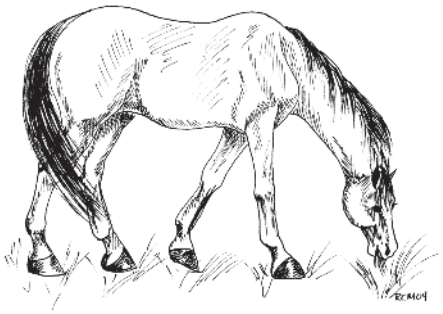
Laboratory 1
THE EQUINE DIGESTIVE SYSTEM



Source: Rachel Monticelli-Turner.

NOTES:

Introduction:

Understanding the anatomical organization and function of the equine digestive system is very important in laying a foundation of knowledge about the nature of feeding horses. In this laboratory exercise the student will review the locations and functions of the organs of digestion, paying particular attention to where the various nutrients are digested and absorbed. This base of knowledge will foster an appreciation for why horses utilize certain types of feeds more efficiently and why horses are prone to various digestive-related disorders.

Objectives:

When finished with the material from this laboratory, the student should be able to:

1. Identify all organs that relate both directly and indirectly to the digestive system of the horse.
2. Define the following terms:
   a. digestion
   b. absorption
   c. metabolism
   d. herbivore
   e. nonruminant
   f. cecal fermenter
   g. ruminant
   h. prehension
   i. mastication
   j. colic
   k. choke.
3. List sizes, capacities, and functions of the organs of the equine digestive tract.
4. List the locations of digestion and absorption for the six classes of nutrients.

Manual of Equine Nutrition and Feeding Management, First Edition.
Carol Z. Buckhout and Barbara E. Lindberg.

Companion website: www.wiley.com/go/buckhout/manual

Ruminant animals such as cows can digest quite efficiently by fermenting feed in a multi-chambered stomach. Most nonruminants lack this fermentation ability in their foregut, and are therefore called "simple stomached". They may either lack fermentation ability (like humans and pigs) or they may be "cecal fermenters" (like horses) where fermentation happens in the hindgut.

NOTES:

5. Describe the types and arrangement of teeth in the horse's oral cavity and how their shape changes over time. Relate the changes to approximate ages of the horse.
6. Identify similarities and differences of the equine digestive system to both the simple and ruminant digestive systems.

Question for further discussion:

1. Why is the horse prone to digestive disorders such as colic and choke? Suggest feeding strategies that would avoid these situations.

General overview:

As a nonruminant herbivore, the horse is designed to live on a diet of plants, the majority of which are forages. Wild horses graze for 12 to 16 hours per day, consuming small amounts at any one time. Hence, the nature of the horse's digestive tract is to accommodate small, frequent intakes. The horse's teeth wear more evenly and consistently when the animal is able to chew coarse plant material for several hours each day. While the majority of horses on the earth today are no longer wild, they still thrive best when their feeding program is organized to provide small meals, primarily consisting of quality forage, throughout the day.

A thorough understanding of the horse's digestive system is paramount to organizing an appropriate feeding regimen. It also creates the base for understanding why the horse is prone to certain digestive disorders. Keep the size of the mature horse in mind while exploring the numerous organs of digestion, their sizes and their functions throughout this lab.

THE EQUINE DIGESTIVE TRACT: PRIMARY AND SECONDARY ORGANS OF DIGESTION

A. Primary organs of digestion: The upper digestive tract

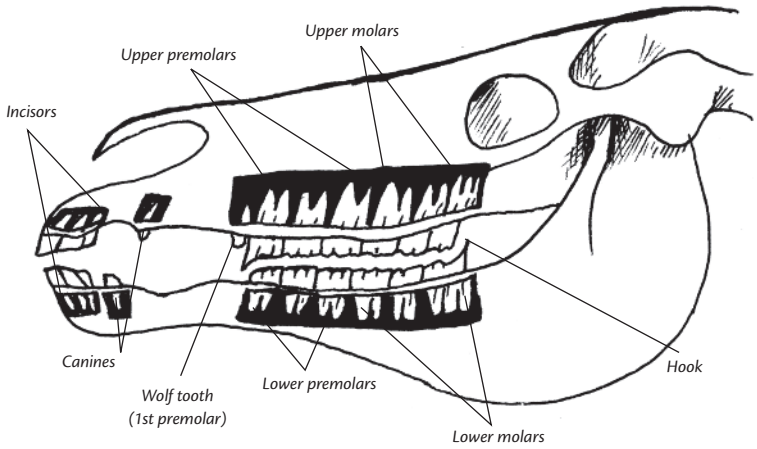
The following outline provides information pertaining to the primary organs of digestion (feed passes through them) that are considered to be part of the upper digestive tract of the horse. Use this guide when observing the specimens and diagrams provided in the laboratory, but also note there are some areas of the outline intended for the student to complete!

1. Oral cavity

a. *Lips:* well developed and muscular; important tactile properties and involved with prehension of feeds

b. *Teeth:* involved with prehension and mastication of feeds; deciduous (baby or milk) teeth erupt first and are then replaced by permanent teeth

Figure 1.1 Teeth of an adult horse. *Source: Rachel Monticelli-Turner.*



c. Identify each of the following types of teeth (Pence, 2002):
   i. Incisors (I) or front teeth: 6 total (3 per side) on both top and bottom jaws of mature horse, named in pairs for their location: central (I1), intermediate (I2), corner (I3)
   ii. Cheek teeth or grinders:
      1. *Premolars (P):* 6–8 on both top and bottom (3–4 per side), depending on whether wolf teeth are present. They are named for their location; P1, P2, P3, and P4. P1 is also known as the wolf tooth. (More information on wolf teeth can be found on the next page in the sidebar.)
      2. *Molars (M):* 6 on both top and bottom (3 per each side)
   iii. Canines (C): a single canine tooth may be located in the diastema (the space between the incisors and the premolars, also called the bar) and it may be in the top and/or the bottom jaw; canines are more commonly associated with stallions or geldings; a horse might not have any canine teeth or it may have as many as four canines; other names for the canines include: eyeteeth, bridle teeth, tusks, or tushes.
   iv. Parts of the equine tooth (Frandson, Wilke & Fails, 2009): locate each part on specimens or diagrams provided:
      1. root—anchors tooth in its bone socket (alveolus) and is attached to the surrounding bone by periodontium (connective tissue), creating a gomphosis (fibrous) joint
      2. crown—the portion of the tooth above the gum line
      3. neck—the space between crown and root; equine teeth do not have prominent necks and are referred to as hypsodont

Dental Formula:

The traditional method for listing the potential number of teeth in a horse is to start with the letter abbreviation of the tooth followed by the number of teeth in the upper jaw placed over the number of teeth in the lower jaw (making it look like a fraction) for half of the horse's head. For example: The total number of incisors for the upper jaw is 6 as well as for the lower jaw. Therefore, the dental formula for only the incisors is:

$$2\left(I\frac{3}{3}\right)=12$$

or 12 total incisors. Deciduous or "baby" teeth are abbreviated with a "D" followed by a lower case letter "i" for incisor or lower case "p" for premolar.

Review the following dental formulas:

Deciduous (milk) teeth

$$2\left(Di\frac{3}{3}, Dp\frac{3}{3}\right)=24$$

Permanent teeth

$$2\left(I\frac{3}{3}, C\frac{0-1}{0-1}, P\frac{3or4}{3or4}, M\frac{3}{3}\right)$$
$$=36-44$$

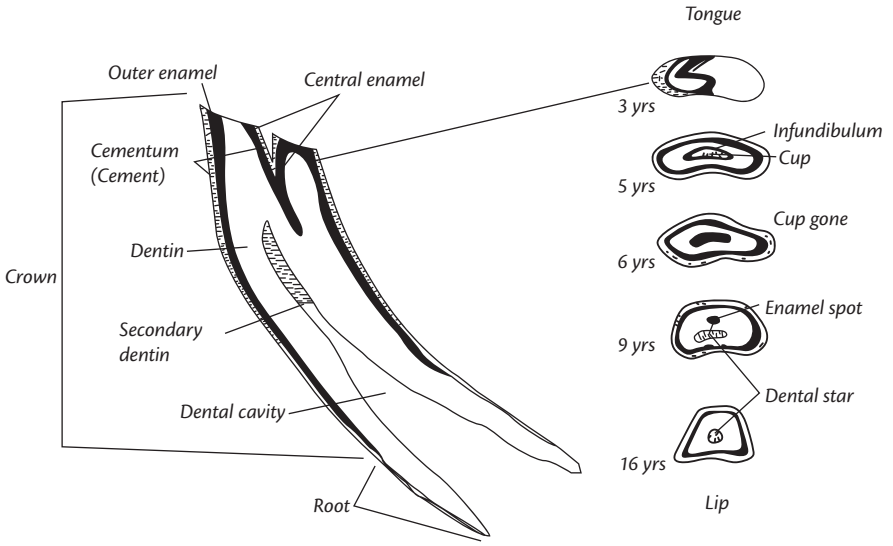
NOTES:

Since mares frequently lack canine teeth they can have as few as 36 teeth.

Wolf teeth—The first premolar, if present, is called the "wolf tooth". These are small vestigial premolars usually found in the upper jaw, but they may also be located in the lower jaw. Their shallow roots allow for a relatively easy removal by a veterinarian. This is often necessary as they will sometimes interfere with the horse's comfort when wearing a bit.

The incisors found in ruminants have a short crown and a more prominent neck than what is found in equines; such teeth are called brachyodont (Frandson, 2003) (Greek: brachy refers to short; hypsi refers to high).

Figure 1.2 Sagittal section and occlusal surfaces of a permanent lower incisor tooth. *Source: Rachel Monticelli-Turner.*



4. dentin—the mineralized substance that comprises most of a tooth's interior; center area called dental cavity contains the dental pulp
5. dental pulp—portion of dental cavity that includes connective tissue, nerves, blood vessels
6. enamel—covers dentin, comprised of inorganic crystals (very hard!); its prominent folds on the grinding surfaces of hypsodont teeth are called cups
7. cementum—thin mineral layer extending from the root and covering the crown of the tooth and filling in the infundibulum of central enamel
8. cup (infundibulum)—the dark central area of the younger tooth created by folds of enamel on grinding surfaces, this may be found on both deciduous and permanent teeth and wears away as the horse ages
9. dental star—this is comprised of the secondary dentin and often first appears as a line in the central incisors, then appears in the intermediate and corner incisors; found on both deciduous and permanent teeth

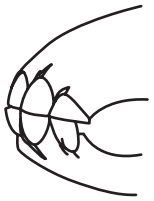
Aging a horse by its teeth: This was a common practice before the current positive identification systems (tattooing, microchipping, etc.) came into use. It is still useful in determining an approximation of age (Riegel and Hakola, 1999).

Dental Time Line

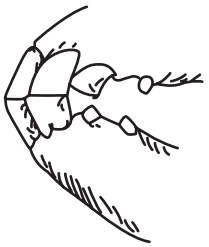
6 days	***eruption of central deciduous incisors***
Birth–2 wks	***eruption of deciduous premolars 2, 3, and 4***
6 wks	***eruption of intermediate deciduous incisors***
6 mo	***eruption of corner deciduous incisors***
1 yr	***deciduous teeth all present and in wear, central and intermediate incisors have longitudinal dental stars, first permanent premolars may be appearing, central incisor cup disappears with wear; first permanent molars have erupted***
1.5 yrs	***intermediate incisor cup disappears with wear***
2 yrs	***central deciduous incisor is missing in preparation for permanent central incisor, corner incisor cup disappears with wear, corner incisor star visible, second permanent premolar erupts***
2.5 yrs	***eruption of central permanent incisor***
3 yrs	***central incisors erupted and in wear with deep cups, deciduous intermediate and corner incisors appear ready to be replaced, if there are any "wolf teeth" they are seen easily, third permanent premolars erupt***
3.5 yrs	***eruption of intermediate permanent incisor, canines may erupt; third permanent molars have erupted***
4 yrs	***permanent central and intermediate incisors in wear, cups on central incisors are deep, deciduous corner incisors appear small, canines may erupt, fourth permanent premolar erupts***
4.5 yrs	***eruption of corner permanent incisor***
5 yrs	***permanent dentition complete, canines completely erupted, all incisors have cups***
6 yrs	***central incisor permanent cup disappears with wear, full length canine teeth may be present***
7 yrs	***intermediate incisor permanent cup disappears with wear, seven year hook on upper corner incisor, dental cup still visible on the corner incisor***
8 yrs	***corner incisor permanent cup disappears with wear, the first dental star appears on the central incisor, very beginnings of a dental star on the intermediate incisor***
9 yrs	***round central incisors with dental stars, intermediate incisors are becoming less oval and more round, corner incisors are oval, seven-year hook has disappeared***
10 yrs	***Galvayne's groove appears on the labial surface (facing the lips) of the upper corner incisor; central and intermediate incisors have become round at this point, central and intermediate incisors have dental stars in the middle of the teeth***
12 yrs	***all incisors are round, dental stars have waned to small yellow dots, Galvayne's groove has progressed one quarter of the way down the tooth***
15 yrs	***Galvayne's groove has progressed half-way down the upper corner incisor, the central incisor has become triangular in shape, round dental stars on all incisors***
20 yrs	***Galvayne's groove reaches the bottom of the tooth***

Source: Riegel and Hakola (1999).

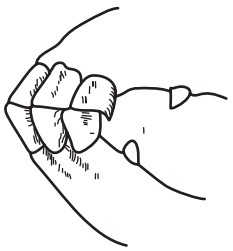
Figure 1.3 Teeth. *Source: Rachel Monticelli-Turner.*



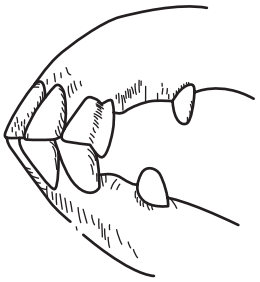
2 Years



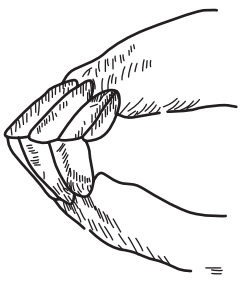
4 1/2 Years



7 Years



11 Years



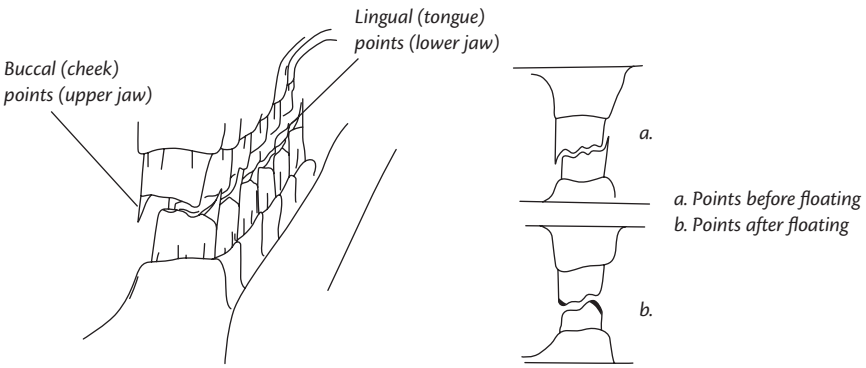
20 Years

NOTES:

Equine dentistry:

Because of the relative difference in the size of the upper jaw and lower jaw the horse tends to wear its teeth unevenly. As the upper jaw is wider this means the outside edge of the teeth experience less grinding activity. Therefore, they wear unevenly forming "points". The same happens on the inner edges of the lower teeth. These points can become sharp enough to cause discomfort (or even lacerations) on the horse's tongue and inner cheeks. Additionally horses can form hooks on the last molar, or can have an overgrown tooth if its opposing tooth is missing. All of these things can add up to less efficient chewing, discomfort, and biting issues. Therefore it is important to have a horse's teeth checked and possibly "floated" once or twice a year by a veterinarian or a qualified equine dental technician.

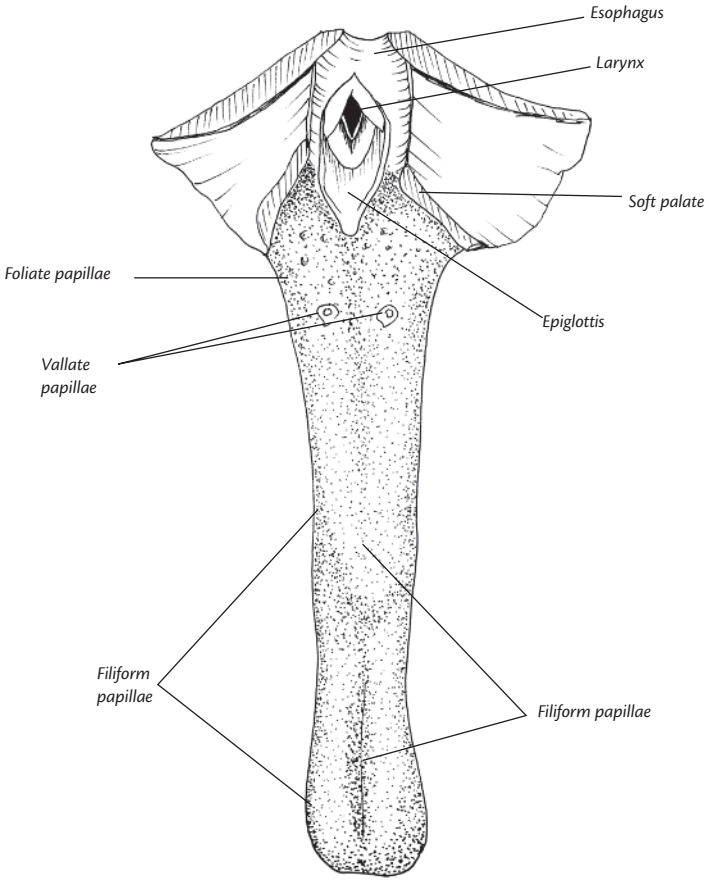
Figure 1.4 Grinding surfaces. *Source: Rachel Monticelli-Turner.*



d. *Tongue:* necessary for movement of feed from front to back of oral cavity; taste buds are located on its surface:
   i. Very muscular; apex (rostral portion) body and root that attaches to hyoid apparatus and mandible; covered by keratinized stratified squamous epithelium (Frandson, Wilke, & Fails, 2009)
   ii. Papillae: large projections, developed dorsally:
      1. filiform—short and soft and give the tongue its velvety feel
      2. fungiform*—interspersed in the filiform, mushroom-shaped
      3. foliate*—resemble foliage; located on lateral margins near root of tongue
      4. vallate*—found on caudal part of the tongue, arranged in a "V" shape; create the divide between the body and root of the tongue, shaped as large, circular projections, surrounded by a deep groove

**contain taste buds*

Figure 1.5 Dorsal view of the tongue and pharynx. *Source: Rachel Monticelli-Turner.*



e. *Pharynx:* the common area for food and air; may include tonsils (groups of lymph nodules) A proper flow of food into the esophagus is accomplished by the action of the epiglottis covering the trachea during the act of swallowing.

2. Esophagus

a. *Location:* extends from pharynx to stomach as a muscular tube (it lies dorsal to the trachea); passes through the mediastinum of the chest cavity and through the diaphragm at the area known as the esophageal hiatus

b. *Size:* 60″ in a mature horse; small and muscular

c. *Description:* contains a combination of skeletal and smooth types of muscle fibers

d. *Function:*

NOTES:

Taste buds: In humans, it is generally assumed that four basic taste sensations may be detected: sweet, sour, salty, and bitter. The grouping of cells referred to as taste buds are not evenly distributed throughout the tongue, but are arranged as follows: lateral sides: sour; base of tongue: bitter; tip of tongue: sweet and salty. Some horse owners may observe a very discriminate sense of taste in their equine friend. This is accommodated through both taste buds and through the horse's keen sense of smell.

Choke in a horse is the obstruction of the ESOPHAGUS (usually by foreign material or partially chewed food). Hence the horse can still breathe, but will cough and drool, often paw, and make unusual head and neck gestures. This of course is quite different from when choking occurs in a human where there is an obstruction of the airway.

NOTES:

3. Stomach

a. *Location:* caudal to left side of diaphragm

b. *Size & shape:* relatively small in the horse, shaped like the letter "J" due to close proximity of cardia and pylorus regions

c. *Function:*

d. External stomach regions (Frandson, Wilke, & Fails, 2009) (*Label the underlined terms on Figure* 1.6):

i. Cardiac: joined to esophagus, contains the well developed cardiac sphincter; this muscle makes it difficult for the horse to vomit

ii. Fundus: large bulge near the cardia; enlarges into the saccus cecus

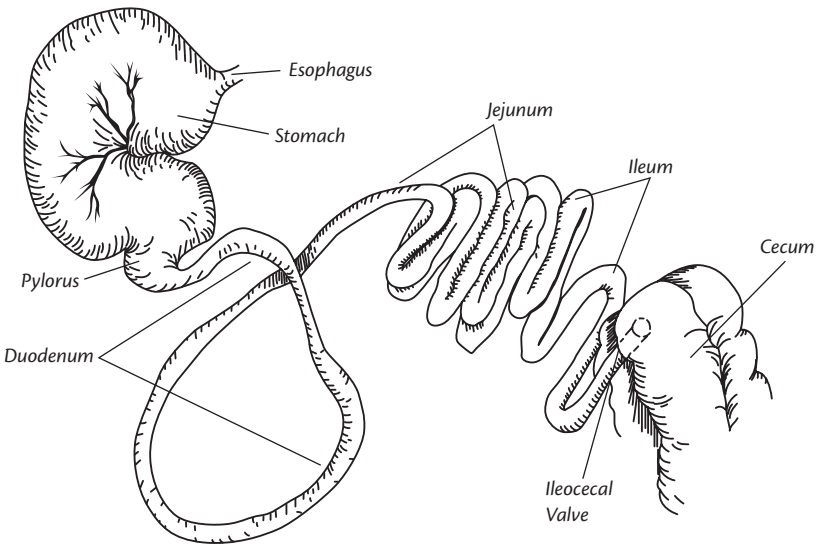
iii. Body: allows for expansion

iv. Pylorus: contains strong pyloric sphincter that regulates outflow of stomach contents

v. Greater curvature: long, convex side

vi. Lesser curvature: short, concave side

Figure 1.6 Upper digestive tract. *Source: Rachel Monticelli-Turner.*

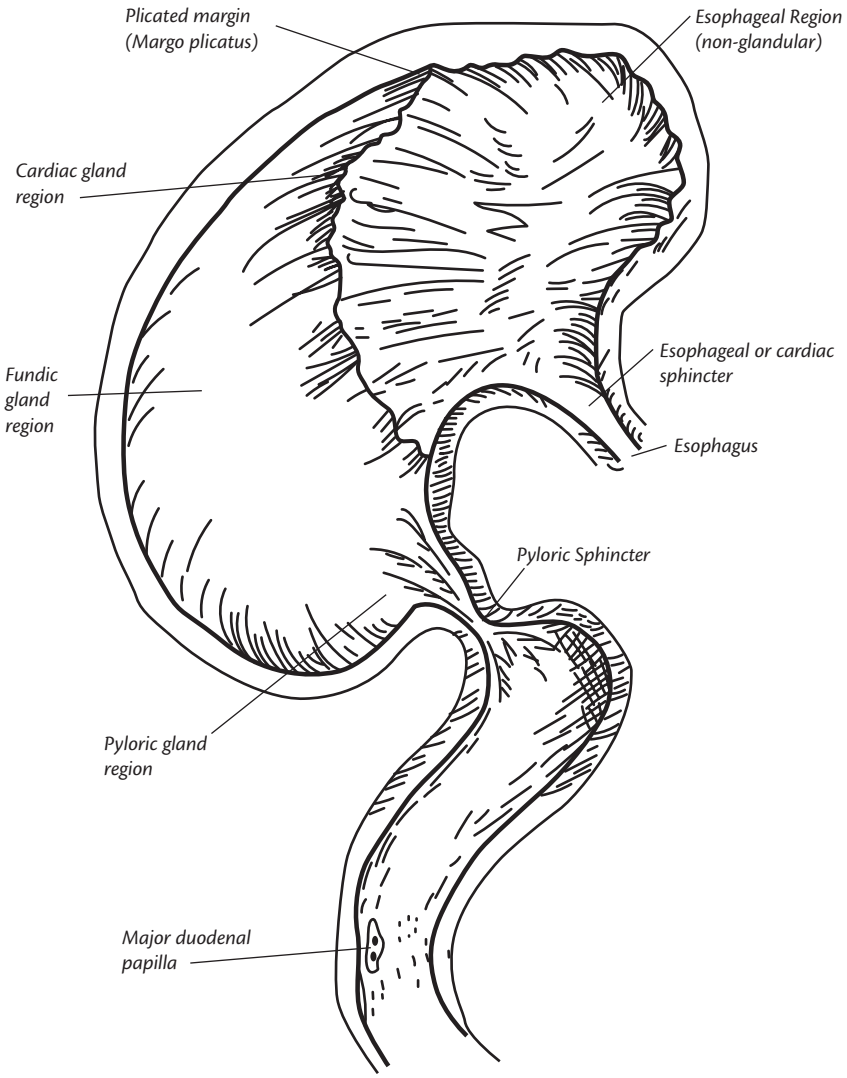


Comparative stomach sizes:

	Man	Pig	Horse	Cow
Body weight	75 kg	181 kg	454 kg	544 kg
	(165 lb)	(400 lb)	(1000 lb)	(1200 lb)
Total approx. stomach size	1 L	8 L	8 L	160 L
	(0.246 gal)	(1.97 gal)	(1.97 gal)	(39.36 gal)
	(1.057 qt)	(8.45 qt)	(8.45 qt)	(169.07 qt)

Source: Maynard and Loosli, 1975

Figure 1.7 Inside view of the stomach and cranial duodenum.
Source: Rachel Monticelli-Turner.



NOTES:

Ulcers are much more common in horses than once thought. These can be brought on by stress (especially in foals and high-performance horses), certain medications (like nonsteroidal anti-inflammatories) plus other factors. The usual location for gastric ulcers would be near the plicated margin on the nonglandular side of the stomach.

NOTES:

e. Internal stomach regions:
   i. *Nonglandular:* the esophageal region is the expanded portion of external cardiac region
   ii. *Margo plicatus:* the demarcation between nonglandular and glandular internal regions
   iii. *Glandular:* made up of three internal regions (see chart below); interspersed with enteroendocrine cells (these secrete hormones which affect secretory and muscular activity of the digestive tract)

Cardiac gland	***mucus***	***protects stomach lining; small in the horse***
Fundic gland	***pepsin***	***acts on proteins; largest glandular area in the horse***
Pyloric gland	***mucus***	***protection of stomach lining***

4. Small intestine (refer to Figures 1.6 and 1.8)

a. *Location:* attaches to pyloric region of stomach
b. *Size:* length in mature horse is approximately 70′; 12 gallon or 45 liter capacity
c. *Functions:*

d. *Regions* (locate each underlined region on Figure 1.6):
   i. Duodenum: first part, 3 ft, receives secretions from liver and pancreas
   ii. Jejunum: middle part and longest portion—54 ft; longer supporting mesentery
   iii. Ileum: last part; 10–12 ft; connects to cecum in horse at *ileo-cecal junction*

B. Primary organs of digestion: The lower digestive tract

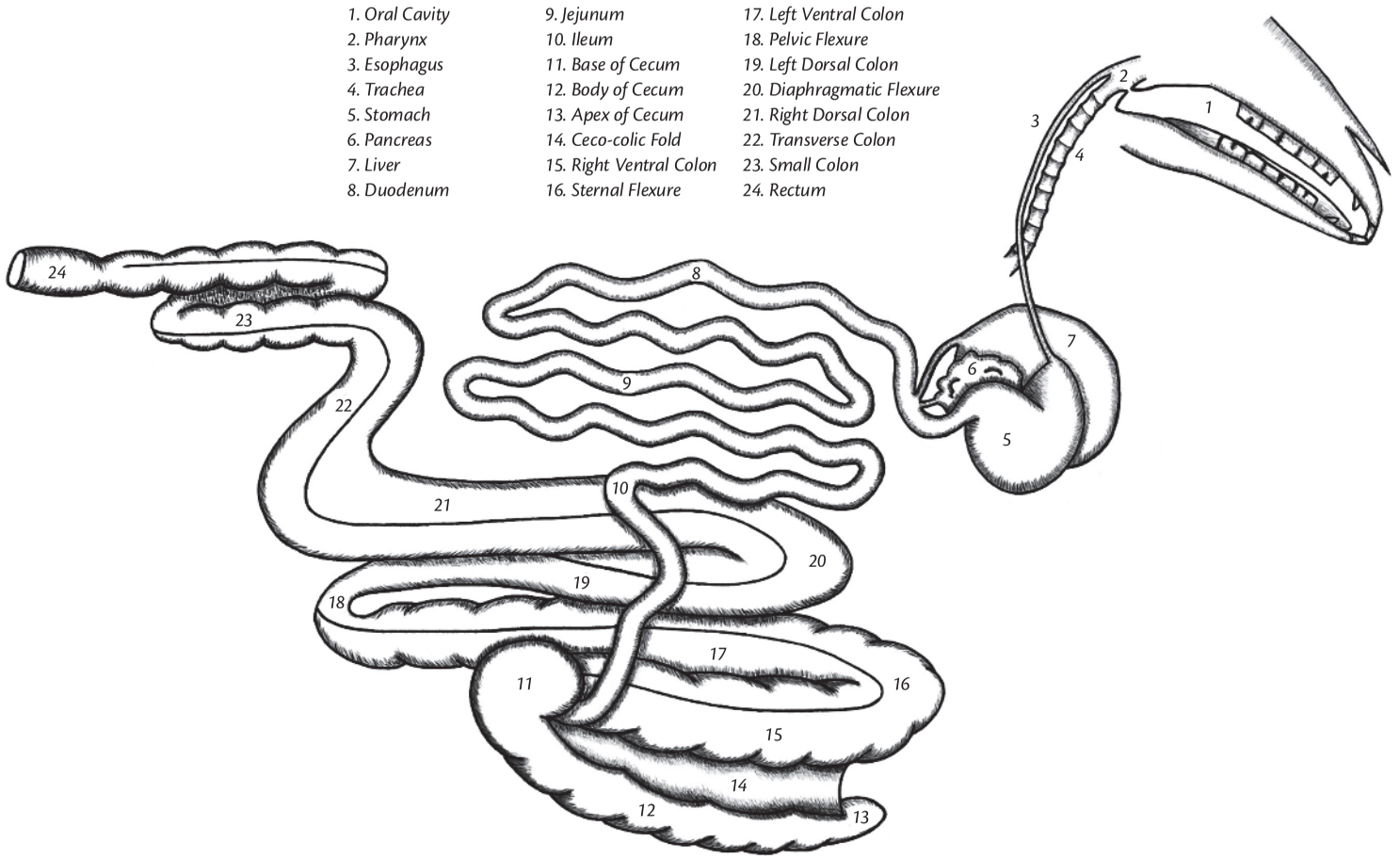
Complete the outline below while studying the unique features of the primary organs that make up the lower digestive tract of the horse. Locate all organs on Figures 1.8 and 1.9.

The cecum of a horse (which is a major site of microbial digestion) is equivalent to the appendix in a human (which is of questionable use).

1. Cecum

a. *Location:* the base of the cecum (location for the ileo-cecal junction) is closest to the horse's right hip, it then extends ventrally and cranially (toward the diaphragm) to the apex as a "blind sac"; the exit for cecal ingesta takes place from the cecal-colic junction located near the ileo-cecal junction.
b. *Size:* In the mature horse, the cecum may contain 8 gallons (about 33 liters) of watery, fibrous ingesta and extends approximately 4 feet within the horse's abdomen.

Figure 1.8 Organs of the equine digestive system.
Source: Carmel Keeley.



NOTES:

Impaction colic is more likely to occur in places where there is a narrowing or turning of the gut pathway. Therefore common places for impactions are at the diaphragmatic and sternal flexures of the large colon (turns), and especially the pelvic flexure (a narrowing and an upwards turn against gravity).

c. *Functions:*

d. *Unique features/appearance:* The large size and function of the horse's cecum makes it unique among animals of its size; other animals with similar digestive properties include the rabbit, the elephant, and the rhinoceros.

2. Large colon

a. *Location:* It begins at the ceco-colic junction near the base of the cecum and ends with the transverse colon, making three turns throughout the horse's abdomen.

b. *Size:* In the mature horse, the large colon may contain up to 16 gallons of ingesta (60 liters) and, when stretched out, may cover 12 feet.

c. *Functions:*

d. *Unique features/appearance:* The large size and capacity and the narrowing of the organ at each flexure makes feeding consistency and frequency along with proper hydration of the horse critical to avoid such issues as colic.

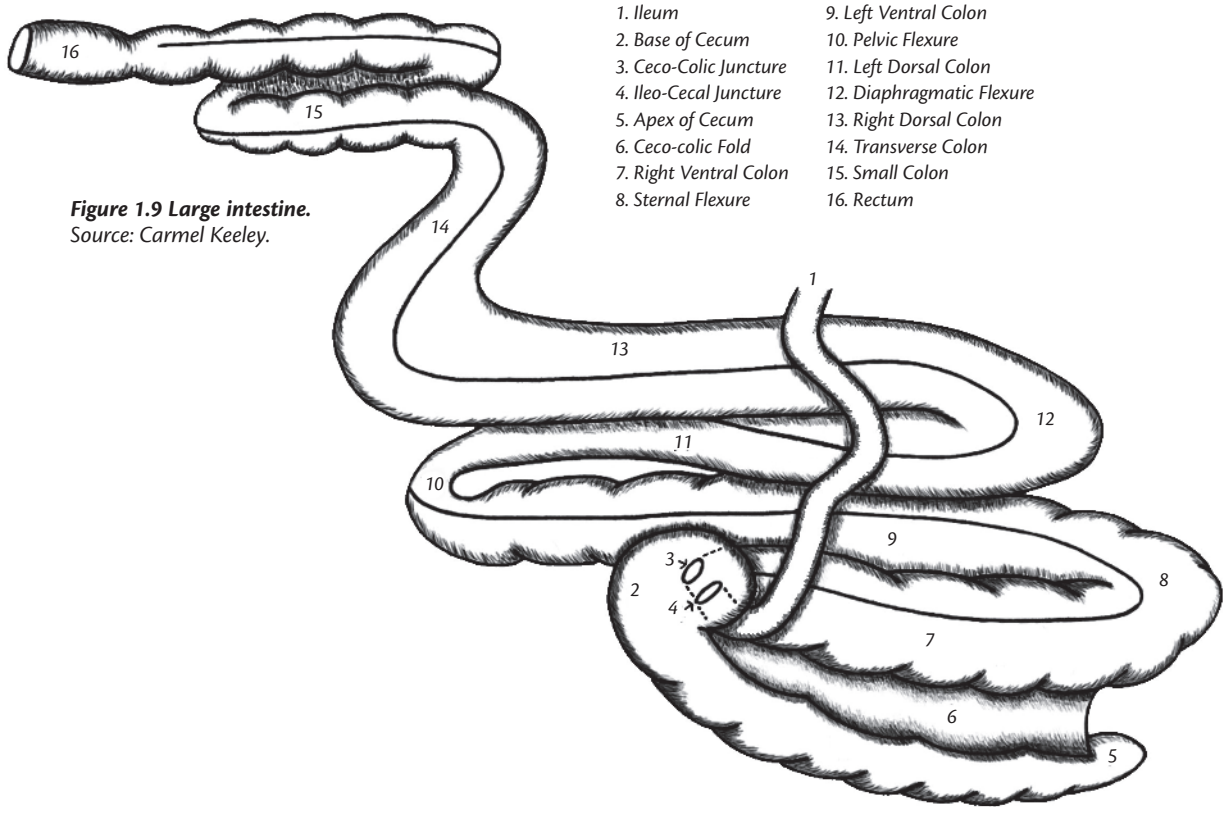


Figure 1.9 Large intestine.
Source: Carmel Keeley.

Figure 1.10 Position of organs of digestion, right view. *Source: Rachel Monticelli-Turner.*

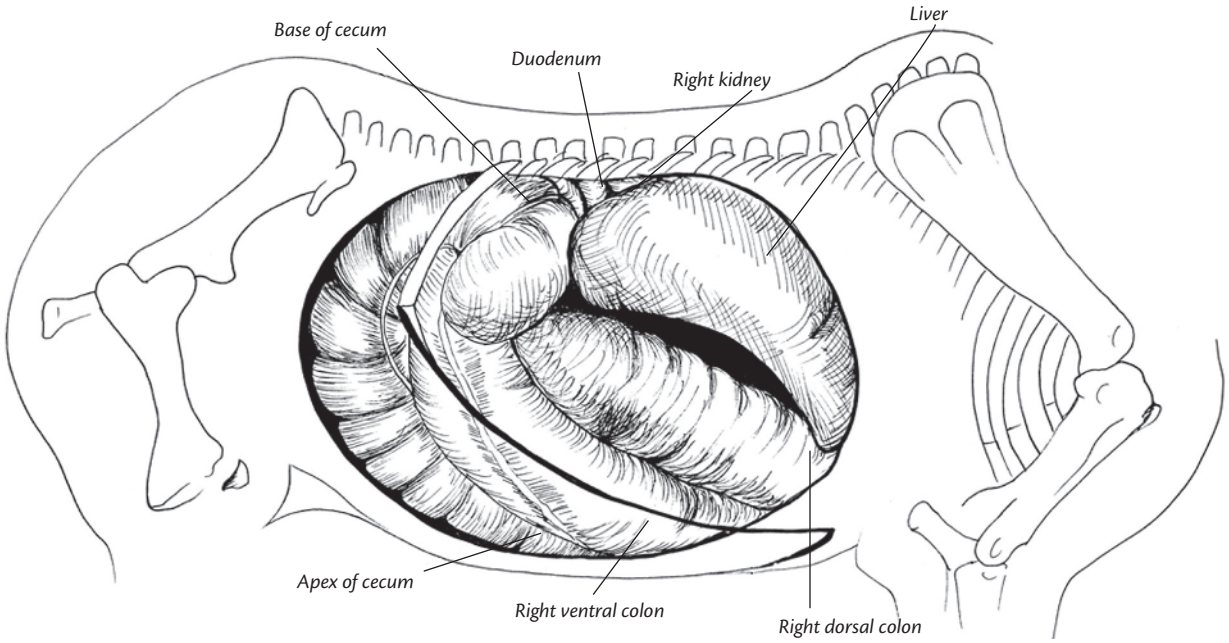
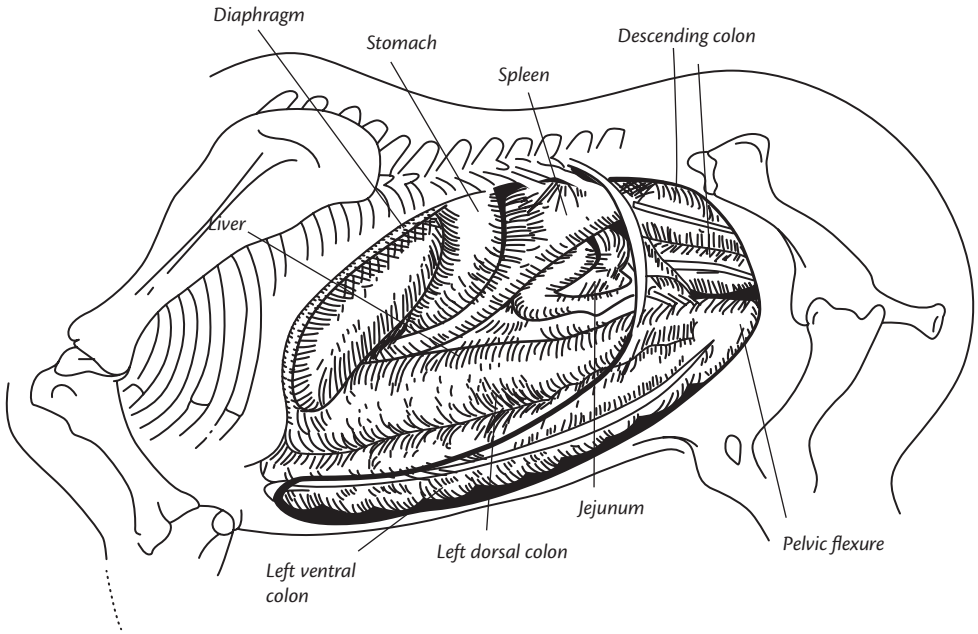


Figure 1.11 Position of organs of digestion, left view. *Source: Rachel Monticelli-Turner.*



The cecum, large colon, and small colon (which includes the transverse colon) are also collectively referred to as the large intestine of the horse.

e. *Regions and flexures*—in sequence from cecum to small colon:
   i. Right ventral colon
   ii. Sternal flexure
   iii. Left ventral colon
   iv. Pelvic flexure
   v. Left dorsal colon
   vi. Diaphragmatic flexure
   vii. Right dorsal colon

3. Small colon

a. *Location:* begins with the transverse colon at the end of the right dorsal colon (where it crosses the horse's midline just cranial to the root of the greater mesentery) and ends with the descending portion that joins to the rectum.

b. *Size:* holds approximately 3–4 gallons or 11–15 liters of ingesta and extends 10–12 feet.

c. *Functions:*

d. *Appearance:* larger in diameter than the small intestine; internally, the contents are drier than the large colon contents.

4. Rectum and anus

a. *Location:* the rectum begins at the pelvic inlet and ends at the exterior opening of the digestive tract, called the anus.

b. *Size:* the rectum is generally about 1 foot long and lies dorsal to numerous organs.

c. *Functions:*

d. *Unique features:* due to its position, rectal palpation is important in enabling the diagnosis of certain disorders, such as colic; or in determining the reproductive status of mares.

C. Secondary organs of digestion

The salivary glands, the pancreas, and the liver all provide secretions that aid in the process of digestion, but since feed does not pass through any of them, they are all considered to be secondary organs of digestion (Frandson, Wilke, & Fails, 2009).

1. Salivary glands

a. Parotid glands:
   i. *Location:* ventral to the ear in relation to caudal border of the mandible
   ii. *Secretions:* serous (watery) saliva

b. Mandibular glands:
   i. *Location:* ventral to parotid glands and caudal to mandible
   ii. *Secretions*: mucus (protective) and serous saliva (mixed glands)

c. Sublingual glands:
   i. *Location:* central to the tongue near floor of the mouth
   ii. *Secretions*: mixed (mucus and serous)

2. Pancreas

a. *Location:* A small lobe-like organ, the pancreas lies next to the first part of the duodenum and adjacent to the stomach.

b. *Secretions and functions:*
   i. Exocrine: produces sodium bicarbonate and digestive enzymes that empty into the proximal duodenum
   ii. Endocrine: produces the hormones insulin and glucagon that assist with blood sugar regulation

3. Liver

a. *Location:* This large organ lies just caudal to the diaphragm and consists of several lobes.

b. *Digestive secretions and functions:* This includes bile that moves directly from the liver to the proximal duodenum and is involved with the break-down of fats. The liver is a major detoxifying organ and venous blood leaving the digestive system travels through the liver for filtration before it passes back through the heart and lungs.

NOTES:

Unlike humans, horses do not have a gallbladder! The gallbladder's function in other animals is to store bile from the liver and secrete it when there is fat to be digested in the small intestine. The horse, however, secretes small amounts of bile constantly, and hence doesn't need a storage area. Some other animals that lack gallbladders are elephants, rats, and rhinoceroses.

Table 1.1 Enzymes in Digestion

Location	Product/ Enzyme secreted	Acts on?	End result?
Mouth	*Ptyalin*	*starch*	*maltose*
	Salivary amylase	*amylase*	*maltose*
Stomach	*HCl*	*dissolves minerals*	
	Pepsinogen (+ HCl = pepsin)	*proteins*	*amino acids*
	Rennin	*milk*	*coagulated milk*
Small Intestine	*Peptidase*	*proteins*	*amino acids*
	Maltase	*maltose (simple sugars)*	*glucose*
	Sucrase	*sucrose (simple sugars)*	*glucose*
	Lactase	*lactose (simple sugars)*	*glucose*
	Enterokinase	*trypsinogen enzyme from pancreas*	*activated trypsin enzyme*
Pancreas	*Trypsin (activated by enterokinase from small intestine) Chemotrypsin*	*proteins*	*amino acids*
	Pancreatic amylase	*starches*	*oligosaccharides (these are further digested by maltase and sucrase to monosaccharides)*
	Pancreatic lipase	*fats*	*fatty acids and monoglycerides*
	Sodium bicarbonate	*chyme (from stomach)*	*raises the pH and enhances the effects of pancreatic enzymes*
	Insulin	*glucose*	*causes glucose uptake by tissues and organs*
	Glucagon	*glycogen*	*causes break-down of glycogen to glucose in the liver (glycogenolysis)*
		fatty acids & proteins	*production of glucose from non-carbohydrate sources in the liver and kidneys (gluconeogenesis)*
Liver	*Bile*	*fats*	*emulsifies globules*
Large intestine	*Only microbial digestion!*	*fiber, mostly*	*Volatile fatty Acids and microbial protein*
All over	*Mucus*	*protects gut lining*	*protects gut lining*

For additional information:

Oke, Stacey DVM, MSc (2018, July). Journey through the Equine GI Tract. The Horse. Retrieved from http://thehorse.com/159348/journey-through-the-equine-gi-tract/.

YouTube videos:

The equine digestive system:
https://www.youtube.com/watch?v=tuzTJ77IQAY

The horse's digestive system:
youtube.com/watch?v=81qk7igz9L4

3D horse digestion guide:
youtube.com/watch?v=maWXVKI-gq4

References:

Frandson, R., Wilke, W., & Fails, A. (2009). *Anatomy and Physiology of Farm Animals*. (7th ed.). Philadelphia, PA: Lippincott, Williams and Wilkins.

Maynard, L., & Loosli, J. (1975). *Animal Nutrition*. 6th edition. New York: McGraw-Hill Book Company.

Pence, P. (2002). *Equine Dentistry A Practical Guide*. Philadelphia, PA: Lippincott, Williams and Wilkins.

Riegel, R., & Hakola, S. (1999). *Illustrated Atlas of Clinical Equine Anatomy and Common Disorders of the Horse* (Vol. 2). Marysville, OH: Equistar Publications, Ltd.

Supplemental Activity
STRINGING IT ALL TOGETHER

Materials:

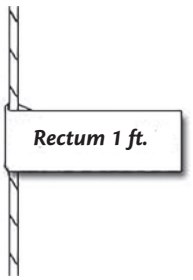
- String
- Scissors
- Tape measure
- Tape or labels that can be written on
- Lengths of all the primary organs of digestion
- Spool to wrap finished product around

Objective:

The idea is to have students gain a better understanding of the true length of the equine digestive tract by measuring out the lengths of the primary digestive organs and marking them on string.

Activity:

1. Add all the lengths of the primary digestive organs and make sure you have at least that length of string.
2. Fasten the string to the spool.
3. Measure one rectum length of string from the spool. (We start at this end so that the beginning of the digestive tract will be on the outside when the string is wound on the spool.)
4. Mark the string by folding a length of tape or a label over the string and sticking it back to itself. Write "rectum" on the tape or label and indicate its length.



5. Continue this process working backwards marking the rest of the primary digestive organs.
6. Use the scissors to trim off excess string.
7. Stretch out your finished product with a friend to get an idea of the true length of the equine digestive tract. Wind your string onto your spool for safekeeping.
8. If you are super ambitious, repeat the process for the human digestive system. Compare the lengths of the two digestive tracts. Can you think of any reasons for the difference in length?

Name_____

Lab Section_____

Lab 1 Assignment
THE EQUINE DIGESTIVE SYSTEM

1. Observe specimens and diagrams related to the equine digestive tract, making note of their unique features, shapes, and sizes. Then complete the chart below:

Organ	*Location*	*Size/Shape*	*Function(s)*
a. lips			
b. tongue			
c. teeth			
d. pharynx			
e. esophagus			
f. stomach			
g. small intestine			
h. cecum			
i. large colon			
j. small colon			
k. rectum			

2. The location of nutrient digestion in the horse is an important factor in successful feeding. Research and list which digestive organ or organs are involved with the digestion and absorption of each nutrient listed. If an accessory organ is involved, please include that along with the primary digestive organ that is associated with it.

	Location of Digestion	***Location of Absorption***
a. carbohydratessimple sugars		
complex carbohydrates (fiber)		
b. proteins		
c. lipids		
d. minerals		
e. vitamins		
f. water		

3. The goal of a horse owner is to maximize digestion and absorption of feed nutrients. How might the following factors impact both digestion and absorption?

    a. The quantity of feed intake at a single feeding.

    b. The order of providing feeds (hay versus grain versus water).

    c. The processing of feeds (such as crimping, grinding, or steaming).

4. Describe (do not just list) <u>three</u> basic differences between the equine digestive tract and the ruminant digestive tract.

5. You recently inherited a small Cleveland Bay breeding farm from an obscure relative that passed away. Unfortunately, because your new Cleveland Bays have no markings and all other physical characteristics are similar because they are all related, your obscure relative was the only one able to tell them apart. Luckily you found a folder with papers on all the current horses. Use your knowledge of teeth and aging along with the descriptions on the next page to determine which horse is which in this brood mare paddock.

    a. Little Red: age 2.5
    b. Big Red: age 5
    c. Little Red Riding Hood: age 11
    d. Maroon: age 15
    e. Rojo: age 25

Horse descriptions:

Horse 1: This horse has what is known as a "full mouth," or full dentition. All of the incisors have cups and the canines are fully erupted, though they are small.

Horse 2: Galvayne's groove has made an appearance. The central and intermediate incisors have a rounded appearance. The corner incisors are moving from oval to round in their shape. The dental stars are waning.

Horse 3: The central permanent incisor is beginning to erupt. There are no wolf teeth. Second permanent premolar has erupted.

Horse 4: Galvayne's groove is half-way down the upper corner incisor. The central incisor has become triangular in shape. There are round dental stars on all of the incisors.

Horse 5: All of the incisors are triangular. Galvayne's groove is half-way down the upper corner incisor. The teeth are more slanted than the #4 horse.