SI A&P - Full Discipline Demo - Fetal Pig

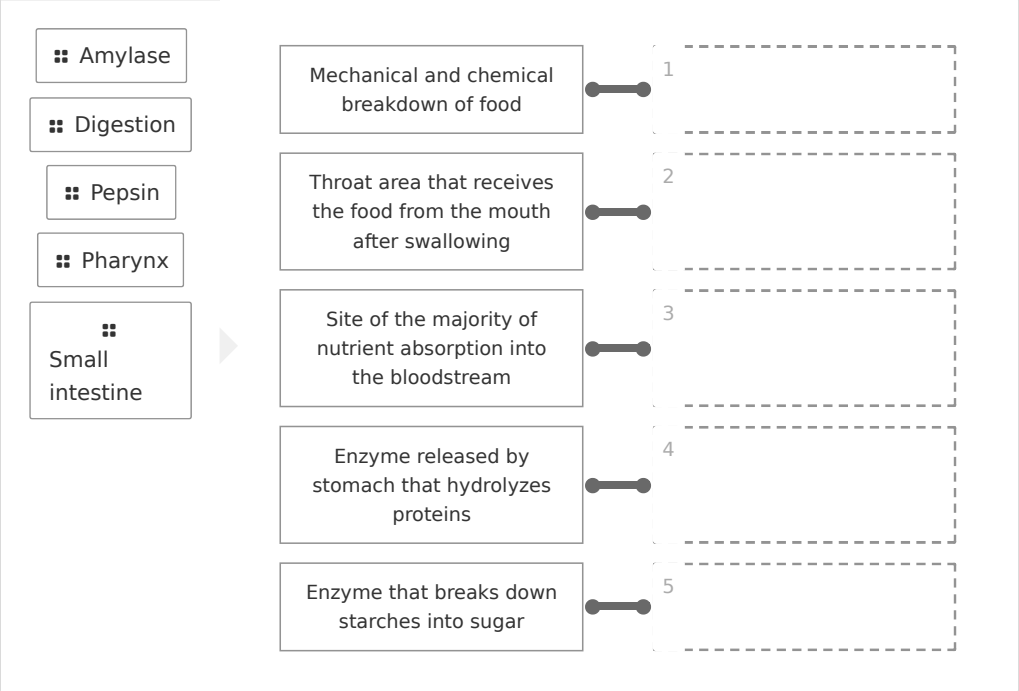
The Digestive System

Final Report - Answer Guide

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

Test Your Knowledge

Match each term to the best description



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 _____ comprise the oral cavity.

- gums
- teeth
- openings of the salivary glands
- All of the above ✔

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

What is the function of foveolar and goblet cells? How did these cells differ in appearance in the stomach, duodenum, ileum, and large intestine? Reference Photos 2 and 4 and Figure 8 in your explanation.

Foveolar (stomach) and goblet cells (intestines) secret mucus which protects the lining of the stomach and aids in the passage of food through the intestines. Foveolar cells line the gastric pits of the stomach tissue as captured in Photo 4. Goblet cells appear as white ovals in the intestine epithelium as captured in Photo 2 and as shown in Figure 8.

Which type of cell is most numerous in pancreatic tissue, endocrine or exocrine? What is the primary function of this cell type? Reference Photo 5 in your explanation.

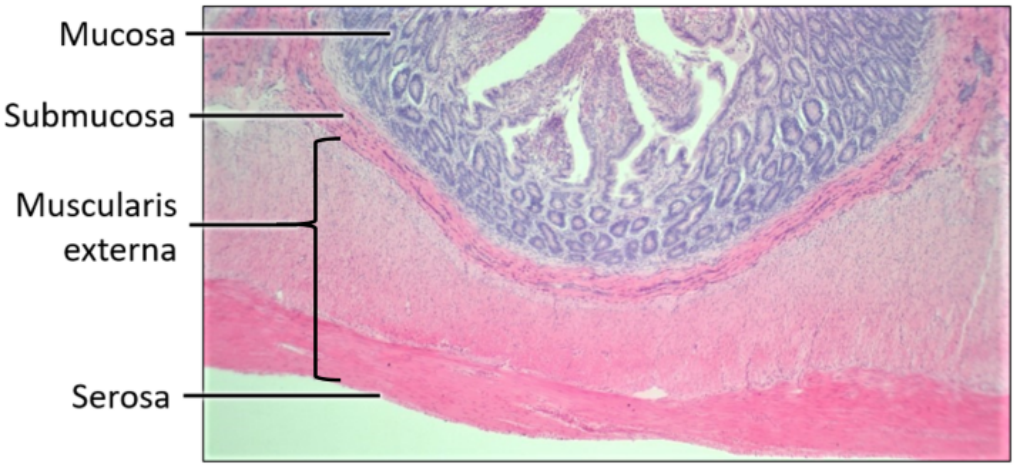
The pancreas is composed mostly of darkly stained exocrine cells, the acinar cells, as captured in Photo 5. Acinar cells secrete digestive enzymes.

What are the main functions of the duodenum? How is this reflected in the structure of the duodenal wall? Reference Photo 1 in your explanation.

The duodenum functions include both digestion and absorption. Both bile, produced by the liver, and a combination of pancreatic enzymes mixed with bicarbonate, released by the pancreas, are excreted into the duodenum, aiding in chemical digestion. The duodenal wall consists of four layers as captured in Photo 1. The mucosa is lined with columnar cells and mucus secreting cells. Under the columnar cells, there is a layer called the lamina propria containing connective tissue, small nerve fibers, and small blood vessels for absorption of nutrients, small lymph vessels, and immune cells. A thin layer of smooth muscle (muscularis mucosae) is external to the mucosa, which can contract to alter the surface area of the outer villi (projections) and invaginations. The submucosa contains connective tissue and larger blood and lymph vessels that supply the cells of the mucosal layer. The muscularis externa has two layers of smooth muscle, one that runs longitudinally and one that is circular. The muscularis externa aids in mixing and moving substances through the digestive system by a series of muscle contractions and relaxations called peristalsis. Finally, the serosa is connective tissue that is a continuation of the peritoneal membrane that lines the abdominal cavity.

Photo 1: Duodenum - All Four Layers

(SAMPLE ANSWER BELOW)



Data Table 1: Microscopic Examination of the Digestive System

(SAMPLE ANSWER BELOW)

Structure	Magnification	Comments

Duodenum - All Four Layers	60X	Students will only answer here if they could not identify and label required structures
Duodenum - Mucosa	600X	Students will only answer here if they could not identify and label required structures
Stomach - All Four Layers	60X	Students will only answer here if they could not identify and label required structures
Stomach - Mucosa	600X	Students will only answer here if they could not identify and label required structures
Pancreas	600X	Students will only answer here if they could not identify and label required structures

Photo 2: Duodenum - Mucosa
(SAMPLE ANSWER BELOW)

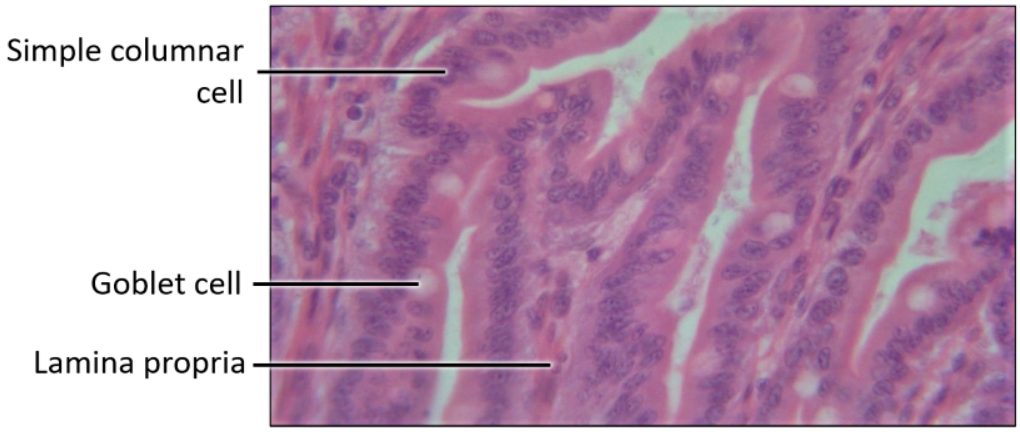


Photo 3: Stomach - All Four Layers
(SAMPLE ANSWER BELOW)

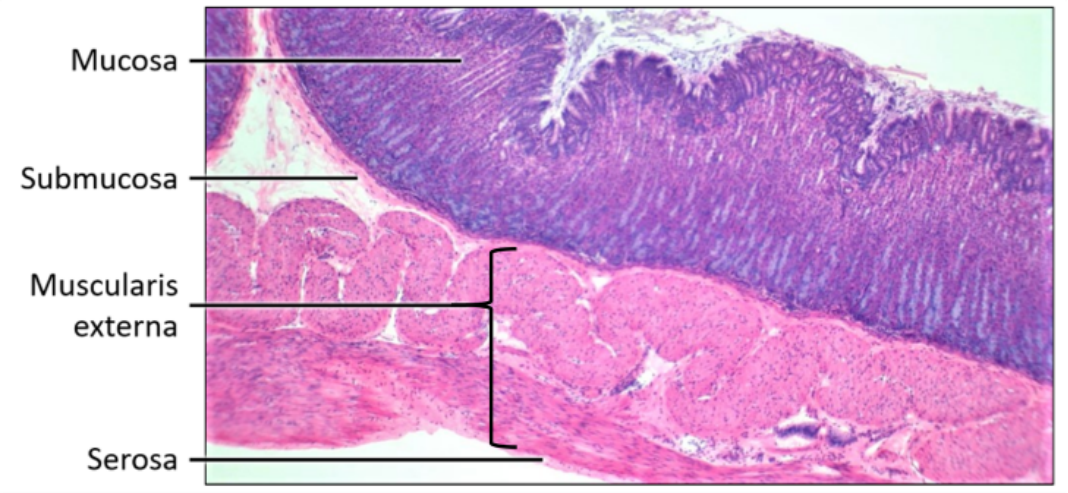


Photo 4: Stomach - Mucosa

(SAMPLE ANSWER BELOW)

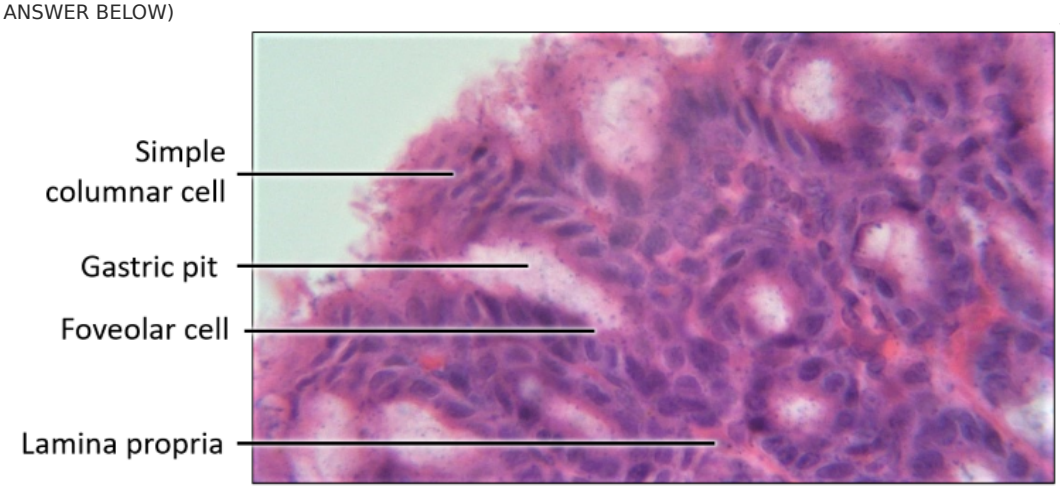
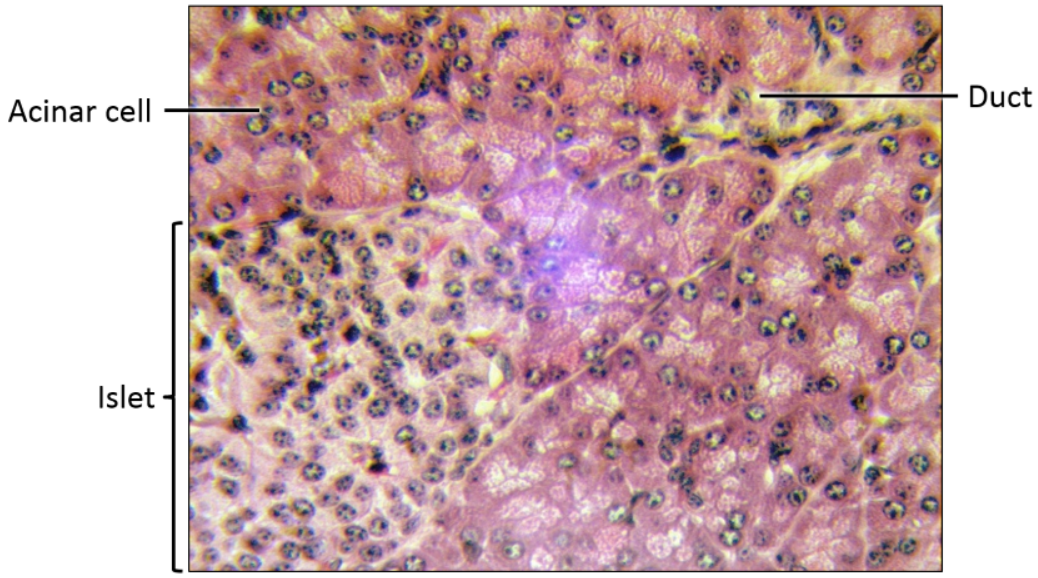


Photo 5: Pancreas
(SAMPLE ANSWER BELOW)



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)

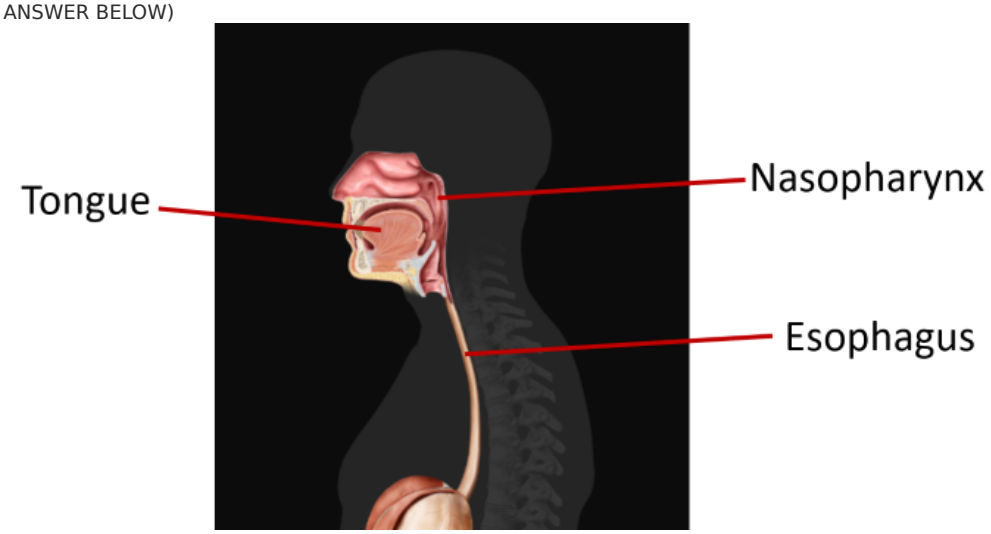
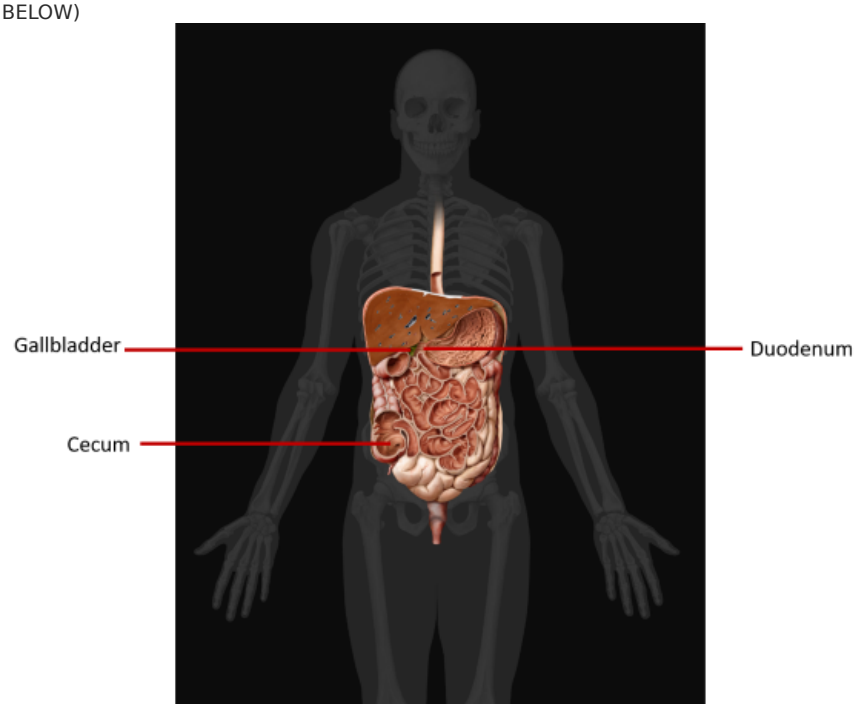


Photo 7: Virtual Model Abdomen
(SAMPLE ANSWER BELOW)



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 predict albumin digestion in the test tube containing both pepsin and HCl.

Data Table 3: Protein Digestion
(SAMPLE ANSWER BELOW)

Test Tube	Treatment	24 hrs	48 hrs
DW	Distilled Water	Sample original size	Sample original size
DWP	Distilled Water, Pepsin	Sample original size	Sample original size
DWHCl	Distilled Water, Hydrochloric acid	Sample original size	Sample original size
PHCl	Pepsin, Hydrochloric acid	Sample slightly smaller.	Sample almost completely dissolved

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
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

Describe the appearance and functions of the rugae in the stomach as labeled in Photo 10.

The rugae appear as folds in the lining of the stomach. They increase the ability to stretch the stomach, which allow for storage of food before it goes to the small intestine.

Which organ comprised most of the length of the gastrointestinal tract of the fetal pig? What does the length suggest about the function of the organ? Reference Photos 8-9 in your explanation.

The small intestine made up the majority of the length of the gastrointestinal tract of the fetal pig as labeled in Photos 8-9. The small intestine in the primary site for digestion and absorption of food and nutrients in the fetal pig.

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

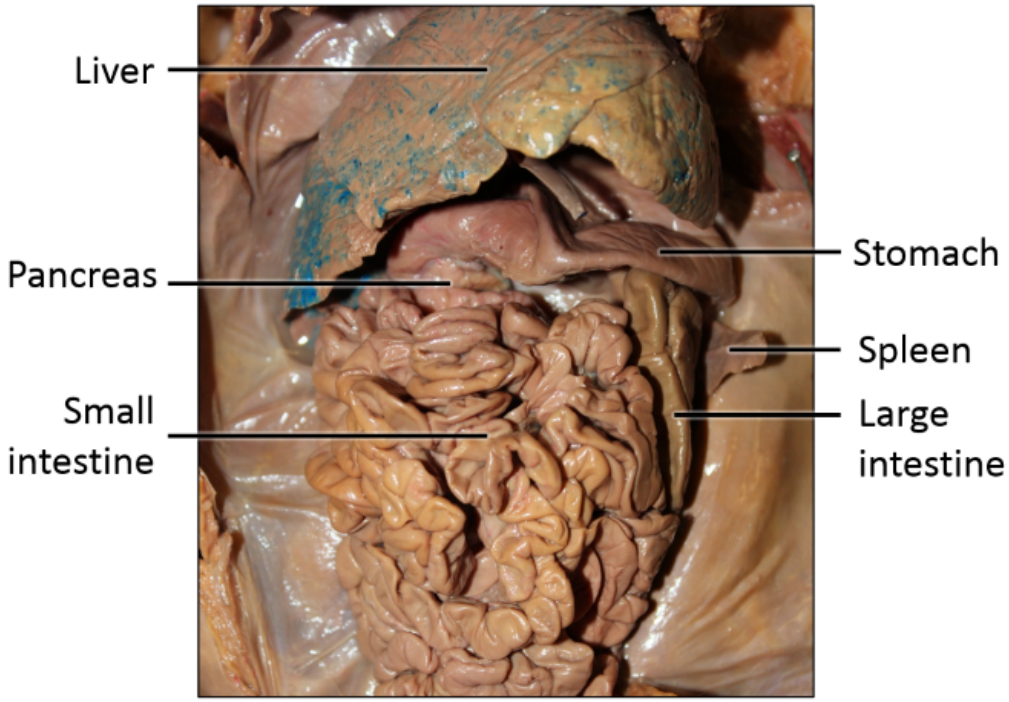
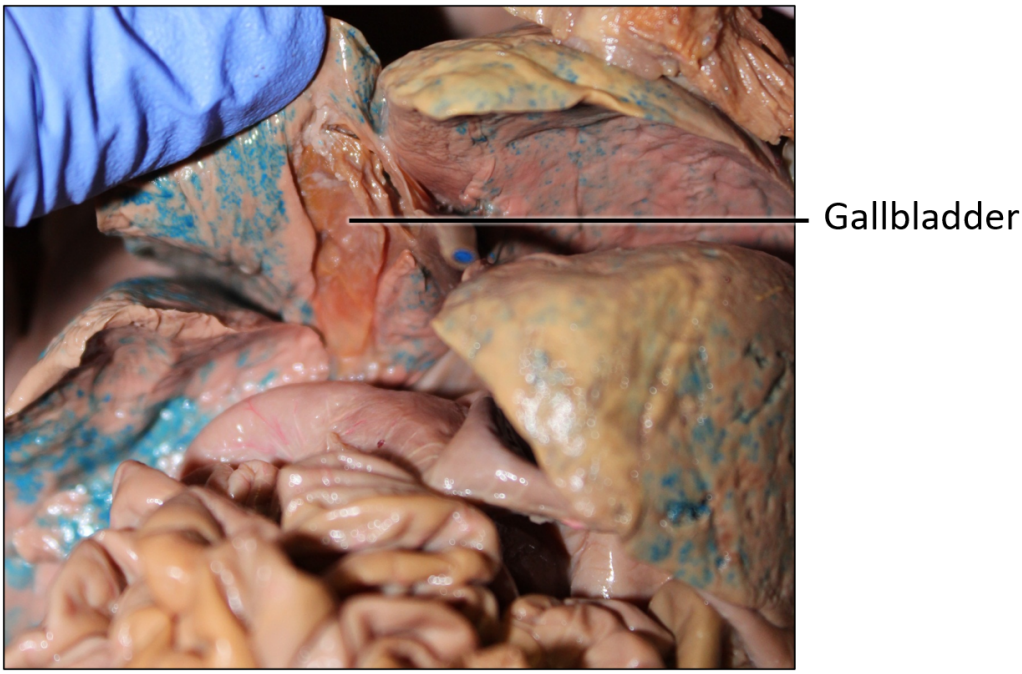


Photo 9: Digestive System Organs in the Abdominal Cavity - Part 2
(SAMPLE ANSWER BELOW)



Data Table 5: Digestive System Comments

(SAMPLE ANSWER BELOW)

Structure(s)	Comments
Digestive System Organs in the Abdominal Cavity	Comments will only be included if students were unable to locate the structure.
Inside of the Stomach	Comments will only be included if students were unable to locate the structure.
Salivary Glands	Comments will only be included if students were unable to locate the structure.
Mouth Anatomy	Comments will only be included if students were unable to locate the structure.

Photo 10: Inside of the Stomach

(SAMPLE ANSWER BELOW)

Photo 11: Salivary Glands
(SAMPLE ANSWER BELOW)

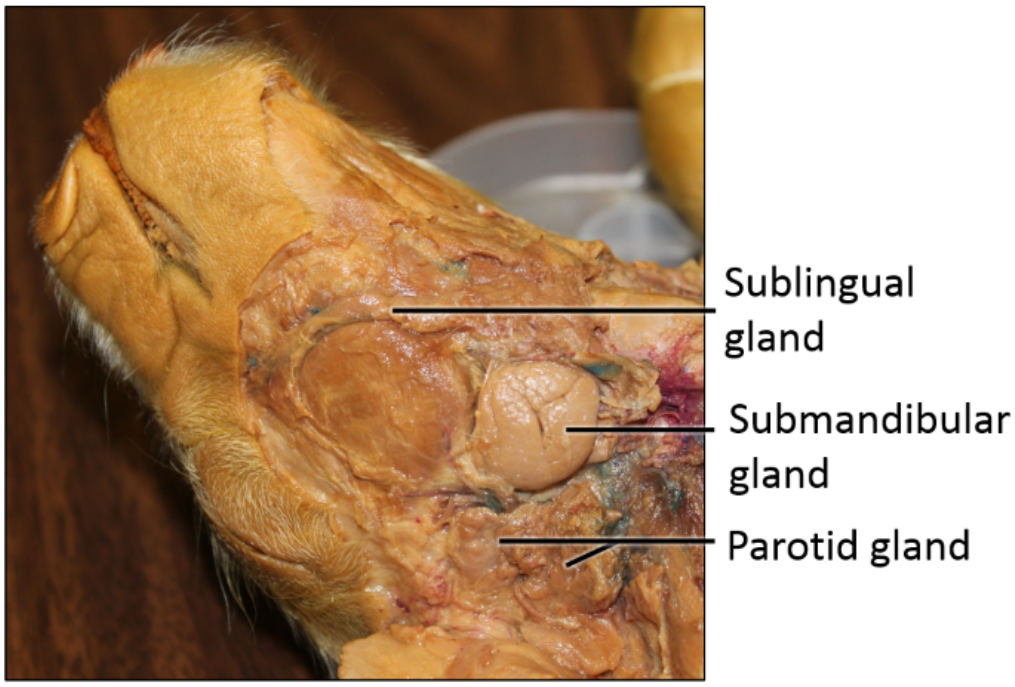
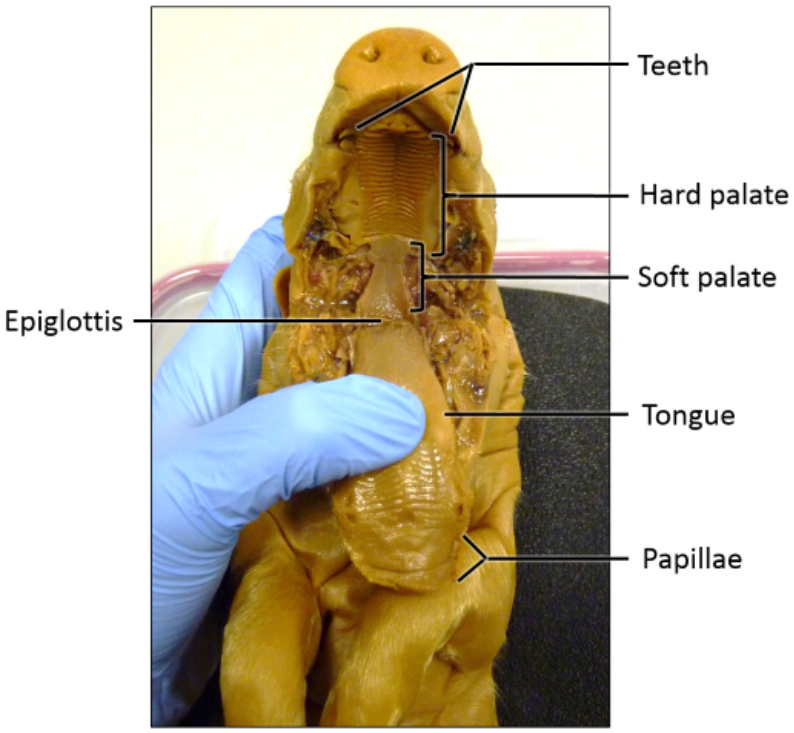


Photo 12: Mouth Anatomy
(SAMPLE ANSWER BELOW)



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

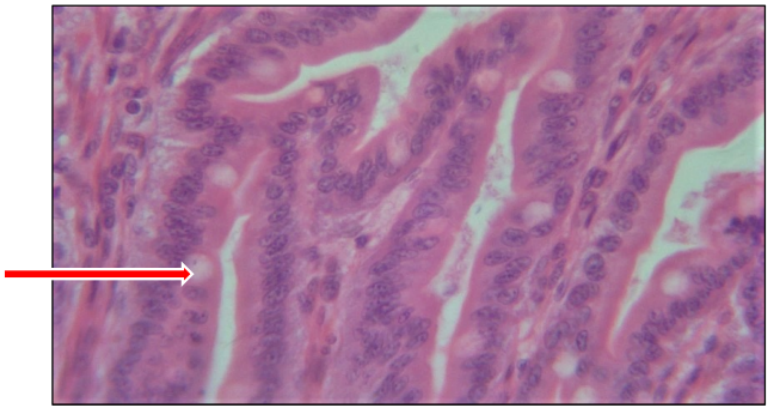
Exocrine functions of the pancreas include producing and releasing several enzymes needed for the digestion of carbohydrates, proteins, and lipids.

- True ✔
- False

____ allows fat and water to mix in the intestine.

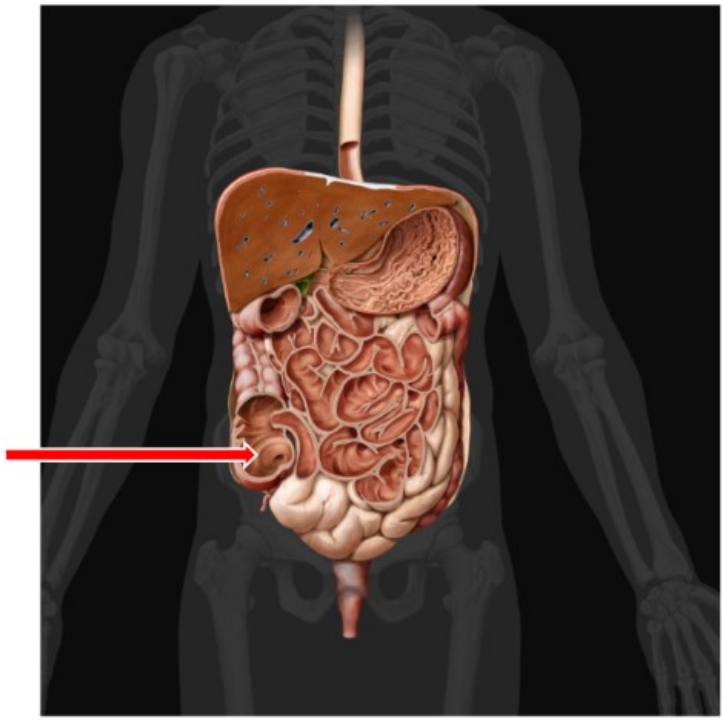
- Amylase
- Bile ✔
- Pepsin
- Lipase

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 37ºC 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.