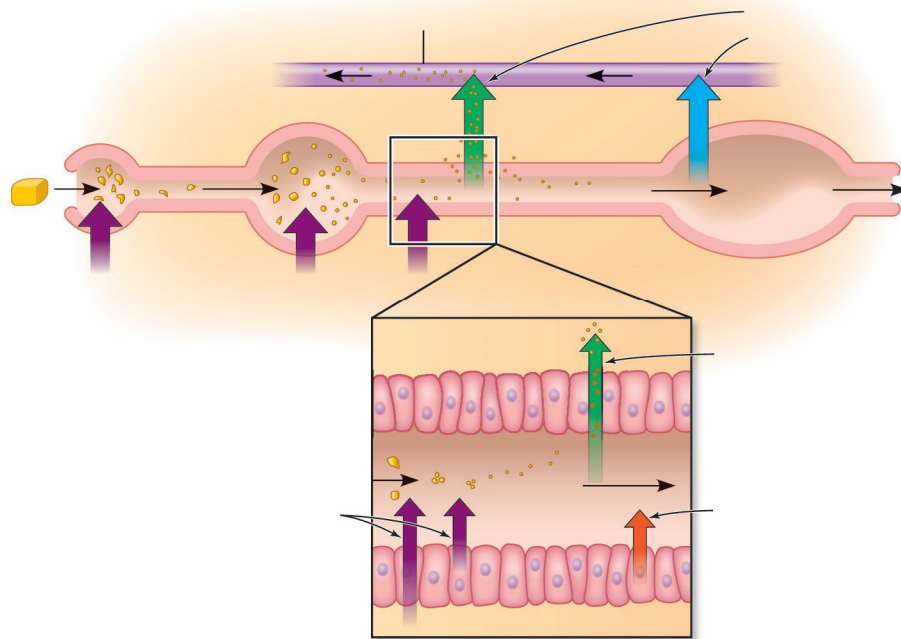


Chapter 41: Animal Nutrition

- 41.1 Describe the dietary needs for chemical energy, organic building blocks, and the four classes of essential nutrients.*
- 41.2 Distinguish the main feeding mechanisms of animals, and define four stages of food processing.*
- 41.3 Describe the major functions of each compartment in the mammalian digestive system.*
- 41.4 Use examples to demonstrate how vertebrate digestive systems are adapted to diet.*
- 41.5 Provide examples of negative feedback in the regulation of nutrient intake, processing, and storage.*

Animals require food to obtain the energy and essential nutrients necessary to grow and reproduce. Animals use various strategies to obtain and maximize food resources. Topics in this chapter will explore symbiotic relationships and feedback regulation as important elements of successful resource acquisition and maintenance of homeostasis. The important actions of enzymes and application of your knowledge of organic molecules and their components is part of the study of digestion.

Study Tip: An animal digests food using compartmentalized processing in a tube-like system. Start at the bottom of Figure 41.1 by labeling structures and explaining how food can be digested while protecting body tissues.



Concept 41.1 *An animal's diet must supply chemical energy, organic building blocks, and essential nutrients*

LO 41.1: *Describe the dietary needs for chemical energy, organic building blocks, and the four classes of essential nutrients.*

1. Use three sentences to explain the three nutritional needs an adequate diet must satisfy.
2. What are *essential amino acids*? What must vegetarians do in order to obtain them?
3. Table 41.1 in your text presents a comprehensive list of vitamins, their dietary sources and functions, and the symptoms of deficiency. Which category of vitamin, *water soluble* or *fat soluble*, is most likely to result in overdose? Why?
4. Complete this chart to gain an understanding of the most common deficiency disorders as well as common vitamin sources.

Deficiency Disorder	Symptoms	Vitamin Deficient?	Dietary Source?
Beriberi			
Scurvy			
Rickets			
	Neural tube defects in babies (see end of concept)		
	Blindness		

5. Complete this chart on mineral requirements to understand the important role of these selected minerals in our diet.

Mineral	Major Functions/Deficiency Symptoms	Dietary Source?
Calcium		
Phosphorus		
Sulfur		
Potassium		
Chloride		
Sodium		
Magnesium		
Iron		
Fluorine		
Iodine		

6. What is the difference between *malnutrition* and *undernutrition*?

Concept 41.2 *Food processing involves ingestion, digestion, absorption, and elimination*

LO 41.2: *Distinguish the main feeding mechanisms of animals, and define four stages of food processing.*

7. What happens in each of these stages of food processing?

ingestion

digestion

absorption

elimination

8. Use Figure 41.5 in your text to list and describe the four main feeding mechanisms of animals.
9. Distinguish between *mechanical digestion* and *chemical digestion*.
10. What is *enzymatic hydrolysis*?
11. Create a chart that shows the four categories of organic macromolecules and the building blocks that result after enzymatic hydrolysis.
12. In what sense are nutrients from a recently ingested meal not really “inside” your body before they enter the absorption stage of food processing?
13. Explain the difference between *intracellular* and *extracellular digestion* and give a description of each process in different organisms.

14. What is an *alimentary canal*? Where does it start and end?

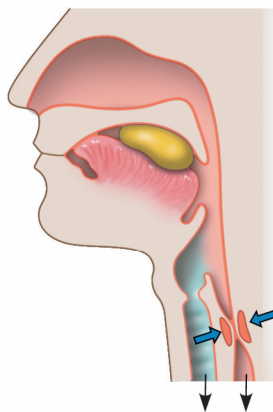
Concept 41.3 *Organs specialized for sequential stages of food processing form the mammalian digestive system*

LO 41.3: *Describe the major functions of each compartment in the mammalian digestive system.*

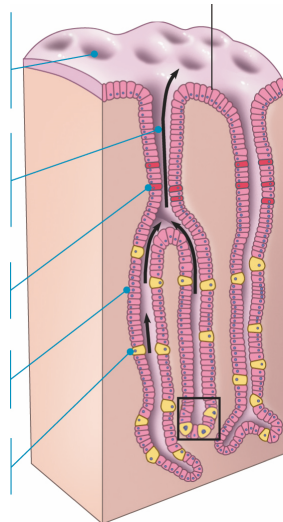
Study Tip

Turn now to the end of this chapter where you will find Figure 41.8. Label and complete this figure as you work through the remainder of the chapter.

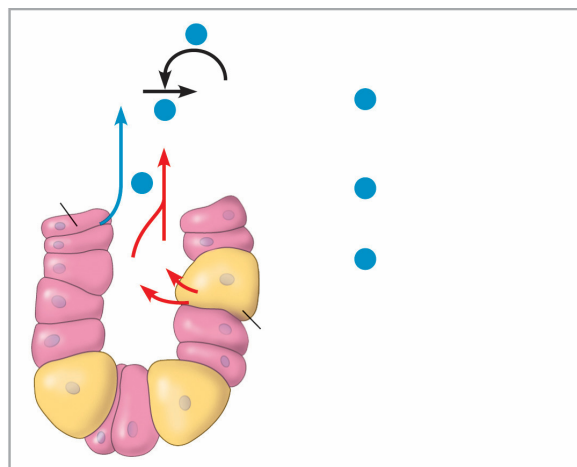
15. Digestion begins in the oral cavity with teeth for mechanical digestion and saliva for chemical digestion.
- a. Major components of saliva include mucus, buffers, and antimicrobial agents. Explain the role of each.
 - b. Why does saliva contain so much *amylase*? Amylase begins the breakdown of starches and sugars in the mouth and is the first enzyme in the digestive pathway. (Remember that bacteria release acid waste products that begin the process of tooth decay.)
16. Label this sketch to show the *bolus* of food, the *glottis*, *epiglottis*, *trachea*, *pharynx*, *esophagus*, and *esophageal sphincter*.



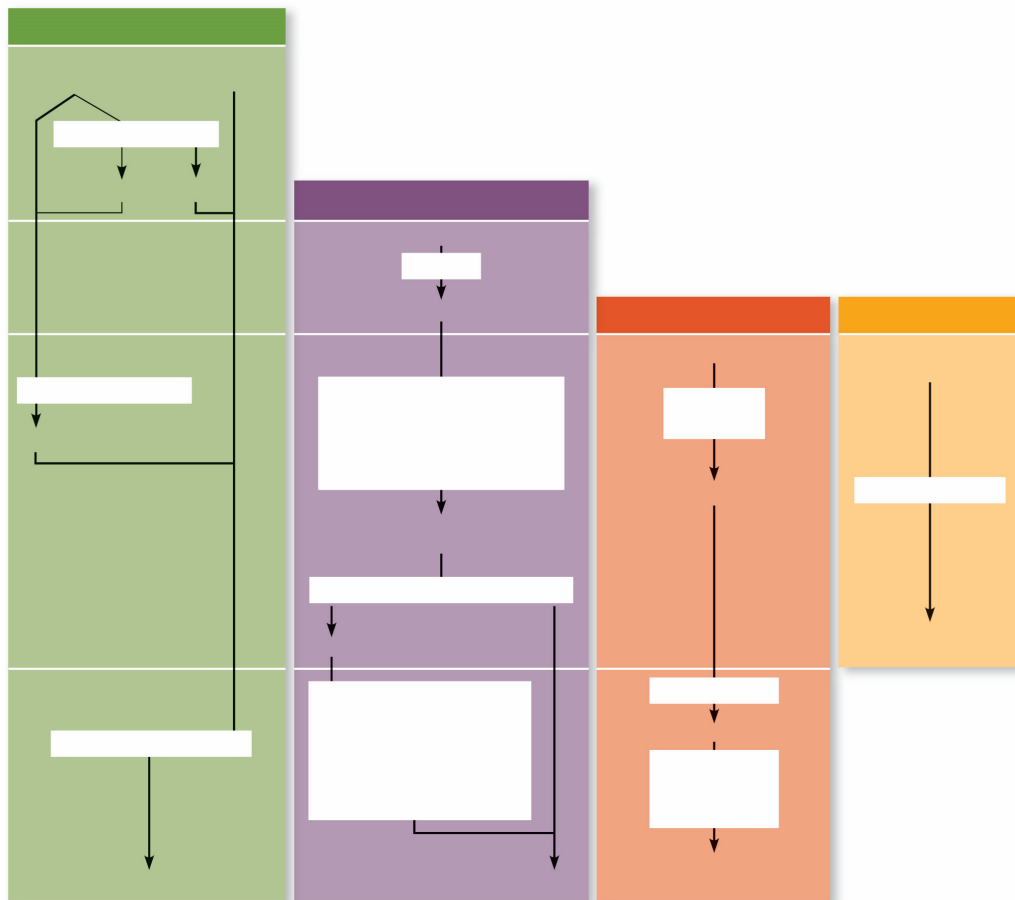
17. How is food kept from entering the trachea when we swallow?
18. What is *peristalsis* and where does it begin?
19. What are the two functions of the stomach?
20. Using Figure 41.10 as a guide, label the interior surface of the stomach, gastric gland, mucus cells, chief cells, and parietal cells. After labeling, explain the function of each labeled structure.



21. Label and explain the positive feedback loop involved in the production of gastric juice.

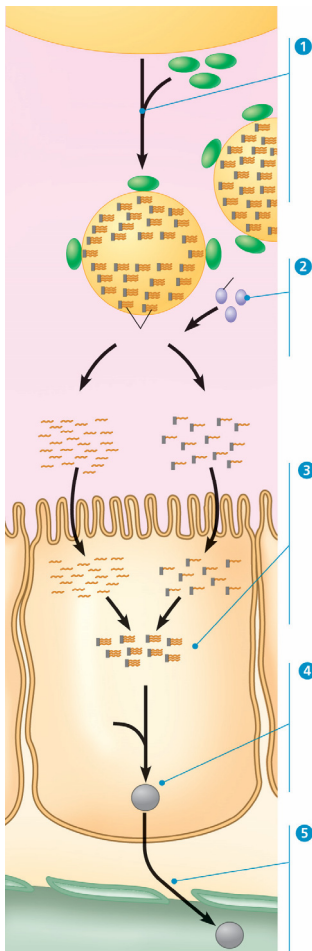


22. Explain, based on tertiary structure, why *pepsin* does not function in the small intestine.
23. What is the digestive function of the liver?
24. What is the function of *bile*? Where is it stored?
25. What are the two digestive functions of the small intestine?
26. Many enzymes are involved in the process of digestion. Begin by labeling the columns (carbohydrates, proteins, nucleic acids, and fats) and rows (oral cavity, stomach, lumen of small intestine (enzymes from pancreas), and epithelium of small intestine).



Now add the enzymes produced or functioning in each organ, and their substrates and products. Review the figure until you can visualize digestion as a single process not divided into organic categories.

27. Remember the mantra: *Structure fits function*. How is that true for the *villi* of the small intestine?
28. Monosaccharides and amino acids move directly into capillaries in the villi and then travel to the liver via the *hepatic portal vein*. What two major functions does this arrangement serve?
29. Although most nutrients leave the small intestines through the blood stream, fats take another route. Use the figure to explain in five steps how fats are absorbed from the small intestines.



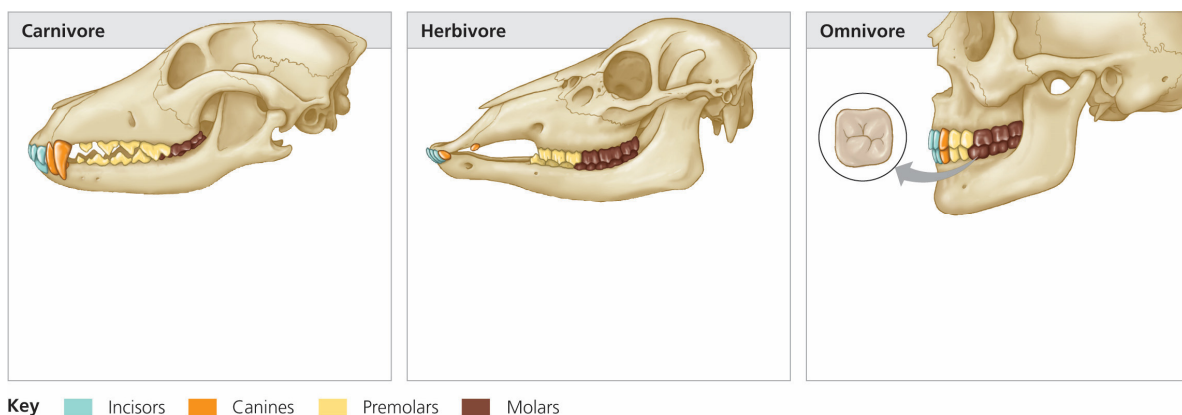
30. What are the *lacteals*? Where are they found?

31. About 7 L of water are secreted in digestive juices each day, but we only take in about 2 L. Explain how water balance is achieved by the small intestine.
32. The small intestine connects to the *large intestine* at a T-shaped junction. One arm forms a blind pouch called the *cecum*. What is the cecum's role in grazing animals?
33. Where is the human appendix located? What function does it have?
34. What is a major function of the colon?
35. What makes up the *feces*?

Concept 41.4 *Evolutionary adaptations of vertebrate digestive systems correlate with diet*

LO 41.4: *Use examples to demonstrate how vertebrate digestive systems are adapted to diet.*

36. From a study of the dentition of a mammal's skull, you should be able to determine its diet. Using Figure 41.15, explain how each animal below is specialized for its diet.



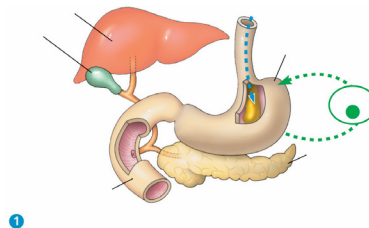
37. Why do herbivores have longer alimentary canals than carnivores?
38. The colon is inhabited by an immense number of bacteria which comprise part of your *microbiome*. What do these mutualistic symbiotic bacteria do for you?
39. Does stress cause ulcers? Discuss the finding that received the 2005 Nobel Prize.

40. How can fecal microbial transplantation play a role in treating intestinal infections?
41. Mutualistic symbiosis is important to digestion in many other species besides man. How do herbivores manage to get their energy from plant cellulose material when they do not have the ability to make enzymes to digest cellulose?

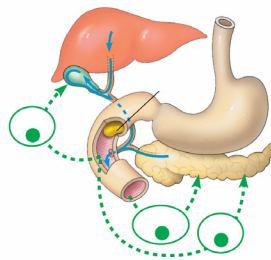
Concept 41.5 *Feedback circuits regulate digestion, energy storage, and appetite*

LO 41.5: *Provide examples of negative feedback in the regulation of nutrient intake, processing, and storage.*

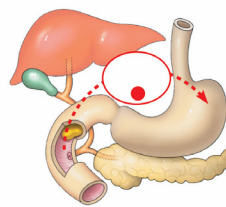
42. Regulation of digestion involves several hormonal feedback pathways. Label the figures below then explain the hormonal interactions below each figure. Note whether the interactions are positive or negative feedback pathways.



1

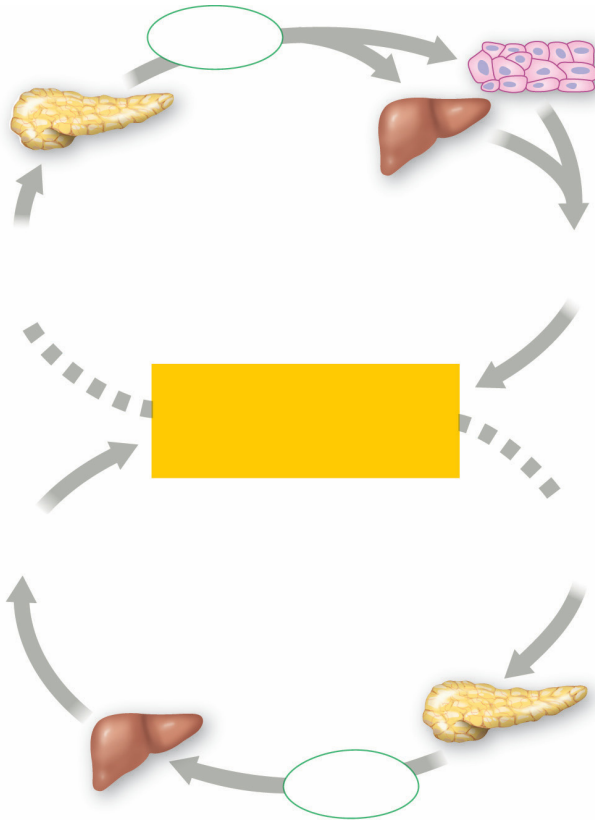


2



3

43. The synthesis and breakdown of glycogen are central not only to energy storage, but also to maintaining glucose homeostasis. Label the figure below and then explain the steps to homeostatic regulation of glucose. Explain the role of the two pancreatic hormones, *insulin* and *glucagon*, in glucose homeostasis.



44. What is *diabetes mellitus*?
- Explain the cause and treatment of *type 1 diabetes*.
 - Explain the cause and treatment of *type 2 diabetes*.
45. Several hormones interact to regulate appetite. What is the role of leptin?
- How is it countered by *ghrelin*?
 - What is the target for all the hormones involved in appetite regulation?

Test Your Understanding, p. 920.

1. _____ 2. _____ 3. _____ 4. _____ 5. _____
6. _____ 7. _____

Label this figure as you read about the various organs of the digestive system. Provide the function of each organ as well as its name. At the end of your study, use this figure to explain the various processes involved in digestion, from the anatomy of the system to the enzymes involved.

