27. Anatomy of the Digestive System
Answers to Pre-Lab Assignments

Pre-Lab Activity 1:
1. a. oral cavity
   b. pharynx
   c. tongue
   d. salivary glands
   e. esophagus
   f. esophagus
   g. liver
   h. gallbladder
   i. stomach
   j. pancreas
   k. small intestine
   l. large intestine

2. a. 2
   b. 5
   c. 1
   d. 3
   e. 4
   f. 6

Pre-Lab Activity 2:
1. a. 2
   b. 3
   c. 6
   d. 1
   e. 4
   f. 5

Pre-Lab Activity 3:
1. a. mucosa
   b. submucosa
   c. muscularis
   d. serosa

2. a. 4
   b. 3
   c. 2
   d. 1
   e. 4
   f. 3
### Making Connections: Organs of the Alimentary Canal

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description/Function</th>
<th>Connections to Things I Have Already Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral cavity</td>
<td>Site of ingestion of food; mastication; contains muscular tongue; teeth chew; salivary glands produce saliva.</td>
<td>Separated from nasal cavity by hard palate (maxillae and palatine bones) and the soft palate.</td>
</tr>
<tr>
<td>Pharynx</td>
<td>Passageway for food, liquids, and air. Skeletal muscles initiate peristalsis.</td>
<td>Divided into nasopharynx, oropharynx, and laryngopharynx.</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Passageway for food.</td>
<td>Is supplied by both the esophageal artery (visceral branch of the thoracic aorta) and a branch of the celiac trunk.</td>
</tr>
<tr>
<td>Stomach</td>
<td>Mixes food with gastric juices to produce chyme; muscular contractions.</td>
<td>Supplied by a branch of the celiac trunk.</td>
</tr>
<tr>
<td>Small intestine</td>
<td>Most digestion and absorption take place here; three divisions: duodenum, jejunum, and ileum.</td>
<td>Supplied by the superior mesenteric artery; drained by the superior mesenteric vein which fuses with the splenic vein to become the hepatic portal vein.</td>
</tr>
<tr>
<td>Large intestine</td>
<td>Reabsorbs water from the undigested material and forms feces.</td>
<td>Supplied by the superior and inferior mesenteric arteries.</td>
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1. a. What is the function of the uvula? **It helps prevent food from entering the nasopharynx.**
   b. Describe and explain the functional significance of what you feel.  **It is a rigid surface against which the tongue pushes food during chewing.**
   c. Identify and name the three regions of the pharynx, and describe the location of each.
The nasopharynx is located behind the nasal cavity; the oropharynx is located behind the oral cavity; the laryngopharynx extends from the epiglottis to the base of the larynx.

d. Identify the esophagus on an anatomical model and describe its location with respect to the trachea. The esophagus is located posterior to the trachea.

e. Which structure extends from the liver to the lesser curvature? lesser omentum
   Which structure extends from the greater curvature to cover the small intestine? greater omentum
   What is the function of this sphincter muscle? Controls passage of food from the esophagus to the stomach.
   What is the function of this sphincter muscle? Controls the movement of food from the stomach to the small intestine.

f. List them in order from shortest to longest. duodenum, jejunum, ileum

g. This valve is located between which two structures? the ileum of the small intestine and the cecum of the large intestine

h. Identify the worm-like structure that extends from the cecum. Describe it and its function. The vermiform appendix performs lymphatic functions.

i. Describe the location of the hepatic and splenic flexures. The hepatic flexure is at the junction of the ascending and transverse colon and the splenic flexure is at the junction of the transverse colon and the descending colon.

Activity 2

Making Connections: Accessory Organs of the Digestive System

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<tr>
<td>Salivary glands</td>
<td>Produce saliva containing amylase (an enzyme that begins the chemical digestion of carbohydrates).</td>
<td>Exocrine glands release their secretory products into the oral cavity.</td>
</tr>
<tr>
<td>Teeth</td>
<td>Cut, tear, crush, and grind food to begin mechanical digestion.</td>
<td>Sit in sockets (alveoli) located in mandible and maxilla; innervated by branches of trigeminal nerve (CN V); supplied by branches</td>
</tr>
</tbody>
</table>
of the maxillary artery, which branches from the external carotid artery.

Tongue | Is composed of skeletal muscles; helps mix food with saliva; contains taste buds. | Contains chemoreceptors.
Liver | Produces bile, which helps in the digestion of fats. | Stimulated by insulin to convert glucose into glycogen.
Gallbladder | Stores bile. | Supplied by a branch of the celiac trunk.
Pancreas | Produces digestive juices. | Has both endocrine and exocrine components; endocrine pancreas releases insulin directly into the bloodstream; exocrine pancreas releases digestive enzymes into duodenum via pancreatic duct.

2. Describe three ways in which the tongue is structurally adapted to its functions.
   
   **Skeletal muscles permit the movement of food for chewing and mixing and initiate swallowing. Also, the superior surface of the tongue contains filiform papillae, which provide a rough surface that helps break down food.**

3. Describe how the following tooth types are adapted to their functions.
   
   Incisor _shaped to cut food_
   Canine _shaped to tear food_
   Premolars and molars _shaped to crush and grind food_

4. Identify the following tooth structures, and describe the function of each.
   
   Enamel _ceramic-like material that covers and protects the dentin of a tooth’s crown_
   Dentin _protein-rich, bone-like connective tissue that makes up most of the tooth’s structure_
   Periodontal ligament _holds the root of the tooth in the alveolar socket of the maxilla or mandible_
   Cementum _covers the dentin of the root and attaches the tooth to the periodontal ligament_
   Pulp cavity _central cavity filled with blood vessels, lymph vessels, and nerves_
Root canal  _the area of the pulp cavity that extends into the distal root_

5. Locate the three pairs of salivary glands on an anatomical model.
   a. Name each pair of glands and describe its location.
      _Parotid glands are located anterior to the ear and superficial to the masseter muscle; submandibular glands are located medial to the mandible; and sublingual glands are located anterior to the floor of the oral cavity._
      Are these glands classified as endocrine glands or exocrine glands? _exocrine_ Explain. _Each of these glands secretes saliva through ducts._
   b. What is the function of this duct? _It transports saliva to the oral cavity._

6. Identify the liver on an anatomical model.
   a. Use your lecture notes and/or text to briefly describe five functions of the liver.
      _Bile production, used for fat digestion; nutrient storage, such as glucose as glycogen; nutrient interconversion, such as the breakdown of amino acids to produce ATP; detoxification, such as the alteration of drug metabolites to less toxic substances; and synthesis of molecules, such as blood proteins._
   b. What structure separates these two lobes and anchors the liver to the anterior body wall? _falciform ligament_
   c. The gallbladder is located in a depression within which lobe? _quadrate lobe_
   d. Which structures enter or exit the liver at the porta hepatis? _hepatic portal vein and hepatic artery_

7. The cystic duct fuses with the common hepatic duct to form the _common bile duct._
   Name the structures through which bile flows from the point at which it is produced until it reaches the duodenum. _right and/or left hepatic ducts, common hepatic duct, cystic duct, common hepatic duct_

8. Identify the pancreatic duct, and describe its appearance. _The pancreatic duct runs the entire length of the pancreas and connects to the common bile duct just as it enters the duodenum._ What is the function of the pancreatic duct? _It transports digestive juices produced by the pancreas to the duodenum._

Activity 3

1. a. Mucosa
   Tissues: _epithelial tissue, lamina propria, muscularis mucosae_
   Function: _production of mucus for protection of underlying layers; absorption of nutrients_
   b. Submucosa
Two. a. Identify the four layers of the esophageal wall and list them from innermost to outermost. mucosa, submucosa, muscularis externa, fibrous adventitia

b. The mucosa consists of which specific tissue type? stratified squamous epithelium
c. What is the function of these glands? mucus secretion
e. How does the muscularis externa of the inferior one-third of the esophagus differ from that of the superior one-third? The inferior one-third contains smooth muscle only, whereas the superior one-third contains skeletal muscle only.

3.  b. Which specific epithelium type is found in the mucosa? simple columnar epithelium with gastric pits
c. How do these two cell types differ histologically? Mucous neck cells are located near the openings of the glands, whereas the chief cells are in the deeper parts of the glands.
d. Which smooth muscle layer is missing from the alimentary canal wall of other organs? The stomach has an additional inner oblique layer that is not found in the other organs of the alimentary canal.

What effect does this extra layer of smooth muscle have on the churning ability of the stomach?
This allows the stomach to move food in multiple directions during churning in addition to forward in peristalsis.

4.  a. Which specific type of epithelium is found in the mucosa? simple columnar epithelium

What structural characteristic of the epithelial cells increases their surface area? cytoplasmic extensions called microvilli

Name two major functions of these epithelial cells. absorption of nutrients and secretion of enzymes

Name two structures located in the center of a villus and state the function of each. Lacteals are specialized lymphatic capillaries that absorb lipids; intestinal crypts secrete intestinal juice.
b. Note any differences you see between the mucosa of the ileum and the mucosa of the duodenum. *The duodenum has duodenal glands.*
c. What is the function of these structures? *They prevent bacteria from entering the bloodstream.*

5. Examine a cross-section of the large intestine under low power.
   b. What are these cells called? *goblet cells*
c. What is the function of these cells? *to produce mucus*
d. How does the absence of these structures correlate with the function of the large intestine? *The large intestine reabsorbs water and forms feces, but does not function to absorb the majority of nutrients.*

6. a. What is the function of these cells? *to produce saliva*
b. What is the function of these cells? *to produce mucus*
c. Why are salivary glands classified as exocrine glands? *They secrete saliva and mucus through ducts.*
d. Which type of enzyme is secreted by the salivary glands? *carbohydrate-digesting enzymes*

7. b. This area contains a portal triad consisting of which three structures? *a branch of the hepatic artery, a branch of the hepatic portal vein, and a bile duct* 

8. a. What is produced by the acinar cells? *pancreatic juice*.
   Into what structures are these secretory products released? *pancreatic duct*

Answers to Post-Lab Assignments
PART I. Check Your Understanding
Activity 1: Exploring the Organs of the Alimentary Canal
1. Identify the labeled structures.
   a. *liver*
b. *gallbladder*
c. *pancreas*
d. *appendix*
e. *salivary gland*
f. *tongue*
g. *pharynx*
h. *esophagus*
i. *stomach*
j. *small intestine*
k. *large intestine (colon)*
l. *large intestine (rectum)*
2. Name the alimentary canal organ that:

- **stomach** (a.) contains three layers of smooth muscle in the muscularis externa.
- **small intestine** (b.) carries out most of the digestion and virtually all of the absorption in the alimentary canal.
- **large intestine** (c.) contains pockets called haustra.
- **stomach** (d.) initiates the chemical digestion of proteins.
- **stomach** (e.) is separated from the small intestine by the pyloric sphincter.
- **oral cavity** (f.) initiates the chemical digestion of carbohydrates.
- **pharynx** (g.) contains three divisions, one of which lacks a digestive function.
- **small intestine** (h.) has an inner wall thrown into circular folds.
- **stomach** (i.) contains enteroendocrine cells that produce gastrin and somatostatin.
- **oral cavity** (j.) functions in mastication.

3. Which structure:
esophageal sphincter a. controls the passage of food from the esophagus to the stomach?
appendix b. is composed of lymphatic tissue and extends from the cecum?
pyloric sphincter c. controls the movement of chyme into the duodenum?
uvula d. is an extension of the soft palate?
ileocecal valve e. controls the movements of materials from the small intestine to the large intestine?

Activity 2: Exploring the Accessory Organs of the Digestive System
1. Identify the labeled structures.
   a. liver
   b. common bile duct
   c. cystic duct
   d. hepatic duct
   e. gallbladder

2. Name the accessory organ(s) of the digestive system that:
   liver a. stores glucose as glycogen.
   salivary gland b. produces amylase.
   teeth c. contain cementum.
   tongue d. contains numerous filiform papillae.
   tongue e. initiates deglutition.
   pancreas f. secretes enzymes that digest carbohydrates, proteins, lipids, and nucleic acids.
liver g. produces bile.

3. Which tooth type(s) is(are) adapted for:
canines a. tearing and piercing?
premolars and molars b. grinding and crushing?
incisors c. biting?

4. Bile is produced by liver cells, or hepatocytes, and enters small canals called bile canaliculi. It then leaves the liver through many smaller hepatic ducts that eventually fuse to form the large common hepatic duct. That duct fuses with the cystic duct, which transports bile from the gallbladder to form the common bile duct, which then transports bile to the duodenum.

Activity 3: Examining the Histology of Selected Digestive Organs

1. Name the predominant specific tissue type in each of the following layers of the alimentary canal wall.
a. Mucosa: _simple columnar epithelium_
b. Muscularis: _smooth muscle_
c. Submucosa: _areolar connective tissue_
d. Serosa: _simple squamous epithelium_

2. Which layer of the alimentary canal wall:
   _muscularis_ a. functions in movements of the digestive tract?
   _submucosa_ b. carries away absorbed nutrients?
   _mucosa_ c. secretes enzymes and absorbs nutrients?
   _serosa_ d. is the visceral peritoneum?

3. In what way is the anatomy of the duodenal mucosa structurally adapted for the secretion of enzymes and the absorption of nutrients? _finger-like projections called villi lined with columnar epithelial cells containing microvilli to increase surface area_

4. From which digestive organ was this tissue taken? _salivary gland_

   Identify the labeled structures in the photomicrograph.
a. _duct_
b. _serous acini_
c. _mucous acini_
5. From which digestive organ was this tissue taken? **small intestine**

Identify the labeled structures in the photomicrograph.

a. *mucosa* (layer)
b. *submucosa* (layer)
c. *muscularis* (layer)
d. *serosa* (layer)
e. *villi*
f. *duodenal glands*
PART II. Putting It All Together
A. Review Questions
Answer the following questions using your lecture notes, your textbook, and your lab notes.

1. Identify the specific part of the alimentary canal or the digestive system accessory organ in which each of the following structures is found.
   - oropharynx a. palatine tonsils
   - cecum b. vermiform appendix
   - small intestine c. microvilli
   - small intestine d. circular folds
   - stomach e. enteroendocrine cells
   - small intestine f. Peyer’s patches
   - liver g. portal triad
   - liver h. sinusoids
   - liver i. falciform ligament

2. Explain why acid reflux into the esophagus damages the esophageal wall and causes pain, whereas gastric juice does not typically irritate the stomach lining. The stomach lining is protected by a layer of mucus whereas the esophagus is not

3. Predict the effect of the removal of the gallbladder on the digestion of fats. It will take longer to digest fats.

4. Jesse, a 7-week-old baby, is experiencing frequent projectile vomiting. An MRI reveals a thickening of the pyloric sphincter and a full stomach, even though it has been hours since he was last fed. What problem is the thickened pyloric sphincter causing? Food is not passing from the stomach to the small intestine.

5. How are the epithelial linings of the esophagus, stomach, and small intestine structurally adapted for their specific functions? esophagus – many layers for protection; stomach – highly specialized cells that release HCL, enzymes, mucous, and hormones; small intestine – villi/microvilli to increase surface area for secretion of enzymes and absorption of nutrients.