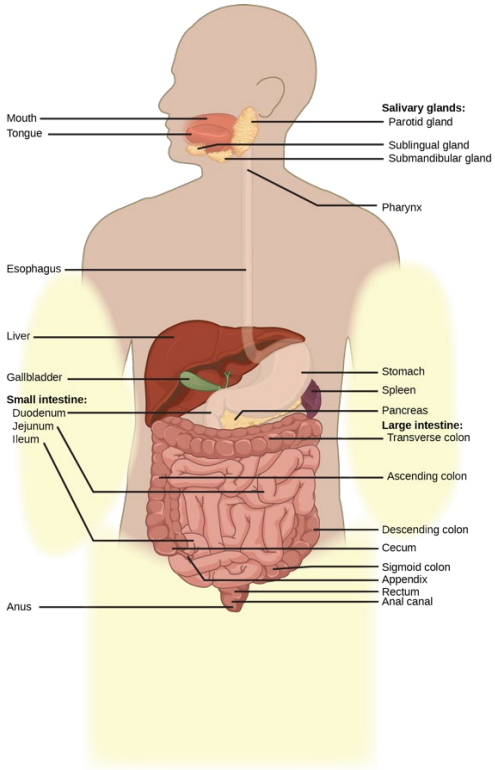
Biology 2e
Unit 7: Animal Structure and Function
Chapter 34: Animal Nutrition and the Digestive System

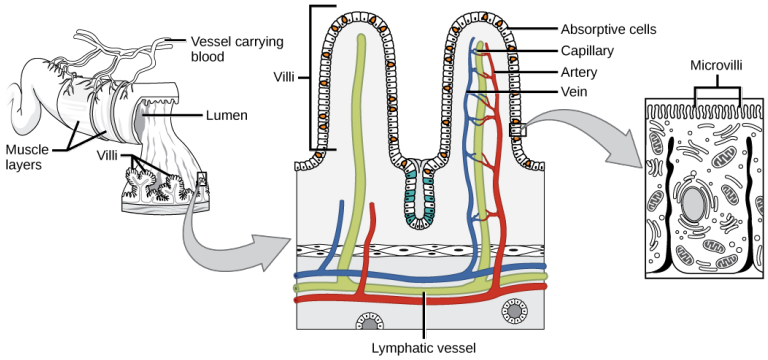
Visual Connection Questions

1. Which of the following statements about the digestive system is false?



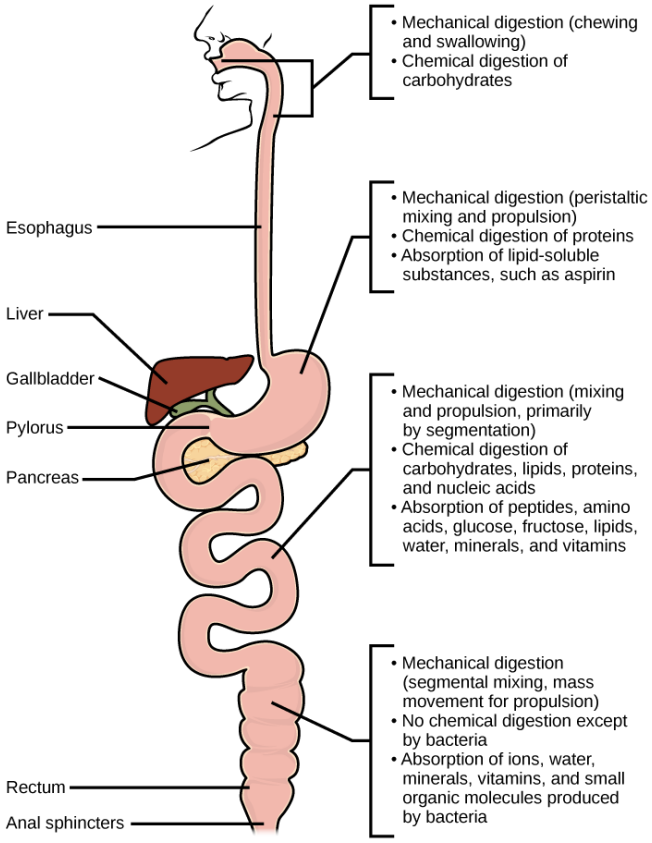
b. Food enters the large intestine before the small intestine.

2. Which of the following statements about the small intestine is false?



c. Microvilli are lined with blood vessels as well as lymphatic vessels.

3. Which of the following statements about digestive processes is true?



c. Bile emulsifies lipids in the small intestine.

Review Questions

4. Which of the following is a pseudo-ruminant?

d. horse

5. Which of the following statements is untrue?

b. Birds eat large quantities at one time so that they can fly long distances.

6. The acidic nature of chyme is neutralized by _____.

c. bicarbonates

7. The digestive juices from the liver are delivered to the _____.

c. duodenum

8. A scientist dissects a new species of animal. If the animal's digestive system has a single stomach with an extended small intestine, to which animal could the dissected specimen be closely related?

b. Snowshoe Hare

9. Which of the following statements is not true?
a. Essential nutrients can be synthesized by the body.

10. Which of the following is a water-soluble vitamin?
d. vitamin C

11. What is the primary fuel for the body?
a. carbohydrates

12. Excess glucose is stored as _____.
c. glycogen

13. Many distance runners "carb load" the day before a big race. How does this eating strategy provide an advantage to the runner?
d. The excess carbohydrates can be stored in the muscles as glycogen.

14. Where does the majority of protein digestion take place?
a. stomach

15. Lipases are enzymes that break down _____.
b. lipids

16. Which of the following conditions is most likely to cause constipation?
b. Dehydration

17. Which hormone controls the release of bile from the gallbladder
c. CCK

18. Which hormone stops acid secretion in the stomach?
b. somatostatin

19. In the famous conditioning experiment, Pavlov demonstrated that his dogs started drooling in response to a bell sounding. What part of the digestive process did he stimulate?
a. Cephalic phase

Critical Thinking Questions

20. How does the polygastric digestive system aid in digesting roughage?
Animals with a polygastric digestive system have a multi-chambered stomach. The four compartments of the stomach are called the rumen, reticulum, omasum, and abomasum. These chambers contain many microbes that break down the cellulose and ferment the ingested food. The abomasum is the "true" stomach and is the equivalent of a monogastric stomach chamber where gastric juices are secreted. The four-compartment gastric chamber provides larger space and the microbial support necessary for ruminants to digest plant material.

21. How do birds digest their food in the absence of teeth?

Birds have a stomach chamber called a gizzard. Here, the food is stored, soaked, and ground into finer particles, often using pebbles. Once this process is complete, the digestive juices take over in the proventriculus and continue the digestive process.

22. What is the role of the accessory organs in digestion?

Accessory organs play an important role in producing and delivering digestive juices to the intestine during digestion and absorption. Specifically, the salivary glands, liver, pancreas, and gallbladder play important roles. Malfunction of any of these organs can lead to disease states.

23. Explain how the villi and microvilli aid in absorption.

The villi and microvilli are folds on the surface of the small intestine. These folds increase the surface area of the intestine and provide more area for the absorption of nutrients.

24. Name two components of the digestive system that perform mechanical digestion. Describe how mechanical digestion contributes to acquiring nutrients from food.

The stomach and the teeth both perform mechanical digestion, which is physically (as opposed to chemically) breaking the food into smaller components. This exposes a larger surface area for chemical digestion and release of nutrients. The teeth are vital to mastication, which breaks large bites of food down into smaller pieces that are easily swallowed. The stomach's muscle contractions churn the food to expose all particles to the acid and digestive enzymes.

25. What are essential nutrients?

Essential nutrients are those nutrients that must be obtained from the diet because they cannot be produced by the body. Vitamins and minerals are examples of essential nutrients.

26. What is the role of minerals in maintaining good health?

Minerals—such as potassium, sodium, and calcium—are required for the functioning of many cellular processes, including muscle contraction and nerve conduction. While minerals are required in trace amounts, not having minerals in the diet can be potentially harmful.

27. Discuss why obesity is a growing epidemic.

In the United States, obesity, particularly childhood obesity, is a growing concern. Some of the contributors to this situation include sedentary lifestyles and consuming more processed foods and less fruits and vegetables. As a result, even young children who are obese can face health concerns.

28. There are several nations where malnourishment is a common occurrence. What may be some of the health challenges posed by malnutrition?

Malnutrition, often in the form of not getting enough calories or not enough of the essential nutrients, can have severe consequences. Many malnourished children have vision and dental problems, and over the years may develop many serious health problems.

29. Generally describe how a piece of bread can power your legs as you walk up a flight of stairs.

A piece of bread is eaten and converted into chemical energy. The bread is broken down in the mouth by mastication and salivary enzymes, then transferred to the stomach for further digestion. After digestion by the acid and digestive enzymes in the stomach, the macromolecules that made up the bread move into the small intestine. In the small intestine, the carbohydrates from the bread are absorbed through the microvilli into the bloodstream. In muscle cells in the legs, the carbohydrates can be broken down into glucose, and then used for cellular respiration to create ATP. The muscles in the leg then use the ATP to perform the mechanical work needed to climb a flight of stairs.

30. In the 1990s fat-free foods became popular among people trying to lose weight. However, many dieticians now conclude that the fat-free trend made people less healthy and heavier. Describe how this could occur.

Fats are an essential component of a healthy diet, and needed by the body to function. Fats are essential for many processes, including the absorption of fat-soluble vitamins and production of some hormones. Fats also send a satiation signal to the brain that regulates hunger. Without fats in their diets many people may have actually consumed more calories, which would have resulted in weight gain.

31. Explain why some dietary lipid is a necessary part of a balanced diet.

Lipids add flavor to food and promote a sense of satiety or fullness. Fatty foods are sources of high energy; one gram of lipid contains nine calories. Lipids are also required in the diet to aid the absorption of lipid-soluble vitamins and for the production of lipid-soluble hormones.

32. The gut microbiome (the bacterial colonies in the intestines) have become a popular area of study in biomedical research. How could varying gut microbiomes impact a person's nutrition?

The gut microbiome includes all the bacteria that aid in chemical digestion in the intestines. Changing its composition can change the way that food is digested since not all bacteria have the same macromolecule-digesting enzymes. Additionally, changes in gut microbiome can lead to the establishment of pathogenic bacteria populations that cause inflammation in the gut or other disease.

33. Many mammals become ill if they drink milk as adults even though they could consume it as babies. What causes this digestive issue?

As mammals wean from their mothers they stop drinking milk. Since they stop consuming the sugar lactose their bodies conserve resources by no longer making the enzyme lactase. If the animals then consume lactose at some point in the future their digestive system cannot break the lactose molecules into glucose and galactose for absorption. When gut bacteria further along the digestive tract interact with the lactose molecules it causes symptoms of lactose intolerance.

34. Describe how hormones regulate digestion.

Hormones control the different digestive enzymes that are secreted in the stomach and the intestine during the process of digestion and absorption. For example, the hormone gastrin stimulates stomach acid secretion in response to food intake. The hormone somatostatin stops the release of stomach acid.

35. Describe one or more scenarios where loss of hormonal regulation of digestion can lead to diseases.

There are many cases where loss of hormonal regulation can lead to illnesses. For example, the bilirubin produced by the breakdown of red blood cells is converted to bile by the liver. When there is malfunction of this process, there is excess bilirubin in the blood and bile levels are low. As a result, the body struggles with dealing with fatty food. This is why a patient suffering from jaundice is asked to eat a diet with almost zero fat.

36. A scientist is studying a model that has a mutation in the receptor for somatostatin that prevents hormone binding. How would this mutation affect the structure and function of the digestive system?

Somatostatin is the hormone that inhibits the release of HCl into the stomach lumen after the chyme has moved to the intestine. If the receptor for somatostatin is non-functional, somatostatin cannot signal to the stomach parietal cells to stop acid secretion. Thus, acid secretion will continue when there is no food present, and can cause damage to the stomach tissue. However, as long as the stomach remains intact the mutation should not slow digestion since acid will always be present in the stomach to digest any new boluses of food.