



THE DIGESTIVE SYSTEM AND BODY METABOLISM

14

The digestive system processes food so that it can be absorbed and used by the body's cells. The digestive organs are responsible for food ingestion, digestion, absorption, and elimination of undigested remains from the body. In one sense, the digestive tract can be viewed as a disassembly line in which food is carried from one stage of its breakdown process to the next by muscular activity, and its nutrients are made available en route to the cells of the body. In addition, the digestive system provides for one of life's greatest pleasures—eating.

The anatomy of both alimentary canal and accessory digestive organs, mechanical and enzymatic breakdown, and absorption mechanisms are covered in this chapter. An introduction to nutrition and some important understandings about cellular metabolism (utilization of foodstuffs by body cells) are also considered in this chapter review.

ANATOMY OF THE DIGESTIVE SYSTEM

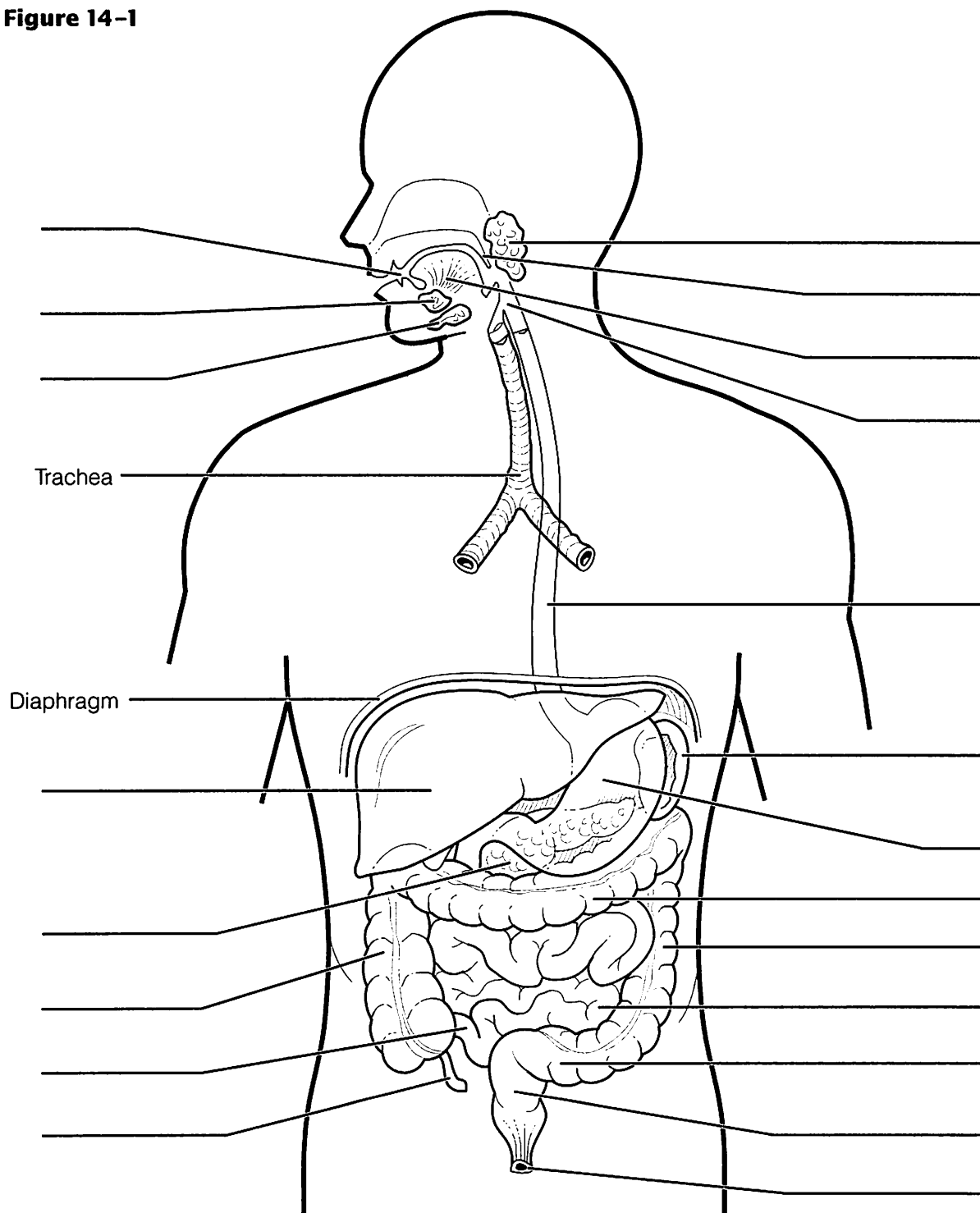
1. Complete the following statements by inserting your answers in the answer blanks.

- _____ 1. The digestive system is responsible for many body processes. Its functions begin when food is taken into the mouth, or _____
- _____ 2. (1). The process called (2) occurs as food is broken down both chemically and mechanically. For the broken-down foods to be made available to the body cells, they must be absorbed through the digestive system walls into the (3).
- _____ 3. _____
- _____ 4. Undigestible food remains are removed, or (4), from the body in (5). The organs forming a continuous tube from the mouth to the anus are collectively called the (6).
- _____ 5. _____
- _____ 6. Organs located outside the digestive tract proper, which secrete their products into the digestive tract, are referred to as (7) digestive system organs.
- _____ 7. _____

2. Figure 14-1 is a frontal view of the digestive system. First, correctly identify all structures provided with leader lines. Then select different colors for the following organs and color the coding circles and the corresponding structures of the figure.

- | | | |
|---------------------------------------|---------------------------------------|------------------------------|
| <input type="radio"/> Esophagus | <input type="radio"/> Pancreas | <input type="radio"/> Tongue |
| <input type="radio"/> Liver | <input type="radio"/> Salivary glands | <input type="radio"/> Uvula |
| <input type="radio"/> Large intestine | <input type="radio"/> Small intestine | |

Figure 14-1



3. Figure 14–2 illustrates oral cavity structures. First, correctly identify all structures provided with leader lines. Then color the structure that attaches the tongue to the floor of the mouth red; color the portions of the roof of the mouth unsupported by bone blue; color the structures that are essentially masses of lymphatic tissue yellow; and color the structure that contains the bulk of the taste buds pink.

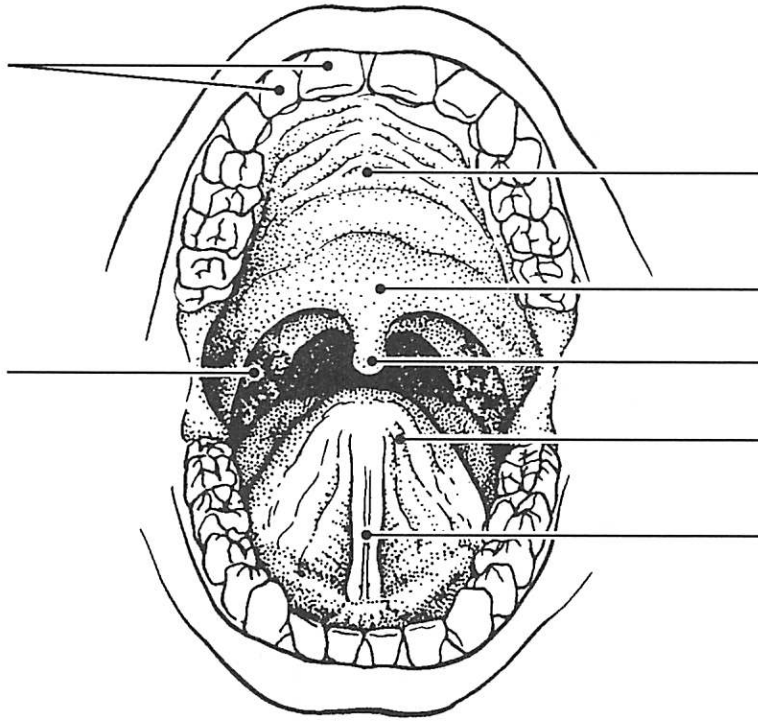


Figure 14–2

4. Various types of glands secrete substances into the alimentary tube. Match the glands listed in Column B to the functions/locations described in Column A. Place the correct term or letter response in the answer blanks.

Column A

- | | |
|-------|---|
| _____ | 1. Produce an enzyme-poor “juice” containing mucus; found in the submucosa of the small intestine |
| _____ | 2. Secretion includes amylase, which begins starch digestion in the mouth |
| _____ | 3. Ducts a variety of enzymes in an alkaline fluid into the duodenum |
| _____ | 4. Produces bile, which is transported to the duodenum via the bile duct |
| _____ | 5. Produce hydrochloric acid and pepsinogen |

Column B

- A. Gastric glands
- B. Intestinal glands
- C. Liver
- D. Pancreas
- E. Salivary glands

5. Using the key choices, select the terms identified in the following descriptions by inserting the appropriate term or letter in the answer blanks.

Key Choices

A. Anal canal	J. Mesentery	R. Rugae
B. Appendix	K. Microvilli	S. Small intestine
C. Colon	L. Oral cavity	T. Soft palate
D. Esophagus	M. Parietal peritoneum	U. Stomach
E. Greater omentum	N. Peyer's patches	V. Tongue
F. Hard palate	O. Pharynx	W. Vestibule
G. Haustra	P. Plicae circulares	X. Villi
H. Ileocecal valve	Q. Pyloric sphincter (valve)	Y. Visceral peritoneum
I. Lesser omentum		

- _____ 1. Structure that suspends the small intestine from the posterior body wall
- _____ 2. Fingerlike extensions of the intestinal mucosa that increase the surface area
- _____ 3. Collections of lymphatic tissue found in the submucosa of the small intestine
- _____ 4. Folds of the small intestine wall
- _____ 5. Two anatomical regions involved in the physical breakdown of food
- _____ 6. Organ that mixes food in the mouth
- _____ 7. Common passage for food and air
- _____ 8. Three extensions/modifications of the peritoneum
- _____
- _____
- _____ 9. Literally a food chute; has no digestive or absorptive role
- _____ 10. Folds of the stomach mucosa
- _____ 11. Saclike outpocketings of the large intestine wall

- _____ 12. Projections of the plasma membrane of a cell that increase the cell's surface area
- _____ 13. Prevents food from moving back into the small intestine once it has entered the large intestine
- _____ 14. Organ responsible for most food and water absorption
- _____ 15. Organ primarily involved in water absorption and feces formation
- _____ 16. Area between the teeth and lips/cheeks
- _____ 17. Blind sac hanging from the initial part of the colon
- _____ 18. Organ in which protein digestion begins
- _____ 19. Membrane attached to the lesser curvature of the stomach
- _____ 20. Organ into which the stomach empties
- _____ 21. Sphincter controlling the movement of food from the stomach into the duodenum
- _____ 22. Uvula hangs from its posterior edge
- _____ 23. Organ that receives pancreatic juice and bile
- _____ 24. Serosa of the abdominal cavity wall
- _____ 25. Region, containing two sphincters, through which feces are expelled from the body
- _____ 26. Anterosuperior boundary of the oral cavity; supported by bone
- _____ 27. Serous membrane forming part of the wall of the small intestine

6. Figure 14–3A is a longitudinal section of the stomach. First, use the following terms to identify the regions provided with leader lines on the figure.

Body	Pyloric region	Greater curvature	Cardioesophageal sphincter
Fundus	Pyloric valve	Lesser curvature	

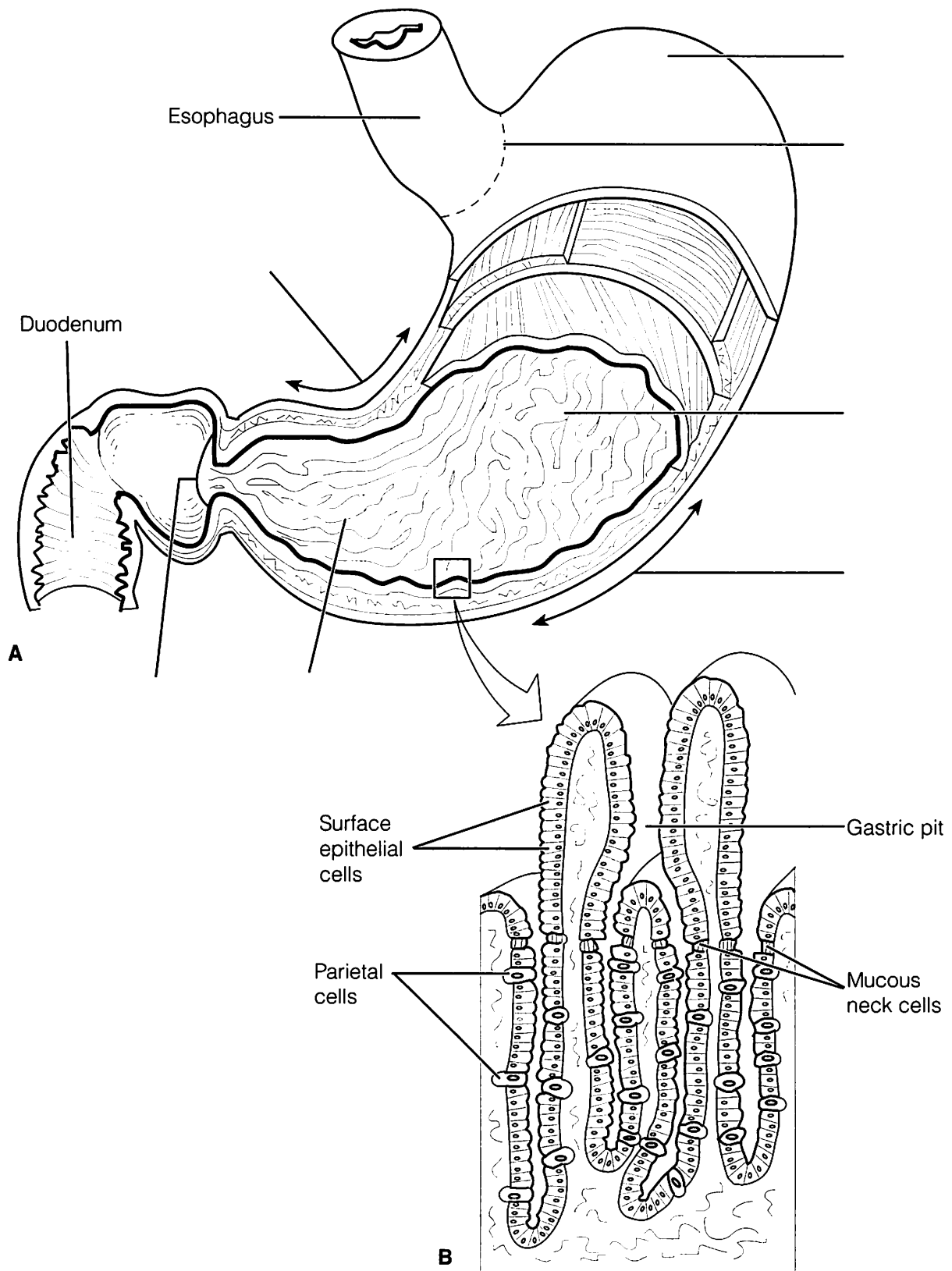
Then select different colors for each of the following structures/areas and use them to color the coding circles and corresponding structures/areas on the figure.

<input type="radio"/> Oblique muscle layer	<input type="radio"/> Longitudinal muscle layer	<input type="radio"/> Circular muscle layer
<input type="radio"/> Area where rugae are visible	<input type="radio"/> Serosa	

Figure 14–3B shows two types of secretory cells found in gastric glands. Identify the third type called *chief cells* by choosing a few cells deep in the glands and labeling them. Then, color the hydrochloric acid–secreting cells red, color the mucus-secreting cells yellow, and color the cells that produce protein-digesting enzymes blue.

7. Circle the term that does not belong in each of the following groupings.

1. Nasopharynx	Esophagus	Laryngopharynx	Oropharynx
2. Villi	Plicae circulares	Rugae	Microvilli
3. Salivary glands	Pancreas	Liver	Gallbladder
4. Duodenum	Cecum	Jejunum	Ileum
5. Ascending colon	Haustra	Circular folds	Cecum
6. Mesentery	Frenulum	Greater omentum	Parietal peritoneum
7. Parotid	Sublingual	Submandibular	Palatine
8. Protein-digesting enzymes	Saliva	Intrinsic factor	HCl
9. Colon	Water absorption	Protein absorption	Vitamin B absorption

**Figure 14-3**

8. The walls of the alimentary canal have four typical layers, as illustrated in Figure 14–4. Identify each layer by placing its correct name in the space before the appropriate description. Then select different colors for each layer and use them to color the coding circles and corresponding structures on the figure. Finally, assume the figure shows a cross-sectional view of the small intestine and label the three structures provided with leader lines.

- _____ ☐ 1. The secretory and absorptive layer
- _____ ☐ 2. Layer composed of at least two muscle layers
- _____ ☐ 3. Connective tissue layer, containing blood, lymph vessels, and nerves
- _____ ☐ 4. Outermost layer of the wall; visceral peritoneum

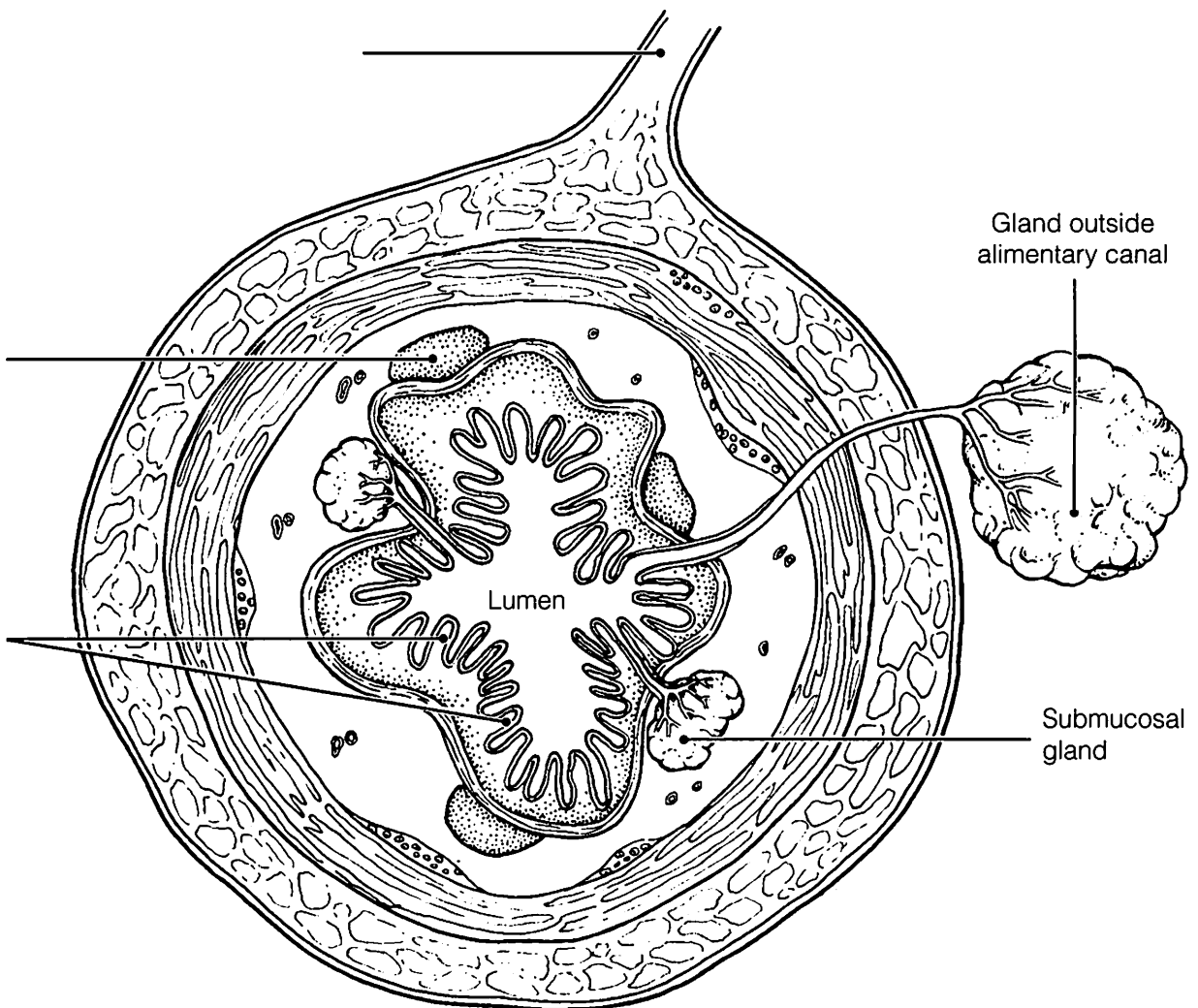


Figure 14–4

9. Figure 14–5 shows three views of the small intestine. First, label the villi in views B and C and the plicae circulares in views A and B. Then select different colors for each term listed below and use them to color in the coding circles and corresponding structures in view C.

○ Surface epithelium ○ Lacteal ○ Capillary network

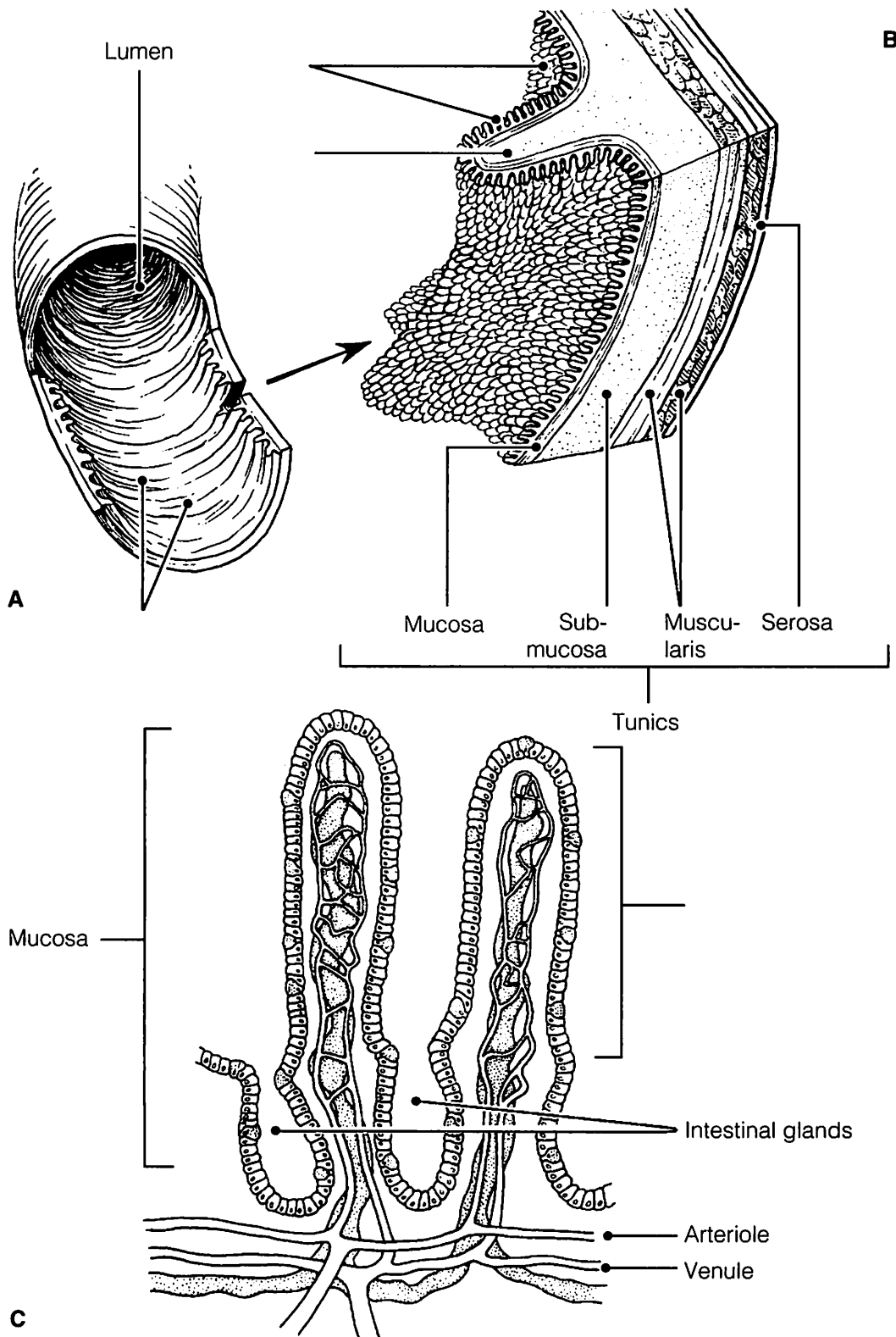


Figure 14–5

- 10.** Three accessory organs are illustrated in Figure 14–6. Identify each of the three organs and the ligament provided with leader lines on the figure. Then select different colors for the following structures and use them to color the coding circles and the corresponding structures on the figure.

☐ Common hepatic duct

☐ Bile duct

☐ Cystic duct

☐ Pancreatic duct

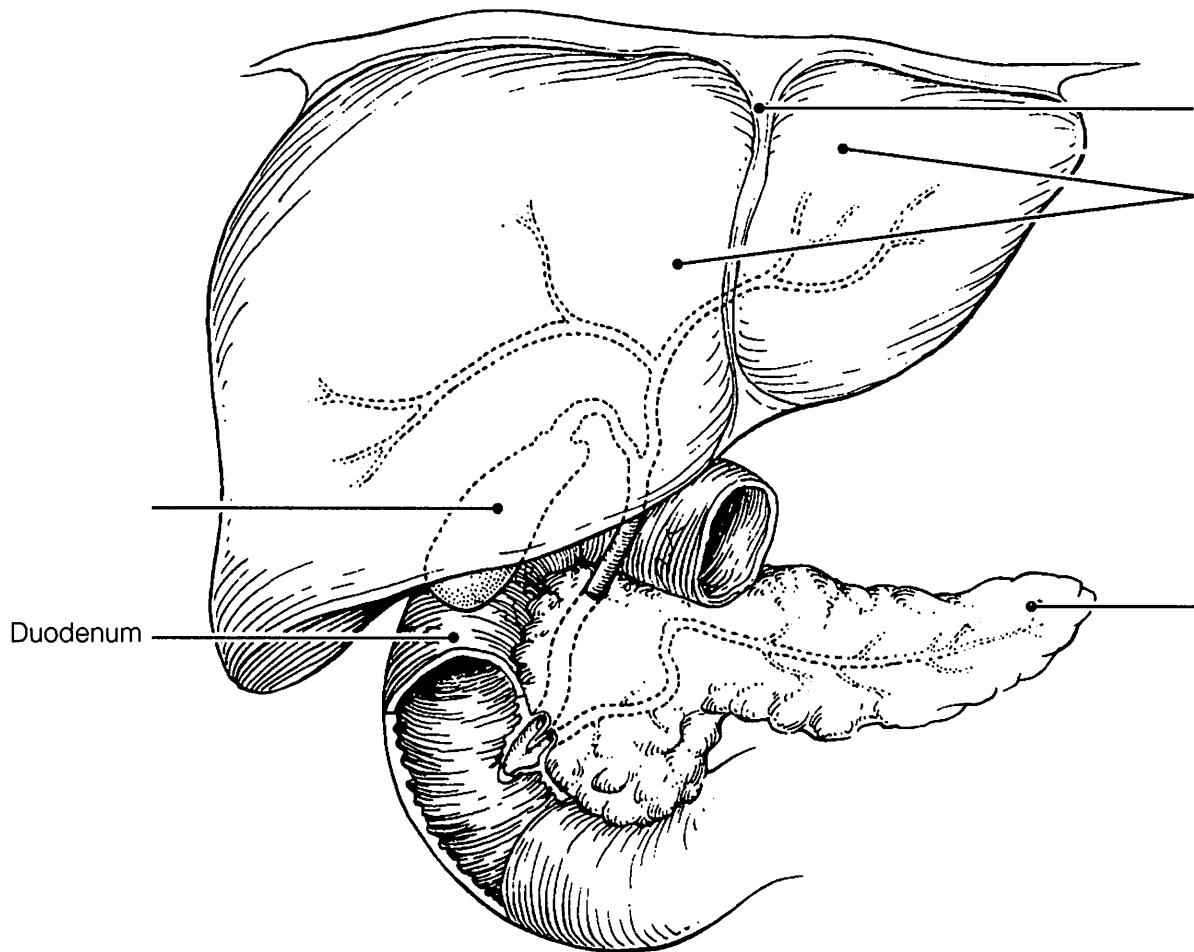


Figure 14–6

- 11.** Complete the following statements referring to human dentition by inserting your answers in the answer blanks.

- _____ 1. The first set of teeth, called the (1) teeth, begin to appear around the age of (2) and usually have begun to be replaced by the age of (3). The (4) teeth are more numerous; that is, there are (5) teeth in the second set as opposed to a total of (6) teeth in the first set. If an adult has a full set of teeth, you can expect to find two (7), one (8), two (9), and three (10) in one side of each jaw. The most posterior molars in each jaw are commonly called (11) teeth.
- _____ 2.
- _____ 3.
- _____ 4.
- _____ 5.

- _____ 6. _____ 9.
 _____ 7. _____ 10.
 _____ 8. _____ 11.

12. First, use the key choices to label the tooth diagrammed in Figure 14–7. Second, select different colors to represent the key choices and use them to color in the coding circles and corresponding structures in the figure. Third, add labels to the figure to identify the crown, gingiva, and root of the tooth. Last, choose terms from the key choices to match the descriptions below the figure.

Key Choices

- ☐ A. Cementum ☐ C. Enamel ☐ E. Pulp
☐ B. Dentin ☐ D. Periodontal membrane (ligament)

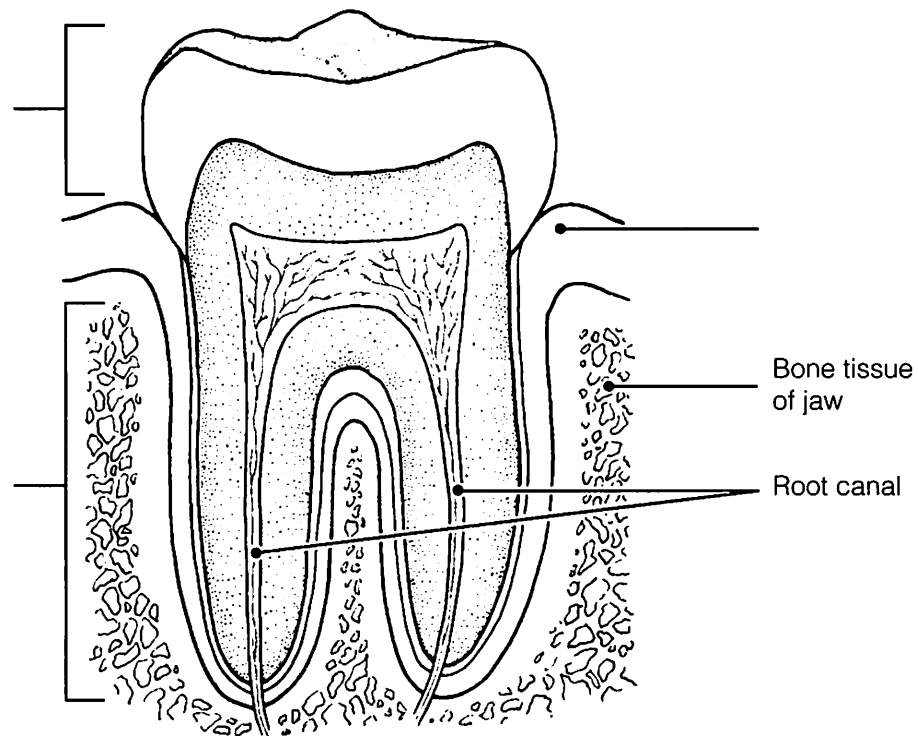


Figure 14–7

- _____ 1. Material covering the tooth root
 _____ 2. Forms the bulk of tooth structure
 _____ 3. A collection of blood vessels, lymphatics, and nerve fibers
 _____ 4. Cells that produce this substance degenerate after tooth eruption

PHYSIOLOGY OF THE DIGESTIVE SYSTEM

13. Match the descriptions in Column B with the appropriate terms referring to digestive processes in Column A.

Column A	Column B
_____ 1. Ingestion	A. Transport of nutrients from lumen to blood
_____ 2. Propulsion	B. Enzymatic breakdown
_____ 3. Mechanical digestion	C. Elimination of feces
_____ 4. Chemical digestion	D. Eating
_____ 5. Absorption	E. Chewing
_____ 6. Defecation	F. Churning
	G. Includes swallowing
	H. Segmentation and peristalsis

14. This section relates to food breakdown in the digestive tract. Using the key choices, select the appropriate terms to complete the following statements. Insert the correct letter or term in the answer blanks.

Key Choices

A. Bicarbonate-rich fluid	F. HCl	K. Mucus
B. Bile	G. Hormonal stimulus	L. Pepsin
C. Brush border enzymes	H. Lipases	M. Psychological stimulus
D. Chewing	I. Mechanical stimulus	N. Rennin
E. Churning	J. Mouth	O. Salivary amylase

- _____ 1. Starch digestion begins in the mouth when (1) is ducted in by the salivary glands.
- _____ 2. Gastrin, which prods the stomach glands to produce more enzymes and HCl, represents a (2).
- _____ 3. The fact that the mere thought of a relished food can make your mouth water is an example of (3).
- _____ 4. Many people chew gum to increase saliva formation when their mouths are dry. This type of stimulus is a (4).
- _____ 5. Protein foods are largely acted on in the stomach by (5).

- _____ 6. For the stomach protein-digesting enzymes to become active, _____ (6) is needed.
- _____ 7. Considering living cells of the stomach (and everywhere) are largely protein, it is amazing that they are not digested by the activity of stomach enzymes. The most important means of stomach protection is the _____ (7) it produces.
- _____ 8. A milk protein-digesting enzyme found in children but uncommon in adults is _____ (8).
- _____ 9. The third layer of smooth muscle found in the stomach wall allows mixing and mechanical breakdown by _____ (9).
- _____ 10. Important intestinal enzymes are the _____ (10).
- _____ 11. The small intestine is protected from the corrosive action of hydrochloric acid in chyme by _____ (11), which is ducted in by the pancreas.
- _____ 12. The pancreas produces protein-digesting enzymes, amylase, and nucleases. It is the only important source of _____ (12).
- _____ 13. A nonenzyme substance that causes fat to be dispersed into smaller globules is _____ (13).
- 15.** Identify the pathologic conditions described below by using terms from the key choices. Insert the correct term or letter in the answer blanks.

Key Choices

- | | | | |
|-----------------|---------------|--------------|----------------|
| A. Appendicitis | C. Diarrhea | E. Heartburn | G. Peritonitis |
| B. Constipation | D. Gallstones | F. Jaundice | H. Ulcer |

- _____ 1. Inflammation of the abdominal serosa
- _____ 2. Condition resulting from the reflux of acidic gastric juice into the esophagus
- _____ 3. Usually indicates liver problems or blockage of the biliary ducts
- _____ 4. An erosion of the stomach or duodenal mucosa
- _____ 5. Passage of watery stools
- _____ 6. Causes severe epigastric pain; associated with prolonged storage of bile in the gallbladder
- _____ 7. Inability to pass feces; often a result of poor bowel habits

- 16.** Hormonal stimuli are important in digestive activities that occur in the stomach and small intestine. Using the key choices, identify the hormones that function as described in the following statements. Insert the correct term or letter response in the answer blanks.

Key Choices

A. Cholecystokinin B. Gastrin C. Secretin

- _____ 1. These two hormones stimulate the pancreas to release its secretions.
- _____ 2. This hormone stimulates increased production of gastric juice.
- _____ 3. This hormone causes the gallbladder to release stored bile.
- _____ 4. This hormone causes the liver to increase its output of bile.

- 17.** Various types of foods are ingested in the diet and broken down to their building blocks. Use the key choices to complete the following statements according to these understandings. Insert the correct term or letter in the answer blanks. In some cases, more than one choice applies.

Key Choices

A. Amino acids D. Galactose G. Maltose

B. Fatty acids E. Glucose H. Starch

C. Fructose F. Lactose I. Sucrose

- _____ 1. The building blocks of carbohydrates are monosaccharides, or simple sugars. The three common simple sugars in our diet are _____, _____, and _____.
- _____ 2. Disaccharides include _____, _____, and _____.
- _____ 3. Protein foods must be digested to _____ before they can be absorbed.
- _____ 4. Fats are broken down to two types of building blocks, _____ and glycerol.
- _____ 5. Of the simple sugars, _____ is most important because it is the sugar referred to as "blood sugar."

- 18.** Dietary substances capable of being absorbed are listed next. If the substance is *most often* absorbed from the digestive tract by active transport processes, put an *A* in the blank. If it is usually absorbed passively (by diffusion or osmosis), put a *P* in the blank. In addition, circle the substance that is *most likely* to be absorbed into a lacteal rather than into the capillary bed of the villus.

_____ 1. Water	_____ 3. Simple sugars	_____ 5. Electrolytes
_____ 2. Amino acids	_____ 4. Fatty acids	

- 19.** Complete the following statements that describe mechanisms of food mixing and movement. Insert your responses in the answer blanks.

_____ 1.	Swallowing, or <u>(1)</u> , occurs in two major phases—the <u>(2)</u> and <u>(3)</u> . During the voluntary phase, the <u>(4)</u> is used to
_____ 2.	push the food into the throat, and the <u>(5)</u> rises to close off the nasal passageways. As food is moved involuntarily
_____ 3.	through the pharynx, the <u>(6)</u> rises to ensure that its passageway is covered by the <u>(7)</u> so that ingested substances
_____ 4.	do not enter respiratory passages. It is possible to swallow water while standing on your head because the water is
_____ 5.	carried along the esophagus involuntarily by the process of <u>(8)</u> . The pressure exerted by food on the <u>(9)</u> valve
_____ 6.	causes it to open so that food can enter the stomach.
_____ 7.	The two major types of movements that occur in the small intestine are <u>(10)</u> and <u>(11)</u> . One of these movements, the
_____ 8.	<u>(12)</u> , acts to continually mix the food with digestive juices, and (strangely) also plays a major role in propelling foods
_____ 9.	along the tract. Still another type of movement seen only in the large intestine, <u>(13)</u> occurs infrequently and acts to
_____ 10.	move feces over relatively long distances toward the anus. Presence of feces in the <u>(14)</u> excites stretch receptors so
_____ 11.	that the <u>(15)</u> reflex is initiated. Irritation of the gastrointestinal tract by drugs or bacteria might stimulate the <u>(16)</u> center
_____ 12.	in the medulla, causing <u>(17)</u> , which is essentially a reverse peristalsis.
_____ 13.	
_____ 14.	
_____ 15.	
_____ 16.	
_____ 17.	

NUTRITION AND METABOLISM

Nutrients Used by Body Cells

20. Using the key choices, identify the foodstuffs used by cells in the cellular functions described below. Insert the correct term or key letter in the answer blanks.

Key Choices

- A. Amino acids B. Carbohydrates C. Fats

- _____ 1. The most used substance for producing the energy-rich ATP
- _____ 2. Important in building myelin sheaths and cell membranes
- _____ 3. Tend to be conserved by cells
- _____ 4. The second most important food source for making cellular energy
- _____ 5. Form insulating deposits around body organs and beneath the skin
- _____ 6. Used to make the bulk of cell structure and functional substances such as enzymes

21. Identify the nutrients described by using the key choices. Insert the correct letter(s) in the answer blanks.

Key Choices

- A. Bread/pasta D. Fruits G. Starch
- B. Cheese/cream E. Meat/fish H. Vegetables
- C. Cellulose F. Minerals I. Vitamins

- _____ 1. Examples of *carbohydrate-rich foods* in the diet.
- _____ 2. Fatty foods ingested in the normal diet include _____.
- _____ 3. The only important *digestible* polysaccharide.
- _____ 4. An *indigestible* polysaccharide that aids elimination because it adds bulk to the diet is _____.
- _____ 5. *Protein-rich foods* include _____ and _____.
- _____ 6. Most examples of these nutrients, which are found largely in vegetables and fruits, are used as coenzymes.
- _____ 7. Include copper, iron, and sodium.

Metabolic Processes

22. Figure 14–8 depicts the three stages of cellular respiration. Label the figure by placing the following terms on the appropriate answer blanks. Color the diagram as suits your fancy, and then answer the questions below the figure.

ATP

Glucose

Mitochondrion

Carbon dioxide

Glycolysis

Pyruvic acid

Chemical energy

Electron transport chain

Water

Cytosol

Krebs cycle

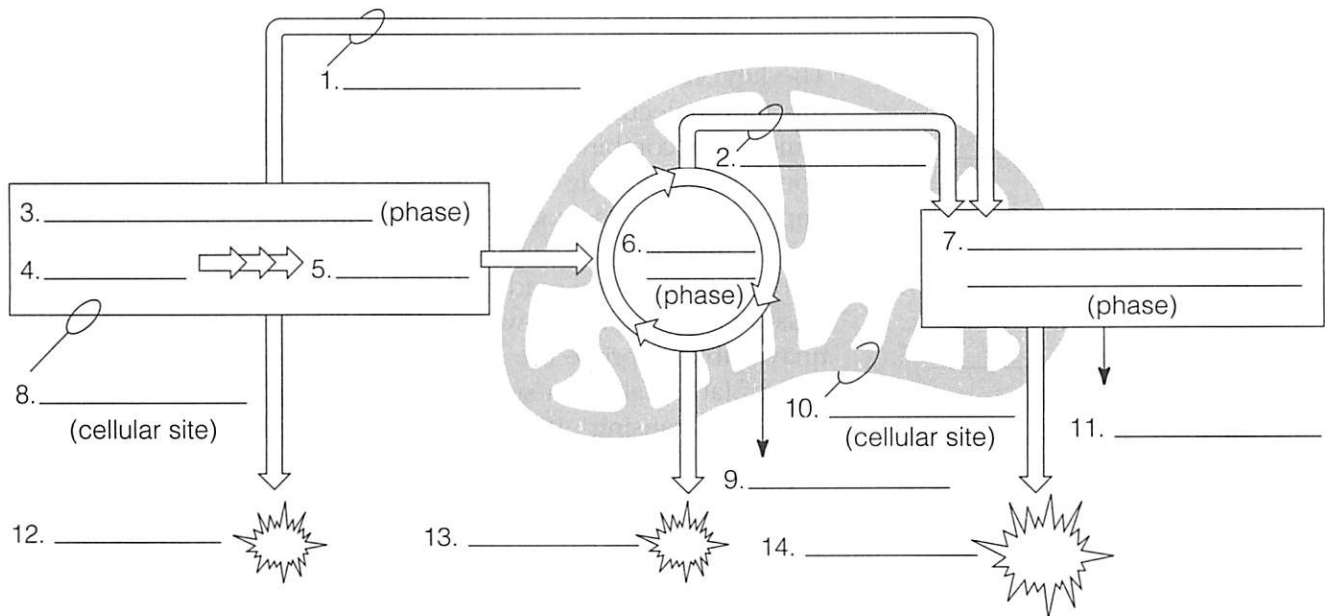


Figure 14-8

1. Which of the oxidative phases does not require oxygen?

2. Which phases do require oxygen? _____

3. In what form is chemical energy transferred from the first two phases to the third phase?

4. Which of the phases produces the largest amount of ATP?

5. Which phase combines energetic H atoms with molecular oxygen?

- 23.** This section considers the process of cellular metabolism. Insert the correct word(s) from the key choices in the answer blanks.

Key Choices

- | | | |
|---------------------|-------------------------------|-------------------------------|
| A. ATP | G. Basal metabolic rate (BMR) | M. Ketosis |
| B. Acetic acid | H. Carbon dioxide | N. Monosaccharides |
| C. Acetoacetic acid | I. Essential | O. Oxygen |
| D. Acetone | J. Fatty acids | P. Total metabolic rate (TMR) |
| E. Amino acids | K. Glucose | Q. Urea |
| F. Ammonia | L. Glycogen | R. Water |

- _____ 1. The key "fuel" used by body cells is (1). The cells break this fuel molecule apart piece by piece. The hydrogen
- _____ 2. removed is combined with (2) to form (3), while its carbon leaves the body in the form of (4) gas. The
- _____ 3. importance of this process is that it provides (5), a form of energy that the cells can use to power all their activities. For
- _____ 4. carbohydrates to be oxidized, or burned for energy, they must first be broken down to (6). When carbohydrates are
- _____ 5. unavailable to prime the metabolic pump, intermediate products of fat metabolism such as (7) and (8) accumulate in
- _____ 6. the blood, causing (9) and low blood pH. Amino acids are actively accumulated by cells because protein cannot be made
- _____ 7. unless all amino acid types are present. The amino acids that *must* be taken in the diet are called (10) amino acids.
- _____ 8. When amino acids are oxidized to form cellular energy, their amino groups are removed and liberated as (11). In the
- _____ 9. liver, this is combined with carbon dioxide to form (12), which is removed from the body by the kidneys.
- _____ 10.
- _____ 11.
- _____ 12.

- 24.** The liver has many functions in addition to its digestive function. Complete the following statements that elaborate on the liver's function by inserting the correct terms in the answer blanks.

- _____ 1. The liver is the most important metabolic organ in the body. In its metabolic role, the liver uses amino acids from the
- _____ 2. nutrient-rich hepatic portal blood to make many blood proteins such as (1), which helps to hold water in the blood-
- _____ 3. stream, and (2), which prevent blood loss when blood vessels are damaged. The liver also makes a steroid substance that is released to the blood. This steroid, (3), has been

- _____ 4. implicated in high blood pressure and heart disease. Additionally, the liver acts to maintain homeostatic blood glucose levels. It removes glucose from the blood when blood glucose levels are high, a condition called (4), and stores it as (5). Then, when blood glucose levels are low, a condition called (6), liver cells break down the stored carbohydrate and release glucose to the blood once again. This latter process is termed (7). When the liver makes glucose from noncarbohydrate substances such as fats or proteins, the process is termed (8). In addition to its processing of amino acids and sugars, the liver plays an important role in the processing of fats. Other functions of the liver include the (9) of drugs and alcohol. Its (10) cells protect the body by ingesting bacteria and other debris.
- _____ 11. The liver forms small complexes called (11), which are needed to transport fatty acids, fats, and cholesterol in the blood because lipids are (12) in a watery medium. The function of (13) is transport of cholesterol to peripheral tissues, where cells use it to construct their plasma (14) or to synthesize (15). The function of high-density lipoproteins (HDLs) is transport of cholesterol to the (16), where it is degraded and secreted as (17), which are eventually excreted. High levels of cholesterol in the plasma are of concern because of the risk of (18).
- _____ 17. Two other important functions of the liver are the storage of vitamins (such as vitamin (19) needed for vision) and of the metal (20) (as ferritin).
- _____ 18.
- _____ 19.
- _____ 20.

25. Circle the term that does not belong in each of the following groupings.

- | | | | |
|-----------------|------------------|------------------|----------------------|
| 1. BMR | TMR | Rest | Postabsorptive state |
| 2. Thyroxine | Iodine | ↓ Metabolic rate | ↑ Metabolic rate |
| 3. Obese person | ↓ Metabolic rate | Women | Child |
| 4. 4 kcal/gram | Fats | Carbohydrates | Proteins |
| 5. Radiation | Vasoconstriction | Evaporation | Vasodilation |

- 26.** Using the key choices, select the terms identified in the following descriptions. Insert the appropriate term(s) or letter(s) in each answer blank.

Key Choices

- | | | |
|---------------------------------------|-----------------|--------------|
| A. Blood | E. Hyperthermia | I. Radiation |
| B. Constriction of skin blood vessels | F. Hypothalamus | J. Pyrogens |
| C. Frostbite | G. Hypothermia | K. Shivering |
| D. Heat | H. Perspiration | |

- | | |
|-------|---|
| _____ | 1. By-product of cell metabolism |
| _____ | 2. Means of conserving/increasing body heat |
| _____ | 3. Means by which heat is distributed to all body tissues |
| _____ | 4. Site of the body's thermostat |
| _____ | 5. Chemicals released by injured tissue cells and bacteria, causing resetting of the thermostat |
| _____ | 6. Death of cells deprived of oxygen and nutrients, resulting from withdrawal of blood from the skin circulation when the external temperature is low |
| _____ | 7. Means of liberating excess body heat |
| _____ | 8. Extremely low body temperature |
| _____ | 9. Fever |

DEVELOPMENTAL ASPECTS OF THE DIGESTIVE SYSTEM

- 27.** Using the key choices, select the terms identified in the following descriptions. Insert the correct term(s) or letter(s) in each answer blank.

Key Choices

- | | | |
|---------------------|-------------------------|------------------------------|
| A. Accessory organs | F. Gallbladder problems | K. Rooting |
| B. Alimentary canal | G. Gastritis | L. Sucking |
| C. Appendicitis | H. PKU | M. Stomach |
| D. Cleft palate/lip | I. Periodontal disease | N. Tracheoesophageal fistula |
| E. Cystic fibrosis | J. Peristalsis | O. Ulcers |

- _____ 1. Internal tubelike cavity of the embryo
- _____ 2. Glands formed by branching from the digestive mucosa
- _____ 3. Most common congenital defect; aspiration of feeding common
- _____ 4. Congenital condition characterized by a connection between digestive and respiratory passageways
- _____ 5. Congenital condition in which large amounts of mucus are produced, clogging respiratory passageways and pancreatic ducts
- _____ 6. Metabolic disorder characterized by an inability to properly use the amino acid phenylalanine
- _____ 7. Reflex aiding the newborn baby to find the nipple
- _____ 8. Vomiting is common in infants because this structure is small
- _____ 9. Most common adolescent digestive system problem
- _____ 10. Inflammations of the gastrointestinal tract
- _____ 11. Condition of loose teeth and inflamed gums; generally seen in elderly people



INCREDIBLE JOURNEY

A Visualization Exercise for the Digestive System

... the passage beneath you opens, and you fall into a huge chamber with mountainous folds.

- 28.** Where necessary, complete statements by inserting the missing word(s) in the answer blanks.

- _____ 1. In this journey you are to travel through the digestive tract as far as the appendix and then await further instructions. You
- _____ 2. are miniaturized as usual and provided with a wet suit to protect you from being digested during your travels. You have a very easy entry into your host's open mouth. You look

around and notice the glistening pink lining, or (1), and the perfectly cared-for teeth. Within a few seconds, the lips part and you find yourself surrounded by bread. You quickly retreat to the safety of the (2) between the teeth and the cheek to prevent getting chewed. From there you



- _____ 3. watch with fascination as a number of openings squirt fluid into the chamber, and the (3) heaves and rolls, mixing the bread with the fluid.
- _____ 4.
- _____ 5. As the bread begins to disappear, you decide that the fluid contains the enzyme (4). You then walk toward the back of the oral cavity. Suddenly, you find yourself being carried along by a squeezing motion of the walls around you. The
- _____ 6. name given to this propelling motion is (5). As you are carried helplessly downward, you see two openings—the
- _____ 8. (6) and the (7)—below you. Just as you are about to straddle the solid area between them to stop your descent,
- _____ 9. the structure to your left moves quickly upward, and a trapdoor-like organ, the (8), flaps over its opening. Down
- _____ 10. you go in the dark, seeing nothing. Then the passage beneath you opens, and you fall into a huge chamber with mountainous folds. Obviously, you have reached the (9). The folds are very slippery, and you conclude that it must be the (10)
- _____ 12. coat that you read about earlier. As you survey your surroundings, juices begin to gurgle into the chamber from
- _____ 13. pits in the “floor,” and your face begins to sting and smart. You cannot seem to escape this caustic fluid and conclude
- _____ 14. that it must be very dangerous to your skin since it contains (11) and (12). You reach down and scoop up some of
- _____ 15. the slippery substance from the folds and smear it on your face, confident that if it can protect this organ it can protect
- _____ 16. you as well! Relieved, you begin to slide toward the organ’s far exit and squeeze through the tight (13) valve into the
- _____ 17. next organ. In the dim light, you see lumps of cellulose lying at your feet and large fat globules dancing lightly about. A few seconds later, your observations are interrupted by a

wave of fluid pouring into the chamber from an opening high in the wall above you. The large fat globules begin to fall apart, and you decide that this enzyme flood has to contain (14), and the opening must be the duct from the (15). As you move quickly away to escape the deluge, you lose your footing and find yourself on a roller-coaster ride—twisting, coiling, turning, and diving through the lumen of this active organ. As you move, you are stroked by velvety, fingerlike projections of the wall, the (16). Abruptly your ride comes to a halt as you are catapulted through the (17) valve and fall into the appendix. Headquarters informs you that you are at the end of your journey. Your exit now depends on your own ingenuity.



AT THE CLINIC

- 29.** Mary Maroon comes to the clinic to get information on a vegetarian diet. What problems may arise when people make uninformed decisions on what to eat for a vegetarian diet? What combinations of vegetable foods will provide Mary with all the essential amino acids?
- 30.** Mr. Ashe, a man in his mid-60s, comes to the clinic complaining of heartburn. Questioning by the clinic staff reveals that the severity of his attacks increases when he lies down after eating a heavy meal. The man is about 50 pounds overweight. What is your diagnosis? Without treatment, what conditions might develop?
- 31.** There has been a record heat wave lately, and many elderly people are coming to the clinic complaining that they “feel poorly.” In most cases, their skin is cool and clammy, and their blood pressure is low. What is their problem? What can be done to alleviate it?
- 32.** During the same period, Bert Winchester, a construction worker, is rushed in unconscious. His skin is hot and dry, and his coworkers say that he just suddenly keeled over on the job. What is Bert’s condition and how should it be handled?
- 33.** Mrs. Ironfield is brought to an emergency room complaining of severe pain in her left iliac region. She claims previous episodes and says that the condition is worse when she is constipated and is relieved by defecation. A large tender mass is palpated in the left iliac fossa, and a barium study reveals a large number of diverticula in her descending and sigmoid colon. What are diverticula, and what is believed to promote their formation? Does this woman have diverticulitis or diverticulosis? Explain.

- 34.** A woman in her 50s complains of bloating, cramping, and diarrhea when she drinks milk. What is the cause of her complaint and what is a solution?
- 35.** Clients are instructed not to eat before having blood tests run. How would a lab technician know if someone “cheated” and ate a fatty meal a few hours before having his blood drawn?
- 36.** Zena, a teenager, has gone to the sports clinic for the past 2 years to have her fat content checked. This year, her percentage of body fat is up, and tissue protein has not increased. Questioning reveals that Zena has been on crash diets four times since the last checkup, only to regain the weight (and more) each time. She also admits sheepishly that she “detests” exercise. How does cyclic dieting, accompanied by lack of exercise, cause an increase in fat and a decrease in protein?
- 37.** Mrs. Rodriguez has a bleeding ulcer and has lost her appetite. She appears pale and lethargic when she comes in for a physical. She proves to be anemic, and her RBCs are large and pale. What mineral supplements should be ordered?
- 38.** Mr. Roddick, a 21-year-old man with severe appendicitis, did not seek treatment in time and died a week after his abdominal pain and fever began. Explain why appendicitis can quickly lead to death.
- 39.** In the mid-1960s, a calorie-free substitute (olestra) that is neither digested nor absorbed hit the market shelves in the United States. At that time there was concern that vitamin deficiencies might result from its use. What type of vitamins concerned them and why?



THE FINALE: MULTIPLE CHOICE

40. Select the best answer or answers from the choices given.

1. Which of the following terms are synonyms?
 - A. Gastrointestinal tract
 - B. Digestive system
 - C. Digestive tract
 - D. Alimentary canal
2. A digestive organ that is not part of the alimentary canal is the:
 - A. stomach
 - B. liver
 - C. small intestine
 - D. large intestine
 - E. pharynx
3. The GI tube layer responsible for the actions of segmentation and peristalsis is:
 - A. serosa
 - B. mucosa
 - C. muscularis externa
 - D. submucosa
4. Which alimentary canal tunic has the greatest abundance of lymph nodules?
 - A. Mucosa
 - B. Muscularis
 - C. Serosa
 - D. Submucosa
5. Proteins secreted in saliva include:
 - A. mucin
 - B. amylase
 - C. lysozyme
 - D. IgA
6. The closure of which valve is assisted by the diaphragm?
 - A. Ileocecal
 - B. Pyloric
 - C. Gastroesophageal
 - D. Upper esophageal
7. Smooth muscle is found in the:
 - A. tongue
 - B. pharynx
 - C. esophagus
 - D. external anal sphincter
8. Which of these organs lies in the right hypochondriac region of the abdomen?
 - A. Stomach
 - B. Spleen
 - C. Cecum
 - D. Liver
9. Which phases of gastric secretion depend (at least in part) on the vagus nerve?
 - A. Cephalic
 - B. Gastric
 - C. Intestinal (stimulatory)
 - D. Intestinal (inhibitory)
10. Which of the following are tied to sodium transport?
 - A. Glucose
 - B. Fructose
 - C. Galactose
 - D. Amino acids
11. Excess iron is stored primarily in the:
 - A. liver
 - B. bone marrow
 - C. duodenal epithelium
 - D. blood
12. A 3-year-old girl was rewarded with a hug because she was now completely toilet trained. Which muscle had she learned to control?
 - A. Levator ani
 - B. Internal anal sphincter
 - C. Internal and external obliques
 - D. External anal sphincter
13. Which cell type fits this description? It occurs in the stomach mucosa, contains abundant mitochondria and many microvilli, and pumps hydrogen ions.
 - A. Absorptive cell
 - B. Parietal cell
 - C. Goblet cell
 - D. Mucous neck cell

14. Which of the following are “essential” nutrients?
A. Glucose C. Cholesterol
B. Linoleic acid D. Leucine
15. Deficiency of which of these vitamins results in anemia?
A. Thiamin C. Biotin
B. Riboflavin D. Folic acid
16. Vitamins that act as coenzymes in the Krebs cycle include:
A. riboflavin C. biotin
B. niacin D. pantothenic acid
17. Substrate-level phosphorylation occurs during:
A. glycolysis C. Krebs cycle
B. beta-oxidation D. electron transport
18. Chemicals that can be used for gluconeogenesis include:
A. amino acids
B. glycerol
C. fatty acids
D. alpha-ketoglutaric acid
19. The chemiosmotic process involves:
A. buildup of hydrogen ion concentration
B. electron transport
C. oxidation and reduction
D. ATP synthase
20. Only the liver functions to:
A. store iron
B. form urea
C. produce plasma proteins
D. form ketone bodies
21. Which events occur during the absorptive state?
A. Use of amino acids as a major source of energy
B. Lipogenesis
C. Beta-oxidation
D. Increased uptake of glucose by skeletal muscles
22. Hormones that act to decrease blood glucose level include:
A. insulin C. epinephrine
B. glucagon D. growth hormone
23. During the postabsorptive state:
A. glycogenesis occurs in the liver
B. fatty acids are used for fuel
C. amino acids are converted to glucose
D. lipolysis occurs in adipose tissue
24. Which transport particles carry cholesterol destined for excretion from the body?
A. HDL C. LDL
B. Chylomicron D. VLDL
25. Glucose (or its metabolites) can be converted to:
A. glycogen
B. triglycerides
C. nonessential amino acids
D. starch
26. Basal metabolic rate:
A. is the lowest metabolic rate of the body
B. is the metabolic rate during sleep
C. is measured as kcal per square meter of skin per hour
D. increases with age
27. Which of the following types of heat transfer involves heat loss in the form of infrared waves?
A. Conduction C. Evaporation
B. Convection D. Radiation
28. PKU is the result of inability to metabolize:
A. tyrosine C. ketone bodies
B. melanin D. phenylalanine