Name _____ Class _____ Date _____

30.3 The Digestive System

Lesson Objectives

- Describe the organs of the digestive system and explain their functions.
- Explain what happens during digestion.
- Describe how nutrients are absorbed into the bloodstream and wastes are eliminated from the body.

Lesson Summary

Functions of the Digestive System

The digestive system converts food into small molecules that can be used by body cells. Food is processed by the digestive system in four phases: ingestion, digestion, absorption, and elimination.

- Ingestion is the process of putting food into your mouth.
- **Mechanical digestion** is the physical breakdown of large pieces of food into smaller pieces. During **chemical digestion**, enzymes break down food into molecules the body can use.
- Food molecules are absorbed into the circulatory system by cells in the small intestine.
- Materials the body cannot digest travel through the large intestine and are eliminated as feces.

The Process of Digestion

During digestion, food travels through the mouth, esophagus, stomach, and small intestine.

- Mechanical digestion begins as teeth tear and grind food. Saliva contains **amylase**, an enzyme that breaks down starches into sugars. This begins the process of chemical digestion. Once food is chewed, it is pushed into the pharynx.
- The tube leading from the pharynx to the stomach is called the **esophagus**. Contractions of smooth muscles, called **peristalsis**, move food through the esophagus to the **stomach**, a large muscular sac that continues digestion.
  - Glands in the stomach lining release hydrochloric acid and the enzyme **pepsin**, which breaks proteins into smaller polypeptide fragments.
  - Contractions of stomach muscles churn the stomach contents, which forms **chyme**, a mixture with an oatmeal-like consistency.
- As chyme moves out of the stomach, it enters the duodenum, the uppermost portion of the **small intestine**. Here, digestive fluids from the pancreas, liver, and lining of the duodenum are added to the chyme.

Absorption and Elimination

Most nutrients from food are absorbed by the small intestine. The large intestine absorbs water and prepares waste for elimination from the body.

- The small intestine has fingerlike projections (**villi**) that are covered with microvilli, which absorb nutrients. Most nutrients are absorbed into the blood, but fats are absorbed into the lymph.
- When chyme leaves the small intestine, it enters the **large intestine**, or colon. The large intestine absorbs water and some vitamins that are produced by bacteria in the large intestine. The remaining waste material leaves the body through the anus.

Name _____ Class _____ Date _____

Functions of the Digestive System

1. What is the function of the organs of the digestive system?

Their function is to help convert foods into simpler molecules that can be absorbed and used by body cells.

2. What are the four phases of digestion?

ingestion, digestion, absorption, and elimination

3. What is mechanical digestion?

Mechanical digestion is the physical breakdown of large pieces of food into smaller pieces.

4. How do absorbed food molecules travel to the rest of the body?

Once the molecules are absorbed by the small intestines, they enter the circulatory system. The circulatory system transports the molecules throughout the body.

The Process of Digestion

Write the letter of the correct answer on the line at the left.

C **5.** Where does chemical digestion begin?

A. the stomach
C. the mouth
B. the small intestine
D. the esophagus

A **6.** Saliva eases the passage of food through the digestive system and contains

A. amylase.
C. sodium bicarbonate.
B. pepsin.
D. bile.

C **7.** Which is the correct order of passage of food through the digestive system?

A. mouth, stomach, esophagus, large intestine, small intestine
B. mouth, stomach, esophagus, small intestine, large intestine
C. mouth, esophagus, stomach, small intestine, large intestine
D. mouth, esophagus, stomach, large intestine, small intestine

B **8.** Which of the following is not a role of the pancreas?

A. produces sodium bicarbonate
B. produces bile
C. produces hormones that regulate blood sugar
D. produces enzymes that break down carbohydrates, proteins, lipids, and nucleic acids

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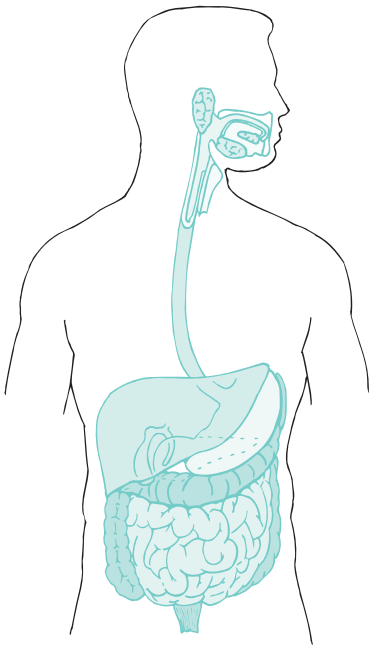
9. Complete the table about the effects of digestive enzymes.

Active Site	Enzyme	Effect on Food
Mouth	*Salivary amylase*	Breaks down starches into disaccharides
Stomach	Pepsin	*Breaks down proteins into large peptides*
Small intestine (released from pancreas)	*Pancreatic amylase*	Continues the breakdown of starch
	Trypsin	*Continues the breakdown of protein*
	Lipase	Breaks down fat
Small intestine	Maltase, sucrase, lactase	*Breaks down remaining disaccharides into monosaccharides*
	Peptidase	Breaks down dipeptides into amino acids

10. THINK VISUALLY Draw and label the digestive system. Include the salivary glands, mouth, epiglottis, esophagus, stomach, liver, gallbladder, small intestine, and large intestine.



Student drawings should show and label salivary glands, mouth, epiglottis, esophagus, stomach, liver, gallbladder, small intestine, and large intestine.

Name _____ Class _____ Date _____

Absorption and Elimination

For Questions 11–16, complete each statement by writing the correct word or words.

11. The folded surface and fingerlike projections of the *small intestine* provide a large surface area for absorption of nutrient molecules.

12. The fingerlike projections are called *villi*.

13. Capillaries in the villi absorb the products of *carbohydrate* and *protein* digestion.

14. Fats and fatty acids are absorbed by *lymph vessels*.

15. In some animals, the *appendix* processes cellulose, but not in humans.

16. Once chyme leaves the small intestine, it enters the large intestine, or *colon*.

17. The small intestine is longer than the large intestine. How did the large intestine get its name?

Although the large intestine is much shorter than the small intestine, its diameter is much greater than the small intestine's diameter.

18. What is the primary function of the large intestine?

The large intestine absorbs water from undigested material.

19. What happens to waste materials when they leave the colon?

Wastes pass into the rectum and are released from the body through the anus.

Apply the Big idea

20. What role does the large intestine play in maintaining homeostasis?

The primary function of the large intestine is to absorb water. Water is the most important nutrient. The large intestine works with other organ systems to maintain water balance in the body.

Name _____ Class _____ Date _____

30.4 The Excretory System

Lesson Objectives

- Describe the structures of the excretory system and explain their functions.
- Explain how the kidneys clean the blood.
- Describe how the kidneys maintain homeostasis.

Lesson Summary

Structures of the Excretory System

Cells produce wastes such as salts, carbon dioxide, and ammonia. For homeostasis to be maintained, these wastes need to be removed from the body. **Excretion** is the process by which metabolic wastes are eliminated from the body.

- The skin excretes excess water, salts, and a small amount of urea in sweat.
- The lungs excrete carbon dioxide and water vapor.
- The liver converts potentially dangerous nitrogen wastes to urea.
- The kidneys are the major organs of excretion. They remove excess water, urea, and metabolic wastes from the blood. **Ureters** carry urine from the kidneys to the **urinary bladder**, where it is stored until it leaves the body through the **urethra**.

Excretion and the Kidneys

The kidneys remove excess water, minerals, and other waste products from the blood. The cleansed blood returns to circulation. Each kidney has nearly a million processing units called **nephrons**. Filtration and reabsorption occur in the nephrons.

- **Filtration** is the passage of a fluid or gas through a filter to remove wastes. The filtration of blood in the nephron takes place in the **glomerulus**, a small, dense network of capillaries. Each glomerulus is encased by a cuplike structure called **Bowman's capsule**. Pressure in the capillaries forces fluids and wastes from the blood into Bowman's capsule. This fluid is called filtrate.
- Most of the material that enters Bowman's capsule is returned to circulation. The process by which water and dissolved substances are taken back into the blood is called **reabsorption**.
- A section of the nephron tubule, called the **loop of Henle**, conserves water and minimizes the volume of filtrate. The fluid that remains in the tubule is called urine.

The Kidneys and Homeostasis

The kidneys remove wastes, maintain blood pH, and regulate the water content of the blood.

- The activity of the kidneys is controlled in part by the composition of blood. For example, if blood glucose levels rise well above normal, the kidneys excrete glucose into the urine.
- Disruption of kidney function can lead to health issues such as kidney stones and serious health issues such as kidney damage, and kidney failure.
  - Kidney stones occur when minerals or uric acid salts crystallize and obstruct a ureter.
  - Kidney damage is often caused by high blood pressure or diabetes.
  - When a patient's kidneys can no longer maintain homeostasis, the patient is said to be in kidney failure.

Name _____ Class _____ Date _____

Structures of the Excretory System

1. Why does the body need an excretory system?

The human body produces chemical waste products. Some of these waste products can be toxic and may cause death if they are not eliminated from the body. The excretory system eliminates these harmful waste products.

2. What is excretion?

Excretion is the process by which metabolic wastes are eliminated from the body to maintain homeostasis.

3. What waste compounds are produced by every cell in the body?

excess salts, carbon dioxide, and ammonia

4. What organs are included in the excretory system?

skin, lungs, liver, kidneys, ureters, urinary bladder, and the urethra

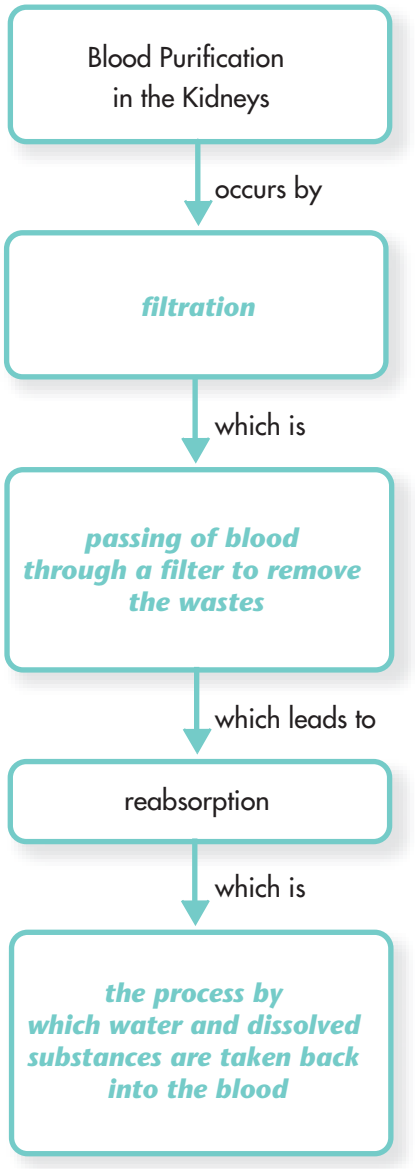
5. Complete the table about the excretory system.

Organs of the Excretory System	
Organ	**Function**
Skin	*Excretes excess water, salts, and urea in sweat*
Lungs	*Excrete carbon dioxide and water vapor when you exhale*
Liver	Converts dangerous nitrogen wastes into urea
Kidneys	*Remove excess water, urea, and metabolic wastes from the blood; produce urine*
Ureters	Transport urine from kidneys to the bladder
Urinary bladder	Stores urine
Urethra	*Releases urine from the body*

Name _____ Class _____ Date _____

Excretion and the Kidneys

6. Complete the concept map.



For Questions 7–10, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

nephrons **7.** Each kidney has nearly a million individual processing units called capillaries.

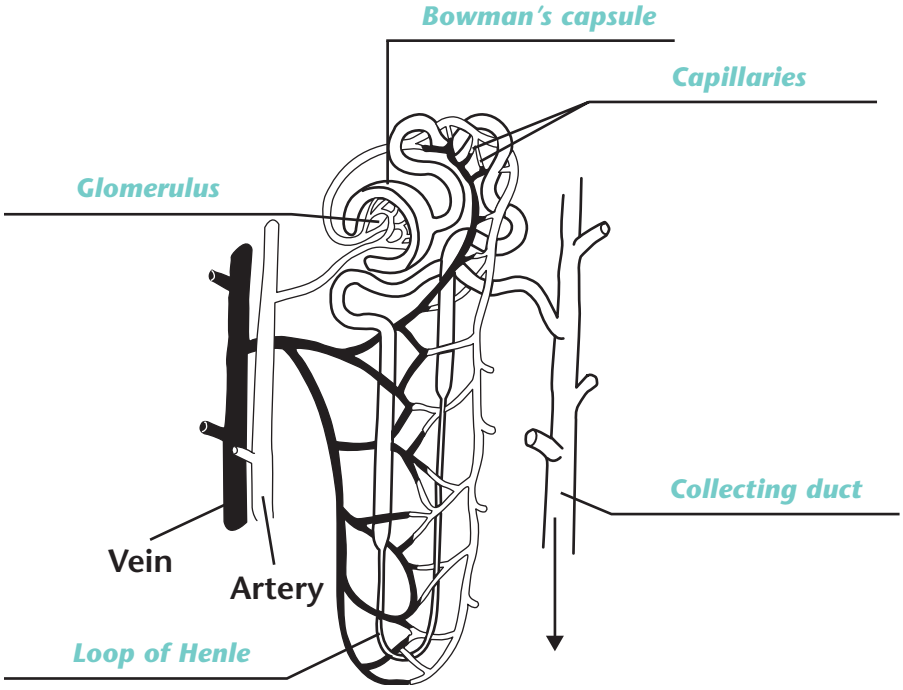
True **8.** The material that is filtered from the blood contains water, urea, glucose, salts, amino acids, and some vitamins.

active transport **9.** A number of materials, including salts, are removed from the filtrate by osmosis and reabsorbed by the capillaries.

loop of Henle **10.** The glomerulus is responsible for conserving water and minimizing the volume of the filtrate.

Name _____ Class _____ Date _____

11. THINK VISUALLY Label the diagram of a nephron.



The Kidneys and Homeostasis

12. Describe three ways that the kidneys help maintain homeostasis.

The kidneys help maintain homeostasis by regulating water balance, pH, and blood glucose.

13. Explain how the kidneys regulate the levels of salt in the blood.

The kidneys respond to the composition of the blood. If the level of salt in the blood is too high, the kidneys will return less salt to the blood during reabsorption.

14. How does dialysis work?

During dialysis, a machine performs the role of the kidneys. The patient's blood is pumped through the machine, cleansed, and pumped back into the body.

Apply the Big Idea

15. Urine testing is a common way that doctors can monitor a patient's health. Suppose a urine test reveals that there are proteins in the patient's urine. What might be wrong with this patient? What part of the excretory system might not be functioning properly?

The presence of protein in the urine can indicate high blood pressure or diabetes. Within each nephron is a cluster of capillaries, called a glomerulus, that filters blood. Usually, proteins do not pass through the walls of the capillaries and into the filtrate in the Bowman's capsule. If proteins are found in the urine, this indicates that the capillaries may be damaged.

Name _____ Class _____ Date _____

Chapter Vocabulary Review

Write the letter of the correct answer on the line at the left.

B 1. Which type of tissue provides support for the body and connects its parts?

A. epithelial tissue **C.** nervous tissue
B. connective tissue **D.** muscle tissue

A 2. Which organ absorbs most of the nutrients during digestion?

A. small intestine **C.** stomach
B. large intestine **D.** esophagus

C 3. Which of the following is an enzyme released by the stomach during chemical digestion?

A. chime **C.** pepsin
B. amylase **D.** bile

For Questions 4–8, complete each statement by writing the correct word or words.

4. The body's systems are constantly working to maintain *homeostasis*.

5. The sugars found in fruits, honey, and sugar cane are simple *carbohydrates*.

6. The *esophagus* is a long tube that connects the mouth and the stomach.

7. The *large intestine* absorbs water from undigested material that will be eliminated.

8. The process by which metabolic wastes are eliminated is called *excretion*.

For Questions 9–18, match the term with its definition.

Terms	Definitions
G 9. Calorie	**A.** Inorganic molecule needed by the body in small quantities
J 10. proteins	**B.** Functional unit of the kidney
F 11. vitamins	**C.** Mixture of stomach fluids and partially digested food
E 12. amylase	**D.** Section of a nephron that conserves water and minimizes urine volume
A 13. mineral	**E.** Enzyme that breaks down carbohydrates
H 14. peristalsis	**F.** Organic molecules that regulate body processes
C 15. chyme	**G.** Unit equal to 1000 calories of heat or 1 kilocalorie
B 16. nephron	**H.** Smooth muscle contractions that squeeze food through the esophagus into the stomach
I 17. Bowman's capsule	**I.** Cup-shaped structure that surrounds a glomerulus
D 18. loop of Henle	**J.** Nutrients that provide the body with the building materials it needs for growth and repair

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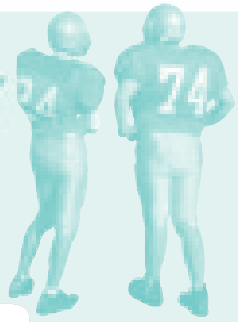
CHAPTER MYSTERY

THE TELLTALE SAMPLE



In the Chapter Mystery, you learned how evidence of illegal drug use can be found by testing a person's urine. In this activity, you'll learn about other substances that athletes should possibly be tested for.

21st Century

Dietary Supplements

Some athletic organizations test competing athletes for illegal drug use. Dietary supplements, on the other hand, are not tested for by most athletic organizations, because they are legal. But since many supplements claim to improve health or boost physical performance, should they be included in athletes' drug tests as well? Are dietary supplements even safe or effective? The following Web page presents one view on supplements.

SportsMedForum > Home > Fitness > Dietary Supplements

Dietary Supplements: Helpful or Hazardous?

Do you agree with the following two statements about the safety and effectiveness of dietary supplements?

"If it weren't safe, they wouldn't be allowed to sell it."
"They can't claim it in their ad if it's not true."

The fact is, both statements are false an awful lot of the time. Neither statement is true, for instance, when you see an ad for a dietary supplement claiming that it will help you lose weight, build muscles, or be happier. Why?

Here's the thing. Before a drug—defined as any substances intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease—can be sold in this country, the manufacturer has to prove to the Food and Drug Administration that the drug is safe and effective. If it doesn't, the FDA won't approve the drug. But dietary supplements are not drugs, and so the rules are different.

Manufacturers are not allowed to sell dietary supplements—defined as substances that are added to a person's diet, but don't have proven disease-treating effects—that are unsafe and/or ineffective. However, the manufacturers don't have to prove to anyone that their product actually is safe and effective. The FDA can only ban a product if it performs its own tests to prove that the product is dangerous or fraudulent. Needless to say, the FDA can't afford to test all of the roughly 29,000 supplements on the market. This means unsafe and ineffective supplements may slip by.

The FDA does have rules about what a manufacturer can claim, but these rules are very easy to get around. For example, product labels are not allowed to include any "false or misleading claims." But is anybody going to test the claims to see if they are false or misleading? No. Manufacturers can't claim that a supplement will "treat, mitigate, or cure a disease," a label reserved for drugs. So they can't say a product will treat high blood pressure but to get around it, they can say it will "promote blood-vessel health." They can't say a supplement will treat depression, but they can say it will "promote a feeling of well-being."

And then there's the phrase I hate the most—"all natural." In how many ads does someone say, "It's all natural, so you know it's safe"? Oh yeah? Poison ivy is "natural," but I wouldn't eat it. Foxglove is "natural," but if you eat it, be prepared for nausea, diarrhea, vomiting, irregular heartbeat, convulsions, and maybe death. Monkshood is "natural," but you can die if you handle it, never mind ingest it.

As always, friends, don't believe everything you read. Even here.

Murray Gelb, D. Jur,. is a practicing attorney.

This column is for entertainment only. Nothing in it should be construed as legal advice.

Continued on next page ▶

Name _____ Class _____ Date _____

21st Century Themes Science and Economic Literacy, Science and Health Literacy

1. What is the difference between a drug and a dietary supplement?

A drug is any substance intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease, while a dietary supplement is a substance that can be added to a person's diet, but that does not have any proven disease-treating effects.

2. What are two FDA rules about labeling on packages of dietary supplements?

The label can't contain any "false or misleading claims," or any claim to "treat, mitigate, or cure a disease."

3. An ad for a dietary supplement says a product builds muscle mass and improves athletic performance. Why should you approach such claims with skepticism? Explain your answer.

SAMPLE ANSWER: Such claims may not be true—a manufacturer does not have to prove that its product is safe or effective, and the product has probably not been tested by the FDA.

4. A dietary supplement's label has the phrase "all natural." Can you assume that the product is safe? Explain your answer.

SAMPLE ANSWER: No, you cannot assume the product is safe. Just because an ingredient is natural does not mean it is safe.

5. If a product label says it will "treat and prevent heartburn and acid indigestion," what does that tell you about the product?

Because it "treats" a condition, the product should be a drug that has been proven to be safe and effective.

21st Century Skills Race for a Cause

The skills used in this activity include **information and media literacy**, **communication skills**, **creativity and intellectual curiosity**, and **social responsibility**.

Go to a local mall, pharmacy, or health food store and look for products taken to improve one's health or well-being that are not FDA-approved. Read the labels. Look at any advertising you see nearby—signs, brochures, pamphlets, and so on. Look at the wording that is used, and how things are phrased.

Write a short essay about these products, giving your opinion on what the products most likely can and cannot do.

Students should use their knowledge of science to identify any possible false claims made by the product's advertising. Evaluate students' essays on the clarity with which they present their opinions.

