

SI A&P - Full Discipline Demo - Digital

The Digestive System - No Materials

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI A&P - Full Discipline Demo - Digital
Course	SI A&P - Full Discipline Demo - Digital
Instructor	Sales SI Demo

Test Your Knowledge

Match each term to the best description

⚙ Amylase	Mechanical and chemical breakdown of food	1
⚙ Digestion	Throat area that receives the food from the mouth after swallowing	2
⚙ Pepsin	Site of the majority of nutrient absorption into the bloodstream	3
⚙ Pharynx	Enzyme released by stomach that hydrolyzes proteins	4
⚙ Small intestine	Enzyme that breaks down starches into sugar	5

Correct answers:

1 Digestion 2 Pharynx 3 Small intestine 4 Pepsin 5 Amylase

Sequence the four main layers of the gastrointestinal (GI) tract wall from the innermost layer (top) to the outermost layer (bottom).

≡ Serosa	
1	Correct answer: Mucosa
≡ Mucosa	
2	Correct answer: Submucosa
≡ Muscularis externa	
3	Correct answer: Muscularis externa
≡ Submucosa	
4	Correct answer: Serosa

Exploration

_____ is the active or passive transfer of substances from the lumen of the GI tract into the body.

☐ Motility	
☐ Excretion	
☐ Secretion	
☒ Absorption	✓

The first section of the large intestine is called the _____.

☐ colon	
☒ cecum	✓
☐ sigmoid	
☐ duodenum	

In the intestine, ____ cells secrete mucus into the lumen.

- ☐ foveolar
- ☒ goblet ✓
- ☐ lamina
- ☐ serosa

The darker-colored cells of the pancreas are the acinar cells that produce various digestive enzymes.

- ☒ True ✓
- ☐ False

Amylase (α -amylase) is an enzyme released by both the salivary glands and the pancreas that breaks down ____.

- ☐ lipids
- ☐ proteins
- ☐ nucleic acids
- ☒ starches ✓

Exercise 1

Why are goblet cells necessary for GI tract function? Was there a difference in the amount of goblet cells in the stomach, duodenum, ileum, and large intestine? Explain why this difference occurs or does not occur.

Goblet cells secrete mucus which allow the food to pass through the digestive tract more smoothly. There was a difference between specific regions of the digestive tract. For example, the stomach has no goblet cells while the duodenum, ileum, and large intestine have many. Not only does the stomach need mucus, but it actually has cells called foveolar cells that secrete mucus to protect the lining of the stomach from harsh contents.

Which type of cell is present in most of the pancreatic tissue, endocrine or exocrine? Explain your answer by referencing Photo 5.

The pancreas is composed mostly of the exocrine cells, specifically the acinar cells. These stain darker than endocrine cells and are much more abundant on the slide.

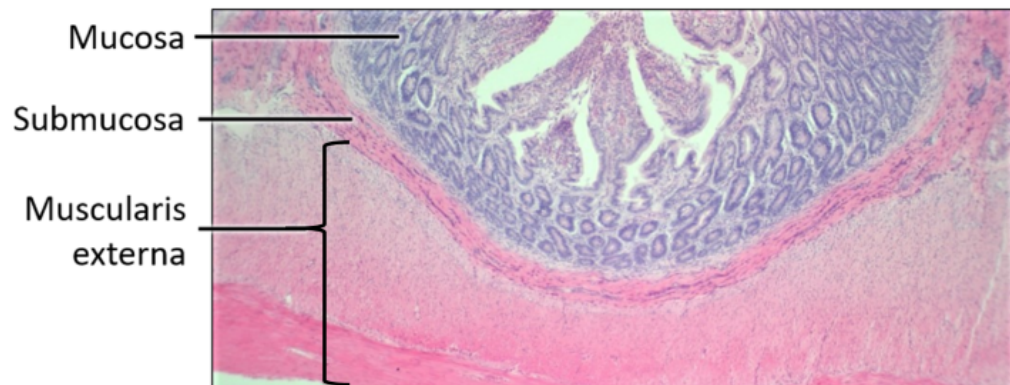
List the four main layers of the GI wall. What is the composition of each layer?

1) **Mucosa**, composed of connective tissue, columnar cells, small blood vessels, and lymph vessels. 2) **Submucosa**, composed of connective tissue and larger blood and lymph vessels. 3) **Muscularis externa**, composed mainly of smooth muscle. 4) **Serosa**, which consists of connective tissue, and is the membrane lining the abdominal cavity, extends into the mesentery.

What are the main functions of the duodenum? How is this reflected in the structure of the duodenal wall?

The main functions of the duodenum include digestion and absorption. The duodenum has villi and microvilli that increase the surface area significantly for digestion and absorption.

Photo 1: Duodenum - All Four Layers
(SAMPLE ANSWER BELOW)





Data Table 1: Microscopic Examination of the Digestive System
(SAMPLE ANSWER BELOW)

Structure	Magnification	Characteristics	Comments
Duodenum - All Four Layers	60X	This slide shows four distinct layers. The mucosa extends out into villi.	Students will only answer here if they could not identify and label required structures
Duodenum - Mucosa	600X	The mucosa appears as narrow villi comprised of single rows of simple columnar cells and periodic goblet cells.	Students will only answer here if they could not identify and label required structures
Stomach - All Four Layers	60X	This slide shows four distinct layers.	Students will only answer here if they could not identify and label required structures
Stomach -	600X	The mucosa of the stomach contains gastric	Students will only

Mucosa		pits that are lined with foveolar cells. The layer of foveolar cells is surrounded by a layer of simple columnar cells.	answer here if they could not identify and label required structures
Pancreas	600X	The tissue can be distinguished by the darker acinar cells and the lighter islet.	Students will only answer here if they could not identify and label required structures

Photo 2: Duodenum - Mucosa
(SAMPLE ANSWER BELOW)

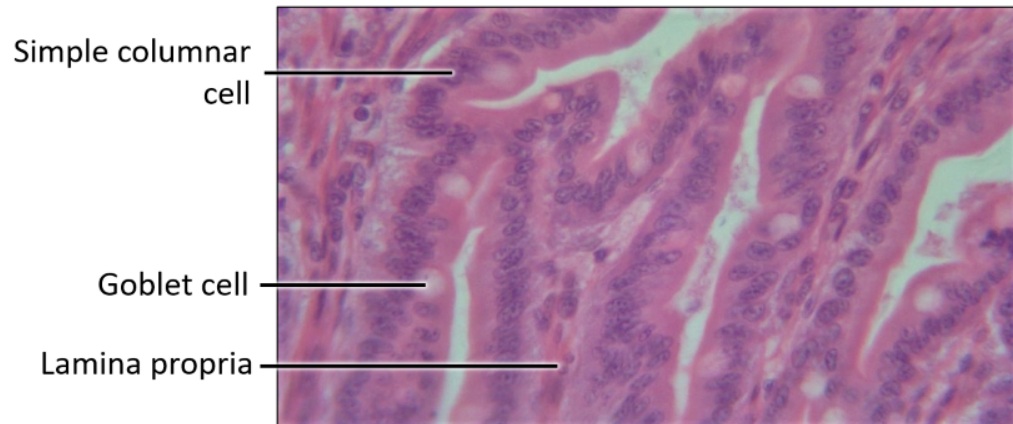


Photo 3: Stomach - All Four Layers
(SAMPLE ANSWER BELOW)

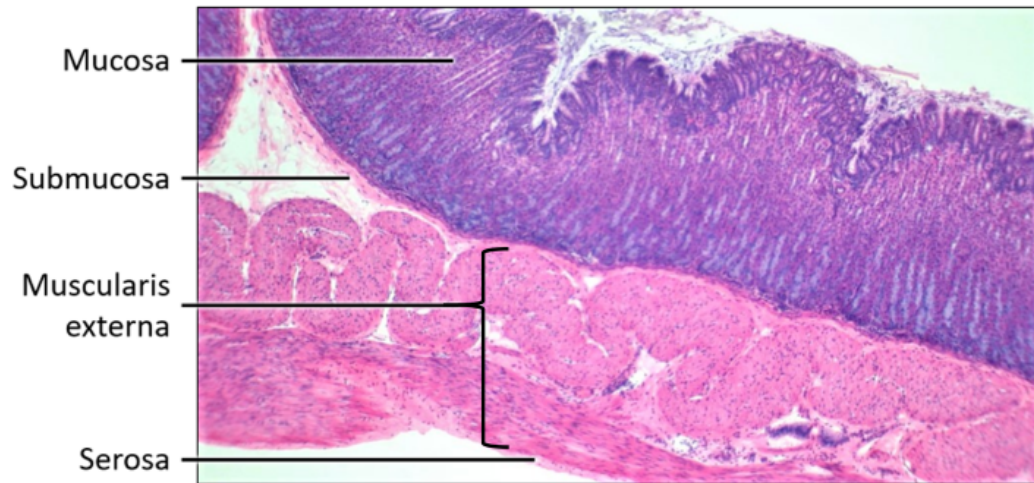


Photo 4: Stomach - Mucosa
(SAMPLE ANSWER BELOW)

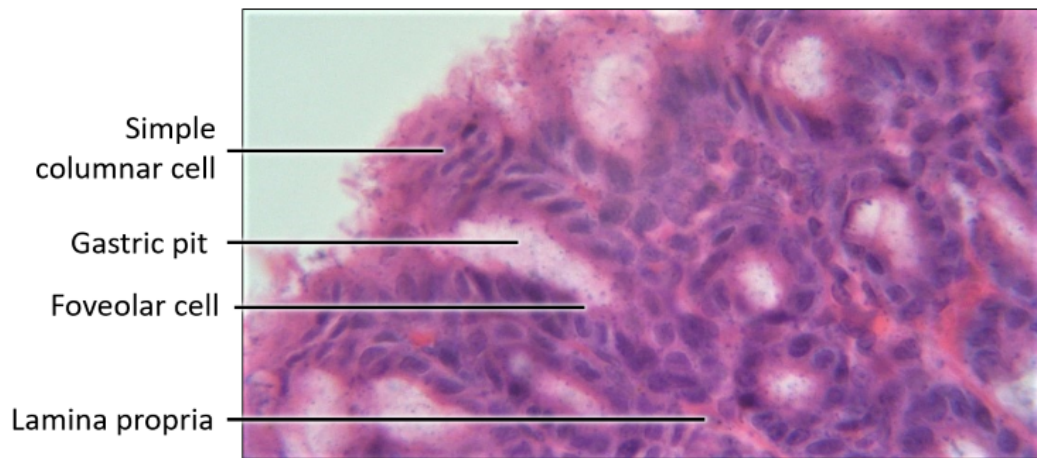
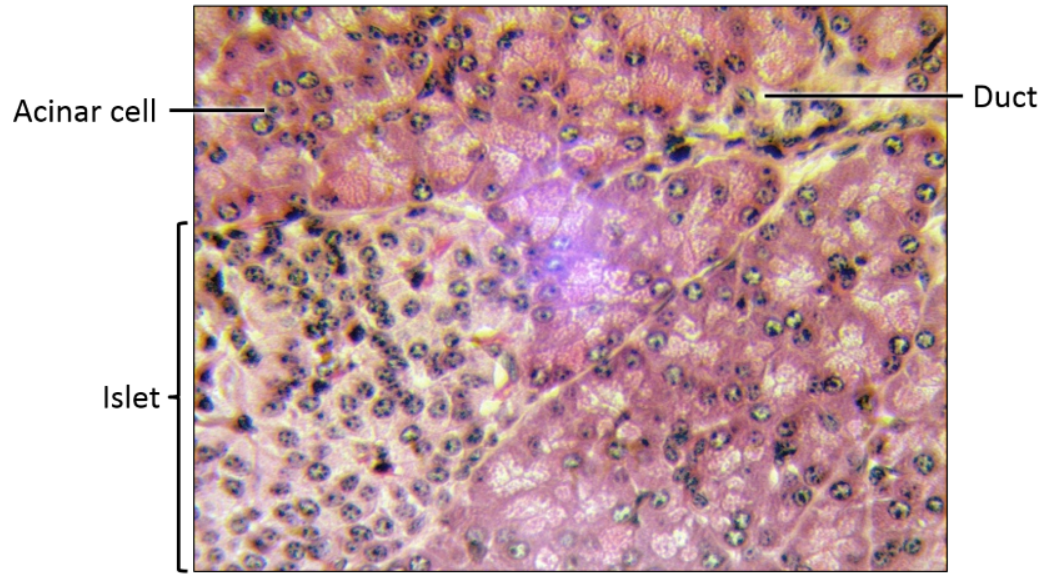


Photo 5: Pancreas

(SAMPLE ANSWER BELOW)



Exercise 2

How does the pharynx labeled in Photo 6 function in the digestive system?

The pharynx, or throat, receives the food from the mouth after swallowing and transfers it to the esophagus.

How is the gallbladder labeled in Photo 7 positioned in relation to the liver. How is the position related to the function of the gall bladder?

The gallbladder is positioned immediately below the liver and functions to store bile which is produced by the liver.

Photo 6: Virtual Model Mouth
(SAMPLE ANSWER BELOW)

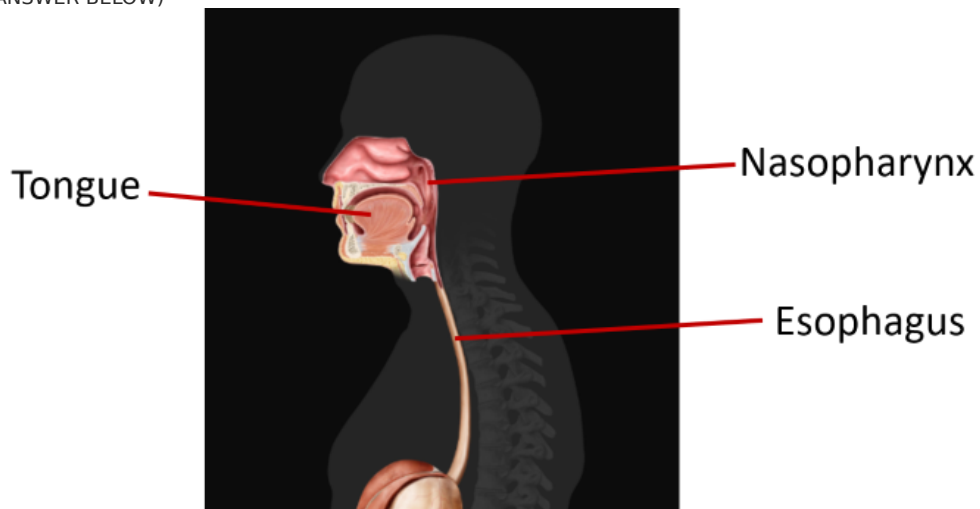
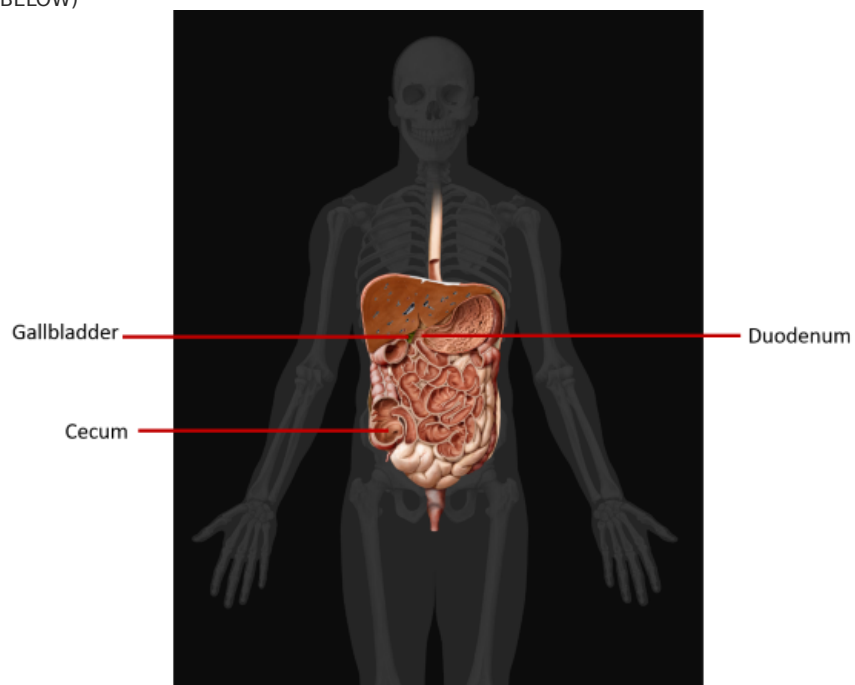


Photo 7: Virtual Model Abdomen
(SAMPLE ANSWER BELOW)



Exercise 3

How did the enzyme amylase affect the digestion of the cracker in Part 1 of this exercise? Reference your results in Data Table 2 and the occurrence of amylase in the human body.

α -amylase resulted in the digestion of the cracker by breaking down starches into sugars which produced the higher glucose readings recorded in Data Table 2. The enzyme was most effective at 37 °C, the temperature of the human body. α -amylase is found in saliva, where it begins digestion of the starches in the mouth.

What is the significance of using a warm water bath that is 37°C in parts 1 and 3 of this exercise? How does this temperature affect the activity of the enzymes tested for the digestion of carbohydrates and fats?

The warm water bath is approximately temperature of the human body. The enzymes used in parts 1 and 3 performed most efficiently in the warm water bath as recorded in Data Tables 2 and 4.

How does the digestion of fats alter the pH of a solution? How was this observed during the procedures of part 3 of this exercise?

The digestion of fats results in the lowering of the pH of a solution. In part 3 of this exercise, the cream solution turned a lighter color as fat digestion progressed because the triglycerides in the cream were broken down into acidic substances (free fatty acids) resulting in the pH indicator phenolphthalein turning from pink to clear.

What is the relationship between bile salts and pancreatin in the digestion of lipids? Reference your results recorded in Data Table 4 in your answer.

Bile salts act as an emulsifier that suspends lipid molecules in solution. Pancreatin is an enzyme that breaks down lipid molecules. The breakdown of the fat molecules occurs more quickly when they are emulsified. The results recorded in Data Table 4 support the actions of bile salts and pancreatin as the test tubes containing both bile salts and pancreatin turned white more quickly than those containing only pancreatin at similar temperatures. All tubes lacking pancreatin remained pink, indicating that only pancreatin was responsible for breaking down the lipids in the cream.

What role did the HCl and pepsin play in digestion of protein in Part 2 of this exercise? How do these results correlate with where these compounds are produced in the human body?

HCl created an acid solution which is required for the enzyme pepsin to digest proteins. Without the addition of HCL, pepsin alone failed to digest the egg white in part 2 of this exercise as recorded in Data Table 3. Both HCl and pepsin are found in the gastric juice produced in the stomach where protein digestion occurs.

How did your prediction for each part of this exercise align with your results? Reference Predictions 1-3 and Data Tables 2-4 in your explanation.

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Data Table 2: Carbohydrate Digestion
(SAMPLE ANSWER BELOW)

Test Tube	Treatment	Initial Measurement	Final Measurement
A37	Amylase solution at 37°C	0 g/dL	250 g/dL
A	Amylase solution at Room Temperature	0 g/dL	100 g/dL
DW37	Distilled Water at 37°C	0 g/dL	0 g/dL
DW	Distilled Water at Room Temperature	0 g/dL	0 g/dL

Prediction 1: Carbohydrate Test
(SAMPLE ANSWER BELOW)

Students should predict a higher level of glucose in the A and A37 test tubes as they contain amylase, which breaks down starch into glucose. Students may also identify that there will be an even higher amount of glucose in the A37 test tube as amylase is an enzyme that functions best at the human body's natural temperature.

Prediction 2: Protein Test
(SAMPLE ANSWER BELOW)

Students should expect to see digestion in the test tubes containing pepsin.

Data Table 3: Protein Digestion
(SAMPLE ANSWER BELOW)

Test Tube	Treatment	Observations	Conclusions
DW	Distilled Water	Sample remained constant at both time intervals	No digestion
DWP	Distilled Water, Pepsin	Sample remained constant at both time intervals	No digestion
DWHCl	Distilled Water, Hydrochloric acid	Sample remained constant at both time intervals	No digestion
PHCl	Pepsin, Hydrochloric acid	Sample slightly smaller after 24 hours, Sample almost completely dissolved after 48 hours.	Digestion occurred

Prediction 3: Lipid Digestion
(SAMPLE ANSWER BELOW)

Students should predict that lipid digestion will occur in the test tubes containing pancreatin powder and that digestion will occur more quickly at 37C.

Data Table 4 : Color Change Over Time
(SAMPLE ANSWER BELOW)

Test Tube	Treatment	Initial Color	2 Minutes	4 Minutes	6 Minutes	8 Minutes	10 Minutes	12 Minutes
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1	Distilled Water at Room Temperature	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink
2	Distilled Water at 37°C	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink
3	Distilled Water and Bile Salts at Room Temperature	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink
4	Distilled Water and Bile Salts at 37°C	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink	Dark Pink
5	Bile Salts and Pancreatin at Room Temperature	Dark Pink	Medium Pink	Light Pink	White	White	White	White
6	Bile Salts and Pancreatin at 37°C	Dark Pink	White	White	White	White	White	White
7	Pancreatin at Room Temperature	Dark Pink	Dark Pink	Medium Pink	Medium Pink	Medium-light Pink	Medium-light Pink	Light Pink
8	Pancreatin at 37°C	Dark Pink	Medium Pink	Medium-light Pink	Light Pink	white	White	White

Exercise 4

What are the three sections of the small intestine? What is the function of each?

The three sections of the small intestine are the duodenum, the jejunum, and the ileum. The duodenum is where chemicals such as bile are introduced for chemical digestion. The jejunum is where chemical digestion and the majority of nutrient absorption takes place. The ileum is where some nutrient absorption takes place.

What role do the salivary glands play in the digestive system?

The salivary glands release saliva into the mouth. The amylase in the saliva starts chemical digestion of carbohydrates in the mouth.

What is the function of the gallbladder? How does the gall bladder removal affect an individual?

The gallbladder stores bile which emulsifies fats (hydrophobic), allowing them to mix with hydrophilic solutions. The liver synthesizes and continually secretes bile, so the gallbladder makes the process more efficient because it stores the extra bile until the body needs it. Without the gallbladder, the liver can still produce bile, but the efficiency of getting bile to the GI tract is slower. An individual who has had their gallbladder removed must eat a diet that is relatively low in fat.

Photo 8: Digestive System Organs in the Abdominal Cavity - Part 1
(SAMPLE ANSWER BELOW)

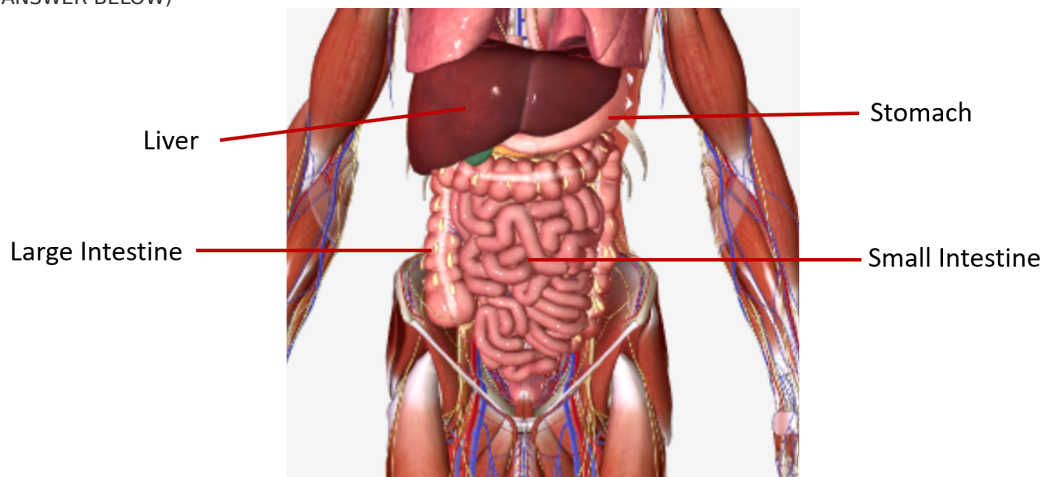


Photo 9: Digestive System Organs in the Abdominal Cavity - Part 2
(SAMPLE ANSWER BELOW)

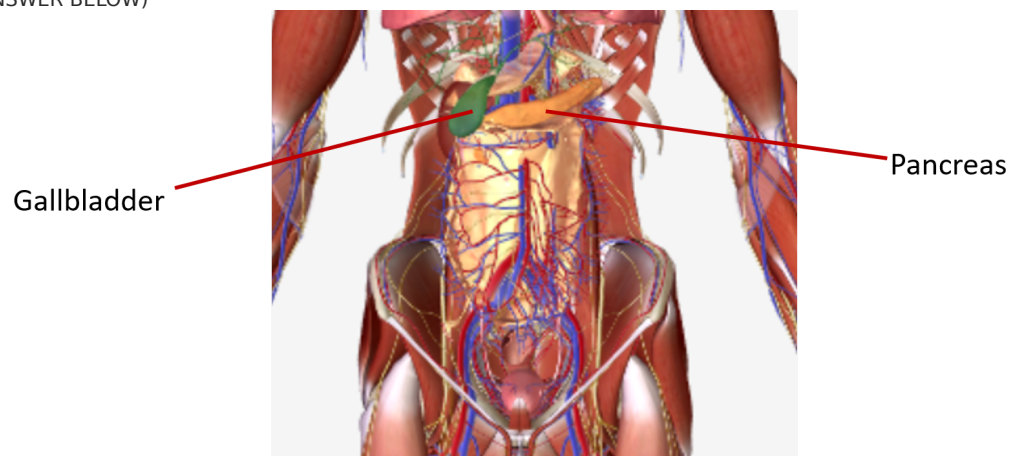


Photo 10: Salivary Glands
(SAMPLE ANSWER BELOW)

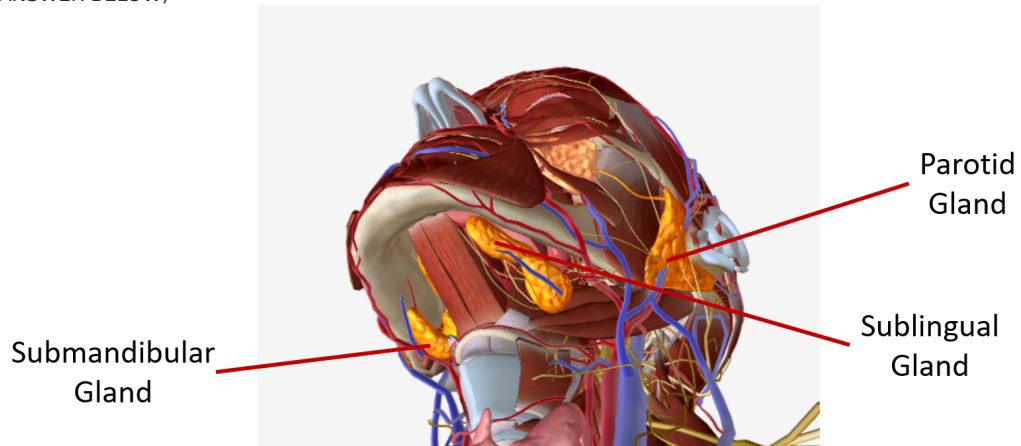
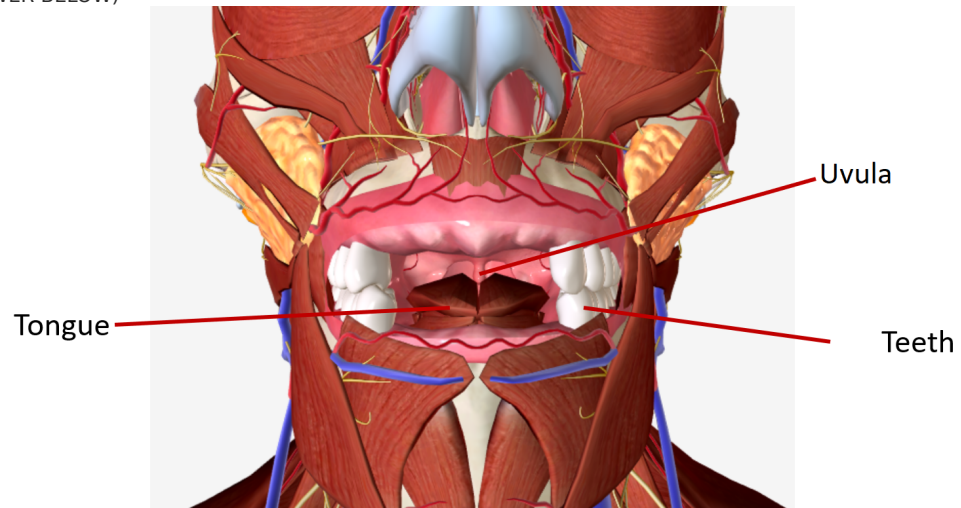


Photo 11: Mouth Anatomy
(SAMPLE ANSWER BELOW)



Competency Review

Food enters the digestive system and digestion begins in the ____.

☐ stomach

☒ mouth

☐ esophagus

☐ intestine



Hydrochloric acid secreted in the stomach lowers the pH of chyme.

☒ True

☐ False



The basic structure of the GI wall consists of ____ main layers.

☐ two

☐ three

☒ four

☐ five



Exocrine functions of the pancreas include producing and releasing several enzymes needed for the digestion of carbohydrates, proteins, and lipids.

☒ True

☐ False

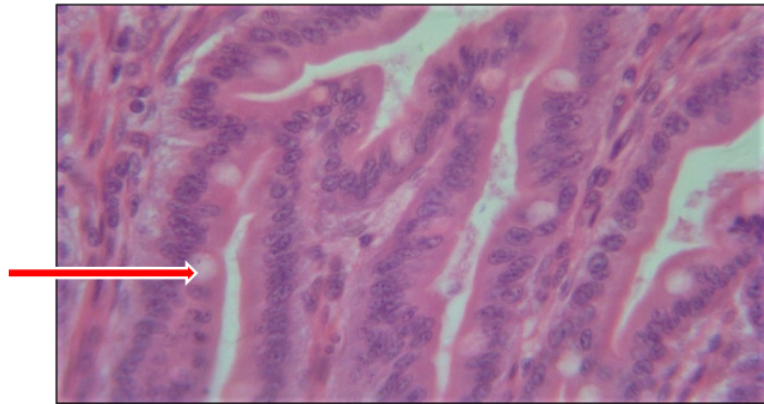


____ allows fat and water to mix in the intestine.

- ☐ Amylase
- ☒ Bile
- ☐ Pepsin
- ☐ Lipase

✓

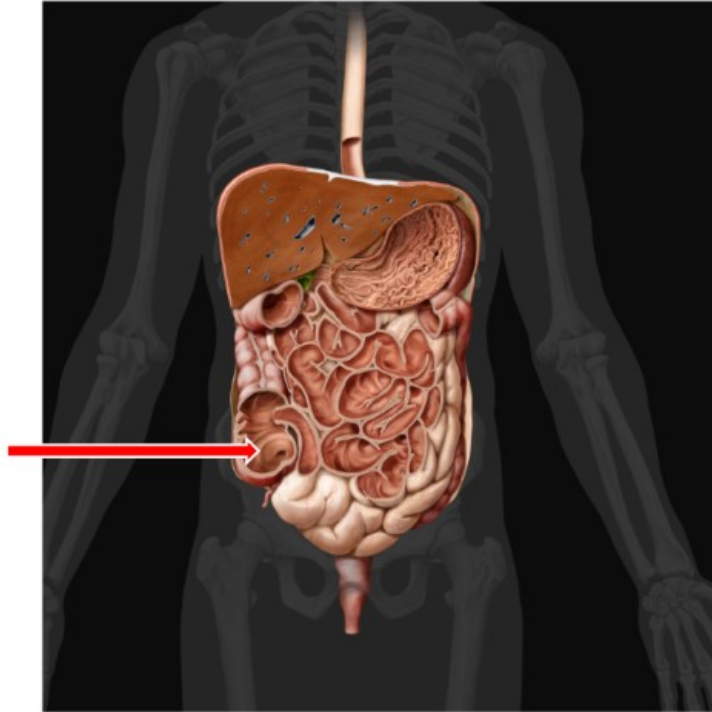
A(n) ____ cell is indicated by the red arrow in the micrograph of duodenal tissue at 600x magnification below.



- ☐ acinar
- ☐ foveolar
- ☒ goblet
- ☐ simple columnar

✓

The ____ is indicated by the red arrow in the image of the virtual model below.



- ☐ cecum
- ☐ duodenum
- ☐ gallbladder
- ☐ esophagus

✓

The enzymes α -amylase and pancreatin function more effectively at 37°C than at room temperature.

- ☐ True
- ☐ False

✓

Extension Questions

The lower esophageal sphincter forms a barrier to prevent stomach acid and digestive enzymes from entering the esophagus. Apply your knowledge of these compounds to explain why dysfunction of the lower esophageal sphincter would be harmful to the esophagus, pharynx, and mouth. (SAMPLE ANSWER BELOW)

If the lower esophageal sphincter does not close all the way or if it opens too often, stomach acid can move into the esophagus. This is called acid reflux. This causes discomfort and/or a burning sensation as the gastric acids and digestive enzymes damage the cells of the esophagus, pharynx,

and even the mouth. If acid reflux occurs often enough, it can result in significant damage to these areas.