

14

*The Digestive System
and Body Metabolism*

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. 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).
- _____ 4. Organs located outside the digestive tract proper, which secrete their products into the digestive tract, are referred to as (7) digestive system organs.
- _____ 5.
- _____ 6.
- _____ 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 | |

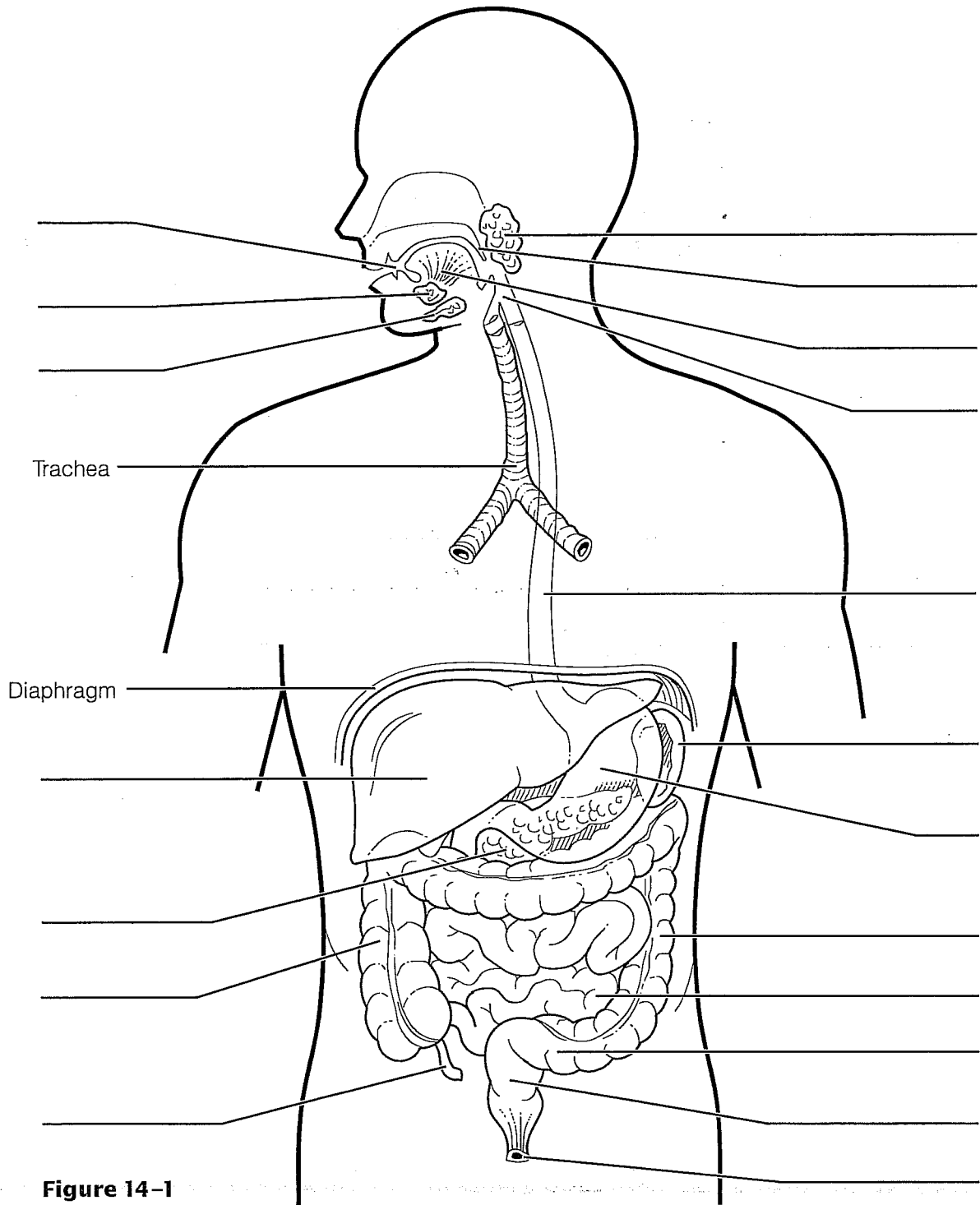


Figure 14-1

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.

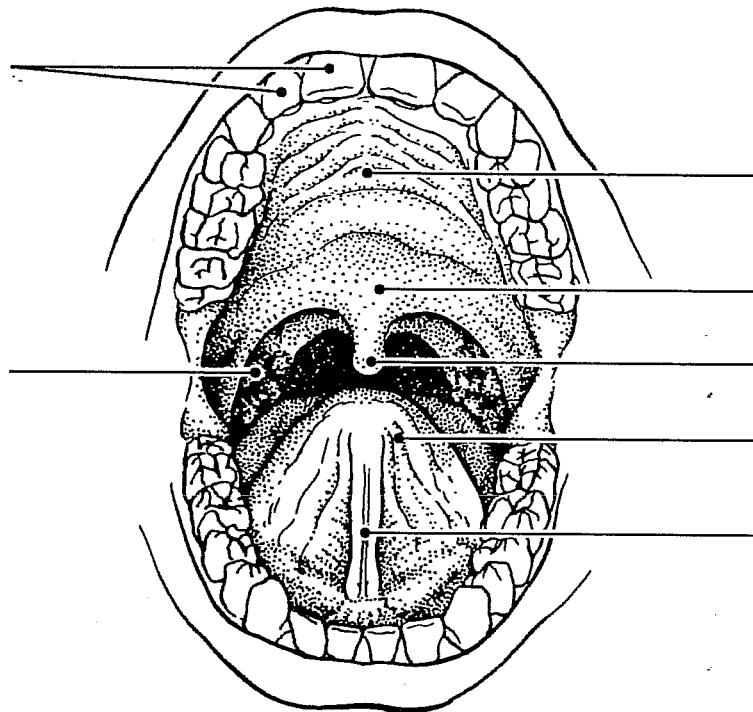


Figure 14–2

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

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 valve
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. Color the hydrochloric acid-secreting cells red 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 |

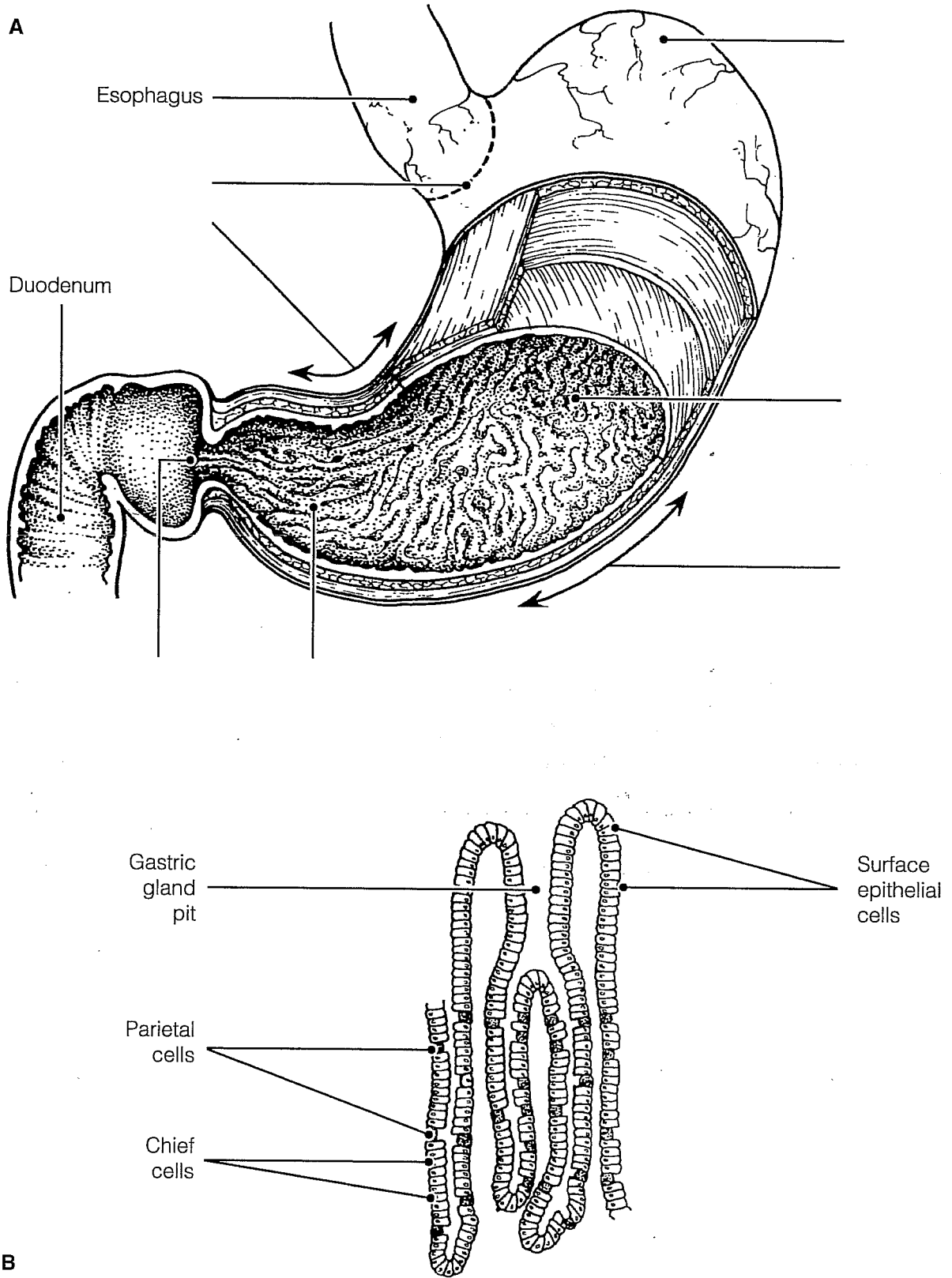


Figure 14-3

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.

- | | |
|---|---------------------------------------|
| <input type="radio"/> Common hepatic duct | <input type="radio"/> Bile duct |
| <input type="radio"/> Cystic duct | <input type="radio"/> Pancreatic duct |

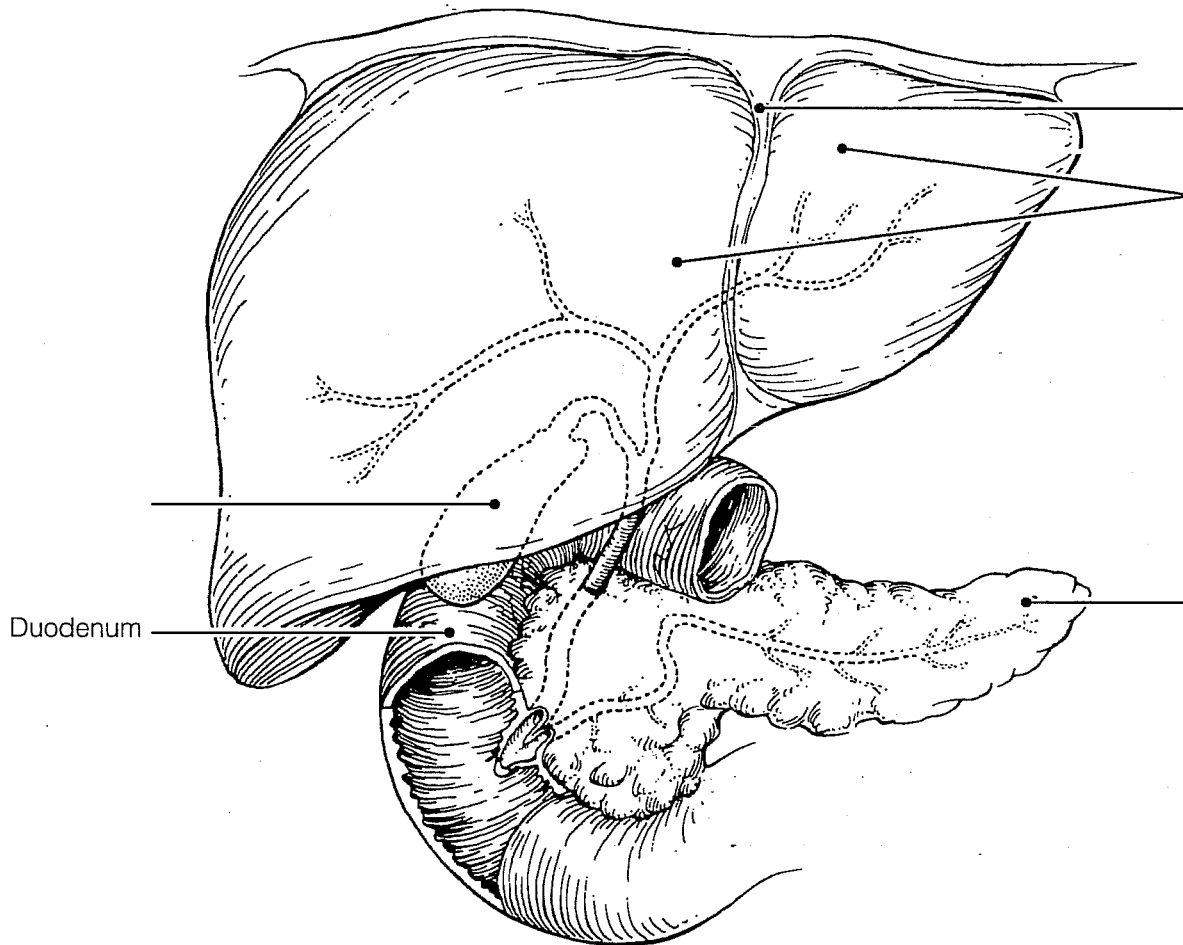


Figure 14-6

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.

- | | |
|----------|-----------|
| _____ 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.

Key Choices

- | | | |
|-----------------------------------|--|-------------------------------|
| <input type="radio"/> A. Cementum | <input type="radio"/> C. Enamel | <input type="radio"/> E. Pulp |
| <input type="radio"/> B. Dentin | <input type="radio"/> D. Periodontal membrane (ligament) | |

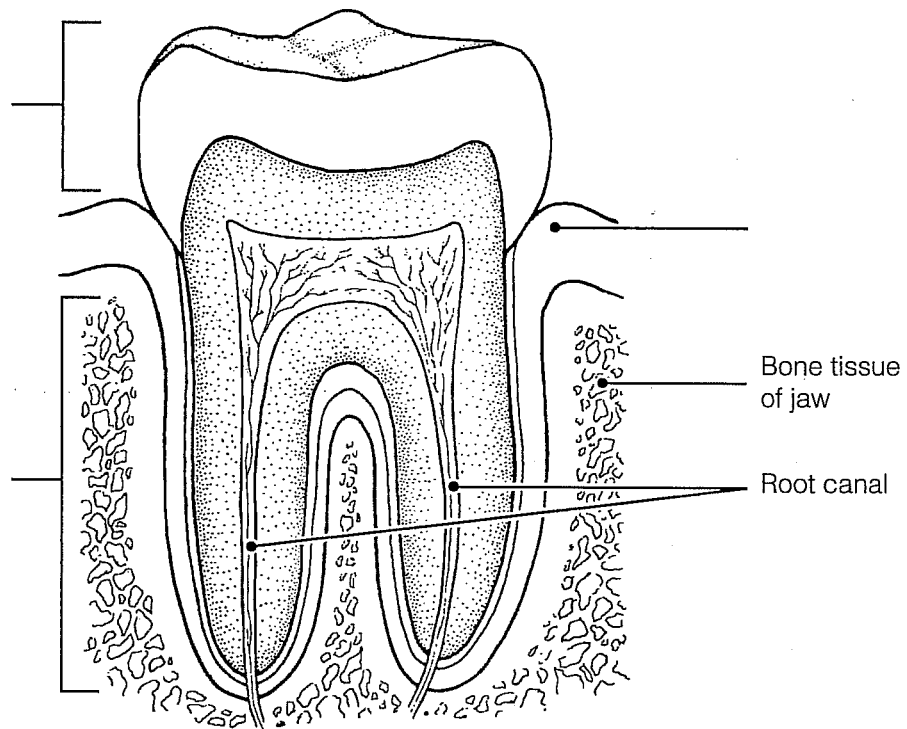


Figure 14-7

FUNCTIONS 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 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 mouth is 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. Since 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."

NUTRITION AND METABOLISM

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.

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 | |

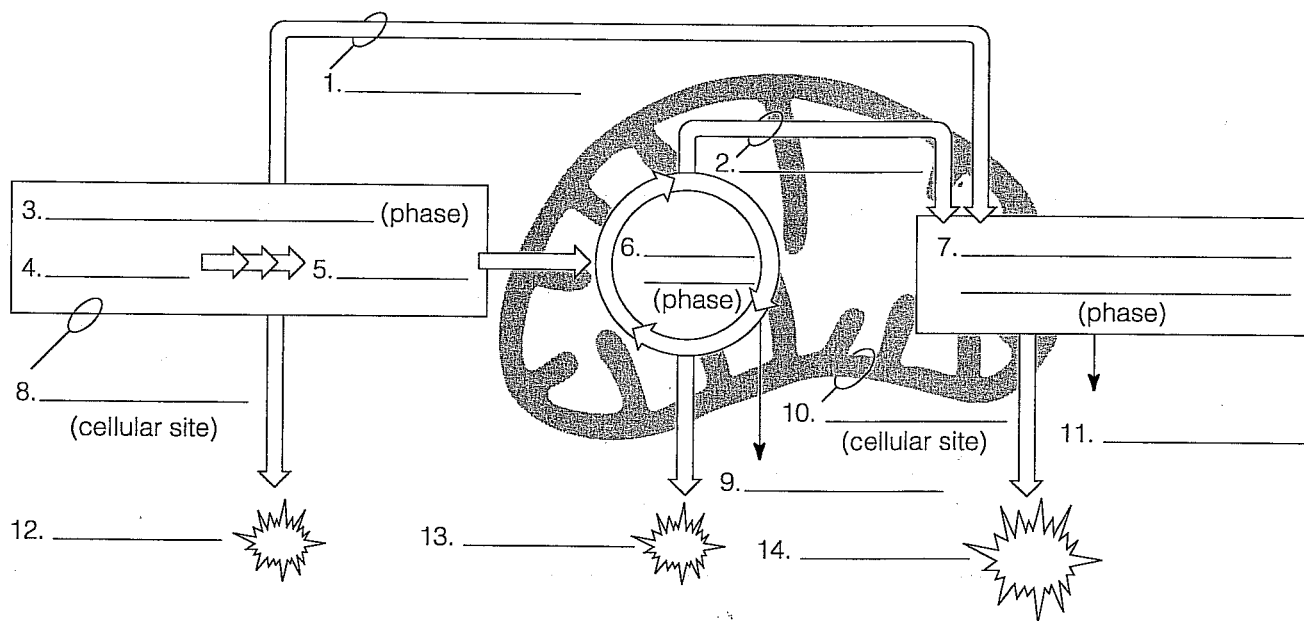


Figure 14–8

- Which of the oxidative phases does not require oxygen?

- Which phases do require oxygen? _____

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

- Which of the phases produces the largest amount of ATP?

- Which phase combines energetic H atoms with molecular oxygen?
