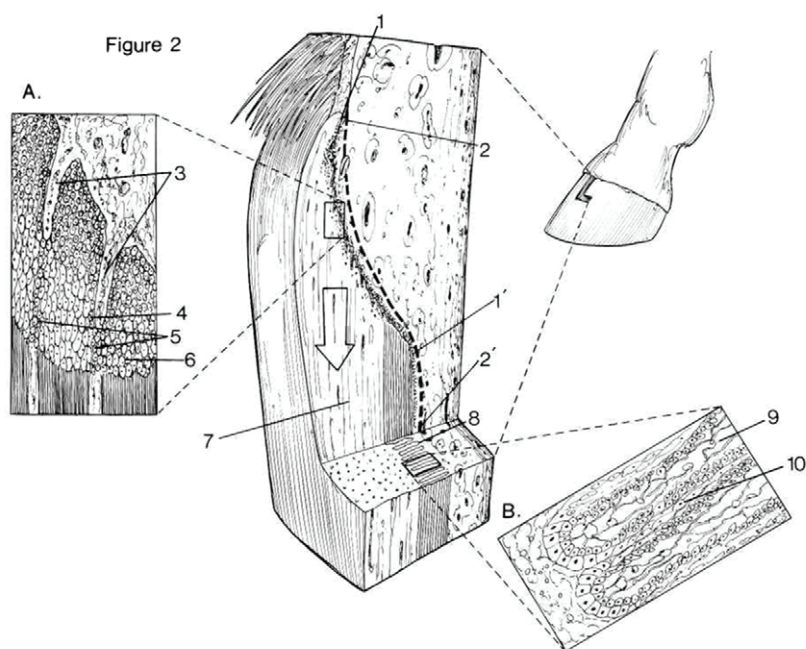
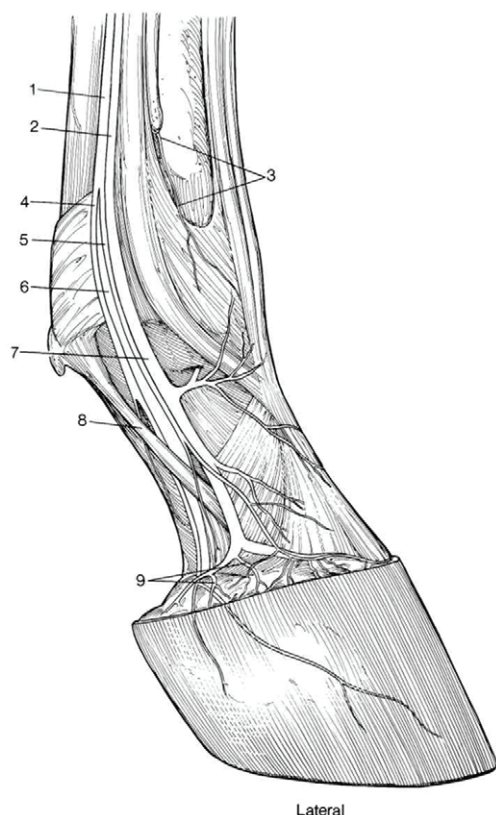


Figure 2





## NERVE AND BLOOD SUPPLY TO THE FOOT



1. Lateral palmar nerve
2. Lateral palmar vein
3. Lateral palmar metacarpal nerve
4. Lateral palmar digital nerve
5. Dorsal branch of 4.
6. Lateral digital artery
7. Lateral digital vein
8. Ligament of the ergot
9. Coronary venous plexus

Notice that the lateral palmar nerve becomes the lateral palmar digital nerve. The vessels follow a similar sequence. Vessels and nerves on the medial side are distributed and named the same, substituting medial for lateral. A complex system of venous sinuses and veins drain into the digital veins.

The **ligament of the ergot** must be distinguished from the **lateral (or medial) palmar digital nerve** in the "nerving" operation (neurectomy). In this procedure a small piece of the nerve is cut out to relieve pain in the caudal part of the foot, particularly in the region of the navicular bone.

## WITHIN THE DIGIT

Figure 1. Insertion of deep digital flexor tendon. Palmar view. Identify and color the following structures:

**Deep digital flexor tendon**

**Navicular bone**

**Collateral sesamoidean ligament** Meets opposite ligament - dashed line.

**Navicular bursa** (podotrochlear bursa) - stippled

Notice the course of the deep digital flexor tendon over the navicular bone with the navicular bursa forming a cushion between the tendon and the navicular bone.

Identify the dashed line indicating the outline of the navicular bone and the dotted line indicating the extent of the navicular bursa.

Figure 2. Parasagittal section through the digit.

1.- 1'. Limits of digital sheath

2. Palmar recess of fetlock joint capsule

3. Proximal sesamoid bone

4. Distal sesamoidean ligaments

5. Superficial digital flexor tendon

6. Deep digital flexor tendon

7. T ligament

8. Proximal pouch of coffin joint capsule

9. Navicular bone

10. Digital cushion

11. Navicular bursa

12. Impar ligament of navicular bone

13. Dorsal pouch of coffin joint capsule

14. Common digital extensor tendon

Figure 1

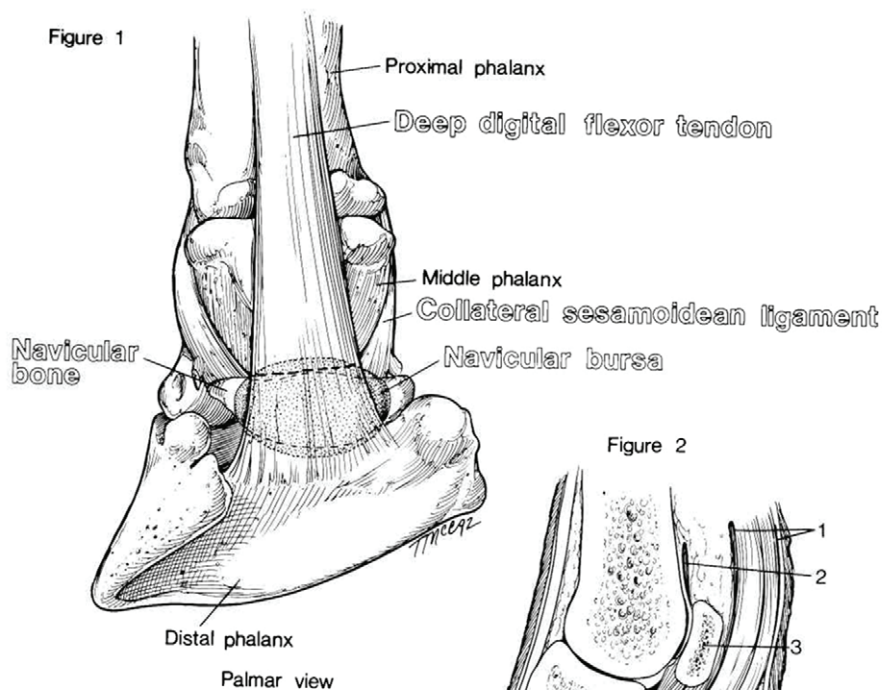
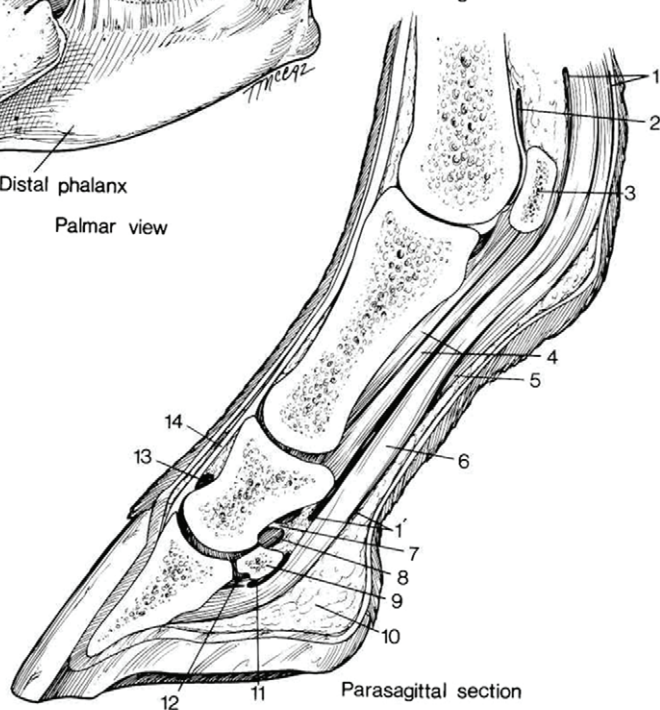
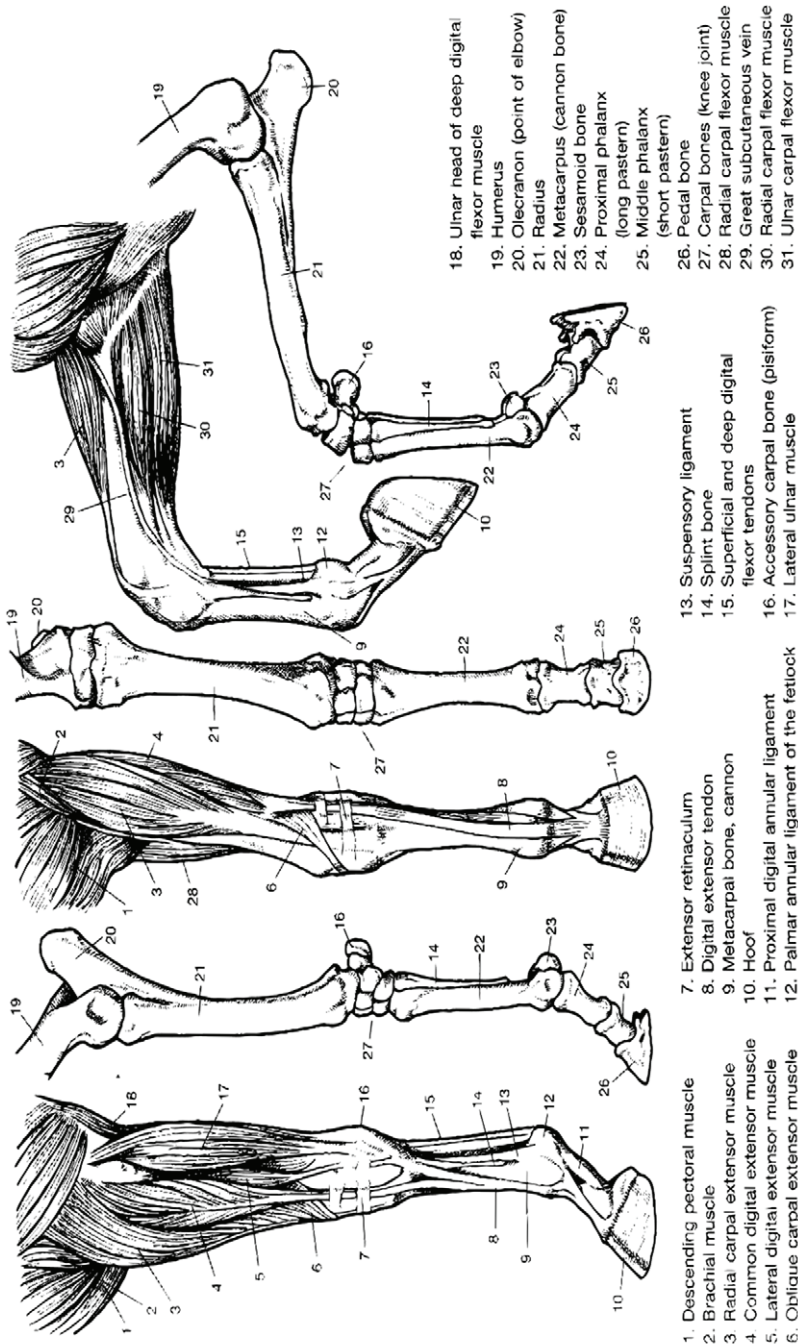


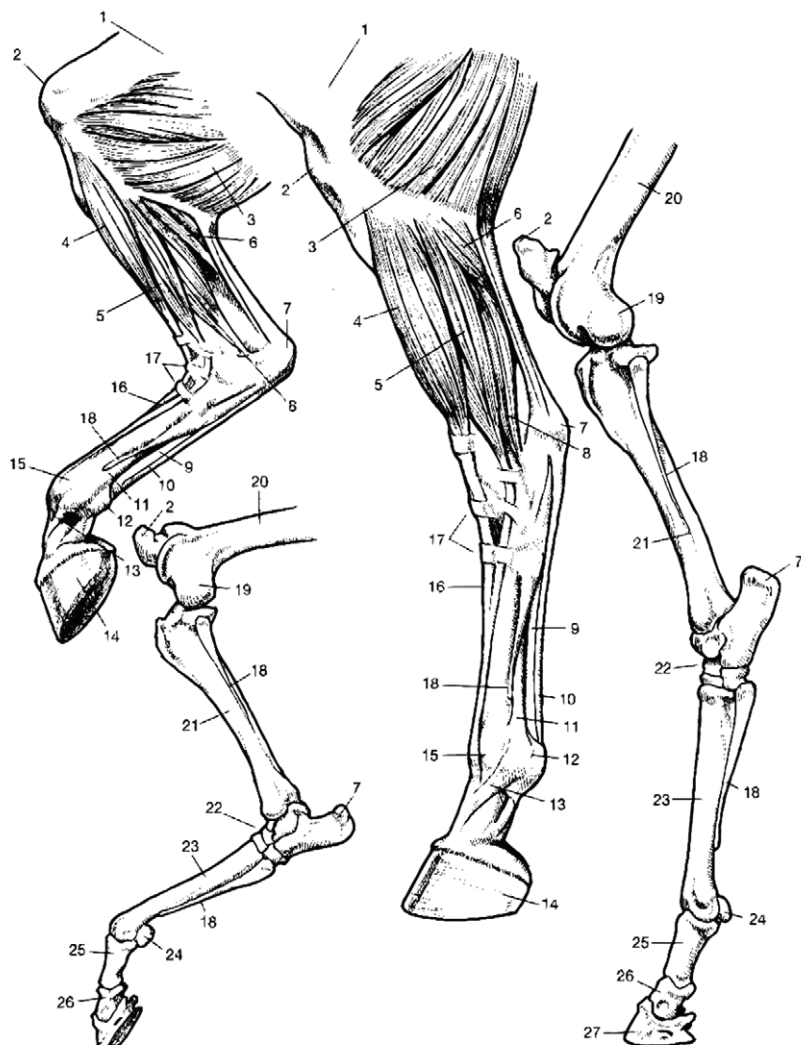
Figure 2



## The Forelimb



## The Hind Limb

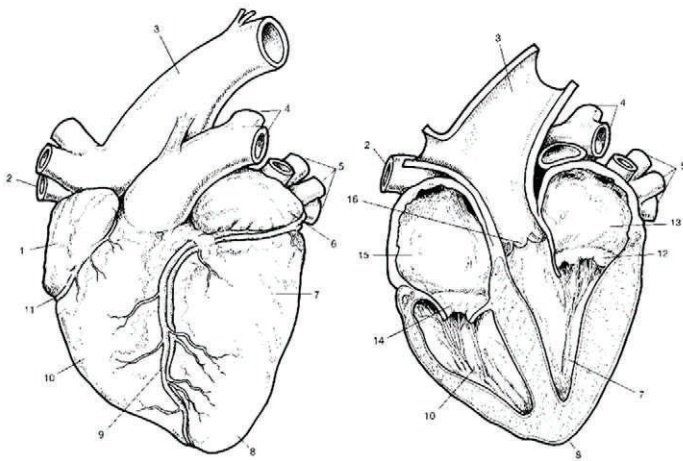


1. Fascia lata
2. Patella
3. Femoris biceps muscles
4. Long digital extensor muscle
5. Lateral digital extensor muscle
6. Gastrocnemius muscle
7. Point of hock
8. Deep digital flexor muscle
9. Deep digital flexor tendon
10. Superficial digital flexor tendon

11. Suspensory ligament
12. Palmar annular ligament
13. Extensor branch of suspensory ligament
14. Hoof
15. Fetlock
16. Tendon of long digital extensor
17. Annular ligaments
18. Split bone
19. Lateral condyle of tibia

20. Femur
21. Tibia
22. Tarsal bones
23. Metatarsal (hind cannon)
24. Sesamoid bone
25. Proximal phalanx (long pastern)
26. Middle phalanx (short pastern)
27. Distal phalanx (pedal bone)

# Cardiovascular system





## THE EQUINE HEART

Figure 1. Left view of the horse's heart. Coronary arteries are the first branches of the aorta. Left and right auricles are outpocketings of atria.

Figure 2. Section of the heart. A-V = atrioventricular; C = cusp of aortic valve; S = approximate location of sinoatrial node.

The **arterial ligament** is a remnant of the arterial duct that shunted blood from the pulmonary trunk to the aorta in the fetus (unborn foal). A depression in the wall between the two atria, the oval fossa (not seen here), indicates the position of the oval foramen, a valve-like opening that shunted blood from the right atrium to the left atrium in the fetus. Most of the blood flowing through the fetal heart is shunted through these two passages, minimizing the flow of blood into the pulmonary circulation. Since the fetal lungs are not functioning, the mare's blood in the placenta supplies the fetus with oxygen and other nutrients.

The **sinoatrial node** (S-A node) in the wall of the right atrium is the pacemaker and coordinator of the rhythmic contractions of the heart. It consists of modified, impulse-conducting heart muscle fibers (Purkinje fibers) and autonomic (definition later) nerve endings. Fibers from the sinoatrial node connect with a similar atrioventricular node (A-V node) in the interatrial septum (not seen here). Two bundles of these specialized fibers descend from the A-V node to the ventricles.

During beating of the heart, the two atria fill and contract; then the two ventricles fill and contract.

Heart sounds are caused by the rush of blood and the closing of heart valves.

Figure 1

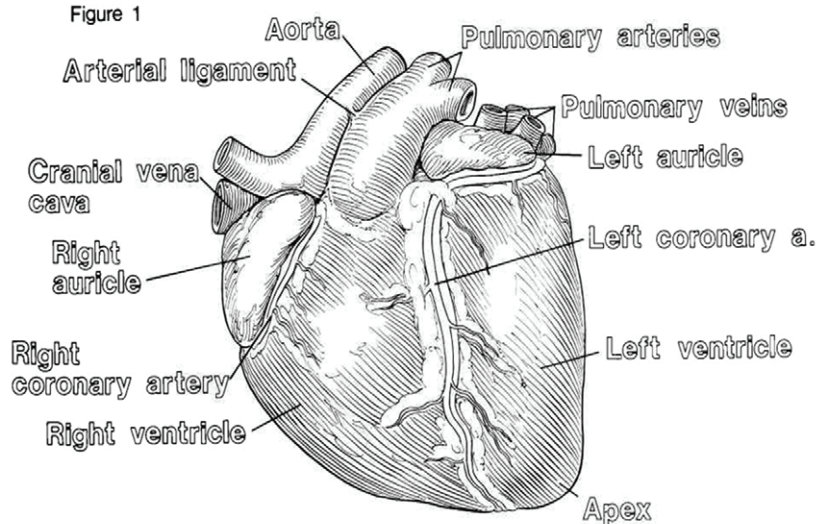
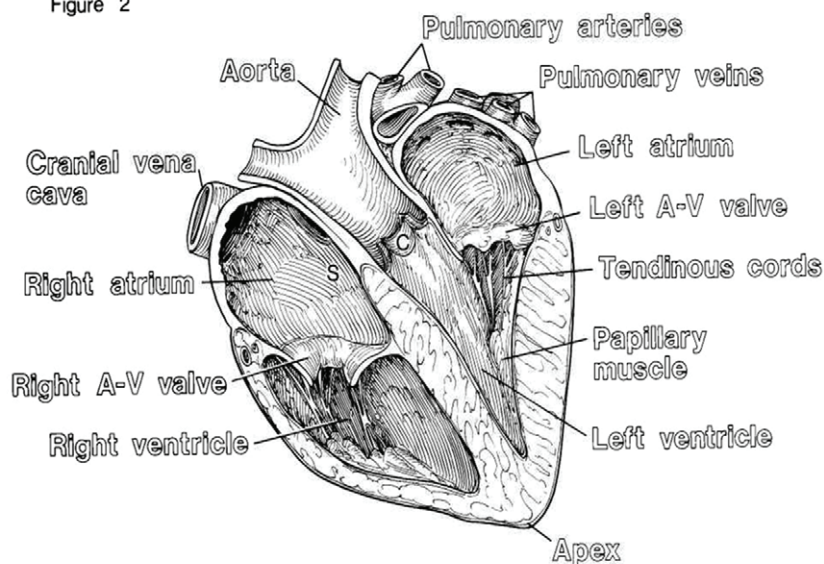
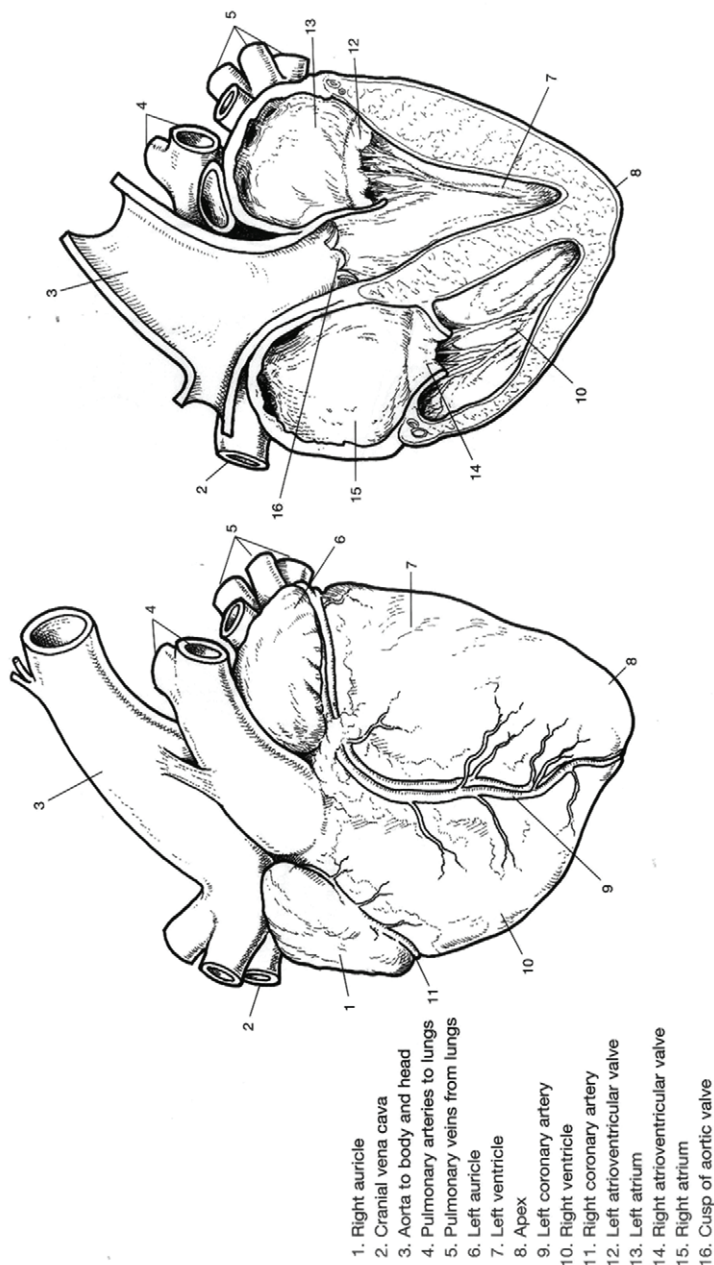


Figure 2



## The Cardiovascular System



The horse's heart consists of four chambers with four sets of valves. The heart pumps blood into the arteries, which extend to all parts of the body. The blood returns to the heart via the veins. The resting heart rate of a

healthy adult horse varies from horse to horse, and from breed to breed. On the average, a horse's heart rate is between thirty-six and forty-two beats per minute.

# Blood Vessels and Lymph Nodes

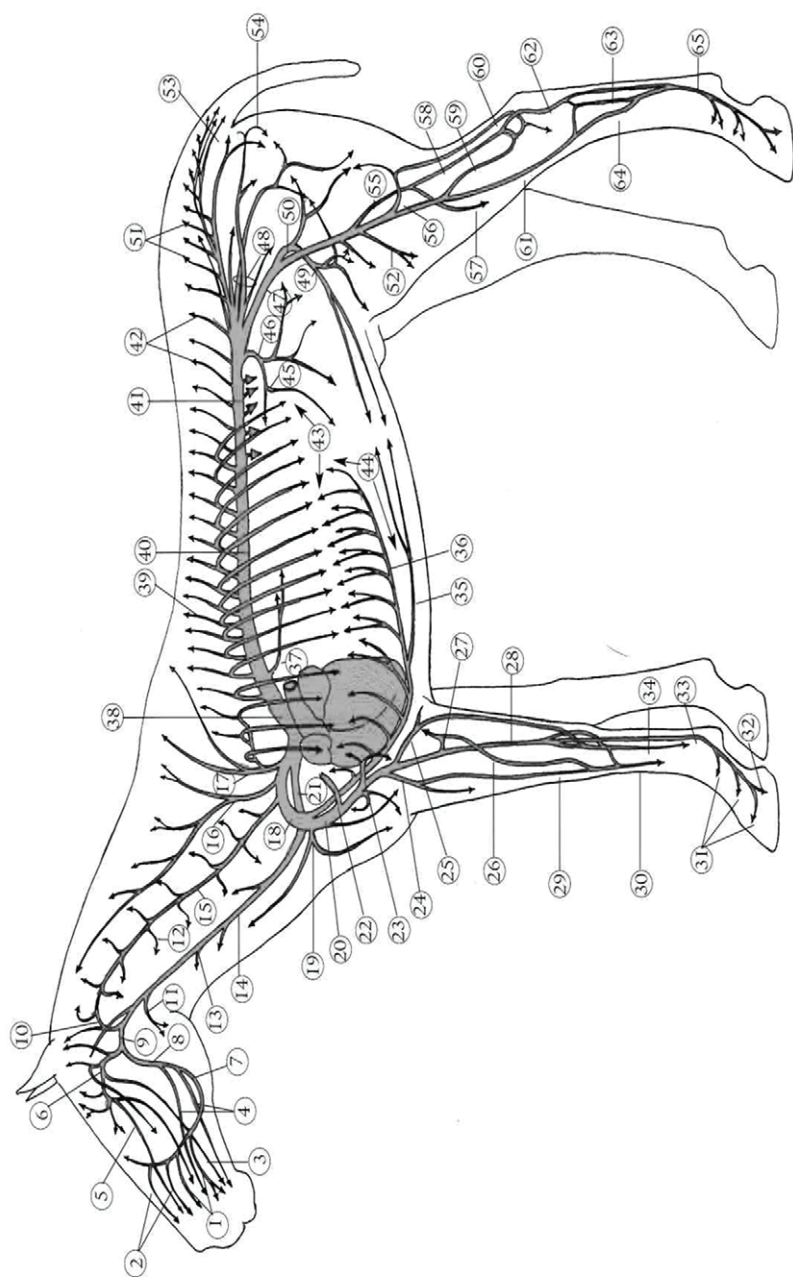
## MAJOR ARTERIES – Lateral Overview

- 1 Maxillary and mandibular labial arteries
- 2 Dorsal and lateral nasal arteries
- 3 Buccal artery
- 4 Lingual and sublingual arteries
- 5 Infraorbital artery
- 6 Maxillary artery
- 7 Facial artery
- 8 Linguofacial artery
- 9 External carotid artery
- 10 Anastomosis between vertebral and occipital arteries
- 11 Cranial thyroid artery
- 12 Spinal arteries
- 13 Oesophageal and tracheal arteries
- 14 Left common carotid artery
- 15 Vertebral artery
- 16 Deep cervical artery
- 17 Dorsal scapular artery
- 18 Left subclavian artery

- 19 Superficial cervical artery
- 20 Axillary artery
- 21 Brachioradial artery
- 22 Subscapular artery
- 23 Deep brachial artery
- 24 Transverse cubital artery
- 25 Collateral ulnar artery
- 26 Cranial interosseous artery
- 27 Common interosseous artery
- 28 Median artery
- 29 Deep carpal branch from transverse cubital artery
- 30 Medial and lateral dorsal metacarpal arteries
- 31 Dorsal branches of palmar digital artery
- 32 Branch of palmar digital artery
- 33 Medial and lateral palmar digital artery
- 34 Medial and lateral palmar metacarpal arteries
- 35 Cranial epigastric artery
- 36 Bronchophrenic artery
- 37 Musculophrenic artery
- 38 Aortic arch
- 39 Thoracic aorta
- 40 Abdominal aorta
- 41 Lumbar arteries
- 42 Dorsal intercostal arteries

- 44 Ventral intercostal arteries
- 45 Left gonadal artery
- 46 Deep circumflex iliac artery
- 47 External iliac artery
- 48 Internal iliac artery (dividing into caudal gluteal artery and internal pudendal artery)
- 49 Caudal epigastric and superficial epigastric arteries
- 50 Deep femoral artery
- 51 Sacral arteries
- 52 Descending genicular artery
- 53 Caudal arteries
- 54 Penile artery
- 55 Saphenous artery
- 56 Distal caudal femoral artery
- 57 Cranial saphenous artery
- 58 Caudal saphenous artery
- 59 Caudal tibial artery
- 60 Distal caudal tibial artery
- 61 Cranial tibial artery
- 62 Medial and lateral plantar arteries
- 63 Medial and lateral plantar metatarsal arteries
- 64 Dorsal metatarsal artery
- 65 Medial and lateral plantar digital arteries

# MAJOR ARTERIES – Lateral Overview



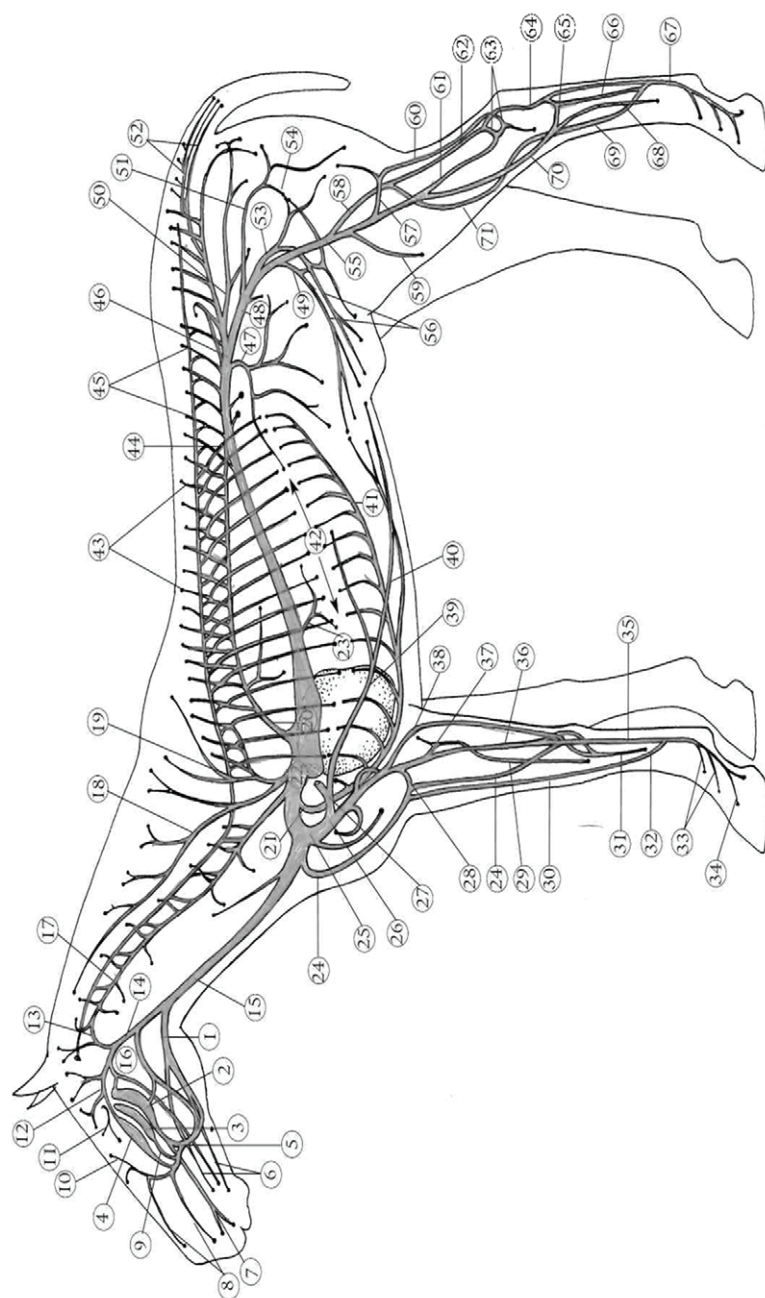


## MAJOR VEINS – Lateral Overview

1	Lingofacial vein	24	Cephalic vein	53	Deep femoral vein
2	Sinus of buccal vein	25	Subclavian vein	54	Penile veins
3	Sinus of deep facial vein	26	Axillary vein	55	Femoral vein
4	Sinus of transverse facial vein	27	Subscapular vein	56	Epigastric veins
5	Buccal vein	28	Transverse cubital vein	57	Distal caudal femoral vein
6	Lingual and sublingual veins	29	Cranial interosseous vein	58	Medial saphenous vein
7	Inferior and superior labial veins	30	Accessory cephalic vein	59	Descending genual vein
8	Dorsal and lateral nasal veins	31	Medial and lateral palmar metacarpal veins	60	Lateral saphenous vein
9	Deep facial vein	32	Dorsal common digital vein	61	Caudal tibial vein
10	Angularis oculi vein	33	Dorsal branches from 1st, 2nd and 3rd phalanges	62	Caudal medial saphenous vein
11	Supraorbital vein	34	Coronary venous plexus	63	Caudal tibial anastomoses with saphenous veins
12	Transverse facial vein	35	Medial palmar vein	64	Medial and lateral plantar veins
13	Vertebral occipital vein anastomosis	36	Median vein	65	Perforating tarsal vein
14	Maxillary vein	37	Common interosseous vein	66	Medial and lateral plantar metatarsal veins
15	External jugular vein	38	Collateral ulnar vein	67	Medial and lateral plantar digital veins
16	Inferior (mandibular) alveolar vein	39	Superficial thoracic vein	68	Dorsal metatarsal vein
17	Vertebral vein	40	External thoracic vein	69	Dorsal common digital vein
18	Deep cervical vein	41	Musculophrenic vein	70	Dorsal pedal vein
19	Dorsal scapular vein	42	Ventral intercostal veins	71	Cranial medial saphenous vein
20	Azygos vein	43	Spinal branches of intercostal veins		
21	Internal thoracic vein	44	Coccygeal vein		
22	Costocervical vein	45	Lumbar veins		
23	Cranial phrenic vein	46	Common iliac vein		
		47	Deep circumflex iliac vein		
		48	External iliac vein		
		49	Pubendopigeal vein		
		50	Internal pudendal vein		
		51	Obturator vein		
		52	Caudal veins		



# MAJOR VEINS – Lateral Overview



# ARTERIES OF THE LOWER LIMBS – Cranial and Caudal Views of Fore and Hind

**Figs. 3 (a) and (b) Arteries of the Lower Forelimb**

- ① Cranial interosseous artery
- ② Dorsal carpal branch from transverse cubital
- ③ Dorsal carpal branch of proximal radial artery
- ④ Medial and lateral dorsal metacarpal arteries
- ⑤ Dorsal branches of palmar digital arteries to 1st, 2nd and 3rd phalanges (on both drawings)
- ⑥ Proximal radial artery
- ⑦ Radial artery
- ⑧ Median artery
- ⑨ Deep palmar arch
- ⑩ Lateral palmar artery
- ⑪ Medial palmar artery
- ⑫ Medial and lateral palm
- ⑬ Medial and lateral palm
- ⑭ Terminal arch (palmar digital arteries uniting inside 3rd phalanx)
- ⑮ Collateral ulnar artery

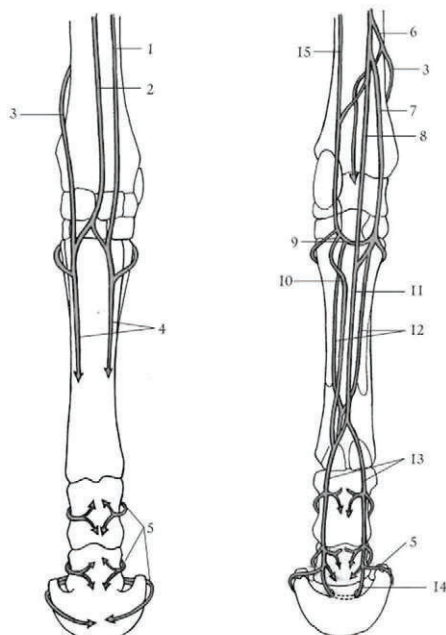


Fig. 3 (a) Lower forelimb – cranial view Fig. 3 (b) Lower forelimb – caudal view

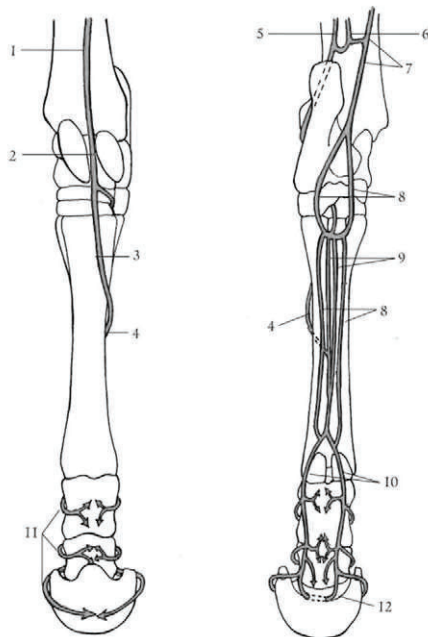
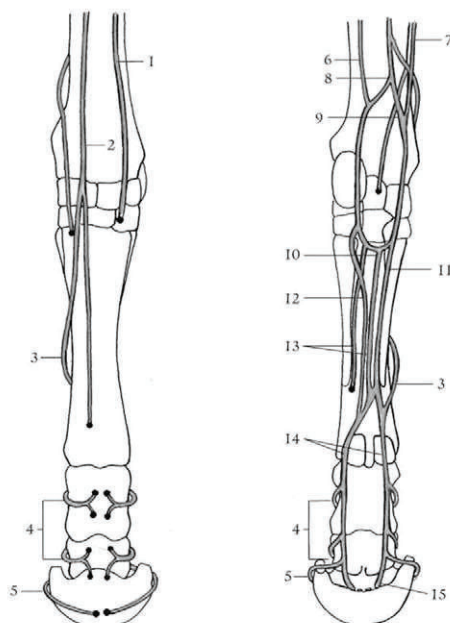


Fig. 3 (c) Lower hind limb – cranial view Fig. 3 (d) Lower hind limb – caudal view

**Figs. 3 (c) and (d) Arteries of the Lower Hind Limb**

- ① Cranial tibial artery
- ② Dorsal pedal artery
- ③ Dorsal metatarsal artery
- ④ Distal perforating artery (on both drawings)
- ⑤ Distal caudal femoral artery
- ⑥ Caudal tibial artery
- ⑦ Caudal saphenous artery
- ⑧ Medial and lateral plantar arteries
- ⑨ Medial and lateral plantar metatarsal arteries
- ⑩ Medial and lateral plantar digital arteries
- ⑪ Dorsal branches of plantar digital arteries to 1st, 2nd and 3rd phalanges
- ⑫ Terminal arch (plantar digital arteries uniting inside 3rd phalanx)

## VEINS OF THE LOWER LIMBS – Cranial and Caudal Views of Fore and Hind



Figs. 7(a) and (b) Veins of the Lower Forelimb

- ① Cranial interosseous vein
- ② Accessory cephalic vein
- ③ Dorsal common digital vein
- ④ Dorsal branches of 1st, 2nd and 3rd phalanges
- ⑤ Coronary venous plexus
- ⑥ Collateral ulnar vein
- ⑦ Cephalic vein
- ⑧ Median vein
- ⑨ Radial vein
- ⑩ Deep palmar arch
- ⑪ Medial palmar vein (palmar common digital)
- ⑫ Lateral palmar vein
- ⑬ Medial and lateral palmar metacarpal veins
- ⑭ Medial and lateral palmar digital veins (palmar proper digitals)
- ⑮ Terminal arch

Fig. 7(a) Lower forelimb – cranial view Fig. 7(b) Lower forelimb – caudal view

## Figs. 7(c) and (d) Veins of the Lower Hind Limb

- ① Cranial and medial saphenous veins
- ② Cranial tibial vein
- ③ Dorsal pedal vein
- ④ Perforating tarsal vein
- ⑤ Dorsal metatarsal vein
- ⑥ Dorsal common digital vein
- ⑦ Caudal tibial vein
- ⑧ Caudal medial saphenous vein
- ⑨ Lateral saphenous vein
- ⑩ Medial and lateral plantar veins (plantar common digitals)
- ⑪ Medial and lateral plantar metatarsal veins
- ⑫ Distal perforating vein
- ⑬ Medial and lateral plantar digital veins
- ⑭ Dorsal branches of 1st, 2nd and 3rd phalanges
- ⑮ Coronary venous plexus
- ⑯ Terminal arch

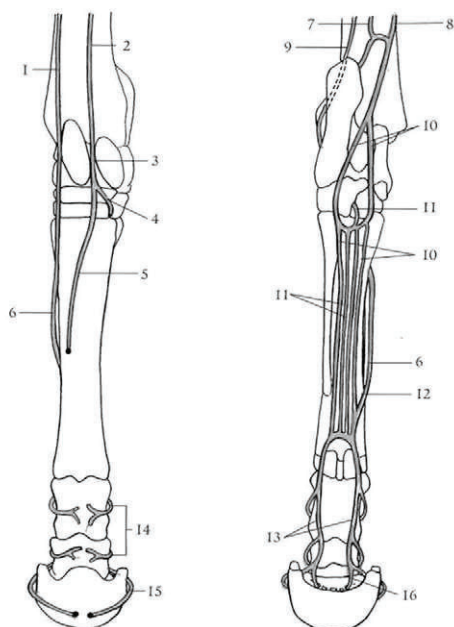


Fig. 7(c) Lower hind limb – cranial view Fig. 7(d) Lower hind limb – caudal view

## BLOOD VESSELS OF THE LOWER LIMBS

### Lateral and Medial Views

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>① Lateral palmar (plantar) vein</li> <li>② Lateral palmar (plantar) artery</li> <li>③ Lateral palmar (plantar) digital vein</li> <li>④ Lateral palmar (plantar) digital artery</li> <li>⑤ Cephalic vein</li> <li>⑥ Medial palmar (plantar) vein</li> <li>⑦ Medial palmar (plantar) artery</li> <li>⑧ Medial palmar (plantar) digital vein</li> <li>⑨ Medial palmar (plantar) digital artery</li> <li>⑩ Dorsal pedal artery</li> <li>⑪ Dorsal pedal vein</li> <li>⑫ Dorsal metatarsal vein</li> <li>⑬ Caudal branch of lateral saphenous vein</li> </ul> | <ul style="list-style-type: none"> <li>⑭ Caudal femoral artery</li> <li>⑮ Caudal fibial vein</li> <li>⑯ Caudal fibial artery</li> <li>⑰ Caudal branch of medial saphenous vein</li> <li>⑱ Caudal saphenous artery</li> <li>⑲ Dorsal common digital vein</li> <li>⑳ Cranial branch of medial saphenous vein</li> <li>㉑ Cranial saphenous artery</li> <li>㉒ Coronary venous plexus</li> </ul> |
|--|---|

Lateral and Medial Views

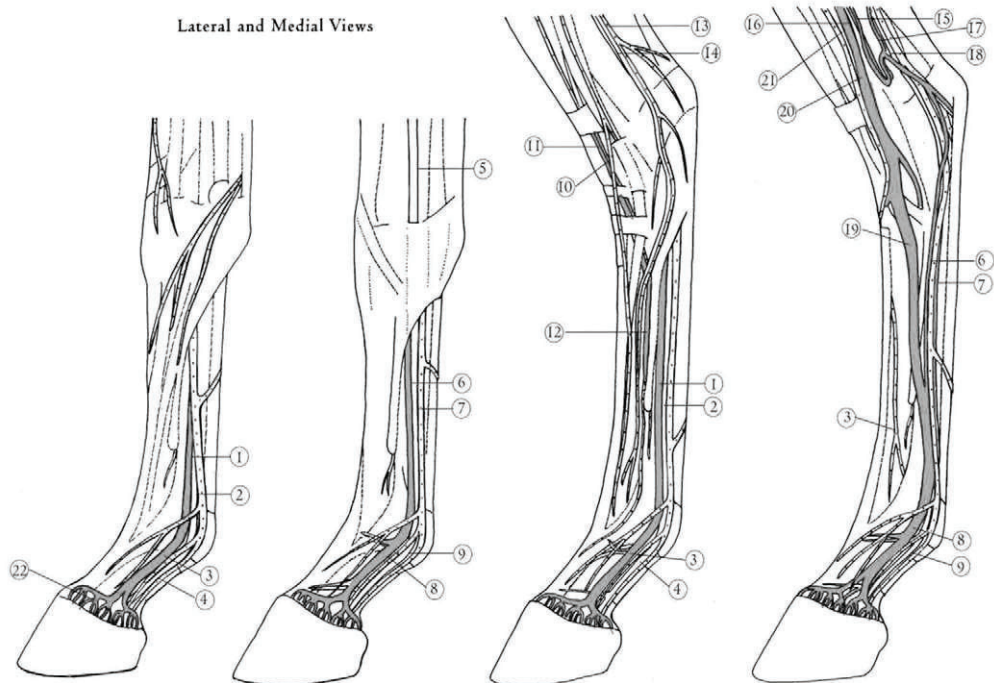


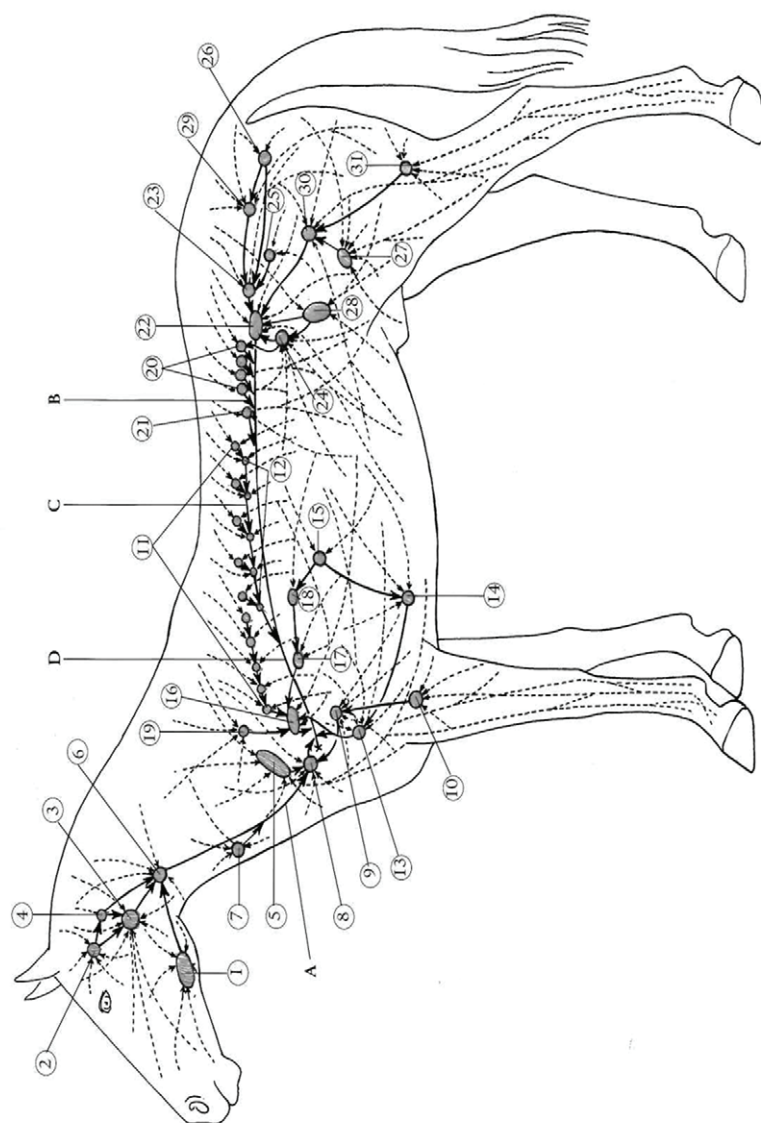
Fig. 8(a) Lower forelimb – lateral view    Fig. 8(b) Lower forelimb – medial view    Fig. 8(c) Lower hind limb – lateral view    Fig. 8(d) Lower hind limb – medial view

# MAJOR LYMPH NODE GROUPS – Lateral View (Figure 9)

- A Tracheal duct
  - B Lymph duct
  - C Cisterni chli
  - D Thoracic duct
- 1 Mandibular nodes – lymph from skin of face; most of muscles and bones of head; nasal cavity, gums, teeth, tongue, hard palate and salivary glands
  - 2 Parotid nodes – lymph from skin of eyelids, cranial and parotid regions; jaw and eyeball muscles; lacrimal and parotid glands
  - 3 Medial and 4 Lateral retropharyngeal nodes – lymph from bones, muscles, deep structures of head and cranial neck
  - 5 Superficial cervical nodes – lymph from skin of ear, back of head, neck, shoulder, thorax and entire forelimb; jaw joint and bones and joints of forelimb (except ulna and elbow joint); muscles of shoulder and breast, digital flexor and extensor tendons
  - 6 Cranial, 7 Middle, 8 Caudal, deep cervical nodes
  - 9 Axillary nodes – lymph from skin of shoulder, arm, thorax, cranial abdominal wall; shoulder and elbow joints and muscles of shoulder, arm and chest
  - 10 Cubital nodes – lymph from skin, muscles, bones and joints of forelimb distal to node, elbow joint and brachiocephalic muscle
  - 11 Intercostal nodes – lymph from muscles of back, upper thorax and abdominal wall; pleura, mediastinum and diaphragm
  - 12 Thoracic aortic nodes – drainage as for intercostals, but also from liver
  - 13 Cranial and 14 Caudal sternal nodes
  - 15 Pivotal nodes – small, constant
  - 16 Cranial, 17 Middle and 18 Caudal mediastinal nodes
  - 19 Nuchal node – lymph from deep muscles of neck
  - 20 Lumbar aortic nodes – lymph from muscles of back and loins; peritoneum and caudal pleura; urogenital organs and kidneys
  - 21 Renal nodes – lymph from adrenal gland, kidney and ureter; peritoneum, liver and duodenum; testicle
  - 22 Medial iliac nodes – lymph from muscles of loins, sacral region, thigh and hip joint; peritoneum and caudal pleura; urogenital organs
  - 23 Sacral nodes – lymph from muscles of rump and thigh; vagina (in mare); seminal vesicles, prostate and bulbourethral glands (in stallion)
  - 24 Lateral iliac nodes – lymph from abdominal muscles, kidney and diaphragm; peritoneum and caudal pleura
  - 25 Obturator node – lymph from iliopectineal and cranial thigh muscles and hip joint
  - 26 Anorectal nodes – lymph from skin and muscles
  - 27 Superficial inguinal nodes – lymph from skin and muscles of caudal thoracic and abdominal wall; skin of hind limb; udder, vulva and clitoris (in mare); scrotum, prepuce and penis (in stallion)
  - 28 Subiliac (prefemoral) nodes – lymph from skin of dorsal and lateral thorax and abdominal wall, lumbar and pelvic regions including thigh and arifle joint
  - 29 Ischiatic nodes – lymph from tail, thigh muscles
  - 30 Deep inguinal nodes – lymph from muscles of abdominal wall, cremaster muscle, all muscles of pelvis and thigh regions, muscles, tendons and joints of leg, foot, peritoneum and penis
  - 31 Popliteal nodes

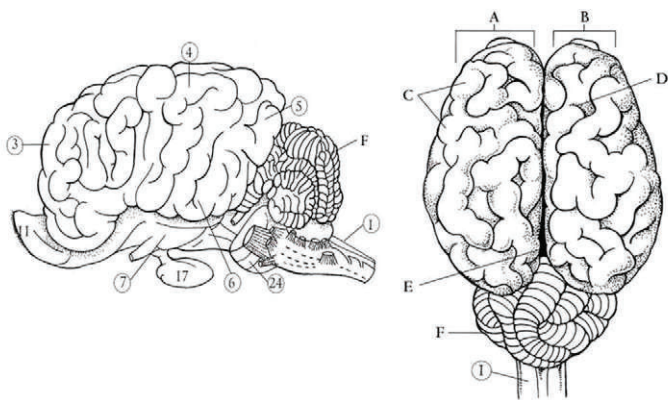


FIGURE 9: MAJOR LYMPH NODE GROUPS – Lateral View

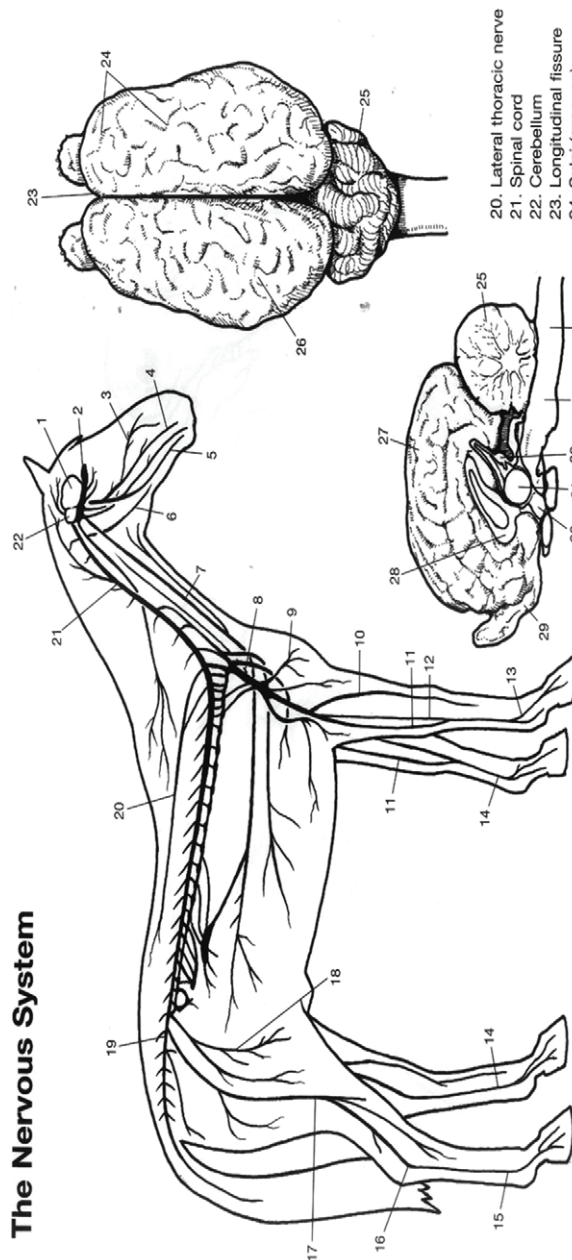




# The Nervous system



# The Nervous System



## The Principal Nerves and the Nervous System

The nervous system is the communications network of the horse's body. It consists of two parts: the central nervous system, made up of brain and spinal cord, and the peripheral nervous system, consisting of nerves radiating from the spinal cord to muscles, internal organs, and skin. Sensations from outside the body, as well as impulses from internal organs and other tissues, are sent to the brain and interpreted. The brain then reacts appropriately.

1. Cerebrum
2. Olfactory bulb
3. Facial nerve
4. Branch of trigeminal nerve
5. Branch of trigeminal nerve
6. Hypoglossal nerve
7. Vagus nerve
8. Brachial plexus
9. Pectoral nerve
10. Radial nerve
11. Ulnar nerve
12. Median nerve
13. Lateral palmar nerve
14. Medial plantar nerve
15. Lateral plantar nerve
16. Tibial nerve
17. Sciatic nerve
18. Femoral nerve
19. Lumbosacral nerve

20. Lateral thoracic nerve
21. Spinal cord
22. Cerebellum
23. Longitudinal fissure
24. Sulci (grooves)
25. Cerebellum
26. Gyri (convolutions)
27. Right cerebral hemisphere
28. Corpus callosum
29. Olfactory bulb
30. Hypothalamus
31. Thalamus
32. Pineal gland
33. Pons
34. Medulla oblongata

## THE BRAIN – Various Views

FIGURE 4

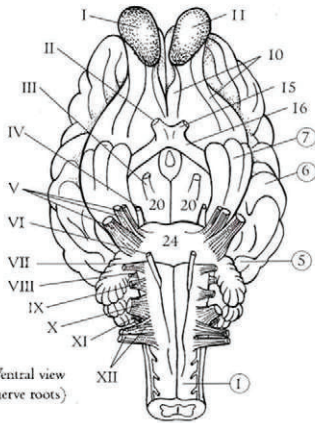


Fig. 4 (a) Ventral view  
(including nerve roots)

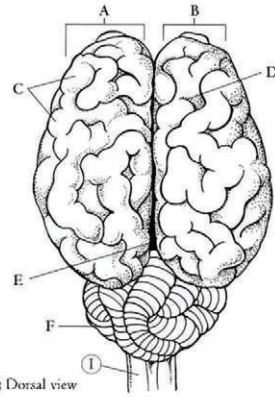


Fig. 4 (b) Dorsal view

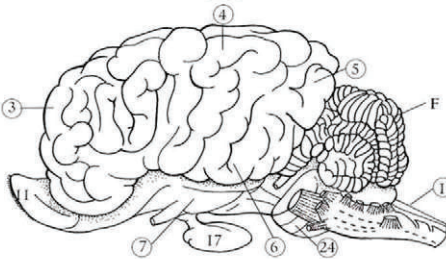


Fig. 4 (c) Lateral view

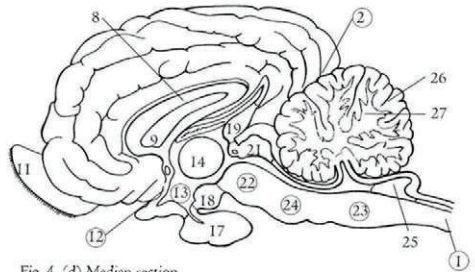


Fig. 4 (d) Median section

### (Figure 4 )

**Figs. 4 (a) Ventral View (Including Nerve Roots), (b) Dorsal View, (c) Lateral View and (d) Median Section**

On Fig. (a),

- (i) Olfactory nerves
- (ii) Optic nerve
- (iii) Oculomotor nerve
- (iv) Trochlear nerve
- (v) Trigeminal nerve
- (vi) Abducent nerve
- (vii) Facial nerve
- (viii) Vestibulocochlear nerve
- (ix) Glossopharyngeal nerve
- (x) Vagus nerve
- (xi) Accessory nerve
- (xii) Hypoglossal nerve

On Fig.(b)

- A Left cerebral hemisphere
- B Right cerebral hemisphere
- C Gyri (convolutions)
- D Sulci (grooves)
- E Longitudinal fissure
- F Cerebellum

#### Forebrain

- (1) Spinal cord
- (2) Transverse cerebral fissure (separating cerebellum from cerebral hemisphere)
- (3) Frontal lobe
- (4) Parietal lobe
- (5) Occipital lobe
- (6) Temporal lobe
- (7) Olfactory lobe
- (8) Body of corpus callosum
- (9) Septum pellucidum
- (10) Olfactory tracts
- (11) Olfactory bulbs
- (12) Terminal lamina (thin rostral wall of brain stem in forebrain)
- (13) 3rd ventricle
- (14) Thalamus
- (15) Optic chiasma
- (16) Optic tract
- (17) Hypophysis (pituitary gland)
- (18) Mammillary body
- (19) Epiphysis

#### Midbrain

- (20) Cerebral crus
- (21) Tectum
- (22) Tegmentum

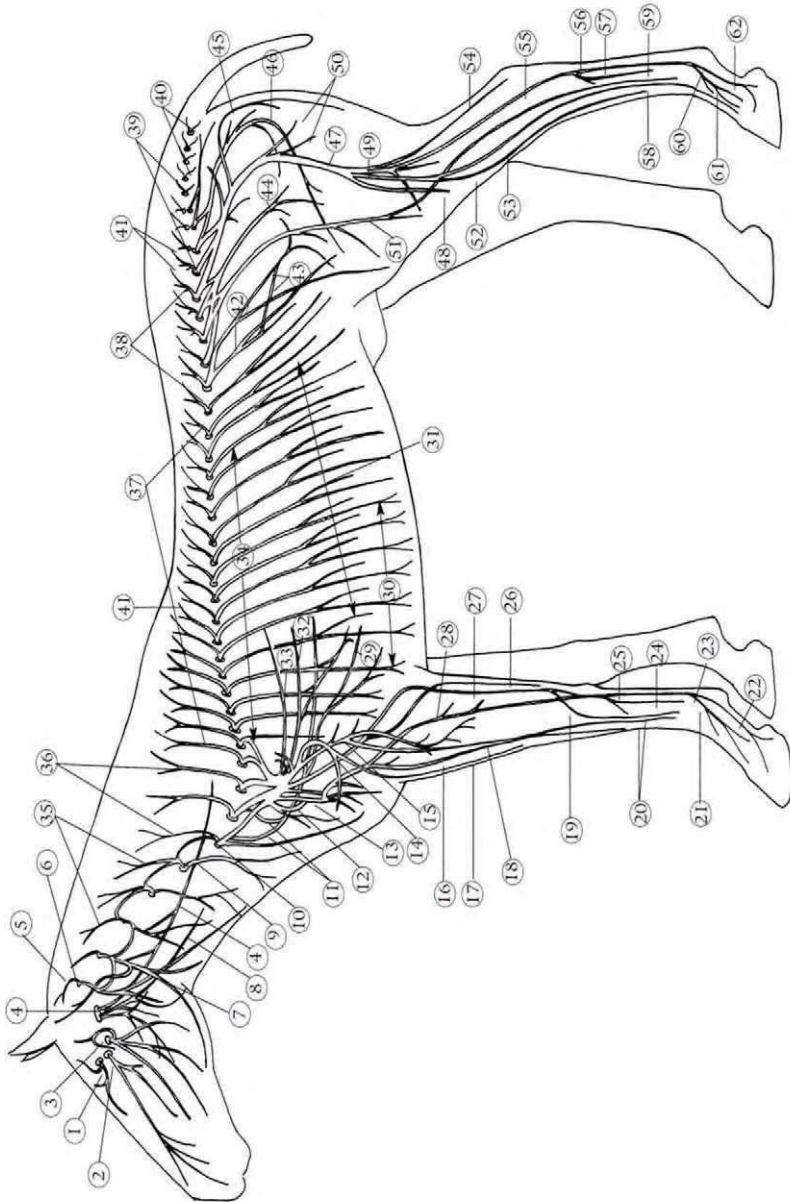
#### Hindbrain

- (23) Medulla oblongata
- (24) Pons
- (25) 4th ventricle
- (26) Cerebellar cortex
- (27) Cerebellar white matter

## PERIPHERAL NERVES — Lateral Overview

- (1) Ophthalmic component of trigeminal nerve
- (2) Maxillary component of trigeminal nerve
- (3) Mandibular component of trigeminal nerve
- (4) Accessory nerve
- (5) Suboccipital nerve
- (6) Ventral rami of cervical nerves C1 to C8
- (7) Transverse cervical nerve
- (8) Vagus nerve
- (9) Ventral rami C3 to C5
- (10) Ventral rami C6 to C8
- (11) Phrenic nerve C5 to C7
- (12) Suprascapular nerve
- (13) Musculocutaneous nerve
- (14) Axillary nerve
- (15) Radial nerve
- (16) Medial cutaneous antebrachial nerve
- (17) Cranial cutaneous antebrachial nerve
- (18) Lateral cutaneous antebrachial nerve
- (19) Dorsal branch of ulnar nerve
- (20) Medial and lateral dorsal metacarpal nerves
- (21) Dorsal branch of palmar digital nerve
- (22) Palmar branch of palmar digital nerve
- (23) Medial and lateral palmar digital nerves
- (24) Medial and lateral palmar metacarpal nerves
- (25) Lateral palmar nerve
- (26) Caudal cutaneous antebrachial nerve
- (27) Ulnar nerve
- (28) Median nerve
- (29) Lateral thoracic nerve
- (30) Ventral cutaneous nerves of thorax
- (31) Lateral cutaneous nerves of thorax
- (32) Thoracodorsal nerve
- (33) Long thoracic nerve
- (34) Intercostal nerves T2 to T17
- (35) Dorsal rami C3 to C5
- (36) Dorsal rami C6 to C8
- (37) Dorsal rami of thoracic nerves T1 to T18
- (38) Dorsal rami of lumbar nerves L1 to L6
- (39) Dorsal rami of sacral nerves S1 to S5
- (40) Dorsal rami of caudal nerves Cd 1 to Cd5
- (41) Dorsal cutaneous nerves
- (42) Ilioinguinal nerve L2
- (43) Genitofemoral nerve L3 and L4
- (44) Obturator nerve
- (45) Caudal cutaneous femoral nerve
- (46) Dorsal penile (clitoridal) nerve
- (47) Ischiatic nerve
- (48) Lateral cutaneous sural nerve
- (49) Common peroneal nerve
- (50) Motor branches from ischiatic nerve
- (51) Saphenous nerve
- (52) Superficial peroneal nerve
- (53) Deep peroneal nerve
- (54) Caudal cutaneous sural nerve
- (55) Tibial nerve
- (56) Deep branch of lateral plantar nerve
- (57) Lateral plantar nerve
- (58) Medial and lateral dorsal metatarsal nerves
- (59) Medial and lateral plantar metatarsal nerves
- (60) Dorsal branch of plantar digital nerve
- (61) Intermediate branch of plantar digital nerve
- (62) Plantar branch of plantar digital nerve

PERIPHERAL NERVES – Lateral Overview





## HORSE'S SPINAL CORD AND SPINAL NERVES

Figure 1. Schematic dorsal view of spinal cord.

Figure 2. Cross section of thoracic spinal cord and its relationships to the vertebral canal and spinal nerves.

- |   |   |
|---|---|
| 1. <b>Epidural space</b> (of vertebral canal)                       | 6. <b>Ventral root</b>                                |
| 2. <b>Meninges</b> (singular, meninx)                               | 7. <b>Thoracic spinal nerve</b>                       |
| 3. <b>Spinal cord</b>   | 8. <b>Communicating branches to sympathetic trunk</b> |
| 4. <b>Dorsal root</b>   | 9. <b>Sympathetic trunk</b>                           |
| 5. <b>Dorsal root ganglion</b><br>(collection of nerve cell bodies) |   |

The spinal cord continues from the medulla oblongata at the foramen magnum, extending caudad to the caudal half of the second sacral vertebra.

Spinal cord segments from the first cervical to the fourth lumbar are in the vertebral canal of the vertebra of same number. Differential growth and displacement accounts for the presence of an eighth cervical segment and the final positions of lumbar, sacral and caudal segments cranial to their corresponding vertebra.

The **cauda equina** (Latin for horse's tail) is the collection of spinal nerve roots that extend caudad from the end of the spinal cord within the vertebral canal.

The diameter of the spinal cord is greatest at the **cervical** and **lumbar enlargements** where the nerve roots for the plexuses supplying the nerves of the limbs originate.

A sensory dorsal root (with its ganglion) and a motor ventral root join to form a **spinal nerve**, which then divides into major dorsal and ventral branches. In the **thoracic** and **lumbar regions**, **communicating branches** go to and come from the **sympathetic trunk**, a series of ganglia connected by nerve lying along the inner surface of the thoracic wall.

The dura mater, outermost meninx covering the spinal cord, is separated from the wall of the vertebral canal by an epidural space containing adipose tissue and an internal vertebral venous plexus.



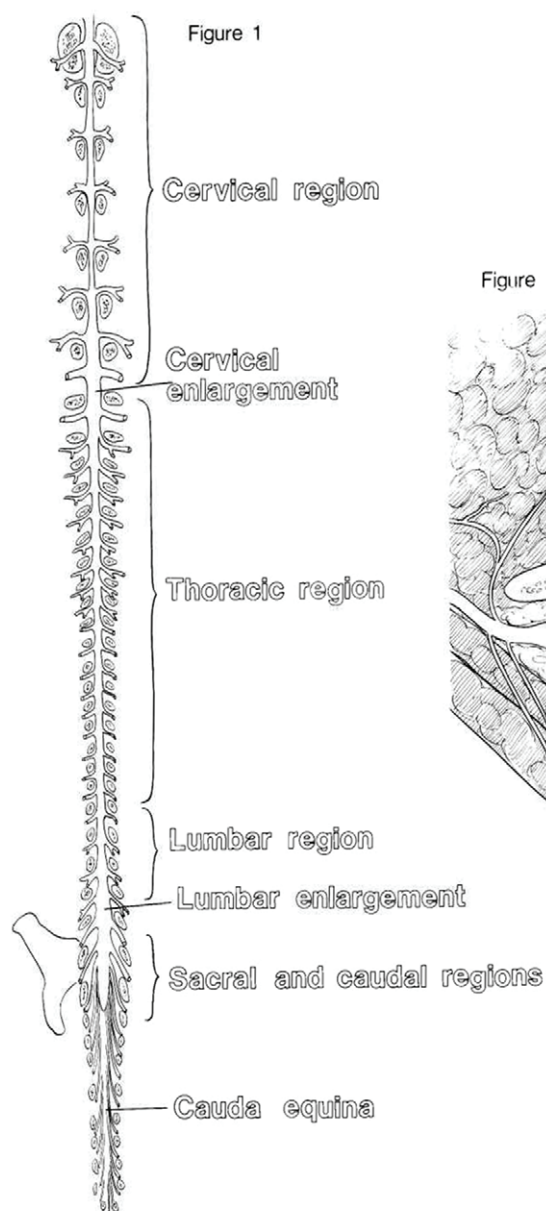
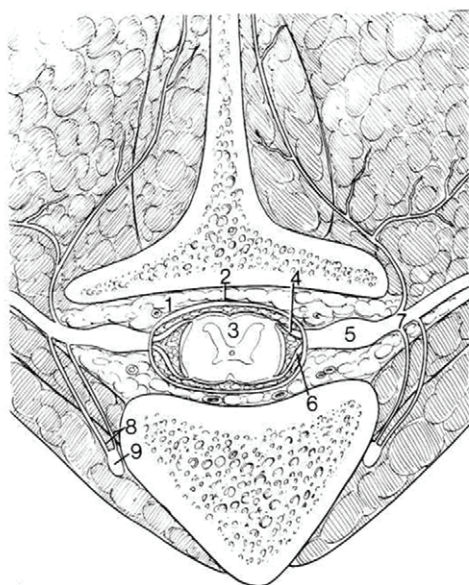


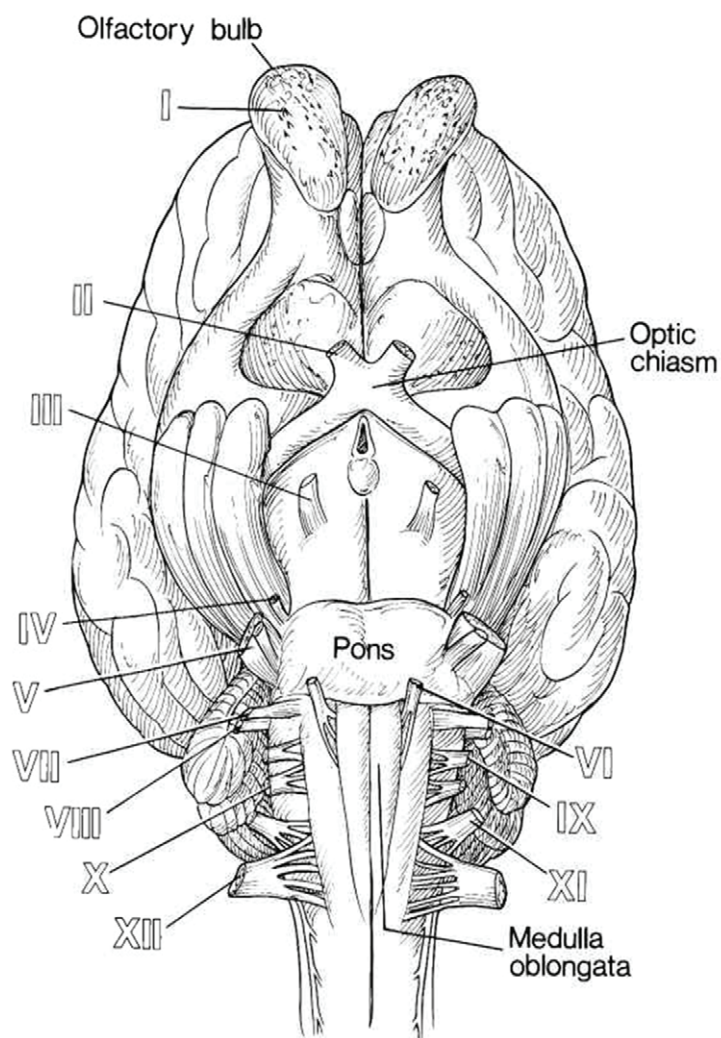
Figure 2



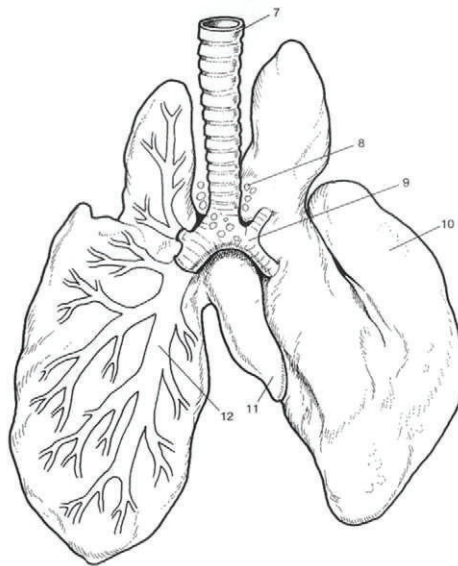
## CRANIAL NERVES

Ventral view of brain and cranial nerve roots.

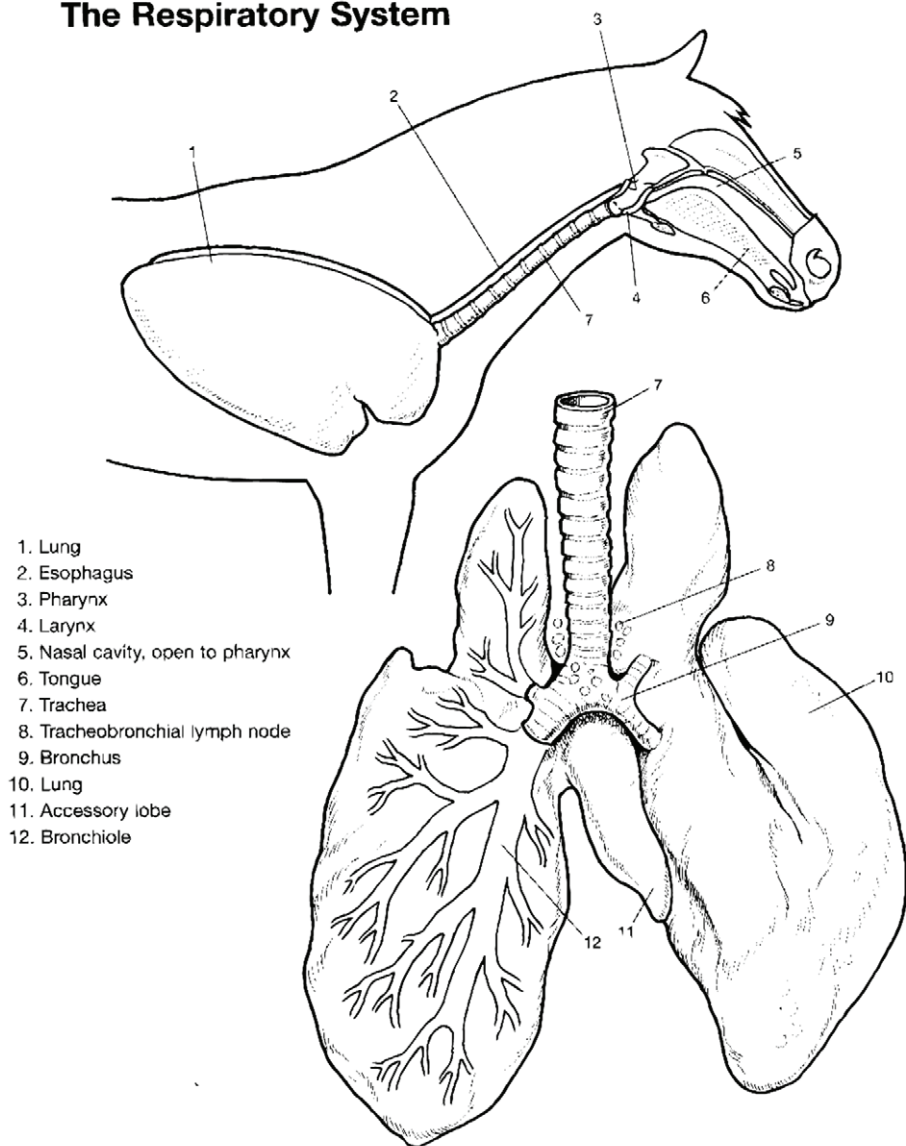
- I. Olfactory nerve** - Sense of smell. Many small nerve fibers come from the mucous membrane of the nasal cavity through openings in the cribriform plate of the ethmoid bone to the **olfactory bulb**.
- II. Optic nerve** - Vision. Some of the fibers coming from the retina of one eye cross over at the **optic chiasm** and continue into the optic tract on the opposite side.
- III. Oculomotor nerve** - Motor to several extraocular muscles. Parasympathetic fibers to intrinsic eye muscles.
- IV. Trochlear nerve** - Motor to a single extraocular muscle.
- V. Trigeminal nerve** - Sensory to face. Motor to muscles of mastication and deep muscles of head. Sensory to teeth. Lingual branch sensory for touch to the tongue.
- VI. Abducent nerve** - Motor to two extraocular muscles.
- VII. Facial nerve** - Motor to facial, eyelid and ear muscles. Its chorda tympani branch joins the lingual nerve to mediate taste to the rostral 2/3 of the tongue. Parasympathetic supply to lacrimal and salivary glands.
- VIII. Vestibulocochlear nerve** - Sensory for hearing and balance.
- IX. Glossopharyngeal nerve** - Motor to muscles of palate and pharynx. Mediates taste from caudal 1/3 of tongue. Sensory to mucous membrane of palate and pharynx. Parasympathetic supply to salivary glands.
- X. Vagus nerve** - Parasympathetic nerves to smooth muscle of cervical, thoracic and abdominal viscera. Sensory to external ear. Sensory to laryngeal mucous membrane and motor to intrinsic laryngeal muscles via cranial and caudal laryngeal nerves.
- XI. Accessory nerve (spinal root)** - The spinal root is formed by tiny rootlets from the cervical region of the spinal cord. It forms the accessory nerve motor to four shoulder muscles. A cranial root from caudal to the vagal roots sends fibers to the vagus nerve that eventually reach the caudal laryngeal nerve.
- XII. Hypoglossal nerve** - Motor to muscles of the tongue.



# The Respiratory system



## The Respiratory System



The respiratory system consists of the air passages of the head, nostrils to pharynx, the pharynx, trachea or windpipe, bronchi, and lungs. The lungs are the two organs in which oxygen and carbon dioxide are exchanged between the blood and the air. The lungs are situated in the chest cavity known as the thorax, the walls (ribs and diaphragm) of which can expand or

contract, allowing the lungs to enlarge or compress. Movements of the chest alternately draw in and expel air from the lungs. The normal breathing rate of a standing horse at rest is eight to sixteen breaths a minute. The rate may be affected by excitement, exercise, age, size, environmental temperature, pregnancy, and/or a full digestive tract.

## RESPIRATORY SYSTEM

### NASAL CAVITY, NASOPHARYNX AND LARYNX

Figure 1. Sagittal section of interior of nasal cavity, nasopharynx and larynx. For a view of the nasal septum, see Plate 50.

Arrow = entrance to auditory tube.

Dashed line = extent of laryngeal ventricle

The **dorsal meatus**, **middle meatus** and **ventral meatus** open into a common meatus limited medially by the nasal septum, a partition of cartilage and bone that divides the nasal cavity into halves. The ventral meatus is the largest. The **vomeronasal organs** are two long tubes of cartilage lined with mucous membrane that course caudad from the incisive ducts (extending in from each ventral meatus) on each side of the vomer bone along the floor of the ventral meatus.

A nasogastric tube (stomach tube) inserted through the nostril is pushed along the ventral meatus, then slides over the soft palate and passes through the nasopharynx into the esophagus.

Figure 2. Flehmen stance of a stallion.

In the flehmen response, the upward-turned upper lip partially closes the nostrils, creating suction in the incisive ducts that draws fluids into the vomeronasal organs. Better analysis of nonvolatile compounds in mucus is accomplished by stimulation of olfactory nerve endings in the mucous membrane. Flehmen behavior is pronounced in stallions investigating the urine and vaginal secretions of mares in heat.



Figure 1

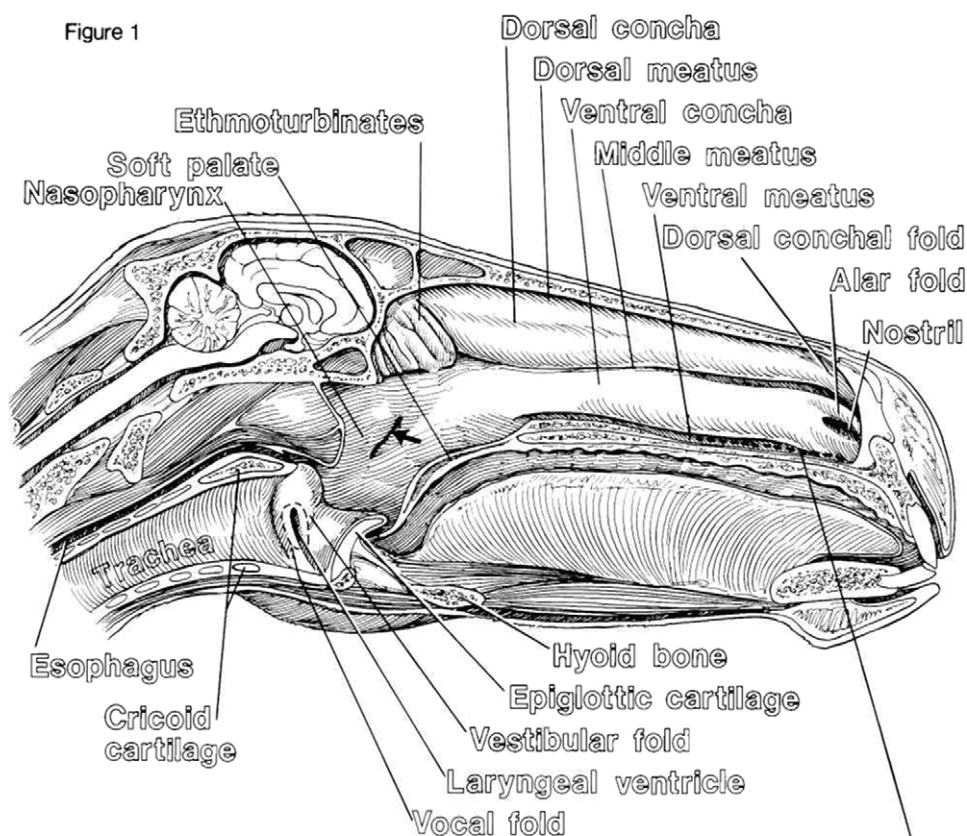
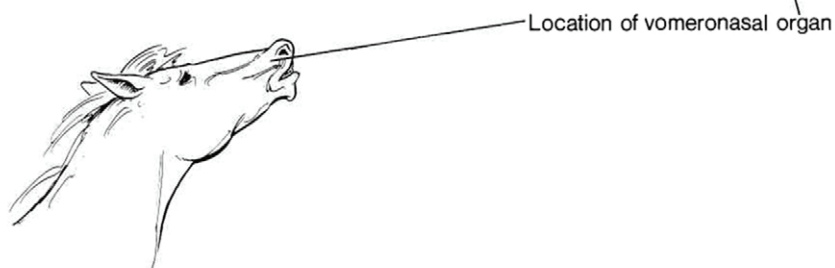


Figure 2



## LARYNX

Figure 1. Right lateral view of laryngeal cartilages.

Figure 2. Right lateral view of laryngeal muscles. Wing of thyroid cartilage cut away.

Figure 3. Rostrocaudal view of larynx. X = **rima** (cleft) of the **glottis**, the walls of which are formed by the **vocal folds** and parts of the **arytenoid cartilages**.

- |  |                                      |
|--|--------------------------------------|
| 1. <b>Cricoid cartilage</b>                                      | 10. <b>Dorsal cricoarytenoid m.</b>  |
| 2. <b>Arytenoid cartilage(s)</b>                                 | 11. <b>Lateral cricoarytenoid m.</b> |
| 3. <b>Thyroid foramen</b>  | 12. <b>Transverse arytenoid m.</b>   |
| 4. <b>Epiglottic cartilage</b>                                   | 13. <b>Hyoepiglottic muscle</b>      |
| 5. <b>Thyrohyoid bone</b>  | 14. <b>Ventricular muscle</b>        |
| 6. <b>Thyroid cartilage</b>                                      | 15. <b>Laryngeal ventricle</b>       |
| 7. <b>Cricothyroid membrane</b><br>Spreads between thyroid wings | 16. <b>Vocal m.</b> (in vocal fold)  |
| 8. <b>Cricotracheal membrane</b>                                 | 17. <b>Cricothyroid muscle</b>       |
| 9. <b>Tracheal rings</b>   | 18. <b>Vocal fold (cord)</b>         |
|  | 19. <b>Vestibular fold</b>           |

### Functions of the larynx:

1. Regulates the volume of air entering the trachea.
2. Prevents foreign material from entering the larynx.
3. Phonation (vocal sounds).

On each side, a **cranial laryngeal nerve** (from the vagus n.) supplies the **cricothyroid m.** and then goes through the **thyroid foramen** to provide sensation to the laryngeal mucous membrane.

**Caudal laryngeal nerves** - terminations of the recurrent laryngeal nerve that ascends the neck from the vagus in the thorax supply all the other laryngeal muscles.

**"Roarer":** When a recurrent laryngeal nerve degenerates (mainly the left nerve), paralysis of the **dorsal cricoarytenoid muscle** lets the **arytenoid cartilage** and the vocal fold move inward to interfere with the flow of air during inspiration. The **laryngeal ventricle** fills with air, causing a "roaring" sound. A horse so afflicted is called a "roarer". There is some indication that this condition may be inherited.

Figure 1

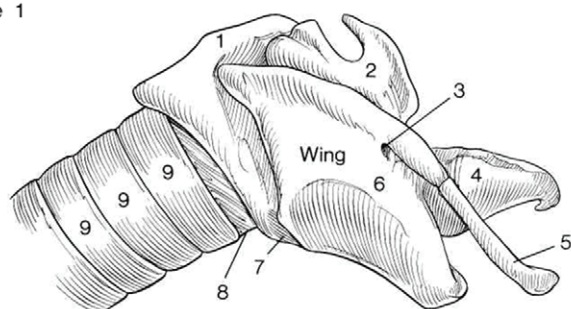


Figure 2

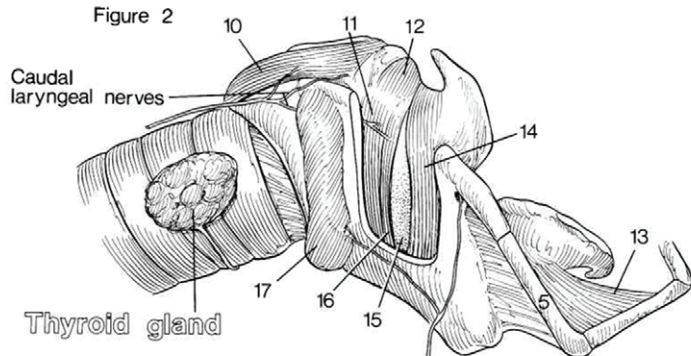
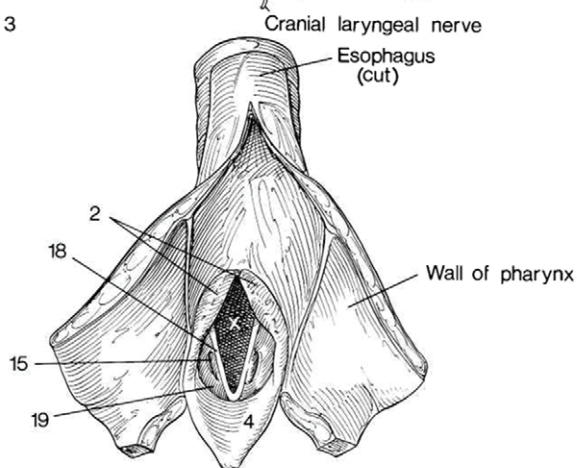


Figure 3



## TRACHEA AND LUNGS

Figure 1. Dorsal view of **trachea** and **lungs**. Diagrammatic drawing of **bronchial tree** in left lung.

Figure 2. Cross section of a cartilaginous **tracheal ring**.

Figure 3. Microscopic view of **alveoli** (little hollows), tiny air sacs with capillaries in their walls.

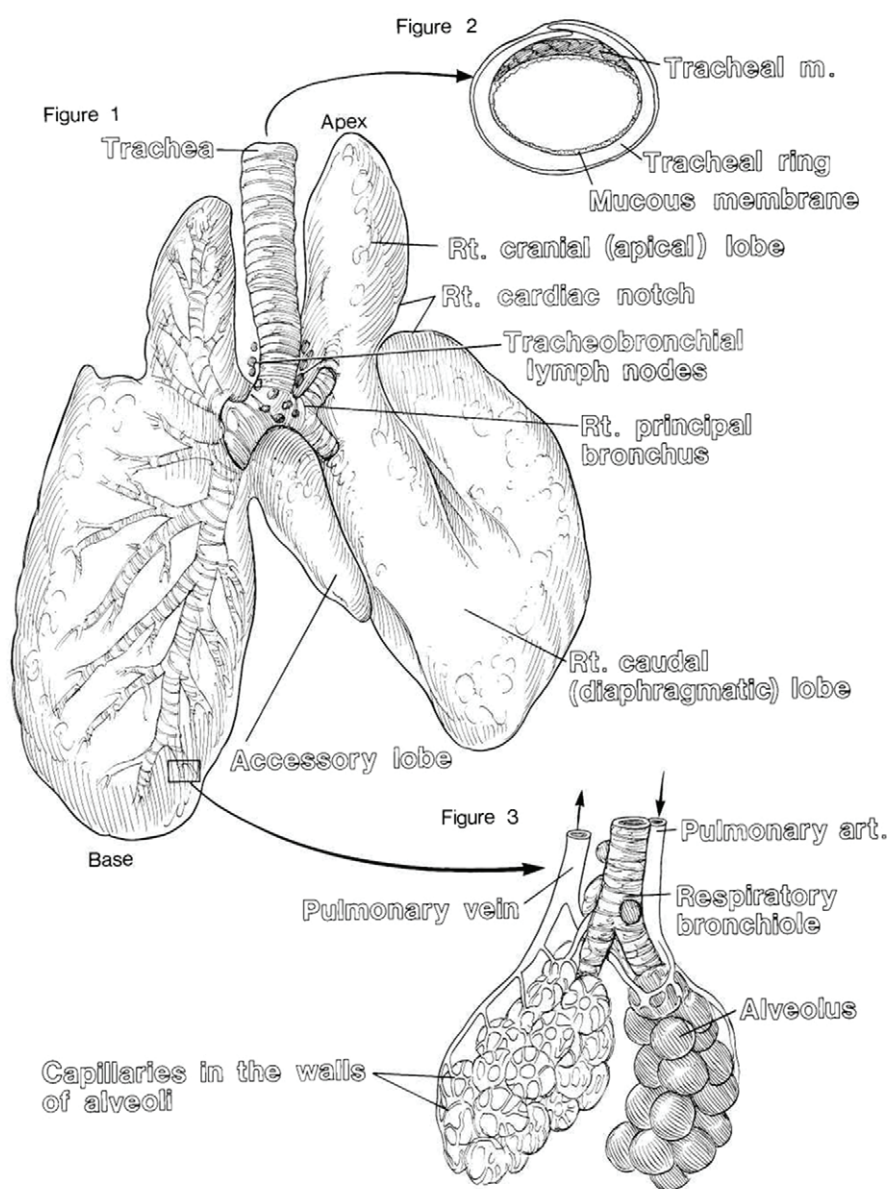
The 50 to 60 cartilaginous rings of the horse's trachea form incomplete hoops opening dorsally. The free ends overlap in the cervical part of the trachea, but in the thoracic part, they gradually fail to overlap. Smooth muscle fibers of the **tracheal muscle** join the inner surface of the free ends of the cartilaginous rings. Extra cartilaginous plates at the fork of the trachea fill in the gaps between the free ends of the main rings. Irregular plates support the left and right **principal bronchi** going to the lungs.

The conducting airways of the bronchial tree divide into smaller and smaller bronchi. When cartilaginous plates are no longer present in the walls of the smallest bronchi, the airway is termed a bronchiole. Terminal bronchioles lead to **respiratory bronchioles** of respiratory units. Exchange of oxygen and carbon dioxide takes place between air within alveoli and blood within capillaries in the alveolar walls. Ciliated epithelium lines most of the airways (beginning in the nasal cavity).

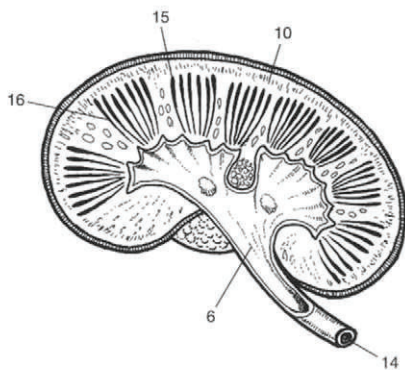
The normal breathing rate of a standing horse at rest is 10 to 14 breaths per minute. The rate may be affected by excitement, exercise, age, size, environmental temperature, pregnancy and/or a full digestive tract. The health of the horse also affects the breathing rate, usually increasing in disease.

Prolonged exposure to dust and molds often results in heaves or broken wind, a chronic inflammation of the airways and overdistension and rupture of alveoli (emphysema). A "heavey" horse coughs a lot, breathes loudly and has a double expiratory effort. A heave line is formed by increased musculature along the costal arch.



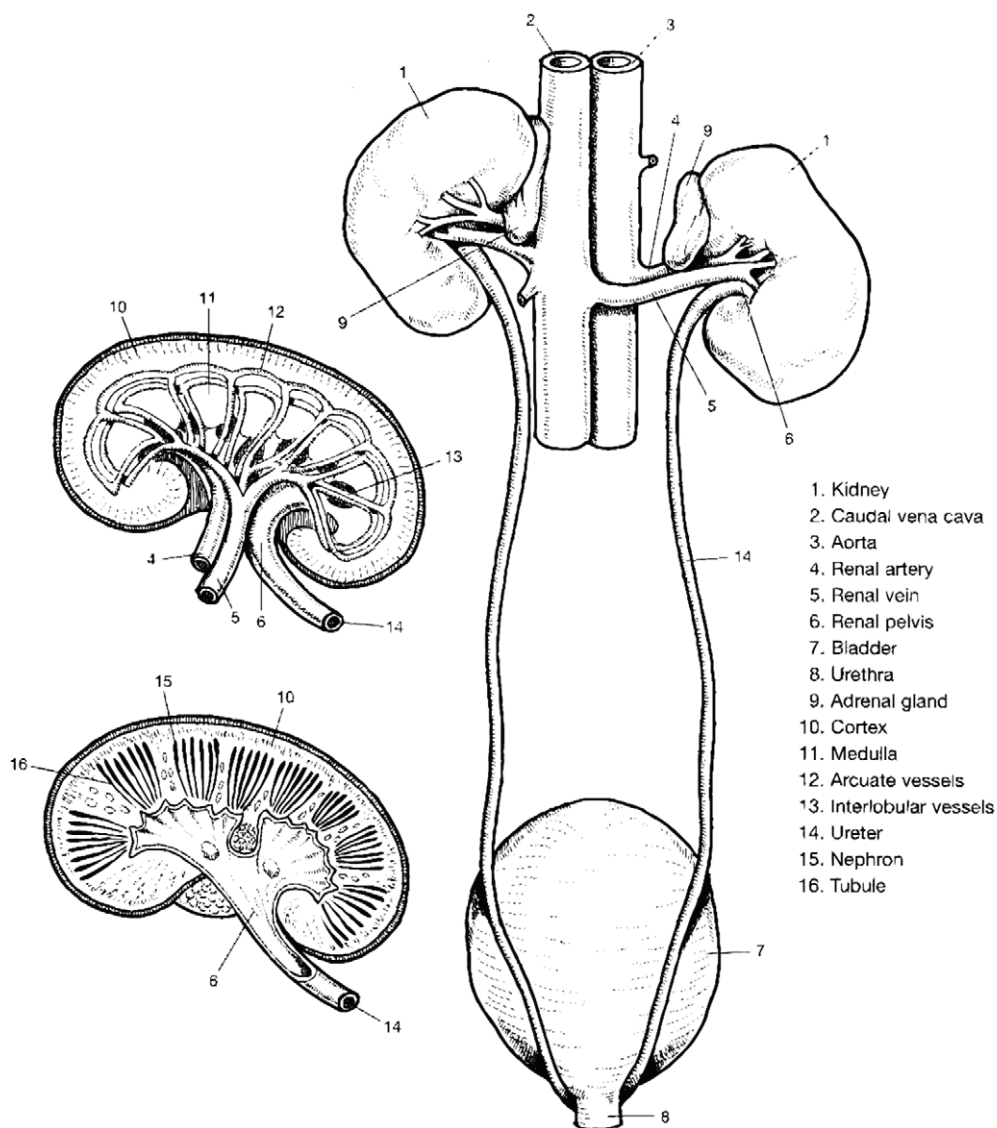


# The Urinary system





# The Urinary System



The horse, like all mammals, has two kidneys, whose function is to filter the blood and form urine. The urine passes to the bladder through the ureters and from there the urine passes to the outside through the urethra. The urethra has a common exit from the body with the sexual tract, the vagina in the mare, and the penis in the

stallion. A horse produces up to ten liters (2½ gallons) of urine daily, the color and consistency of which vary in everyday situations. Normal equine urine is cloudy and yellow in color. Urine samples are important laboratory aids to clinical diagnosis

## URINARY SYSTEM

### KIDNEYS, URETERS, BLADDER AND URETHRA

Figure 1. Ventral view of urinary organs of the horse.

Figure 2. Frontal section of **right kidney**.

The tubules of the kidney produce urine by removing waste products from the great volume of blood flowing through the organ. Collecting ducts open on the **renal crest**, emptying urine into the **pelvis** of the kidney. The pelvis is essentially the expanded beginning of the ureter.

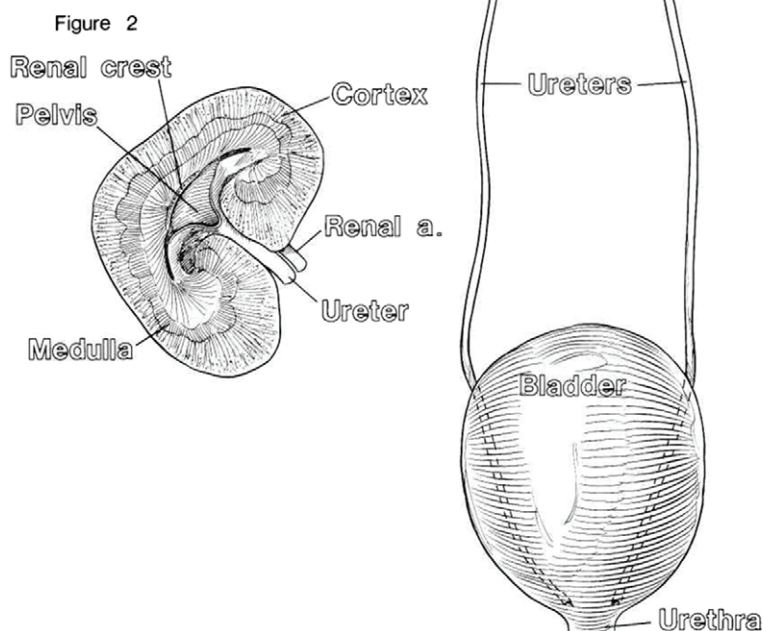
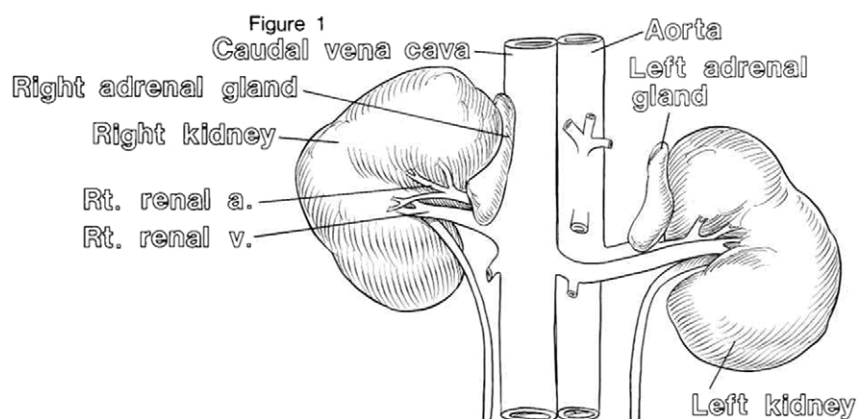
Urine contains the products of nitrogen and sulfur metabolism (Metabolism - processing substances, mainly nutrients, by the various tissues of the body), inorganic salts and pigments.

Normal equine urine is -

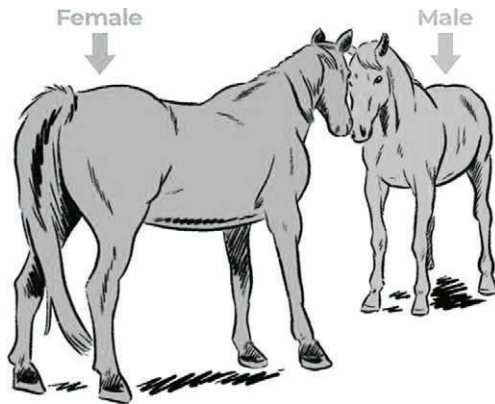
- 1) Somewhat thick and syrupy due to the presence of mucus secreted by mucous glands in the pelvis and first part of each ureter.
- 2) Cloudy due mainly to the presence of suspended calcium carbonate crystals. If a urine sample is allowed to stand, these crystals settle out.
- 3) Colored yellow to orange.

Volume of urine excreted -

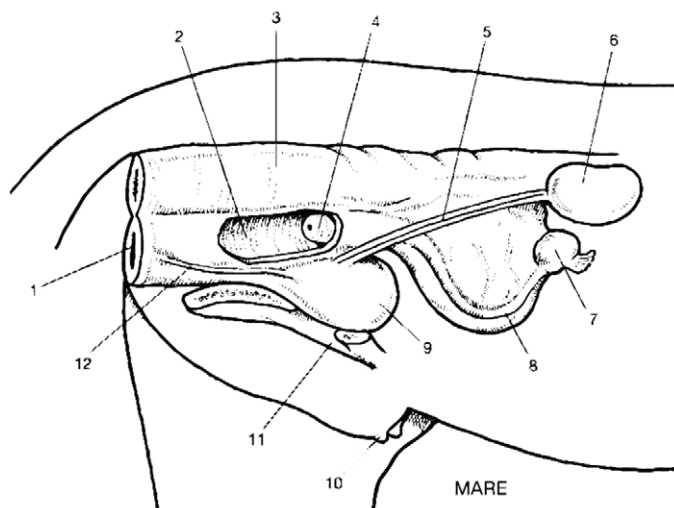
A horse weighing around 1000 lb. voids from 1 1/2 to 8 1/2 quarts of urine daily. The volume depends on the quantity of water consumed, type of feed, amount of work and the environmental temperature.



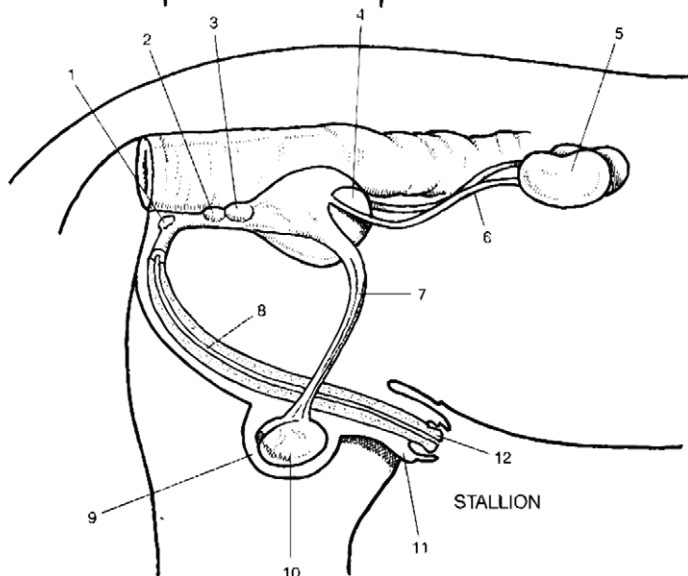
# The Reproductive system



## The Reproductive System



1. Vulva
2. Vagina
3. Rectum
4. Cervix
5. Ureter
6. Right kidney
7. Right ovary
8. Uterus
9. Bladder
10. Teat
11. Floor of pelvis
12. Urethra



1. Bulbourethral gland
2. Prostate
3. Seminal vesicle
4. Bladder
5. Kidneys
6. Ureter
7. Sperm duct
8. Urethra
9. Scrotum
10. Testes
11. Sheath
12. Penis

The genital organs of the mare consist of two ovaries and oviducts or fallopian tubes, the uterus, cervix, vagina, and vulva. The ovaries are responsible for producing the female sex cell, i.e. the egg, or ovum. The stallion's sex organs consist of two testes (housed in the scrotum) in which spermatozoa are produced; collecting ducts which

connect with the urethra after traveling in the spermatic cord with arteries and veins; the accessory glands comprising the prostate, seminal vesicles, bulbourethral gland, and penis. The penis is housed in the prepuce or "sheath."

## FEMALE REPRODUCTIVE SYSTEM

### VULVA AND VAGINA. UDDER

Figure 1. Caudal view of **vulva** and female perineum. **Vulvar labia** (Latin, lips) parted.

Figure 2. Dorsal view of opened vulva and **vagina** (L., sheath). Bladder displaced to one side.

Figure 3. A. **Lactating udder**. B. Sagittal section of one-half.

**Labia** and **clitoris**, homolog (corresponding organ) of the penis, comprise the **vulva**. The **vestibule** is considered part of the vagina. Mucous glands and, on each side, an erectile vestibular bulb are present in the walls of the vestibule. Depressions in the clitoral skin contain smegma and perhaps harmful bacteria.

**Constrictor muscles** act on the vestibule and the vulva. In addition to constricting the vulvar opening, the constrictor of the vulva elevates the clitoris. Following urination, movement of the labia and clitoris aid in expelling the last drops of urine. During heat (estrus), quick opening and closing of the labia and elevation of the clitoris is called winking.

The mare's **udder** consist of halves, each half consisting of a cranial and a caudal gland complex and lactiferous duct system. The cranial gland and duct system is the larger. A **gland cistern** and a **teat cistern** are parts of the lactiferous sinus of each duct system. The teat from each half of the udder has two (sometimes three) openings of **streak canals**, one caudal to the other. A nonlactating udder is small with laterally flattened teats. Wrinkled skin in the groove between the halves is covered with dark smegma that can be peeled away.

Colostrum (first milk) is produced during the final part of pregnancy. The foal can absorb immunoglobulins (antibodies) in the colostrum produced by the mare within the first 8 to 12 hours after birth. Both the production of colostrum and its absorption taper off rapidly from birth to 12 hours.

The average-size mare produces from 9 to 11 qt. of milk daily. Milk fat in mare's milk is low (1.8% early to 1.4% late in lactation); lactose (milk sugar) is quite high (6.2% early to 6.5% later). These amounts are important when preparing a mare's milk substitute for an orphan foal. The orphan must be fed frequently - every 2 to 3 hours.



Figure 1

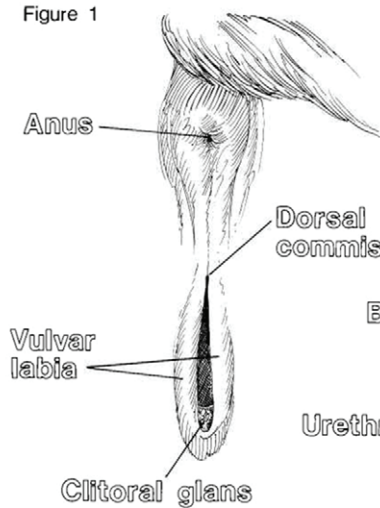


Figure 2

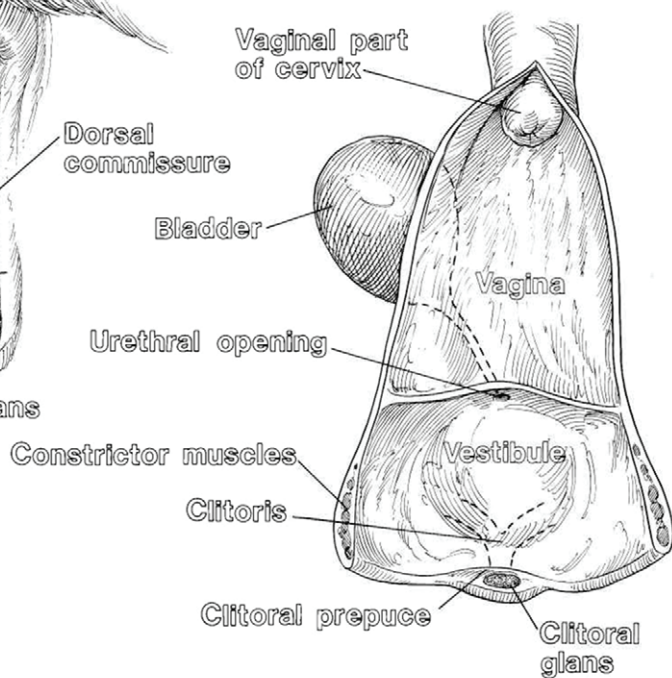
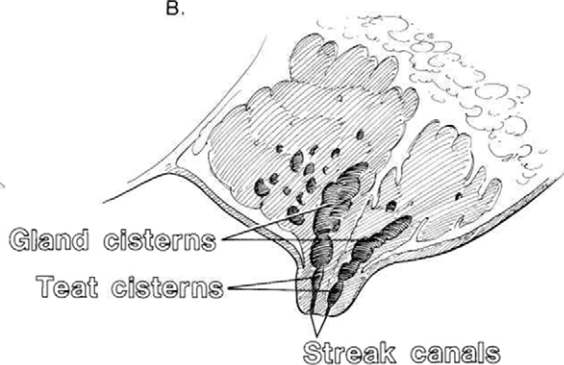


Figure 3

A.



B.



## UTERUS, UTERINE TUBES AND OVARIES

Figure 1. A. Dorsal view of isolated female reproductive organs. B. Enlarged view of **ovary** and **uterine tube**.

Figure 2. Frontolateral view of female reproductive organs and associated structures with intestinal mass removed.

The **uterus** consists of four parts - **cervix** (Latin for neck), **body** (Latin, corpus) and two **horns** (Latin, cornua). The cervix of the uterus protrudes into the vagina.

The mare's ovary has an indentation, the ovulation fossa. It is covered by the **infundibulum** (Latin, funnel) of the **uterine tube** (oviduct, salpinx, Fallopian tube). Ova (Latin for eggs) leave the ovary at the ovulation fossa, pass into the infundibulum and through the rest of the uterine tube to the **uterine horn**. Cilia (waving projections) on the lining cells and smooth muscle in the wall move ova through the uterine tube to the end of the uterine horn.

The **broad ligament** (mesovarium + mesosalpinx + mesometrium) is connecting peritoneum suspending the ovary, uterine tube and uterus. In the mare, the **uterine artery** is a branch of the external iliac artery. The **ovarian artery** arises directly from the aorta. It divides into ovarian and uterine branches. The Greek word, metra, means uterus (Latin). Endometrium is the lining of the uterus. Endometritis is inflammation of this lining. Metritis is inflammation of the entire uterine wall. Contagious equine metritis is caused by a bacterium that can be isolated from sinuses (depressions) in the clitoral glans. The reproductive tract of stallions is also affected. Horses imported from several countries are quarantined for this disease before being admitted to the United States.

Figure 1

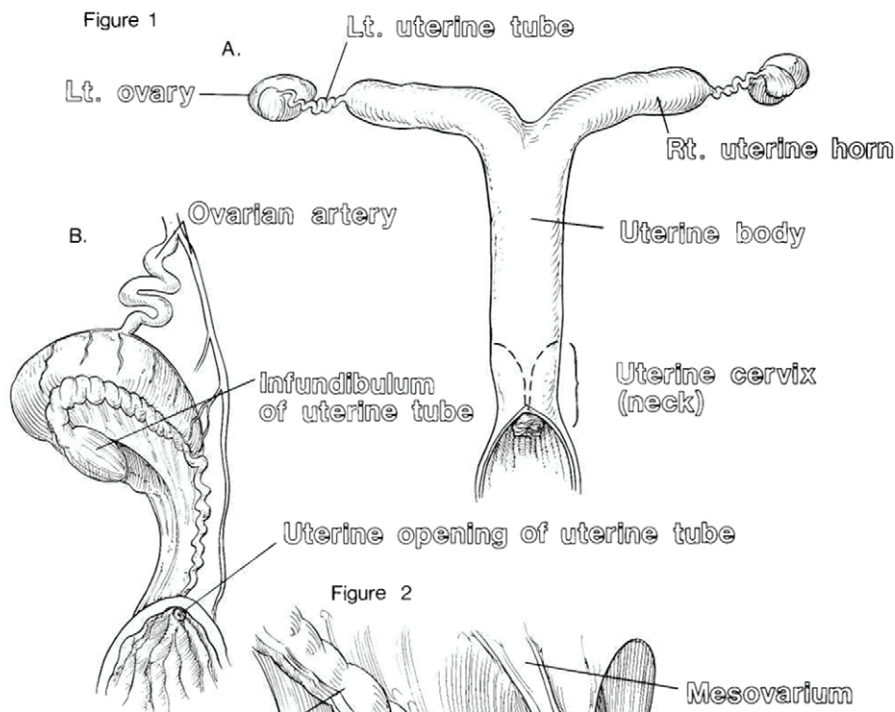
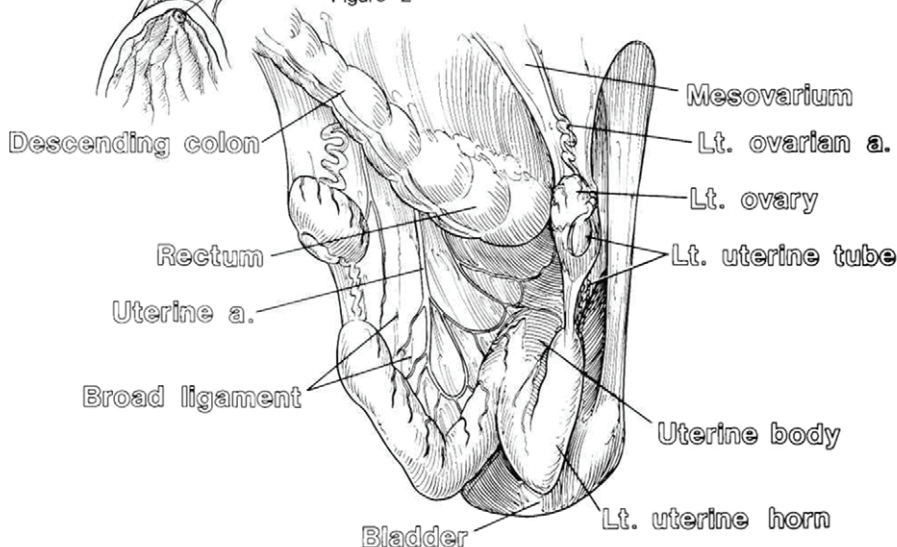


Figure 2



## OVARIAN CYCLE

Color the open words and the structures indicated and relate the notes on the drawing to the text below.

Estrous cycles are recurring periods of heat (estrus) when the mare will mate with a stallion. Mares are seasonally polyestrous. They have several estrous cycles during a breeding season that lasts from April to October in the Northern hemisphere.

Duration of each estrous cycle ranges from 19 to 22 days. Ponies and donkeys have longer estrous cycles - around 25 days.

Estrus (follicular phase) usually lasts 5 to 7 days, but periods of 2 to 12 days can occur. The length of estrus appears to be repeatable for individual mares.

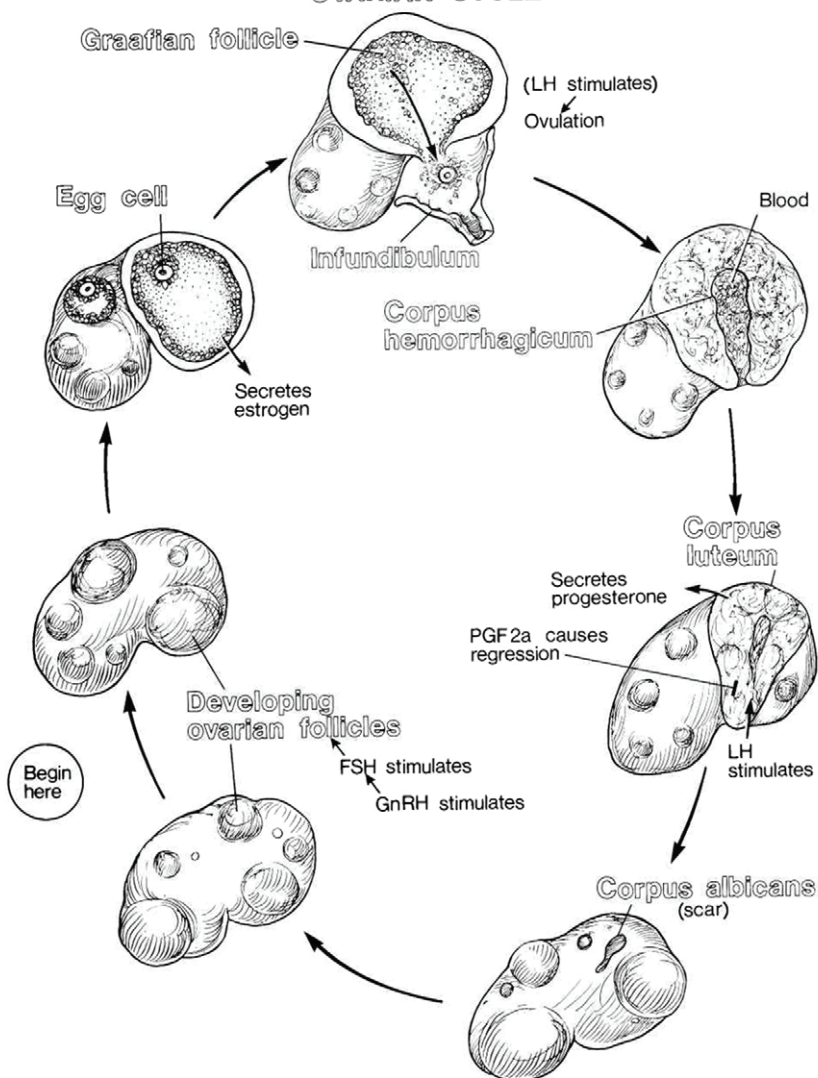
Ovulation (release of the egg cell) occurs 24 to 48 hours before the mare refuses to accept the stallion.

Diestrus (luteal phase) is the rest of the estrous cycle, lasting an average of 14 to 15 days.

Changes in behavior and in the functional anatomy of the reproductive tract during estrus and diestrus are stimulated by events in the **ovarian cycle**:

1. Initiation of estrous cycles is triggered by increasing periods of daylight stimulating the hypothalamus of the brain to secrete gonadotropin releasing hormone (GnRH). (Ovaries and testicles are gonads.)
2. GnRH causes secretion of follicle stimulating hormone (FSH) by the pituitary gland.
3. FSH stimulates the maturation of a **developing ovarian follicle** into a **Graafian follicle**, the source of the hormone, estrogen. FSH formation and release are decreased by inhibin produced by cells in the Graafian follicle.
4. Estrogen prepares the reproductive tract for mating and fertilization (union of the stallion's spermatozoon with the mare's ovum). Estrogen also stimulates the secretion of luteinizing hormone (LH) by the pituitary gland.
5. LH causes final development of the dominant Graafian follicle, ovulation (release of the egg cell), and formation of the **corpus luteum** (Latin, yellow body) (CL). The CL develops through the transformation of follicular cells in the site of the shortlived, bloody **corpus hemorrhagicum** that occurs in the follicle following ovulation.
6. Progesterone produced by the CL turns off sexual desire and prepares the reproductive tract for the embryo as it moves through the uterine tube to the uterus.
7. Prostaglandin F<sub>2a</sub> (PGF<sub>2a</sub>) produced by the uterus causes regression of the corpus luteum.
8. The **corpus albicans** (Latin, white body) is a scar at the site of the corpus luteum.

# OVARIAN CYCLE





## EQUINE EMBRYONIC AND FETAL MEMBRANES

Figure 1. Embryo and embryonic membranes on day 25 of pregnancy.

Figure 2. Embryo and embryonic membranes on day 36 of pregnancy.

Figure 3. Equine fetus and mature fetal membranes.

Inset: Detail of placental attachment.

E = embryo; F = fetus; arrows = growth of allantois.

In early pregnancy, the **yolk sac** from the midgut of the embryo forms the **yolk sac placenta** with the endometrium of the mare's uterus. As the **allantois** grows out from the hindgut and fuses with the **chorion** and **amnion**, the **allantoic cavity** fills with a larger volume of fluid than the fluid in the **amniotic cavity**.

Around day 36 of pregnancy, girdle cells from the **chorionic girdle** invade the endometrium. These cells multiply and transform into cup cells in placental outgrowths called **endometrial cups**. Cup cells secrete equine Chorionic Gonadotropin (eCG), a hormone that stimulates estrogen production by the corpus luteum. Growth and hormone production by fetal gonads may also be stimulated by eCG. Endometrial cups are most active from day 55 to day 65 of pregnancy. An immune response from the mare causes degeneration and sloughing of endometrial cups. They are gone by day 100 to day 130.

The horse has a diffuse, epitheliochorial, adeciduate placenta. Chorionic cells contact endometrial lining cells throughout the placenta (except in the **cervical star** opposite the internal opening of the cervix). When the placenta is expelled, there is no loss of maternal tissue and very little bleeding.

The **umbilical cord** contains two arteries, a vein and the urachus, a tube extending from the fetal bladder to the allantoic cavity. Blood vessels course throughout the allantochorion.

Fetal blood in capillaries in the tiny **microcotyledons** of the allantochorion is separated from maternal blood in capillaries in the endometrium by six layers of tissue.

**Hippomanes** are soft, brown or white floating masses of organic material and minerals deposited on some cellular debris in the allantoic fluid. They are normal features.



Figure 1

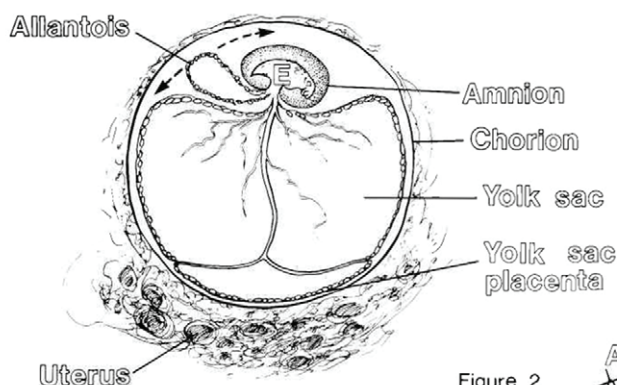


Figure 2

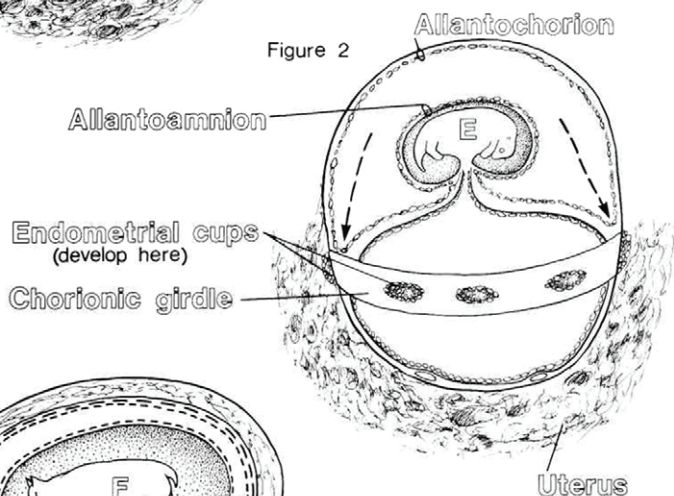
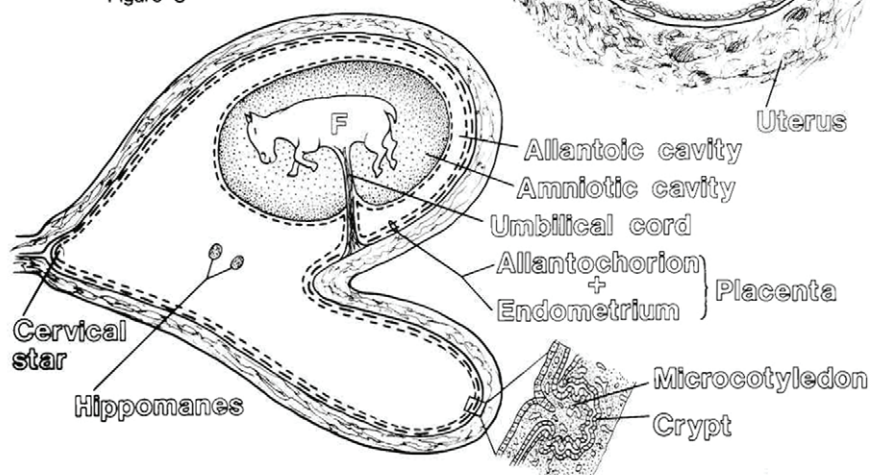


Figure 3



## STAGES OF PARTURITION

Figure 1. Signs of impending parturition.

Figure 2. Cranial presentation of foal during delivery.

Figure 3. Normal expelled placenta spread out on a flat surface.

Length of the gestation period (duration of pregnancy) in the mare: 335 to 342 days.

Extremes range from 305 to 400 days.

Signs of impending parturition, the process of giving birth:

1. Enlarged and dropped abdomen. Some ventral tissue fluid.
2. Sinking in at paralumbar fossa.
3. Relaxation and softening of muscles and ligaments adjacent to the tailhead. Softening of cervix and vulva.
4. Filling of udder with colostrum. Waxing of teats due to excessive secretion by oil glands at openings. Usually occurs around 48 hours before parturition.

Three stages of parturition:

### Stage I - Onset of labor

At first, foal is upside down (dorsopubic position).

Mare is restless - paces, lies down and gets up, sweats in patches as early as 4 hours before delivery.

No straining, but uterine muscular activity increases.

Foal rolls over to upright (dorsosacral position) with its head and forelimbs extended toward the cervix.

Cervix dilates until it is even with the vaginal wall.

### Stage II - Delivery of foal

"Water breaks" - Allantochoion ruptures and allantoic fluid passes through vulva. If intact allantochoion appears first, it should be broken at once.

Stretched tissues cause strong contractions of abdominal muscles and the diaphragm.

Allantoamnion appears. Mare lies on her side.

Groups of expulsive contractions occur. Mare may get up and change position.

One forelimb and then the other appear. Strongest contractions occur to force the head and shoulders through the mare's pelvic cavity. When the foal's hips clear the vagina, straining stops.

Time for Stage II: Around 20 minutes.

As short as 10 minutes; rarely as long as 60 minutes.

Following delivery, mare lies quietly for 10 to 15 minutes with foal's hindlimbs still in the vagina.

### Stage III - Expulsion of placental membranes

Uterine contractions continue. Walk a distressed mare.

Placental vessels collapse.

Allantochoion is turned inside-out and rolled down the uterine horns as microcotyledons are freed from endometrial crypts.

Time for Stage III: 1/2 hour to 3 hours after delivery.

Placental membranes spread out on a flat surface should be complete and have a normal velvety appearance due to the microcotyledons on the inside-out allantochoion.

Figure 1

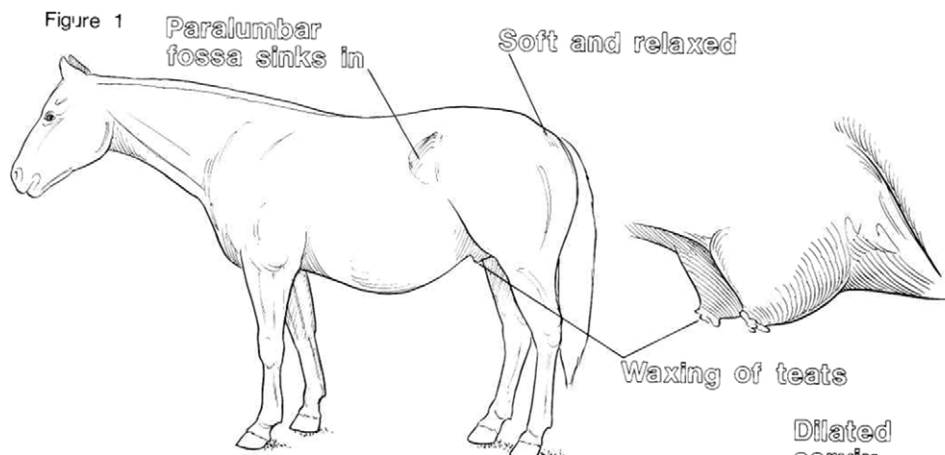


Figure 2

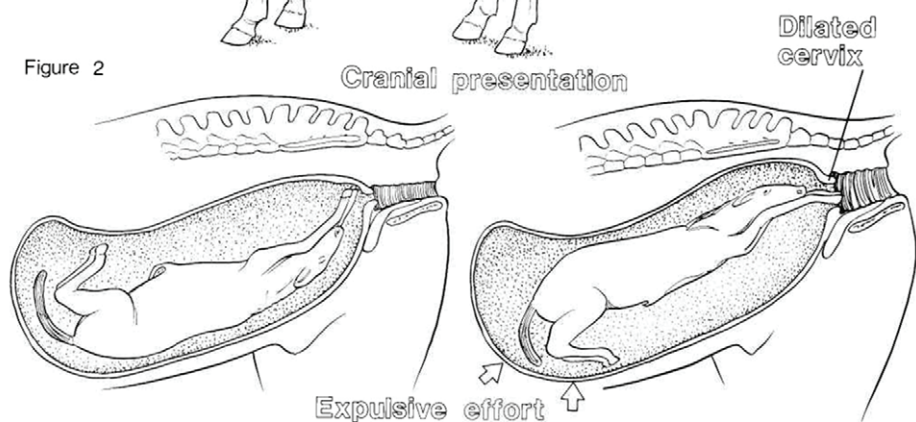
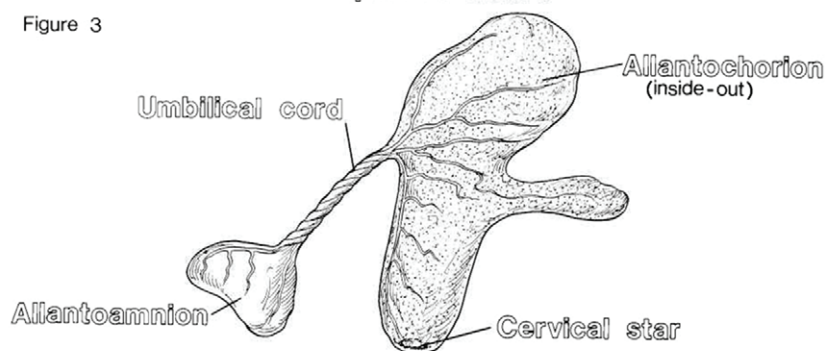


Figure 3



## MALE REPRODUCTIVE SYSTEM

### GENITAL ORGANS OF THE STALLION

Figure 1. Left lateral view of dissected male genital organs.

Figure 2. Diagrammatic drawing of the right testis and epididymis.

Spermatozoa (sperm cells) develop in **seminiferous tubules**, then pass through **straight tubules**, **rete tubules** and **efferent ducts** in the **head of the epididymis**. As spermatozoa pass through the **body of the epididymis**, they mature under the influence of secretions of the epithelium lining the epididymal duct. The **tail of the epididymis** and the first part of the **deferent duct** contain mature, motile spermatozoa with whip-like tails. The very muscular **deferent duct** continues from the tail of the epididymis up the **spermatic cord** through the inguinal canal, ending as the expanded **ampulla**. A cremaster muscle (detached from the internal abdominal oblique) covers the lateral aspect of each spermatic cord.

During ejaculation, each powerful deferent duct propels spermatozoa to the pelvic part of the **urethra** where they are joined by secretions from the ampullary glands, the **prostate gland** and the paired **seminal vesicles** and **bulbourethral glands**, forming semen.

Each **testis** (Latin), (English, testicle; Greek, orchid) is suspended by a fold of peritoneum, the mesorchium, and enclosed by its continuation, the **vaginal tunic**. Deep to the visceral part of the **vaginal tunic**, the dense fibrous connective tissue **tunica albuginea** and its internally projecting septa support the testis. The **scrotum** is a pouch of skin, smooth muscle, fascia and parietal vaginal tunic that contains the testicles. Smooth muscle in the scrotum and skeletal muscle of the external cremaster muscles assist in regulating the temperature of the testicles by raising and lowering them from the body wall. The left testicle is often larger than the right.



Figure 1

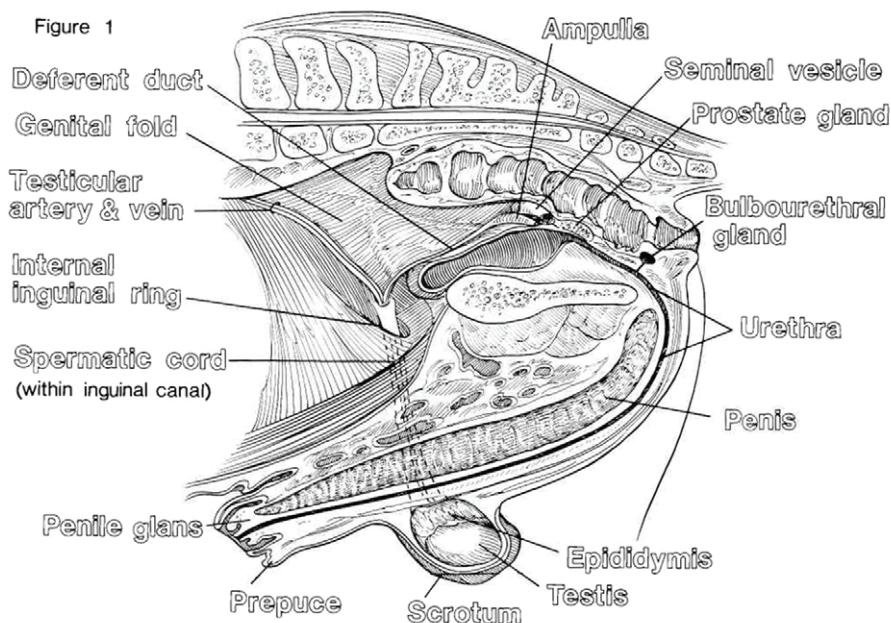
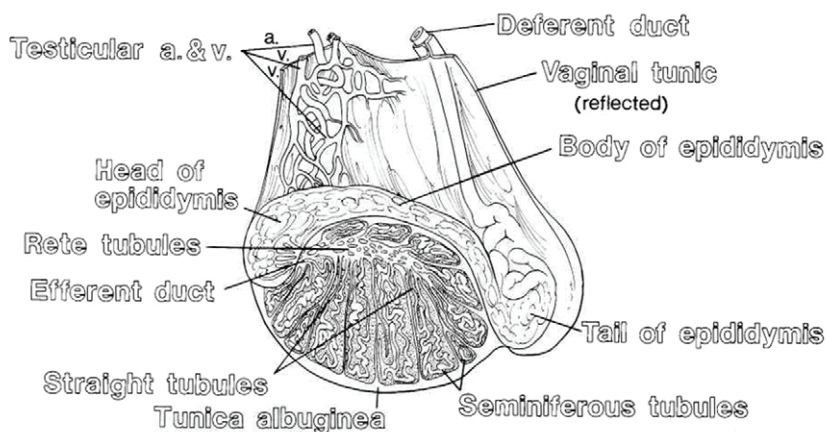


Figure 2



## ACCESSORY SEX GLANDS. PENIS AND PREPUCE

Figure 1. Dorsal view of accessory sex glands.

Figure 2. Right lateral view of dissected penis.

Figure 3. End of penis protruding from prepuce. **External part of prepuce cut.**

Dotted lines indicate the position of the **urethral sinus** dorsal to the **urethral process**.

- |  |                              |
|--|------------------------------|
| 1. Urethral muscle                               | 7. Obturator artery          |
| 2. Ischiocavernosus muscle                       | 8. External pudendal artery  |
| 3. Retractor muscles of penis<br>(smooth muscle) | 9. Cranial artery of penis   |
| 4. Bulbospongiosus muscle                        | 10. Middle artery of penis   |
| 5. Genital fold                                  | 11. Dorsal artery of penis   |
| 6. Bladder                                       | 12. Suspensory lig. of penis |
|  | 13. Urethral sinus           |

**Seminal vesicles** add the greatest volume of secretion to semen. They do not store sperm cells.

The non-haired skin of the preputial lining as far as the preputial fold contains many sebaceous (oil) and sweat glands. A "bean" of cheesy smegma and dead cells may fill the **urethral sinus**. Excessive accumulations of smegma should be washed away.

The stallion has a musculocavernous penis. The **cavernous body** (L., corpus cavernosum) continues caudad on each side into a crus that attaches to the ischiadic arch. Vascular spaces enclosed by connective tissue and smooth muscle occur within the cavernous body and the spongy body (L., corpus spongiosum) surrounding the urethra. These spaces fill with blood during erection of the penis.

The spongy body expands into the **glans penis**. Erection is brought about by relaxation of some small internal arteries, pumping action of the ischiocavernosus muscles, and pressure against veins returning blood from the penis. The penis protrudes stiffly during erection.

"Flaring" is an enlargement of the glans penis during erection with the **crown** reaching a large diameter. It is noticeable just after the stallion dismounts from breeding.

During urination, the penis extends loosely from the prepuce. **Retractor muscles** act to pull the penis into the prepuce.



Figure 1

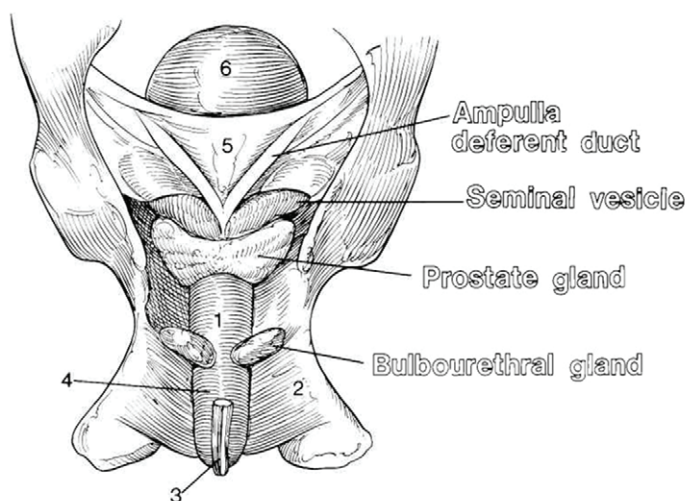


Figure 2

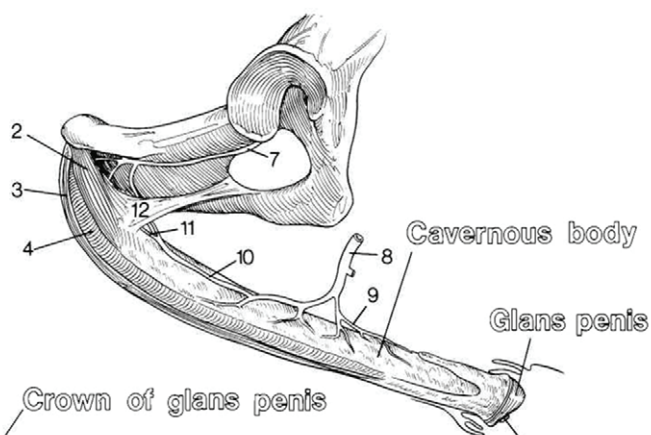
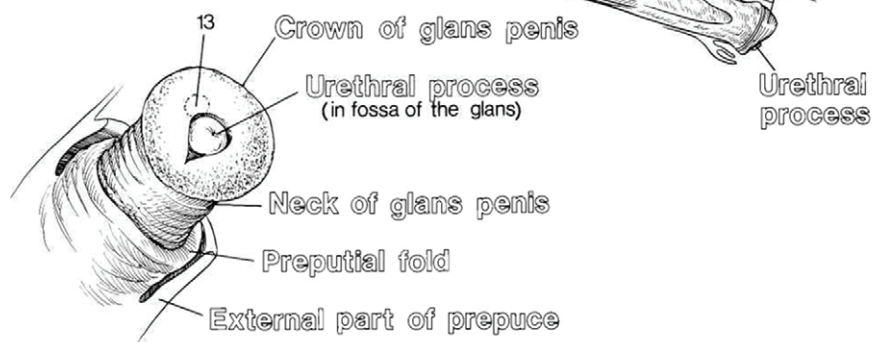
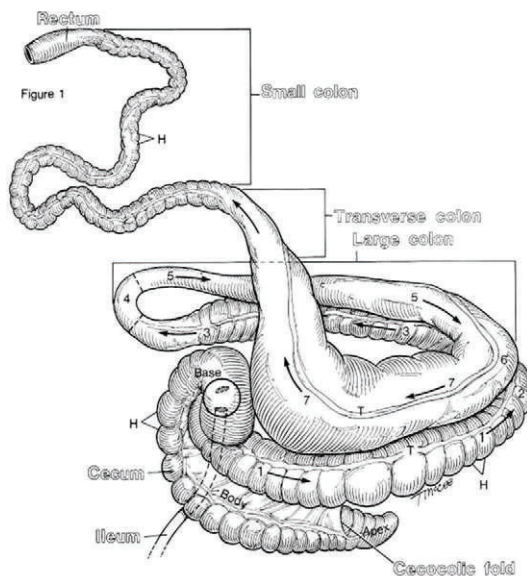


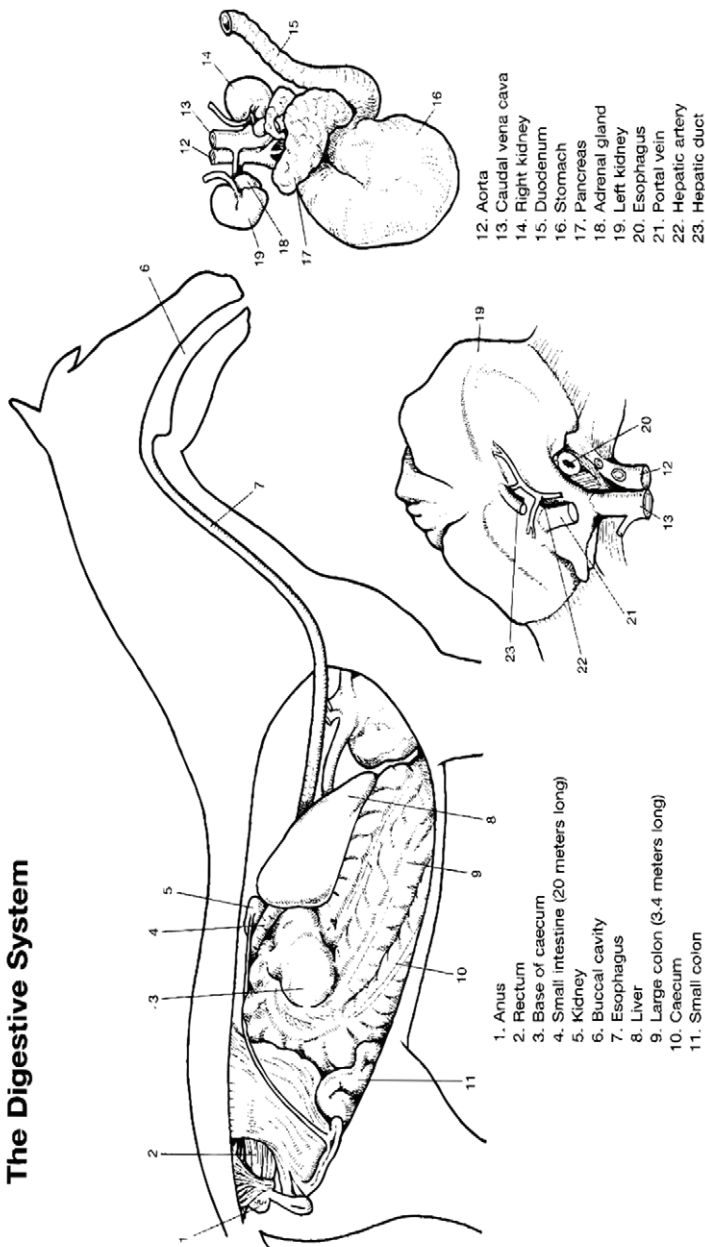
Figure 3



# The Digestive system



## The Digestive System



Most of the horse's internal organs work in the same way as those of other mammals, but the horse has three unique features in the digestive system which distinguish it from other mammals. These are (1) the greatest volume of the alimentary tract is at the rear, where the major digestive processes

take place; (2) the stomach is very small for the animal's size; and (3) there is no gall bladder. The reason for this is because the horse needs a constant supply of bile, as it is a continuous feeder.

## DIGESTIVE SYSTEM

### ORAL CAVITY, PHARYNX AND ESOPHAGUS

Figure 1. Right lateral view of a sagittal section of the head. **G.p.s. = Septum between the two guttural pouches**

Figure 2. Dorsal view of tongue and dissected pharynx. The dorsal wall of the **nasopharynx** is cut on the midline and each half pulled laterad. In a similar manner, the **soft palate** is cut and displaced. The free edge of the soft palate is continuous on each side with a **palatopharyngeal arch**. These arches unite over the entrance to the esophagus.

The **pharynx** is a musculomembranous chamber common to both the digestive and respiratory tracts. Its three parts are: oropharynx, nasopharynx and laryngopharynx. During breathing - the free edge of the soft palate is usually under the **epiglottis** and the laryngeal entrance is open.

During swallowing - Mylohyoid and hyoglossus muscles raise the tongue, pressing feed or water against the **hard palate**. The root of the tongue is pulled caudad, the laryngeal entrance is narrowed, the epiglottis is pulled over the entrance, and the long soft palate is elevated to the caudal wall of the pharynx. Increased pressure in the pharynx forces feed or water into the **esophagus** where automatic contractions carry material toward the stomach.

A variety of diseases can cause dorsal displacement of the soft palate, preventing its return to the normal breathing position.

**Vallate, foliate and fungiform papillae** contain taste buds.

**Filiform papillae** are longer on the root of the tongue.

The esophagus (not seen here) follows a course at first dorsal and then down the left face of the trachea, then dorsally on the trachea through the mediastinum (space between the lungs) and finally through the esophageal hiatus (passage) in the diaphragm and to the stomach. Its position in the left side of the neck may be seen during swallowing.

Figure 1

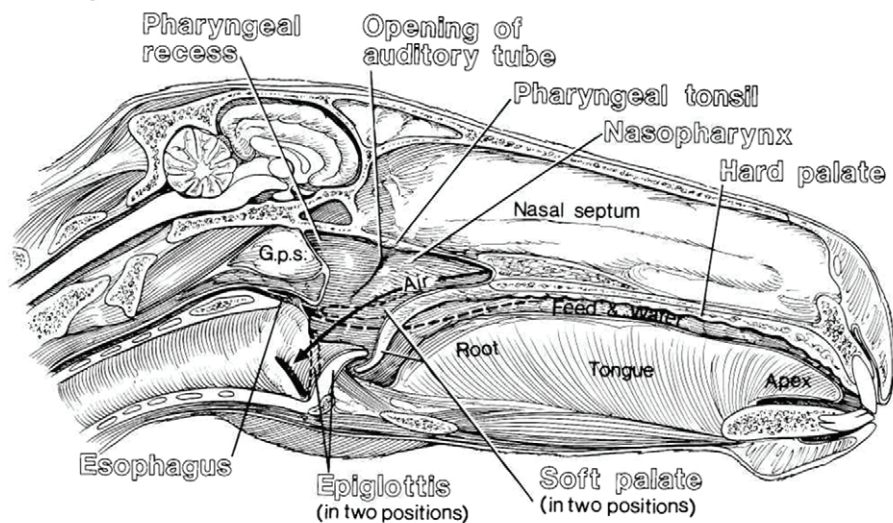
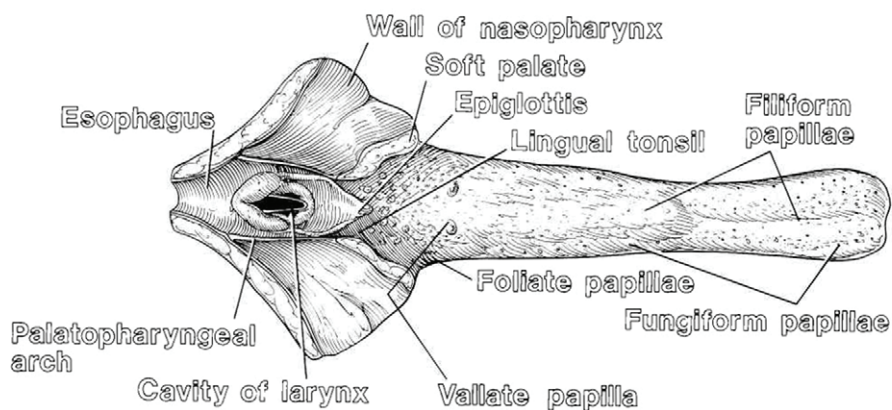


Figure 2





## STOMACH AND SMALL INTESTINE

Figure 1. Schematic drawing of the horse's stomach and small intestine viewed from the right.

- |                      |                    |   |
|----------------------|--------------------|---|
| 1. Esophagus         | 6. Cranial part    | } of<br>duodenum                        |
| 2. Cecal sac         | 7. Descending part |   |
| 3. Greater curvature | 8. Ascending part  |   |
| 4. Lesser curvature  |                    |   |
| 5. Pyloric antrum    | 9. Jejunum         | } Mesenteric part of<br>small intestine |
|                      | 10. Ileum          |   |

Figure 2. The inside of the stomach and cranial part of the duodenum. Regions of the mucous membrane.

The relatively small stomach of the horse varies considerably in size, shape and position. The parietal (wall) surface lies against the diaphragm and the liver; that part around the entrance of the esophagus is termed the cardia. The visceral (gut) surface faces the intestines and pancreas.

The **esophageal region** of the stomach's mucous membrane (lining) is like that of the esophagus. It lacks glands. The **cardiac gland region** and **pyloric gland region** contain mucous glands. Glands of the **fundic gland region** secrete hydrochloric acid and pepsin, a protein-digesting enzyme.

A pyloric sphincter muscle regulates the flow of stomach contents into the duodenum.

The bile duct and pancreatic duct empty at the **major duodenal papilla**; the accessory pancreatic duct, at the **minor duodenal papilla**.

The long, highly coiled small intestine averages around 70 feet in length.

Vomiting is very rare and inefficient in the horse apparently due to the tight caudal esophageal sphincter muscle. Acute distension of the stomach can cause rupture with or without vomiting.



Figure 1

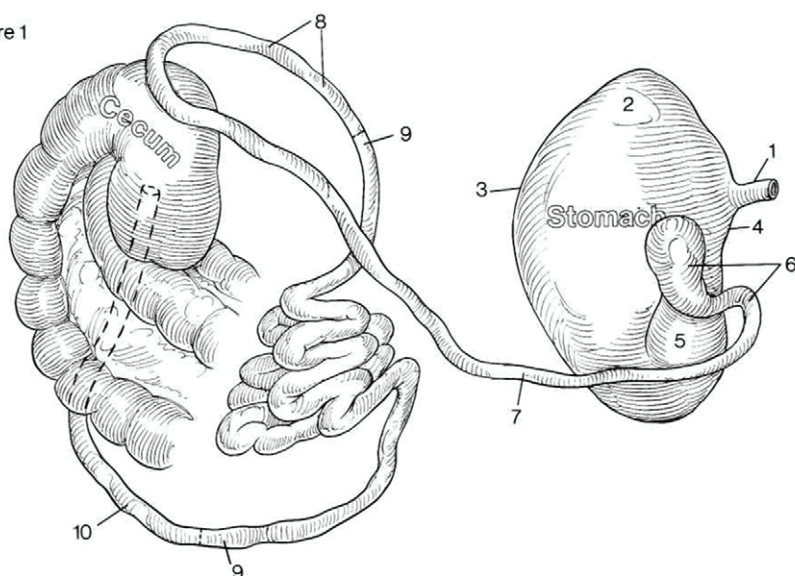


Figure 2

Esophageal  
region

Plicated  
margin

Cardiac  
gland  
region

Fundic  
gland  
region

Cardiac orifice

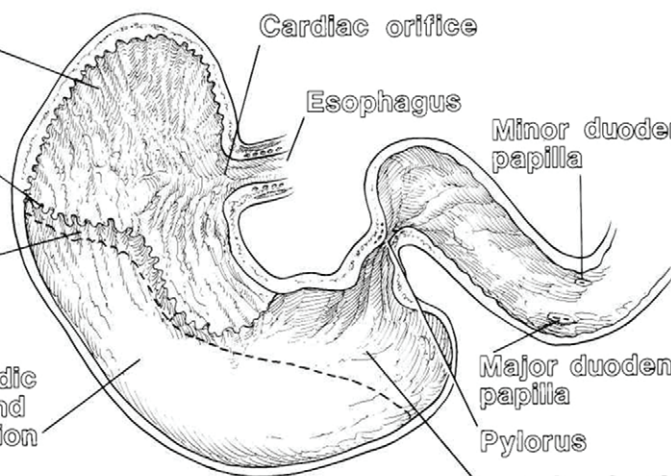
Esophagus

Minor duodenal  
papilla

Major duodenal  
papilla

Pylorus

Pyloric gland  
region



## LARGE INTESTINE

Figure 1. Schematic drawing of the isolated large intestine viewed from the right with parts slightly separated.

Identify the major parts of the large intestine.

Arrows indicate movement of ingested feed toward the rectum.

**Cecum** - receives the ileum, last part of the small intestine.

**Large (ascending) colon.**

1. Right ventral colon
2. Sternal flexure
3. Left ventral colon
4. Pelvic flexure
5. Left dorsal colon
6. Diaphragmatic flexure
7. Right dorsal colon

**Transverse colon** - narrows as it leads from the large colon to the small colon.

**Small (descending) colon** - more folded in the living horse.

**Rectum** - continues caudad from the brim of pelvis, ending at the anus.

**H = sacculations (haustra)** of the large intestine.

**T = longitudinal bands (taeniae coli)** consisting mainly of smooth muscle.

Figure 2. Openings (orifices) in the base of the cecum.

A **sphincter** of smooth muscle surrounds the **ileal orifice**, providing a valve-like action.

The **cecocolic orifice** leads into the right ventral colon.

Colic (abdominal pain) has many causes. Impaction (obstruction) by feed, meconium (a foal's first stool) or foreign bodies is one cause of colic. Impaction is most likely to occur where the intestine narrows: **ileal orifice**, **pelvic flexure** or beginning of the **transverse colon**.

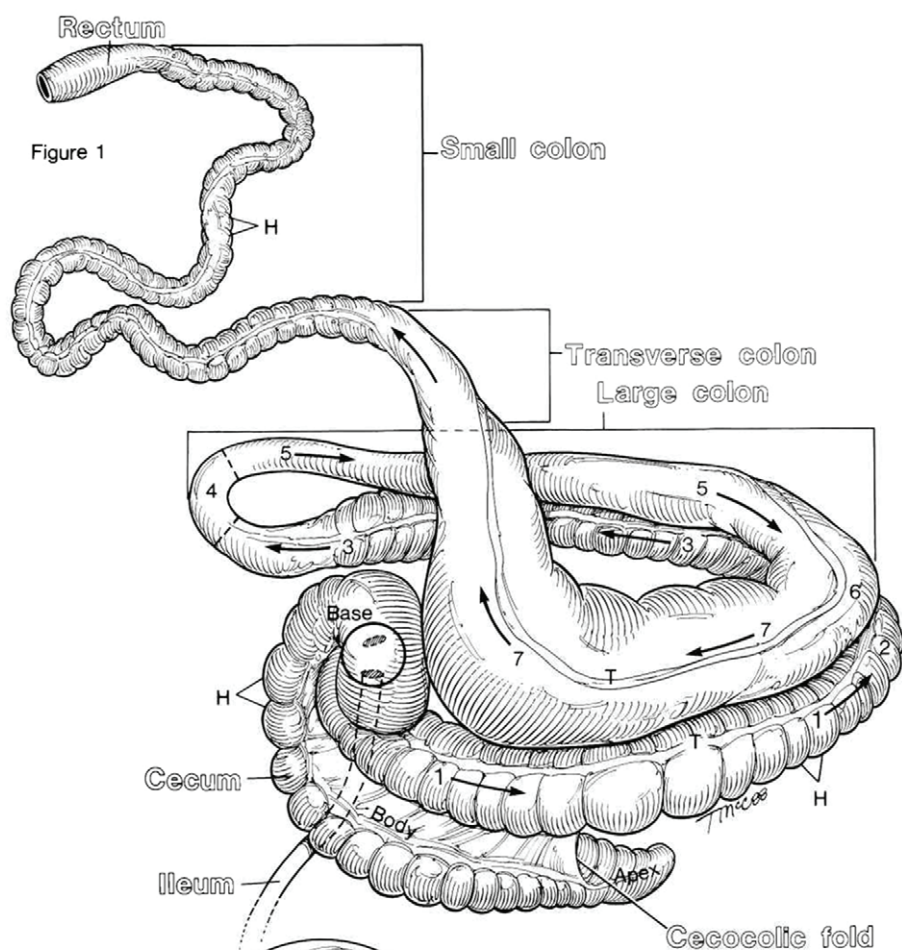
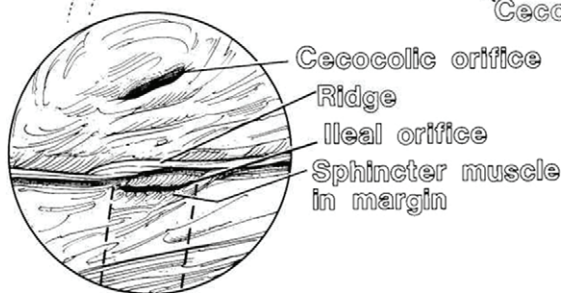


Figure 2



## RECTUM AND ANUS

Figure 1. Lateral dissection of pelvic wall deep to the broad sacrotuberal ligament.

Figure 2. Deeper lateral dissection of female pelvic cavity and caudal part of abdominal cavity.

Figure 3. Median section of female pelvic cavity and caudal part of abdominal cavity.

Figure 4. Caudal view of dissected anus and male perineum. Thermometer through anal canal into rectum.

- |  |                                 |
|--|---------------------------------|
| 1. Rectum  | 10. Urinary bladder             |
| 2. Coccygeus m.                                    | 11. Left horn of uterus         |
| 3. External anal sphincter m.                      | 12. Left ovary                  |
| 4. Anal levator m.                                 | 13. Left kidney                 |
| 5. Dorsal sacrocaudal muscles                      | 14. Termination of small colon  |
| 6. Rectococcygeus m.                               | 15. Narrow part of rectum       |
| 7. Retractor m. of clitoris<br>( of penis in male) | 16. Ampulla of rectum           |
| 8. Internal anal sphincter m.                      | 17. Anal canal                  |
| 9. Vagina  | 18. Ventral sacrocaudal muscles |
|  | 19. Right crus of root of penis |

Notice the relationships of the rectum to adjacent organs. Most of them may be palpated (felt) by a hand in the rectum.

The **rectococcygeus** and **internal anal sphincter muscles** are smooth muscle continuations of the muscular wall of the rectum. **Dorsal sacrocaudal muscles** act together to elevate the tail. **Anal levator muscles** reduce protrusion of the anus during the passage of feces (defecation). **Anal sphincter muscles** close the **anal canal**. **Coccygeus muscles** acting on each side with **ventral sacrocaudal muscles** depress the tail.

The horse's normal rectal temperature is from **99.5° to 101.5°F**. It is higher in the day than at night and higher in summer than in winter.

The perineum is the region between the tail and the ischiadic arch, especially between the anus and scrotum in the male and between the anus and vulva in the female.

Figure 1

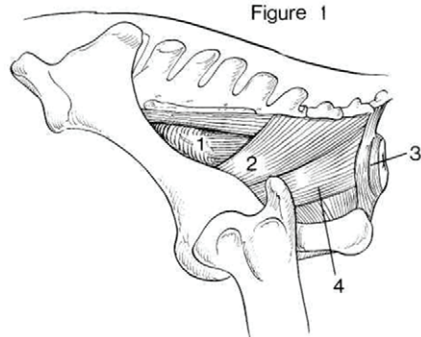


Figure 2

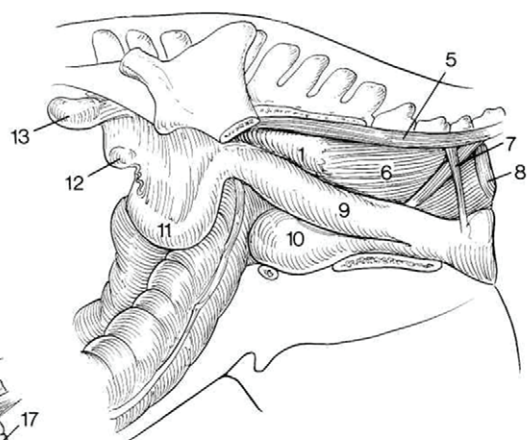


Figure 3

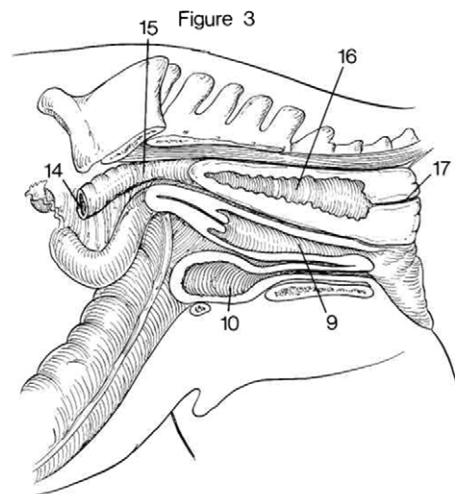
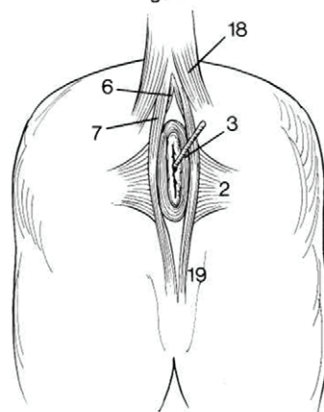


Figure 4





## LIVER AND PANCREAS

Figure 1. Diaphragmatic surface of horse's liver. Embalmed in place.

Figure 2. Visceral (gut) surface of same liver.

Figure 3. Ventral view of pancreas and related organs.

Identify the words and structures indicated on the drawings.

Peritoneal ligaments that support the liver:

1. **Right triangular ligament**

3. **Coronary ligament**

2. **Left triangular ligament**

4. **Falciform ligament**

The **liver** is the horse's largest gland with an average weight of 11 lb. Its secretion of bile is delivered directly to the **duodenum** by the **bile duct**, since the horse lacks a gall bladder for storing bile. In the intestine, bile aids in the digestion of fat by breaking large globules into small globules.

Two blood vessels supply the liver:

- 1) The **portal vein** carries blood from the intestines to the liver's sinusoids - spaces between sheets of liver cells.
- 2) The **hepatic artery's** branches supply needed nutrients, especially oxygen, to the liver's cells, eventually emptying into sinusoids.

Blood flows from sinusoids into branches of the **hepatic veins**. Hepatic veins empty into the **caudal vena cava**.

Nutrients and other substances (for example, toxins) absorbed from the intestines and carried to the liver by the portal vein are processed by liver cells.

The **pancreas** is two glands in one:

- 1) The exocrine part (secretion carried by pancreatic ducts to the duodenum) produces digestive enzymes.
- 2) The endocrine part (products secreted into the blood for transport to target tissues elsewhere) secretes the hormones, **insulin** and **glucagon**. These hormones are produced by specific cells in masses termed Islets of Langerhans. Insulin decreases blood sugar (glucose); glucagon mobilizes blood sugar.



Figure 1

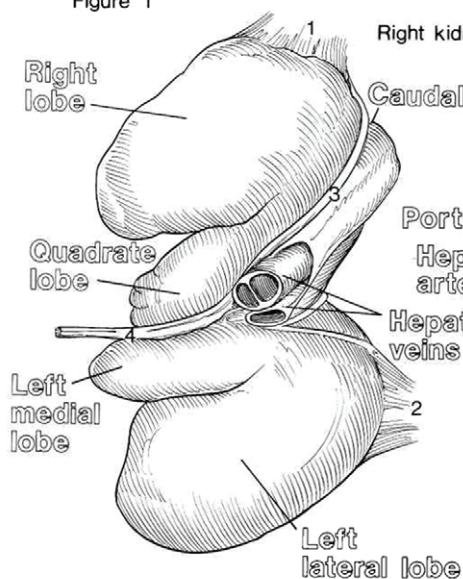


Figure 2

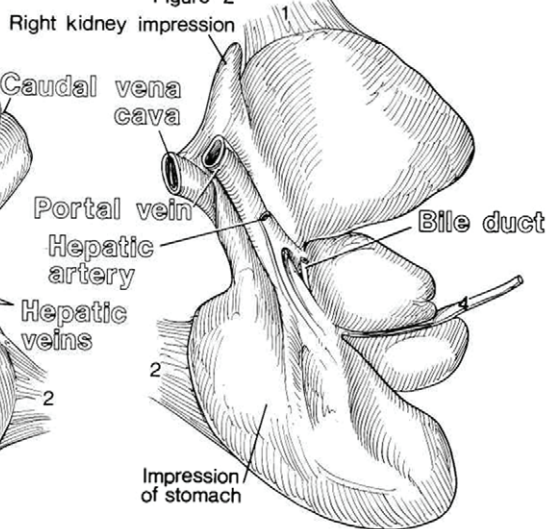
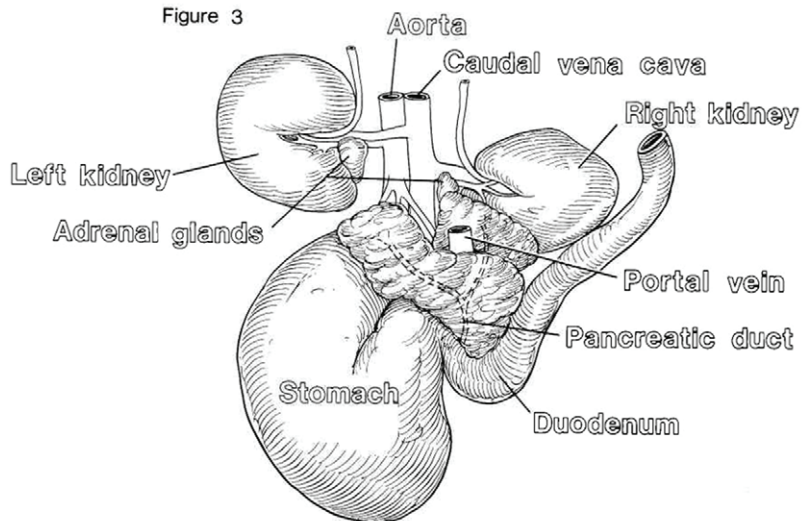
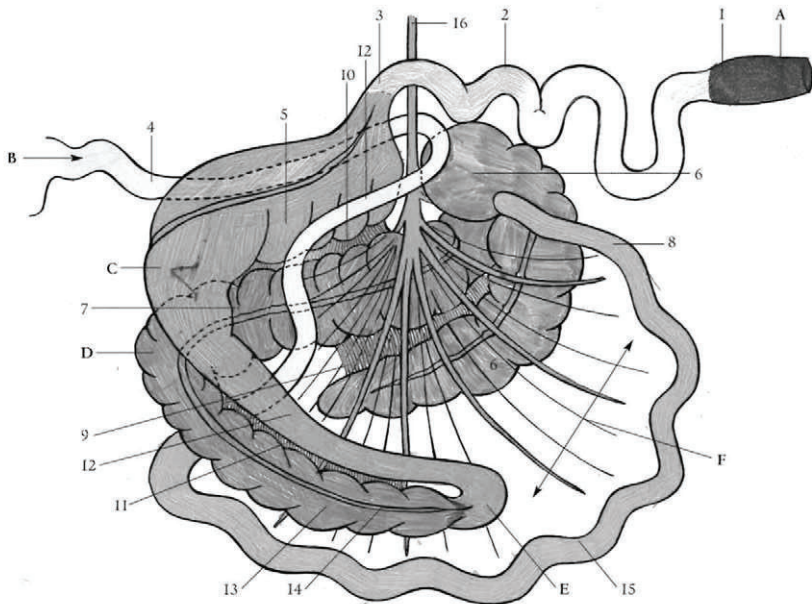


Figure 3



## GUT SCHEMA – Left Lateral View



Gut schema – left lateral view.

A – Anal canal

B – Stomach

C – Dorsal diaphragmatic flexure of colon

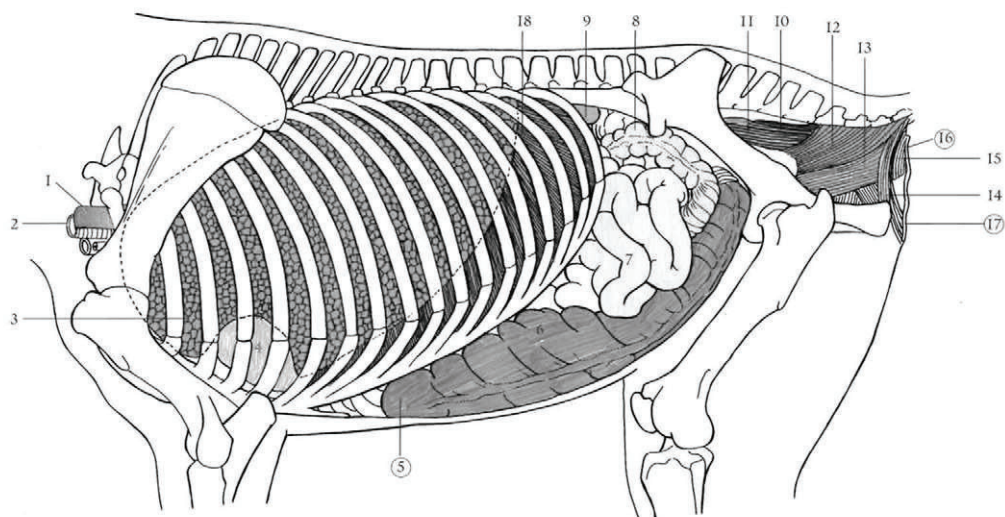
D – Ventral diaphragmatic flexure of colon

E – Pelvic flexure

F – Gastral mesentery

- |                                   |   |
|-----------------------------------|---|
| 1. Rectum                         | 10. Intercolic ligament connecting right dorsal and right ventral colon |
| 2. Small colon (descending colon) | 11. Intercolic ligament connecting left ventral and left dorsal colon   |
| 3. Transverse colon               | 12. Left dorsal colon   |
| 4. Descending duodenum            | 13. Left ventral colon  |
| 5. Right dorsal colon             | 14. Lateral free band of left ventral colon                             |
| 6. Caecum                         | 15. Coils of small intestine (mainly jejunum)                           |
| 7. Right ventral colon            | 16. Cranial mesenteric artery   |
| 8. Ileum                          |   |
| 9. Caecocolic ligament            |   |

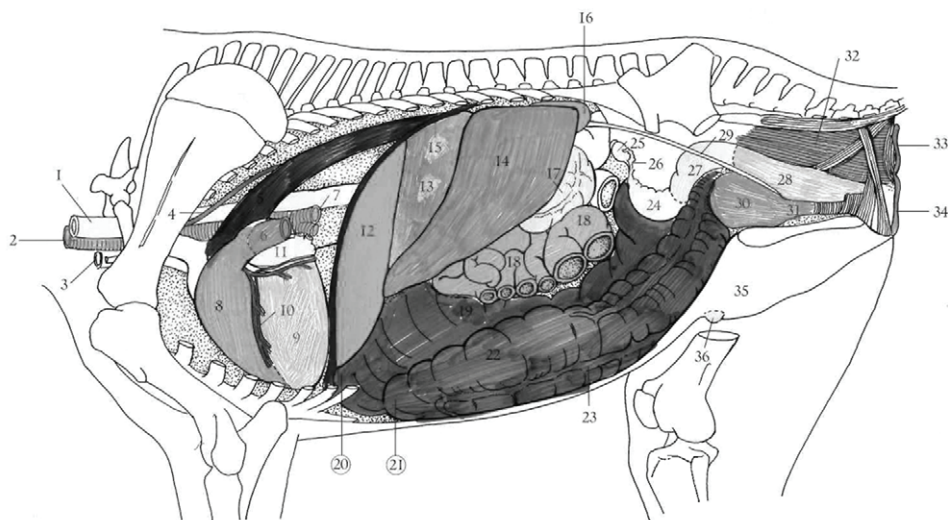
# THORACIC, ABDOMINAL AND PELVIC VISCERA OF THE MARE – Lateral Superficial View



Thoracic, abdominal and pelvic viscera of the mare – lateral superficial.

1. Oesophagus
2. Trachea
3. Left lung
4. Heart
5. Ventral diaphragmatic flexure of colon
6. Left ventral colon
7. Small intestine (jejunum)
8. Small colon or descending colon
9. Left kidney
10. Ventral sacrococcygeal muscle
11. Rectum (interpelvic part of small colon)
12. Coccygeal muscle
13. Levator ani muscle
14. Constrictor vulvae muscle
15. External anal sphincter muscle
16. Anus
17. Vulva
18. Costal muscle fibres of diaphragm

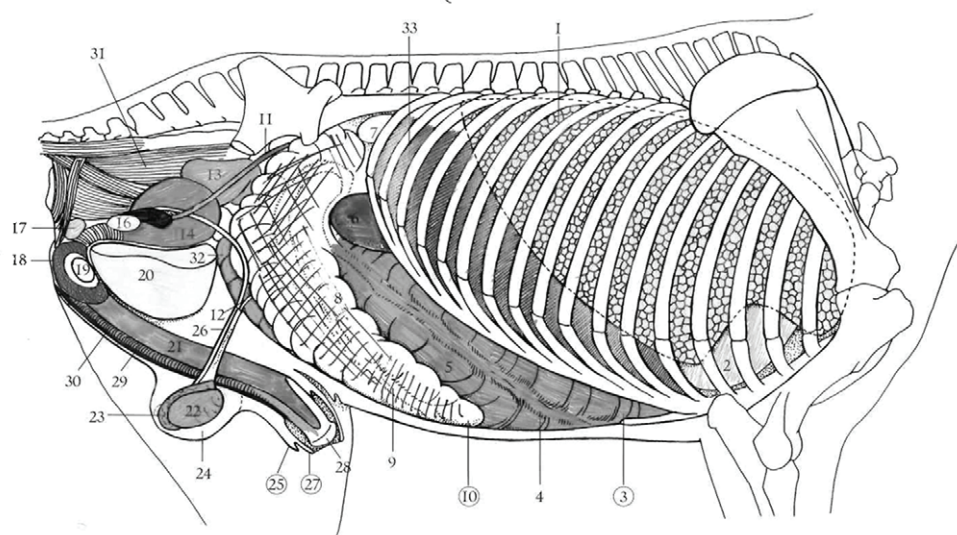
# THORACIC, ABDOMINAL AND PELVIC VISCERA OF THE MARE – Lateral Deep View



Thoracic, abdominal and pelvic viscera of the mare – lateral superficial.

- |   |   |
|---|---|
| 1. Oesophagus                             | 21. Ventral diaphragmatic flexure of colon      |
| 2. Trachea                                | 22. Left ventral colon                          |
| 3. Cranial vena cava                      | 23. Lateral free band of left ventral           |
| 4. Thoracic lymphatic duct                |   |
| 5. Aorta                                  | 24. Left uterine horn                           |
| 6. Pulmonary trunk                        | 25. Left ovary                                  |
| 7. Left bronchus                          | 26. Left fallopian tube                         |
| 8. Right ventricle                        | 27. Body of uterus                              |
| 9. Left ventricle                         | 28. Cervix                                      |
| 10. Coronary artery and vein              | 29. Left ureter                                 |
| 11. Left atrium                           | 30. Urinary bladder                             |
| 12. Liver                                 | 31. Urethra surrounded by the urethralis muscle |
| 13. Stomach                               |   |
| 14. Spleen                                | 32. Rectum                                      |
| 15. Diaphragm                             | 33. Anus  |
| 16. Left kidney                           | 34. Vulva                                       |
| 17. Small colon (descending colon)        | 35. Mammary gland (udder)                       |
| 18. Small intestine (jejunum)             | 36. Teat  |
| 19. Left dorsal colon                     |   |
| 20. Dorsal diaphragmatic flexure of colon |   |

# THORACIC, ABDOMINAL AND PELVIC VISCERA OF THE STALLION – Lateral Superficial View

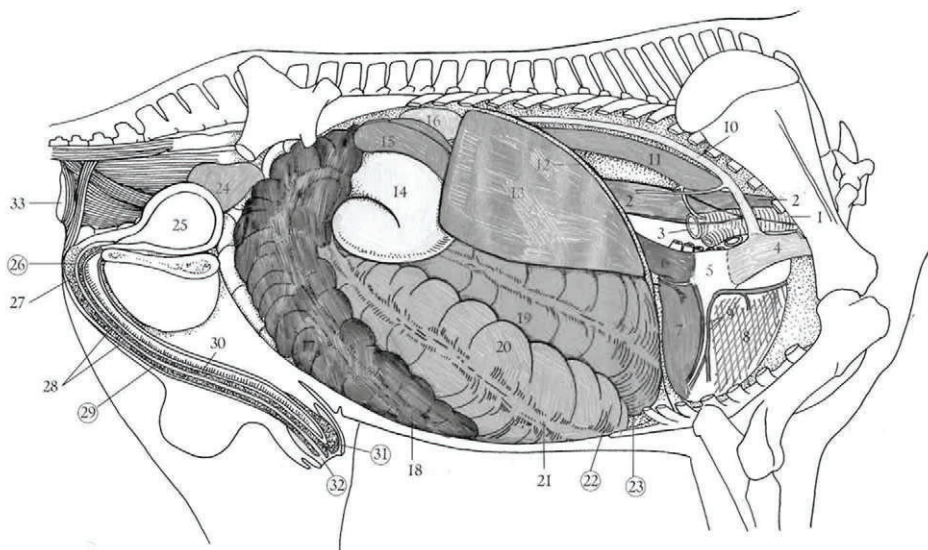


Thoracic, abdominal and pelvic viscera of the stallion – lateral superficial.

- |  |                                       |
|--|---------------------------------------|
| 1. Right lung                              | 19. Root of penis                     |
| 2. Heart                                   | 20. Gracilis muscle                   |
| 3. Ventral diaphragmatic flexure of colon  | 21. Body of penis                     |
| 4. Lateral free band of left ventral colon | 22. Right testicle, or testis         |
| 5. Right ventral colon                     | 23. Epididymis                        |
| 6. Base of caecum                          | 24. Scrotum                           |
| 7. Duodenum                                | 25. External fold of prepuce          |
| 8. Body of caecum                          | 26. Spermatocord                      |
| 9. Lateral caecum band                     | 27. Prepuce                           |
| 10. Apex of caecum                         | 28. Glans penis                       |
| 11. Right ureter                           | 29. Bulbospongiosus muscle            |
| 12. Vas deferens                           | 30. Retractor penis muscle            |
| 13. Pelvic flexure of colon                | 31. Rectum                            |
| 14. Urinary bladder                        | 32. Small intestine                   |
| 15. Seminal vesicle                        | 33. Costal muscle fibres of diaphragm |
| 16. Prostate gland                         |                                       |
| 17. Bulbourethral gland                    |                                       |
| 18. Ischiocavernosus muscle                |                                       |



## THORACIC, ABDOMINAL AND PELVIC VISCERA OF THE STALLION – Lateral Deep View



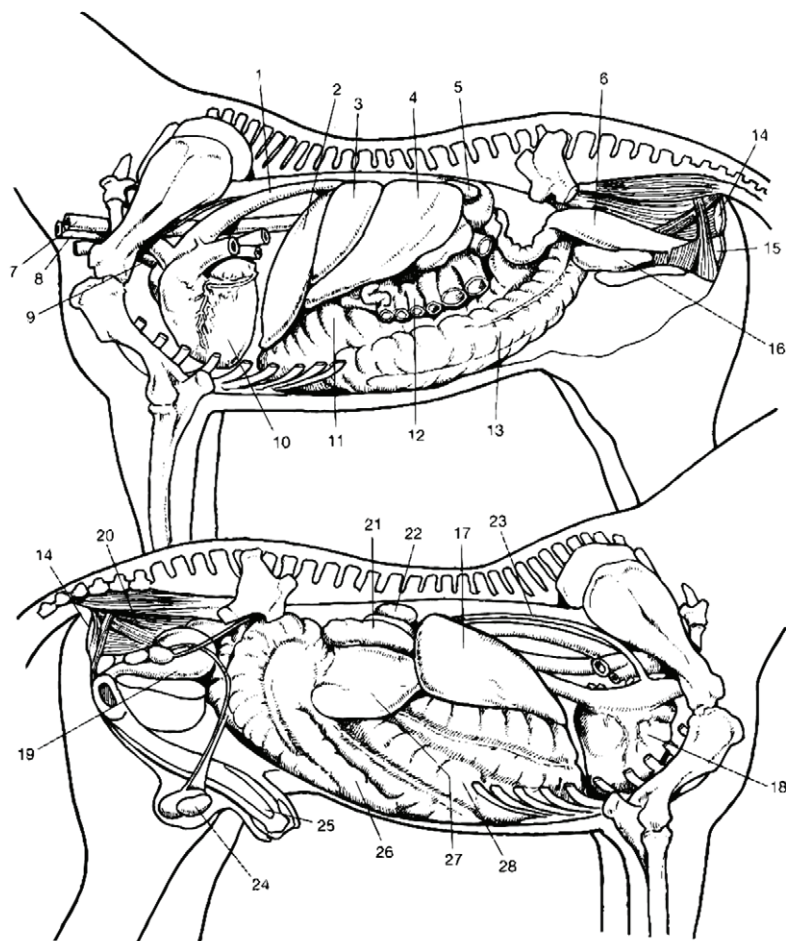
Thoracic, abdominal and pelvic viscera of the stallion – lateral deep view.

- |                             |   |
|-----------------------------|---|
| 1. Trachea                  | 20. Right ventral colon                         |
| 2. Oesophagus               | 21. Lateral free band of right ventral colon    |
| 3. Right bronchus           | 22. Ventral diaphragmatic flexure of colon      |
| 4. Cranial vena cava        | 23. Diaphragmatic flexure of right dorsal colon |
| 5. Right atrium             |   |
| 6. Caudal vena cava         | 24. Pelvic flexure of colon                     |
| 7. Left ventricle           | 25. Urinary bladder                             |
| 8. Right ventricle          | 26. Pelvic part of urethra                      |
| 9. Coronary artery and vein | 27. Bulb of penis                               |
| 10. Azygos vein             | 28. Spongy body of penis                        |
| 11. Aorta                   | 29. Penile urethra                              |
| 12. Diaphragm               | 30. Cavernous body of penis                     |
| 13. Right lobe of liver     | 31. Glans penis                                 |
| 14. Dorsal sac of caecum    | 32. External urethral orifice                   |
| 15. Descending duodenum     | 33. Anus  |
| 16. Right kidney            |   |
| 17. Body of caecal          |   |
| 18. Lateral caecal band     |   |
| 19. Right dorsal colon      |   |

# The Internal Organs of the Horse

Most of the horse's internal organs work in the same way as those of other mammals. The liver is the animal's largest organ, weighing an average of 11lbs. Its secretion of bile is delivered directly to the duodenum by the

bile duct, since the horse lacks a gall bladder for storing bile. The stomach of the horse is very small for the animal's size. The illustration shows the left side of a mare and the right side of a stallion.



1. Aorta
2. Left lobe of the liver
3. Stomach
4. Spleen
5. Left kidney
6. Body of the uterus
7. Esophagus
8. Trachea
9. Left vagus nerve
10. Left ventricle of the heart

11. Left dorsal colon
12. Small intestine
13. Left ventral colon
14. External anal sphincter
15. Vulva
16. Urinary bladder
17. Right lobe of liver
18. Right ventricle of heart
19. Urinary bladder
20. Rectum

21. Descending duodenum
22. Right kidney
23. Azygos vein
24. Right testicle
25. Body of penis
26. Lateral caecal band
27. Dorsal sac of caecum
28. Right ventral colon

