EQUINE ANATOMY

Instructional Outcomes:

• Demonstrate the ability to determine the age of a horse.

• Discuss the common blemishes found in horses.

• Identify the major or common body parts of the horse.

• Explain the procedure followed to correct a horse’s movement by trimming the hoof.

• Using a model of a joint, demonstrate flexion and extension.

• Describe the differences between cardiac and skeletal muscle.

• Differentiate between slow-twitch and fast-twitch muscle fibers.

• Identify the major bones of the equine forelimb and rearlimb.

• Determine the elastic deformation of bones.

• Determine a horse’s height and estimate its weight.

• Identify different types of equine tissue including bone, tendon, ligament, cartilage, and muscle.

• Identify and describe the procedure for shoeing and trimming a horse’s hoof to maintain its productivity.

• Analyze the stance of a horse to determine its correctness.

• Describe what is meant by body conformation and how it relates to form and function.

• Demonstrate the ability to select a horse based on conformation.
Equine Anatomy

The musculo-skeletal system of the horse is made up of muscles (musculo-), bones (skeletal), and the tissues that connect them and assist them in functioning. Two types of connecting tissues are ligaments and tendons. Tendons connect muscle to bone and are responsible for the movement of bone. Ligaments connect one bone to another bone and help make up a joint.

Joints are places within the skeleton where two or more bones join. Joints are important in the absorption of shock while the horse is in motion. Some general types of joints that exist in the horse are ball and socket, hinge, and fixed. The hip of the horse is a ball and socket joint. The top of the femur inserts into the pelvis allowing for a range of motion similar to that of the human hip. The elbow of the horse is a hinged joint. The elbow has a more limited range of motion than the hip. Fixed joints are different from all other types of joints as there is no movement at a fixed joint. The bones of the skull are joined together by fixed joints. The most important joint movements in the horse are flexion and extension. When a joint extends or opens (>180 degrees) it is termed extension. Conversely, flexion is when a joint closes or bends (<180 degrees).

Learning Activity

Use the diagram of the exploded view of the front leg to teach about extension and flexion in the horse’s hind leg. Provide a copy of the exploded view of the front leg to each student and have them cut out the four sections. Provide each student with a thumbtack to be used as the tendons that hold the joint together. The two sections with tabs (marked as dotted lines) are placed under the section that they are connected to. The femur goes on top of the scapula. Place the thumbtacks through the black circle on the end of each section and bend the needle part down so the thumbtack will stay in place. Students will have a model that demonstrates how joints flex and extend.

Bones only move because muscles move. Muscle is the most predominant tissue type in the body of a horse. There are three general types of muscle: cardiac, smooth, and skeletal.

The heart is the only source of cardiac muscle in the horse. Cardiac muscle is an involuntary muscle as it performs its duties without any conscious thought by the horse. This type of muscle allows the horse to live without having to worry about making its heart beat. Another type of involuntary muscle is smooth muscle. An example of smooth muscle is in the gastrointestinal tract. Skeletal or striated
Exploded View of Equine Forelimb

Converging arrows indicate angles of flexion for the joints depicted
muscle is the third type of muscle. A horse uses skeletal muscle any time it moves its head, legs, or chews food. Skeletal muscle is called voluntary skeletal muscle because it requires the horse to consciously choose to make those muscles move.

Suggested Activity

To show the difference between cardiac and skeletal muscle, purchase beef heart and some cut of steak for students to observe. Have students prepare cross sections of the two types of muscle under the dissecting microscope. Have them hypothesize what the predominant type of muscle fiber is in the steak.

All three muscle types are composed of different fibers. These different fibers control the movement and function of the muscle. As the fibers shorten, the muscle contracts and when the fibers lengthen the muscle relaxes. Skeletal muscle fibers are further divided into two special types: slow-twitch and fast-twitch. Slow-twitch fibers are fibers that do not tire easily. These fibers are used for long periods of standing, grazing or sleeping. Fast-twitch fibers tire much more rapidly and are used during short periods of hard work or fast running. Different breeds of horses have different amounts of each of these fibers. This helps explain why different breeds are suited to different activities. For example, American Quarter Horses have more fast-twitch fibers and are generally better suited to short bursts of intense activity such as quarter-mile races than Arabians who have a higher percentage of slow-twitch fibers and are generally better suited for endurance events.

The skeleton of the horse provides support, protection, and gives the horse its shape. Two major divisions of the skeletal system are the axial skeleton and the appendicular skeleton. The axial skeleton encompasses the skull, spine and ribs, while the limbs are the sole component of the appendicular skeleton. The bones that make up the skeleton come in many different shapes and sizes and can be grouped into four basic categories: irregular, flat, short, and long bones. An example of a flat bone is a rib. Ribs are important because they protect the lungs and heart. Horses have more ribs than most other species to protect their large lungs (the lung volume of the horse enhances its athletic ability). The backbones (vertebrae) are good examples of irregular bones, so named because of their irregular shape. Vertebrae are important to the protection of the spinal cord, which, in addition to the brain, composes the horse’s central nervous system. The pastern bone (phalanx) is an example of a short bone, and the cannon bone is an example of a long bone.
Laboratory
Bone as a Spring

Activity adapted from Fish, F. E. (1993). How-To-Do-It: Bone as a Spring. The American Biology Teacher, 55, 495-496. Used with permission from the National Association of Biology Teachers.

Introduction

Bones and tendons, such as the tibia and deep flexor tendon, help comprise the skeleton. Besides skeletal support, bones and tendons function in movement through joints, as shock absorbers, for protection of vital organs, in force transmission, and as a spring. Bones and tendons display a number of properties including rigidity, flexibility, and elasticity. An advantage of elasticity is that energy can be stored in deformation and recovered during recoil. Horses use this energy recovered from elastic deformation for rapid acceleration and for efficient movement. The “wishbone” of uncooked chickens can be used to demonstrate the spring-like properties of bone.

Objective

Given a chicken furcula (“wishbone”), students will be able to determine the amount of energy used to deform the “wishbone” that is recovered in elastic recoil of the furcula.

Materials

For each group of two to three students:

• 1 furcula from an uncooked chicken (keep refrigerated)
• 1 dissecting needle
• 1 ring stand
• 1 pan to hold weights
• 1 caliper
• 10 0.2 kilogram weights

Anticipated Outcomes

Have students hypothesize possible results. One possible hypothesis is the wishbone will return to its original shape.
Procedures

1. Make small marks on the tips of the shafts of the furcula with a pencil or dissecting needle to be used as reference points to measure the deformation of the bone.

2. Tie one end of the bone to the ring stand and tie a string to the other end to hold a pan for the weights.

3. Using calipers measure the initial distance between the two reference marks. Record the measurement.

4. Loading: Add a 0.2 kg weight and measure the distance between the reference marks again. Add additional weights to the pan while measuring the distance after each addition of weight. Record each observation. (limit the total amount of mass so that the distance between the marks is no greater than 120% of the initial distance — e.g., if initial was 2.5 centimeters do not exceed 3 centimeters)

5. Unloading: Reverse the procedure measuring the distance between the reference marks after removing each weight.

Results

Make a plot of the force as a function of the deformation of the furcula. The y axis is force, in newtons (kg\(\cdot\)m\(\cdot\)s\(^{-2}\)), which is computed as the mass in kilograms times the gravitational acceleration (9.80 m\(\cdot\)s\(^{-2}\)). The x axis is deformation, in meters, which is the distance between reference marks minus the initial distance. The two curves for loading and unloading will not be the same and consequently will form a loop. This loop is termed hysteresis. The narrower the loop, the more springlike the furcula. The difference between the work of loading and unloading the furcula is the energy lost to heat.

Ideas for Other Laboratories

- Substitute a small wire spring and compare the results to the furcula.
- Use a cooked furcula instead of a raw one.
- Use a hydraulic press to determine the elastic deformation and breaking point of ribs obtained from the meat counter. (SAFETY NOTE: Be sure that there are shields in place on the press and that students are wearing eye protection)
- Soak ribs in vinegar for up to two weeks to remove the calcification to demonstrate how calcium adds strength and rigidity to bones.
Suggested Activity

Have students identify the major parts of the horse. Use a handout with the landmark features numbered and have students fill in the appropriate names.

The Head

The skull of the horse is made up of many flat bones. The main function of the skull is to house and protect the brain and eyes. Because horses don’t have hands to get food into their mouth, they use their lips. Horses have excellent control over their lips, and can easily select grasses and other feedstuffs.

A horse’s teeth are hypsodont and are unique to the horse. A horse’s age can be estimated by looking at its teeth (“mouthing”) because of their uniqueness. Baby (deciduous) teeth are acquired approximately eight days following birth and are called first incisors. The second set of baby incisors appears by around eight weeks of age, and the third and final set of baby incisors are acquired by age eight months. At two and a half years, the first set of baby incisors is being pushed out by the first pair of permanent incisors. The second sets of permanent incisors replace their respective baby teeth at three and a half years. By age four and a half, all deciduous incisors have been replaced with permanent incisors.

After age five, a horse is aged through close inspection of the teeth. As the horse’s incisors wear down, the center of the incisor loses its “cup”. With wear the “cups” turn into stars that finally totally wear away by the time the horse turns 10 years old. Older horses will have more wear on their teeth due to a longer period of usage. At age 10, a groove appears on the upper third incisor. The groove (Galvayne’s groove) continues to extend down the tooth for the next 10 years. At age 15, it is halfway down the tooth and at age 20, it is completely down. Then the Galvayne’s groove begins making its way back up the tooth. At age 25, the groove is halfway up the tooth and by age 30, it completely disappears from the tooth.

Behind the third set of incisors, there is a gap where no teeth exist (interdental space). This gap is important because it is where the bit is placed. Further back from this space are two sets of teeth. The six sets of premolars and molars compose the cheek teeth. In some horses, there are special upper premolars known as wolf teeth. Premolars and molars are not generally utilized in the aging of the horse simply because they are too difficult to see.
Learning Activity

Visit a local stable, breeding farm, or school horse lab where there are a number of different age horses. Have students determine the horses' age by mouthing them. Be sure to obtain records of the horses' actual age. Slides of horse mouths or copies of teeth from books could be substituted. Be sure to have students check horses for overbite and underbite when they are mouthing the horse. Emphasize the importance of being able to estimate a horse's age by mouthing in terms of purchasing a horse.

The Eye

Many differences exist between the eye of a human and the eye of a horse. A horse's eyes are oval instead of round. Unlike a human, each eye of the horse focuses separately of the other eye. As a result a horse's vision is usually monocular compared to the binocular vision of humans. The eyes of a horse are also set differently than those of a person. Because the horse's eyes are more on the side of its head, its vision greatly differs from ours. The horse's peripheral vision is greatly increased, but its depth perception suffers due to this conformation. An approaching person appears to be far away one moment, then instantly appears right beside the horse. The position of the head is vital to the accuracy of the vision of the horse. The horse cannot see the end of its muzzle nor can it see directly behind itself. The horse has color vision to some degree, but it is far less discerning than that of a human. Problems that commonly afflict the horse's eyesight are ulcers, cataracts, and uveitis. Ulcers occur when cells on the outer layer of the eye are abraded or infected. Cataracts occur when the lens of the eye becomes clouded, and uveitis is an inflammation of the area that brings the supply of blood into the eye (uveal tract). Uveitis is also known as moon blindness.

The Spine

The spine runs from the skull to the tail of the horse, and is composed of irregular bones known as vertebrae. Vertebrae serve as points of muscle attachment and as a protective barrier to the spinal cord. The spinal cord exits the brain through the base of the skull, and supplies motor and sensor perception to the entire body of the horse. Sensory nerves are responsible for carrying messages to the brain for such senses as touch, taste, hearing, smell, and sight. These messages reach the brain and a response is sent through the motor nerves to the area from which the original message was sent. There are 51 - 57 vertebrae in the spine of the horse, 15 - 21 of which compose the tail.
Equine Skeleton

Illustration courtesy of the American Association of Equine Practitioners.
Learning Activity


Bring in one or more horses for an external anatomy laboratory. Have students work in groups to identify the major parts of a horse. Students should determine their horse's height and weight.

Height is determined by measuring the distance from the highest point of the withers to the ground. The horse should be standing on a smooth, level surface when measured. A straight, stiff, unbendable stick fitted with a cross piece at a ninety degree angle should be used as a standard. The standard should be fitted with a plumb bob or spirit level to make sure the standard is perpendicular from the withers to the ground and that the cross piece is parallel with the ground surface.

\[
\text{Height (hands)} = \frac{\text{Distance from withers to ground (inches)}}{4}
\]

Weight of a horse can be estimated by measuring the heart girth (A) (inches) and measuring the body length (B) from point of shoulder to point of buttock (inches).

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\text{Estimated Weight (pounds)} = \frac{\text{Heart Girth}^2 \times \text{Length}}{330}
\]

Illustration courtesy of the American Quarter Horse Association.
Equine Structure

[Diagram of horse with labeled parts such as forehead, poll, crest, point of hip, back, loin, croup, buttock, shoulder, barrel, neck, girth, abdomen, stifle joint, gaskin, hock, cannon, ankle, pastern, coronet, hoof, arm, elbow, forearm, knee, upper lip, lower lip, underlip, throat latch, bridge of nose, nostril, muzzle, upper lip, lower lip, underlip, point of shoulder, chest, point of shoulder, chest, arm, elbow, forearm, knee, hoof, withers, back, loin, croup, buttock, abdomen, stifle joint, gaskin, hock, cannon, ankle, pastern, coronet]

Illustration courtesy of the American Quarter Horse Association.
Equine Structure

Illustration courtesy of the American Quarter Horse Association.
Limbs

The limbs or legs of horses are similar to those of a human. The front leg is comparable to the human arm while the rear leg is similar to the human leg. The shoulder blade (scapula), is attached to the axial skeleton by many large muscles. The shoulder blade connects with the upper arm (humerus) to form the shoulder joint. The lower (distal) end of the humerus connects with the two lower arm bones (radius and ulna) to form the elbow joint. Unlike many animals the radius and ulna are connected in the horse, with the ulna forming the point of the elbow. The distal ends of these two bones help form what would be the wrist joint in a human but is the horse's knee. Horses' knees are actually made up of three separate joints which include two rows of small bones called carpal or cuboidal bones. As we continue down, the bones found in a person's palm compose the horse's shin (cannon) bone. On both sides of the cannon bone there are two small bones known as splint bones (metacarpals). Although these bones serve little function, they are important because they are a common site of injury. The cannon bone meets with the long pastern to form the fetlock joint. There are two small bones in the back of the fetlock joint called sesamoids. The long pastern meets with the short pastern bone to form the pastern joint. The last joint on the front limb of the horse is called the coffin joint. This joint is composed of the short pastern and the coffin bone. The horse has evolved so that its digits or fingers have moved from their original positions. Our thumb and pinky finger are not present in the horse. The bones in our palm that attach to our ring and pointer fingers have become the horse's splint bones. Our middle finger has three bones that represent the horse's bones from the long pastern down to the coffin bone. This means that the foreleg of the horse is comparable to our middle finger.

The hind leg is also structurally similar to the leg of a human being. The hip joint, is formed by the pelvis and upper leg bone, the femur. At the distal end of the femur is the kneecap (patella) the tibia and the fibula. The tibia is very large but the fibula is small. The tibia joins with the tarsal bones to form the hock joint. The horse's hock is comparable to the human ankle. As we continue down, the bones that appear to be the shins of the horse are the same bones found in the human foot. As in the front leg, this bone is known as the cannon bone, and is flanked by two splint bones. The structure of the bones and joints of the hind limb below the hock are identical to those of the front limbs below the knee. An interesting note about the anatomy of a horse is that very few muscles exist below the carpal and tarsal bones. These areas are dominated by tendons and ligaments. While ligaments attach bone to bone, tendons attach muscle to bone, and allow the horse to move when muscles contract and relax. For the horse to move efficiently, the tendons have built-in pulleys known as sesamoid bones. Sesamoid bones are irregular bones that allow for a pulley-lever action to occur between muscles and bones. The tendon
Equine Forelimb

- Scapula
- Ulna
- Radius
- Carpus
- Splint
- Cannon
- Sesamoids
- Long Pastern
- Navicular Bone
- Short Pastern
- Coffin Bone
Equine Rearlimb

- Sacrum
- Pelvis
- Femur
- Fibula
- Tibia
- Tarsus
- Splint
- Cannon
- Sesamoids
- Long Pastern
- Navicular Bone
- Short Pastern
- Coffin Bone
acts as the string, the sesamoid bone acts as the pulley, and the bones are the objects being lifted. One of the most important sesamoid bones is the navicular bone. Despite its lack of size, it is vital to the movement of the horse, as it acts as a pulley for the deep distal flexor tendon and is a common site of disease or injury.

Legs not only provide locomotion for the horse, they also allow the horse to rest, conserve energy, or even sleep while standing. The ability to rest while standing provides a horse with an additional defense, in that they do not have to get up before fleeing when threatened by danger. They can immediately run away. The anatomic feature responsible for this ability is known as the stay apparatus and involves both the front and hind limbs. The basic premise behind the stay apparatus is the transfer of the horse’s body weight from the muscles to the tendon and ligaments. These connective tissues do not tire as easily as muscles and thus are an efficient way to rest. This is accomplished in the front limbs by locking the elbow so that from the elbow down the leg is perfectly straight. This stretches the major tendons and ligaments, allows them to accept the horse’s body weight, and thus rests the muscles. In the hind limb, the knee cap is locked in a fashion similar to the elbow.

Learning Activity


A horse foot that has been laterally sectioned is an ideal specimen to observe and study bone, tendon, ligament, cartilage, and muscle. However, acquiring horses’ feet is difficult in most parts of the country. An alternative model for the study of the muscular and skeletal system is the acquisition of pig feet from the local meat counter. Since the pig feet are already sectioned laterally, the entire lab is spent examining and manipulating the exposed structures of bone, tendon, ligaments, cartilage, and muscle. When selecting pig feet at the meat counter for this lab be sure to only purchase specimens that are cut through a metatarsal.

Suggested Activity

Identify inner structures of a horse using a skeleton or a cadaver. Work with the local veterinarian to locate a horse that has to be destroyed. Often times the owner is willing to have the horse be used for educational purposes.
Equine Leg - Lateral View

Illustration courtesy of the American Association of Equine Practitioners.
Soundness in the horse is of extreme importance because its performance is dependent on efficient movement. Any abnormal deviation in the structure of a horse constitutes unsoundness.

**BASE WIDE**
Feet are wider apart than a line straight down from each shoulder.

**BASE NARROW**
Feet are closer together than a line straight down from each shoulder.

**KNOCK-KNEED**
Knees are inside the line straight down from each shoulder.

**BENCH-KNEED**
Cannon bones are not centered with the carpal bones.

**BACK AT THE KNEES**
Knees are behind the line straight down from each shoulder.

**BUCK-KNEED**
Knees are in front of the line straight down from either shoulder.

**TOED-IN**
Toes are not parallel and are pointed toward each other (pigeon-toed).

**TOED-OUT**
Toes are not parallel and are pointed away from each other. Other problems can occur resulting from injury, disease, or improper care.

**BOWED TENDONS**
A stretch, tear, or general inflammation of a tendon. This can be due to improper conditioning, fatigue, and/or poor conformation of the horse’s limbs.

**RINGBONE**
Occurs in pastern and coffin joints from excess bone growth in these areas. It causes the horse to be lame and is the result of injury, excessive work, or disease. A visible ring may actually grow around the leg of the horse.

**CAPPED ELBOW**
Injury of the elbow usually caused by the horse lying with its legs folded up or by horse shoes that are too long. The hoof or shoe damages the tissue of the elbow.
CAPPED HOCK  Similar to capped elbow; usually caused by kicking an object or being hit by a closing gate/stall door.

SESAMOIDITIS  Sesamoid bones become inflamed, lose density and may fracture.

**Learning Activity**

Conduct a horse judging contest with your class. Have students judge horses using live animals, video of previous contests, or slides. Videos and judging manuals are available free from the American Quarter Horse Association, P.O. Box 200, Amarillo, Texas, 79168. Videotape local, regional, state, and/or national horse judging contests for use in class.

**Learning Activity**

Have a local veterinarian come into class and discuss the process of a vet check. Have a live horse available for the veterinarian to use as an example. Have the veterinarian discuss what the prospective owner should do before buying a horse in terms of transporting the horse, preparing the facilities, and once the horse is home.

**The Hoof**

The hoof performs many functions in the horse. It supports the weight of the horse, absorbs shock and gives the horse traction. The structures of the hoof can be broken down into two classes, insensitive structures and sensitive structures. Insensitive components of the horse’s hoof protect the hoof and give it structure. The hoof wall is a hard covering of non-living cells that is seen when the horse is standing normally. The hoof wall is divided into four sections: the back part is called the heel, the sides are called the quarters, and the front of the wall is called the toe. These divisions are fairly general, as no natural boundaries are seen on the hoof wall itself. The area where the hoof wall meets the living skin tissue of the horse is known as the coronet band. The coronet is also important because it is the point of the hoof from which growth originates. The manner in which a hoof grows is very similar to how the fingernail of a human grows. The hoof wall varies in thickness at different parts of the hoof. It is thickest at the toe, thinnest at the heel, and has medium thickness at the quarters. The hoof wall turns inward when it reaches the heel and turns back toward the toe to form the bars.
The triangular shaped frog is separated from the bars by two small grooves in the sole known as the sulci. Underneath the hoof wall are the structures that hold the hoof together, they are known as laminae. Laminae are tissues that act like interlocking fingers to hold the hoof together and give it some degree of flexibility. There are two types of laminae that perform very different functions. Sensitive laminae supply the blood and nerves that allow the hoof to function properly. Insensitive laminae are a rigid type of tissue that works to transfer the weight of the horse to the hoof wall to decrease the burden on the sole. The sole of the hoof is concave and joins the hoof wall at a junction known as the white line. The white line marks the boundary between the sensitive and insensitive structures of the hoof. This is very important to know during the shoeing of the horse as driving nails into the sensitive structures of the hoof will not only cause the horse a great deal of pain, but could also cause substantial or permanent damage. Shoeing a horse is generally beneficial because the wear on the hoof itself is decreased.

Learning Activity

When a student's horse needs to be shod have the farrier shoe the horse at school for a class demonstration. Have the farrier discuss the anatomy of the hoof and leg and the importance of correct shoeing. Collect the hoof trimmings from the farrier and have students study the different parts of the hoof wall under dissecting microscopes and sketch the different types of laminae. Have student(s) videotape a horse being shod if unable to arrange for a shoeing demonstration at school. Talk to a farrier and have them collect hoof trimmings for a day for students to observe. Be sure to keep the hoof trimmings in a plastic bag so they won't dry out.

Learning Activity

Work with a veterinarian to obtain x-rays of healthy feet and feet that have navicular and other problems. Examine bones within the fetlock and hoof, especially understanding navicular problems. Have the veterinarian teach a class on navicular disease and other physical problems resulting in lameness.
Illustrations courtesy of the American Association of Equine Practitioners.
The hoof has the important characteristic of being flexible. That is, when the hoof hits the ground it expands and when it is lifted, it contracts. This trait allows the horse to have proper circulation. When the blood goes down the leg, it has to fight gravity to get back to the heart and lungs. When the horse moves, blood flow is assisted. Blood is forced up the veins when the hoof expands and contracts. To further aid the blood in getting up the leg, veins have valves that only open in one direction. These valves prevent the blood from flowing backwards down the leg and thus keep the blood flowing in one direction.

**Learning Activity**

An easy demonstration of valves in a vein can be done with students' veins on the inside of their wrist. Have students turn their hand palm up so they can observe the veins running along their wrist. Have the students stroke their veins with the forefinger or thumb of the opposite hand in the same direction the blood is flowing (from the hand toward the heart). There will be no visible change in the appearance of the vein. Then have them slowly stroke the vein against the flow of blood (toward the hand). When their finger passes over a valve the vein below the valve will no longer be visible because the valve is preventing the backflow of blood (for an inch or so).

**HIH 525**

Proper care and maintenance of the hoof are a major part of the overall health and usefulness of the animal. It is necessary to trim or shoe the hoof approximately every four to eight weeks. Removal of excess hoof wall will improve the balance of the hoof and overall stride quality of the horse. If the hoof is not properly trimmed, uneven breakage of the hoof wall can result causing lameness. Trimming and shoeing can also help to assist a horse in overcoming an unsoundness. If a horse is toed-in, it will have much more wear on the outside of its hoof than on the inside causing it to amplify the unsoundness. In such a case, one should trim the inside of the foot to even out the foot and allow the horse to walk more efficiently. In the case of a toed-out horse, simply trim the outside of the hoof to balance the excess wear on the inside of the hoof.

The hoof is constantly in use, and because of this, diseases and other problems that afflict the hoof can be severe. Navicular disease is an inflammation or fracture of the navicular bone. This may be caused by a problem with the circulation of blood in the hoof. This problem results in pain in the heel of the foot when it hits the ground. Corrective shoeing may also be implemented, but as of today there is no permanent cure for navicular disease. Laminitis is a disease in which the sensitive laminae swell causing them to separate from the insensitive laminae. In an ex-
treme case, the horse can detach the hoof from the foot and step out of the hoof. Thrush is a disease that affects the frog of the hoof. This disease causes the frog to produce a dark, smelly discharge, and is usually the result of poorly maintained, moist or unsanitary stalls. The treatment for thrush is to remove affected areas, clean the hoof and keep it dry. Very dilute bleach solution (10%) can be used topically to help control the causative bacteria.

The understanding of the function and anatomical structures of the horse can prove invaluable to anyone who has an interest in these animals. Whether one is purchasing a horse, judging a horse, or breeding horses, having knowledge of the mechanics and structural composition of the horse is imperative.

**Learning Activity**

Students can be used to demonstrate what happens when a hoof is not balanced either by incorrect trimming or by loss of shoe. Have students place a one-inch shim in their left shoe and have them walk around for five minutes. Have them write down their observations of how the shim affects their movement and other parts of the body. Have them hypothesize what would happen if they had to walk and run with the shim for the next six weeks. In order to model a horse losing a shoe, have students take off one of their shoes and walk around with one foot barefoot. Again, have them note their observations and guesses if they had to walk like that for a long period of time.

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