**Chapter 19: Respiration and Excretion**

### Chapter Organizer

#### Activity Materials

**Explore**

- Pages 519: stopwatch or timer with second hand

**Activities**

- Pages 530-531: timer, drinking straws, 200 mL bromothymol blue solution, 2 12-ounce glass cups, metric measuring cups, p. 539: large animal kidney, scalpel, hand lens

**MiniLabs**

- Pages 524: tape, paper, scissors
- Pages 525: dirt, cup, funnel, filter paper, water

#### Key to Teaching Strategies

- The number of recommended single-period sessions
- The number of recommended blocks
- One session and one-half block are allowed for chapter review and assessment.

### Chapter Review

- pp. 37-38
- pp. 67-68

### Assessment Resources

- Chapter Review, pp. 37-38
- Performance Assessment in the Science Classroom (PASC)
- MindJogger Videoquiz
- National Geographic Society: STV
- Internet Connection, p. 527
- Internet Connection, p. 534

### Standards

**National**

- California Science Content Standards: A1, A2, B1, C1, C3, E1, F1, F3, F4, F5, G1, G3

### Reproducible Resources

- Activity Worksheets, pp. 103-104, 107
- Critical Thinking/Problem Solving, p. 10
- Enrichment, p. 53
- Laboratory Manual, pp. 111-114
- Laboratory Manual, pp. 115-116
- Reinforcement, p. 53
- Study Guide, pp. 73-74

### Technology

- MindJogger Videoquiz
- Alternate Assessment in the Science Classroom
- Performance Assessment, p. 10
- Chapter Review Software
- Computer Test Bank

---

**Objectives**

1. **State** three functions of the respiratory system.
2. **Explain** how oxygen and carbon dioxide are exchanged in the lungs and in tissues.
3. **Trace** the pathway of air in and out of the lungs.
4. **Name** three effects of smoking on the respiratory system.

### Activities/Features

- **Explore Activity:** Observe Breathing Rate, p. 519
- **Using Math,** p. 522
- **MiniLab:** Measuring Surface Area, p. 524
- **Physics Integration,** p. 525
- **Using Math,** p. 528
- **Skill Builder:** Making Models, p. 529
- **Science Journal,** p. 529
- **Activity 19-1:** The Effects of Exercise on Respiration, pp. 530-531
- **How It Works:** Scuba, p. 532

### National Content Standards

- **A1, A2, B1, C1, C3, E1, F1, F3, F4, F5, G1, G3**

### Activity Worksheets

- pp. 103-104, 107

---

**Standards Reproducible Resources Technology**

- National: Standards: A1, A2, C1, C3, E1, F1, F3, F4, F5, G1, G3
- National Content Standards: UCP1, UCP4, A1, A2, C1

---

**Activity Worksheets**

- pp. 105-106, 108
- pp. 103-104, 107
- pp. 105-106

---

**Cooperative Learning**

- Cooperative Learning activities are designed for small group work.
- These strategies represent student products that can be placed into a best-work portfolio.
- Multiple Learning Styles logos, as described on page 63T, are used throughout to indicate strategies that address different learning styles.
Chapter 19

Respiration and Excretion

This is a representation of key blackline masters available in the Teacher Classroom Resources. See Resource Manager boxes within the chapter for additional information.

Activity Worksheets

Lab Manual

Assessment

Chapter Review

Test Practice Workbook

Critical Thinking/Problem Solving

Multicultural Connections
Functions of the Respiratory System (Section 19-1)

In order to function, cells need nutrients. These nutrients must be oxidized in order to release energy. The process of obtaining energy from nutrients is called cellular respiration. The most commonly used carbohydrate used in respiration is glucose. The oxidation of glucose produces water, carbon dioxide, and energy.

$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{H}_2\text{O} + 6\text{CO}_2 + \text{energy}$

Obtaining oxygen and the removing of carbon dioxide are the major functions of the respiratory system. There are two successive phases of the functioning of the system—breathing and transporting gases.

In order to effectively exchange the gases involved in respiration, a large surface area is required. It is estimated that the surface area of the alveoli of an adult is nearly 100 m$^2$. The required surface area of about 93 m$^2$, nearly 50 times the surface area of about 93 m$^2$, is divided into three lobes—the superior, middle, and inferior. The two lungs are separated by a structure, which contains the heart, trachea, esophagus, and blood vessels.

There are 300 million to 400 million alveoli in each lung. The air sacs of both lungs have a total surface area of about 93 m$^2$, nearly 50 times the total surface area of the skin.

Lungs (Section 19-1)

Lungs are pink at birth, but as a person ages, they become gray and mottled from tiny particles breathed in with the air. Usually, people who live in cities and industrial areas have darker lungs than those who live in the country.

The symptoms of hay fever include abundant tears and a runny nose. It is a common allergic reaction. So many people are affected that the ability of the system to change size, the elasticity of the lung tissue, and the differential in pressure between the lungs and chest.

Lungs (Section 19-1)

In the adult human, the left lung is divided into two sections, or lobes—the superior and the inferior. The right lung is somewhat larger than the left lung and is divided into three lobes—the superior, middle, and inferior. The two lungs are separated by a structure, which contains the heart, trachea, esophagus, and blood vessels.

The major organs of the respiratory system are a pair of bean-shaped structures called kidneys, each of which is approximately 10 cm long and 5 cm wide. They weigh about 170 g each. The filtering unit of the kidney is the nephron. It is only the urea and uric acid are wastes from the metabolism of proteins. The usual cause is Streptococcus bacterium. Pneumonia most readily attacks people who are already weakened by illness or who have damaged lungs. Blood infections, chronic alcoholism, inhalation of fluids into the lungs, or even prolonged bed rest can predispose a person to infection of the lungs by microorganisms.

Your Urinary System (Section 19-2)

The metabolic processes of the body produce waste products. The respiratory system rids the body of carbon dioxide. The digestive system eliminates solid wastes. The urinary system removes a variety of salts and nitrogenous wastes from the blood and lymph systems.

The rate of urinary infections in females gradually increases with age. Such infections are rarely seen in boys and young men. Urinary tract infections are common, second only to respiratory infections. Normally, urine is sterile. An infection occurs when microbes—usually bacteria from the digestive tract—adhere to the opening of the urethra and begin to multiply. Most infections can be traced to one type of colon bacteria, Escherichia coli (E. coli). The bacteria move from the urethra to the bladder causing a bladder infection. Urinary infections are rarely seen in boys and young men. The rate of urinary infections in females gradually increases with age. Such infections are treated with specific antibacterial drugs.

Urine (Section 19-2)

In the adult human, the left lung is divided into two sections, or lobes—the superior and the inferior. The right lung is somewhat larger than the left lung and is divided into three lobes—the superior, middle, and inferior. The two lungs are separated by a structure, which contains the heart, trachea, esophagus, and blood vessels.

There are 300 million to 400 million alveoli in each lung. The air sacs of both lungs have a total surface area of about 93 m$^2$, nearly 50 times the total surface area of the skin.

Hay Fever and Pneumonia (Section 19-1)

The symptoms of hay fever include abundant tears and a runny nose. It is a common allergic reaction. So many people are affected that the ability of the system to change size, the elasticity of the lung tissue, and the differential in pressure between the lungs and chest.

Lungs (Section 19-1)

In the adult human, the left lung is divided into two sections, or lobes—the superior and the inferior. The right lung is somewhat larger than the left lung and is divided into three lobes—the superior, middle, and inferior. The two lungs are separated by a structure, which contains the heart, trachea, esophagus, and blood vessels.

There are 300 million to 400 million alveoli in each lung. The air sacs of both lungs have a total surface area of about 93 m$^2$, nearly 50 times the total surface area of the skin.

In the adult human, the left lung is divided into two sections, or lobes—the superior and the inferior. The right lung is somewhat larger than the left lung and is divided into three lobes—the superior, middle, and inferior. The two lungs are separated by a structure, which contains the heart, trachea, esophagus, and blood vessels.

There are 300 million to 400 million alveoli in each lung. The air sacs of both lungs have a total surface area of about 93 m$^2$, nearly 50 times the total surface area of the skin.

Hay Fever and Pneumonia (Section 19-1)
Chapter Overview

Section 19-1 This section details the basic anatomy and physiology of the respiratory system. The mechanics of breathing is a description of respiratory diseases and disorders are included.

Section 19-2 The organs of the respiratory system and other excretory organs are introduced and are used to maintain homeostasis is explained.

Chapter Vocabulary

- pharynx
- larynx
- trachea
- bronchi
- alveoli
- diaphragm
- bronchitis
- emphysema

Theme Connection

Energy Transformation is a central theme in this text. Cells require oxygen in order to utilize nutrients and provide the energy for all cellular activities. Chemical energy is transformed into thermal and mechanical energy.

Explore Activity

Have you ever played basketball or run so hard that it felt like your lungs would burst? How long did it take your breathing rate to return to normal? You can live more than a week without food. You might live several days without water. But, you can live only several minutes without oxygen. Your body has the ability to store food and water. It cannot store much oxygen. It needs a continuous supply to keep your body cells functioning. Sometimes, your body needs a lot of oxygen. In the following activity, find out about one factor that can change your breathing rate.

Observe Breathing Rate

1. Put your hand on your chest. Take a deep breath. Feel your chest move up and down slightly. Notice how your rib cage moves out and upward when you inhale.
2. Count your breathing rate for 15 s. Multiply this number by four to figure your average breathing rate.
3. Jog in place for one minute and count your breathing rate again.
4. How long does it take for your breathing rate to return to normal?

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

How long does it take for your breathing rate to return to normal?

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.

Explore Activity

In your Science Journal, record your breathing rate before and after physical activity. Also, write down how long it took for your breathing rate to return to normal. Describe any changes you observed.
19.1 The Respiratory System

Functions of the Respiratory System

People have always known that air and food are needed for life. However, until about 225 years ago, no one knew why air was so important. At that time, a British chemist discovered that a mouse couldn’t live in a container in which the candle had previously been burned. He reasoned that a gas in the air of the container had been destroyed when the candle burned. He also discovered that if he put a plant into the container, whatever was necessary for life returned in eight or nine days, and a mouse again could live in the container. What do you think the plant produced when it was in the container? Think about photosynthesis. It had produced the gas needed for life that was later named oxygen.

Breathing and Respiration

People often get the terms breathing and respiration confused. Breathing is the process whereby fresh air moves into and stale air moves out of lungs. Fresh air contains oxygen, which passes from the lungs into your circulatory system. Blood then carries the oxygen to your individual cells. At the same time, your digestive system has prepared a supply of glucose in your cells from digested food. Now, oxygen is used in a series of chemical reactions to release the energy in glucose. These reactions, shown in the equation in Figure 19-1, are called respiration and occur in the mitochondria of cells. Carbon dioxide and water molecules are waste products of respiration. These molecules are carried in your blood to your lungs. When you exhale, you get rid of respiration’s waste product.

Figure 19-2 shows a place where there is decreased air pressure. The air is less dense at extreme heights, so there are fewer oxygen molecules in every breath you take. Why would it be harder to breathe on top of mountains?

Breathing is the moving in and expelling of air in our body. Respiration is the process of releasing energy from foods.
Organs of the Respiratory System

Your respiratory system is made up of body parts that help move oxygen into your body and carbon dioxide out of your body. The major structures and organs of your respiratory system are shown in Figure 19-3. These include your nasal cavity, pharynx (FEAR ingks), larynx (LAIR ingks), trachea (TRAY kee uh), bronchi (BRAHN ki), bronchioles (BRAHN kee ohz), lungs, and alveoli. Air enters your body through two openings in your nose called nostrils or through your mouth. Once inside the nostrils, hair traps dust from the air. From your nostrils, air passes through your nasal cavity, where it gets moistened and warmed. Glands that produce sticky mucus line the nasal cavity. The mucus traps dust, pollen, and other materials that were not trapped by the nasal hair. This helps filter and clean the air you breathe. Tiny hair-like structures, called cilia, move mucus and trapped material to the back of the throat where it can be swallowed.

Figure 19-3 Air can enter the body through both nostrils and the mouth. What is the advantage of having air enter through the nostrils?

Figure 19-4 Sound made by your vocal cords gets louder with increased air pressure. Pitch gets higher as muscles pull your vocal cords tighter, thus causing the glottis to close.

Pharynx, Larynx, and Trachea

Warm, moist air now moves to the pharynx, a tubelike passageway for both food and air. At the lower end of the pharynx is a flap of tissue called the epiglottis. When you swallow, the epiglottis folds down over the glottis, the opening between your vocal cords. By doing this, food or liquid is prevented from entering your larynx. The food goes into your esophagus instead. What do you think could happen if you talk or laugh while eating?

The larynx is the airway to which your vocal cords are attached. Look at Figure 19-4. When you speak, muscles tighten or loosen your vocal cords. Sound is produced when air moves past, causing them to vibrate. Below the larynx is the trachea, a tube about 12 cm in length. C-shaped rings of cartilage keep the trachea open and prevent it from collapsing. The trachea is lined with mucous membranes and cilia to trap dust, bacteria, and pollen. Why is it necessary for the trachea to stay open all the time?

What do you think could happen if you talk or laugh while eating? Food might enter the larynx and cause choking. Why is it necessary for the trachea to stay open all the time? If the trachea collapsed, it would be difficult or impossible to breathe.

CA Science Content Standards
Page 522: 5a, 5b
Page 523: 5a, 5b

Across the Curriculum

Music Divide the class into small groups and distribute a balloon to each group. Ask students to visualize the balloon as a lung and its neck as a trachea. Have students blow up their balloons, then stretch the opening into a narrow slit. Students should note the sound. Then have them stretch the slit to make it longer and release a bit to make it shorter, noting the changes in pitch. Ask them to correlate the higher-pitched sounds and tauter stretch with the shorter vocal cords typical of females and the lower-pitched sounds and looser stretch with the longer vocal cords typical of males.

Answers to Text Questions

What do you think could happen if you talk or laugh while eating? Food might enter the larynx and cause choking. Why is it necessary for the trachea to stay open all the time? If the trachea collapsed, it would be difficult or impossible to breathe.

Teacher FYI

When a person chokes on a piece of food, he or she often comments that “it went down the wrong tube.” The pharynx serves as the passageway of food into the esophagus and air into the trachea. The epiglottis is a small flap of tissue that normally closes over the tracheal opening when food is swallowed. Sometimes food or liquid gets past the epiglottis and goes into the trachea, triggering the choking reflex.

Activity: Kinesthetic Have students place their fingers on the front of their necks, tilt their heads backwards, and gently move their fingers up and down. Ask students whether they can feel the ridges that are the rings of cartilage around the trachea.

Using an Analogy The nasal cavity traps air particles in a similar manner as a dust mask traps pollen from the air.
The Bronchi and the Lungs

At the lower end of the trachea are two short branches, called bronchi (singular, bronchus), that carry air into the lungs. Your lungs take up most of the space in your chest cavity. Within the lungs, the bronchi branch into smaller and smaller tubes. The smallest tubes are the bronchioles. At the end of each bronchiole are clusters of tiny, thin-walled sacs called alveoli (at VE ul eez). As shown in Figure 19-5, lungs are actually masses of alveoli arranged in grapelike clusters. Capillaries surround the alveoli. The exchange of oxygen and carbon dioxide takes place between the alveoli and capillaries. This happens easily because the walls of the alveoli and the walls of the capillaries are only one cell thick. Oxygen diffuses through the walls of the alveoli and then through the walls of the capillaries into the blood. There the oxygen is picked up by hemoglobin in red blood cells and carried to all body cells. Hemoglobin is a chemical that can carry oxygen and carbon dioxide. As this takes place, carbon dioxide is transported back from body cells in the blood. It diffuses through the walls of the capillaries and through the walls of the alveoli. Carbon dioxide then leaves your body when you breathe out, or exhale.

How You Breathe

Breathing is partly the result of changes in air pressure. Under normal conditions, a gas moves from an area of high pressure to an area of low pressure. When you squeeze an empty plastic bottle, air rushes out. This happens because pressure outside the top of the bottle is less than inside the bottle while your hand is gripping it. As you release your grip on the bottle, the pressure inside the bottle becomes less than outside the bottle. Air rushes back in, and the bottle resumes its shape.

Inhale and Exhale

Your lungs work in a similar way to the squeezed bottle. Your diaphragm (DI uh fram) is a muscle beneath your lungs that helps move air in and out of your body. It contracts and relaxes when you breathe. Like your hands on the plastic bottle, the diaphragm exerts pressure or relieves pressure on your lungs. Figure 19-6 illustrates breathing.

**Visualizing Breathing**

- **Inhale**: When you inhale, your diaphragm contracts and moves down. The upward movement of your rib cage and the downward movement of your diaphragm causes the volume of your chest cavity to increase. Air pressure is reduced in your chest cavity. Air under pressure outside the body pushes into your air passages and lungs. Your lungs expand as the air rushes into them.

- **Exhale**: When you exhale, your diaphragm relaxes and moves up to return to its dome shape. Your rib cage moves downward. These two actions reduce the size of your chest cavity. Your lungs also return to their original position. Pressure on your lungs is increased by these two actions. The gases inside your lungs are pushed out through the air passages.

**Enrichment**

Have students research how dry air taken in through the nostrils has about 100 percent humidity by the time it reaches the alveoli.

**Using Science Words**

Alvearium is the Latin word for “bee hive” and relates this to the air cells of the lungs, the alveoli.

**Discussion**

Interpersonal Discuss with students ways singers practice their breathing in order to have greater breath control while singing.
A Life-Saving Maneuver

The epiglottis closes over your larynx to stop food from entering the trachea. Sometimes, this process does not happen quickly enough. Each year, thousands of people die because food or other objects become lodged in the trachea. Air flow between the lungs and the mouth and nasal cavity is blocked. Death can occur in a matter of minutes.

Pressure Dislodges the Food

Rescuers use abdominal thrusts (also called the Heimlich maneuver). Figure 19-7, to save the life of a choking victim. CAUTION: This maneuver can cause harm and should be done only if necessary. The theory behind this maneuver is to use pressure to force out the food or object. When the diaphragm is forced up, the volume of the chest cavity quickly decreases. Pressure is suddenly increased. Air is forced up in the trachea. There may be enough force to dislodge food or an object. The victim is able to breathe again.

Figure 19-7 Abdominal thrusts are used to save a person from choking.

Hands-on Activity

Figure 19-8 Cilia help trap and move foreign matter from your respiratory passageways.

Teacher FYI

A field guide to First Aid occurs at the end of the chapter on Immunity. This guide could be referenced as abdominal thrusts are discussed.

Diseases and Disorders

If you were asked to list some of the things that can harm your respiratory system, you would probably put smoking at the top. Many serious diseases are related to smoking. Being around others who smoke also can harm your respiratory system. Smoking, polluted air, and coal dust have been related to respiratory problems such as bronchitis, emphysema, cancer, and asthma.

Chronic Bronchitis

Bronchitis is a disease in which the bronchial tubes are irritated and too much mucus is produced. Many cases of bronchitis clear up within a few weeks, but sometimes the disease will last for a long time. When bronchitis persists for a long time, it is called chronic bronchitis. Many cases of chronic bronchitis result from smoking. People who have chronic bronchitis cough often to try to clear the mucus from the airway, as Figure 19-8 shows. However, the more a person coughs, the more the cilia and bronchial tubes can be harmed. When cilia are damaged, their ability to move mucus, bacteria, and dirt particles out of the lungs is impaired. If this happens, harmful substances, such as sticky tar from burning tobacco, build up in the airways. Sometimes, scar tissue forms, impairing the ability of the respiratory system to function.

Teacher FYI

Hiccups are caused by spasmodic contractions of the diaphragm. The result is a sudden inhaling of air. Choking could result if a reflex action did not automatically cause the epiglottis to close over the trachea and prevent any food from entering.
3 Assess

Check for Understanding Activity

Linguistic Have students write a paragraph describing why air moves into the lungs when the ribs move downward.

Reteach

Use a lung demonstration apparatus to illustrate how the downward movement of the diaphragm is caused by the movement of the chest cavity.

Extension

For students who have mastered this section, use the Reinforcement and Enrichment masters.

4 Close

Proficiency Prep

Use this quiz to check students’ recall of section content.

1. What keeps the trachea tube from collapsing?
2. Masses of what structure are described as grape-like clusters?
3. What keeps the trachea open 24 hours/day, or 8640 bottles.

4. Close

Content Background

Factors that trigger asthma include irritants but they do not cause inflammation and therefore do not cause asthma. Airways will react more quickly to triggers if inflammation is already present in the airways. Common triggers include everyday stimuli such as cold air, dust, strong fumes, exercise, inhaled irritants, emotional upset, and smoke. The most common causes of asthma include respiratory viral infections and allergens. The most common inhaled allergens include pollen, animal secretions (especially cats and horses), molds, and dust mites.

Asthma

Some lung disorders are common in nonsmokers. Asthma (AZH mah) is a disorder of the lungs in which there may be shortness of breath, wheezing, or coughing. When a person has an asthma attack, the bronchial tubes contract quickly. Asthma attacks are generally treated by inhaling drugs that enlarge the bronchial tubes. Asthma is often an allergic reaction. An asthma attack can result from a reaction to breathing certain substances, such as cigarette smoke or plant pollen. Eating certain foods or stress also have been related to the onset of asthma attacks.

Except for certain bacteria, all living things would die without oxygen. Your respiratory system takes in oxygen and gets rid of carbon dioxide. This system also helps get rid of some waste products. You can help keep your respiratory system healthy by avoiding smoking and breathing polluted air. Regular exercise helps increase your body’s ability to use oxygen.

Section Assessment

1. Supplies oxygen to the blood and removes carbon dioxide.
2. Oxygen and carbon dioxide are exchanged via blood.
3. Movement of the diaphragm and rib cage and differences in pressure.
4. Alveoli stretch and lose their elasticity.
5. Think Critically: The digestive system provides food for respiration in cells. The circulatory system transports oxygen to break down food and carries respiration waste products to the lungs to be expelled.

Science Journal

Use library references to find out about a lung disease common among coal miners, stonecutters, and sandblasters. In your Science Journal, write a paragraph about the symptoms of this disease. Research what safety measures are now required when working with coal and rock.

Section Assessment

1. Supplies oxygen to the blood and removes carbon dioxide.
2. Oxygen and carbon dioxide are exchanged via blood.
3. Movement of the diaphragm and rib cage and differences in pressure.
4. Alveoli stretch and lose their elasticity.
5. Think Critically: The digestive system provides food for respiration in cells. The circulatory system transports oxygen to break down food and carries respiration waste products to the lungs to be expelled.
**Activity 19-1**

### The Effects of Exercise on Respiration

Breathing rate increases with an increase in physical activity. A bromothymol blue solution changes color when carbon dioxide is bubbled into it. Can you predict whether there will be a difference in the time it takes for the solution to change color before and after exercise?

**Possible Materials**
- Clock or watch with second hand
- Drinking straws
- Bromothymol blue solution (200 mL)
- Glass cups (12 oz.) (2)
- Beakers (400 mL) (2)
- Metric measuring cup
- Graduate cylinder (100 mL)
- Alternate Materials

**Form a Hypothesis**

State a hypothesis about how exercise will affect the amount of carbon dioxide exhaled.

**Goals**
- Observe the effects of the amount of carbon dioxide on the bromothymol blue solution.
- Design an experiment that tests the effects of a variable, such as the amount of carbon dioxide exhaled before and after exercise, on the rate at which the solution changes color.

**Safety Precautions**

Protect clothing from the solution. Wash hands after using the solution. CAUTION: Do not inhale the solution through the straw.

**Possible Precedure**

Label the beakers A and B. Use beaker A for the resting test and beaker B for the exercise test. Pour 100 mL of bromothymol blue solution into each beaker. Exhale through the straw into the solution. Continue exhaling for 15 seconds or until the bromothymol blue solution changes color. Record the time it takes for the color change to occur. Exhale using the same force for both tests.

**Test Your Hypothesis**

1. As a group, agree upon and write out the hypothesis statement.
2. As a group, list the steps that you will need to take to test your hypothesis. Consider each of the following factors: How will you introduce the exhaled air into the bromothymol blue solution? How will you collect data on exhaled air before and after physical activity? What kind of activity is involved? How long will it go?
3. List your materials. Your teacher will provide instructions on safe procedures for using bromothymol blue.
4. Design a data table and record it in your Science Journal so that it is ready to use as your group collects data.
5. Read over your entire experiment to make sure that all the steps are in logical order.
6. Identify any constants, variables, and controls of the experiment.

**Analyze Your Data**

1. What caused the bromothymol blue solution to change color? What color was it at the conclusion of each test?
2. What was the control? What was the variable(s)?
3. Compare the time it took the bromothymol blue solution to change color before exercise and after exercise. Explain any difference.
4. Prepare a table of your data and graph the results.

**Draw Conclusions**

1. Did exercise affect your rate of respiration? Explain your answer using data from your experiment.
2. Using your graph, estimate the time of color change if the time of your physical activity were twice as long.

**Expected Outcome**

Results will reveal that more carbon dioxide is exhaled after exercising, and the bromothymol blue solution changes color from blue to yellow more quickly.

**Draw Conclusions**

1. Answers will vary, but they should show a change in the rate. Students active in physical activities may show less of a rate change. Students should use data from activity to defend their answers.
2. Estimates will vary, but should indicate that it would take less time for a color change if the physical activity were twice as long.

**Teaching Strategies**

Tell interested students that the carbon dioxide that bubbled into the water forms a carbide acid, which causes the color change in the bromothymol blue solution.

**Assessment**

- **Performance**
  - To further assess students’ abilities to analyze the effects of respiration, have them design an experiment to detect the water vapor exhaled in an hour or in a day. Use Performance Assessment in the Science Classroom, p. 23.

**Gifted**

Have students brainstorm methods for testing for moisture in exhaled air. Breathe on a cool, shiny metal or glass surface; minute water droplets can be seen and felt. Paper treated with cobalt chloride will turn from blue to pink when it comes in contact with moisture.

### Alternate Materials

Lime water (a saturated Ca(OH)2 solution) can be used instead of bromothymol blue solution. Cobalt chloride will turn from blue to pink when the solution changes color when carbon dioxide is bubbled into it. It will take less time for the solution to change color before and after exercise.

### Inclusion Strategies

**Gifted**

Have students investigate why the bromothymol blue solution changes color. They can try other acid-base indicators such as blue litmus solution.

**ELL**

Students will design and carry out an experiment to show how exercise affects the amount of carbon dioxide exhaled by the lungs.

**COOP LEARN**

As a group, have students brainstorm methods for testing for moisture in exhaled air. Breathe on a cool, shiny metal or glass surface; minute water droplets can be seen and felt. Paper treated with cobalt chloride will turn from blue to pink when it comes in contact with moisture.

### Process Skills

- Recognizing cause and effect
- Interpreting data
- Making and using inferences
- Hypothesizing
- Designing an experiment

### Process Skills

- Logical-Mathematical:
  - Students will design and carry out an experiment to show how exercise affects the amount of carbon dioxide exhaled by the lungs.

### Standards

- **CA Science Content Standards**
  - Page 350: 5a, 5b, 7a, 7c, 7e
  - Page 353: 5a, 5b, 7a, 7c, 7e
Scuba

For humans, having a constant supply of oxygen is a matter of life or death. People get the oxygen they need from the air they breathe. This means swimmers can stay underwater only for as long as they can hold their breath. Those who want to dive deeper and stay underwater longer must use scuba equipment. Scuba stands for Self-Contained Underwater Breathing Apparatus.

GEARED FOR THE DEPTHS

Three pieces of equipment (the diver, the dive, and the regulator) must work together to allow scuba divers to swim and breathe compressed air.

1. BCD Before the dive, the BCD—an inflatable vest or jacket—is partially filled with air. The diver descends by letting air out of the BCD. The dive maintains his or her position at different depths by controlling the amount of air in the BCD.

2. Scuba tank Worn on the diver’s back, the tank holds a large amount of compressed air—that has been squeezed into a small space under high pressure. The diver breathes the air in this tank while underwater. The compressed air in the scuba tank also is used to add air to the BCD to increase a diver’s buoyancy (make a diver rise in the water).

3. Regulator On the water’s surface, air pressure in the lungs is equal to outside air pressure, measured as atmospheres (atm). Pressure increases at a rate of 1 atm for each 10 m underwater. As a diver descends, the regulator automatically compensates for the increase in depth (and thus, pressure). So, the regulator supplies air from the tank to the diver at the same pressure as the surrounding water. The diver never feels squashed by the increased pressure of the deeper water.

Think Critically

1. The volume of air increases as pressure decreases. Relate this to the fact that divers should never hold their breath as they ascend.

2. Why does a diver use a weight belt in addition to a BCD when diving?

Career CONNECTION

Professional scuba divers are paid to dive for specific purposes. Professional divers work for the military, the government, and commercial agencies. A military diver may look for a hidden bomb under the sea. A commercial diver may work on an oil platform. Law enforcement agencies use divers to look for missing bodies or weapons.

The Excretory System

Functions of the Excretory System

Just as wastes, in the form of sewage or garbage, are removed from your home, your body also eliminates wastes by means of your excretory system. Undigested material is eliminated by your digestive system. The waste gas, carbon dioxide, is eliminated through the combined efforts of your circulatory and respiratory systems. Some salts are eliminated when you sweat. Together, these systems function as a part of your excretory system. If wastes aren’t eliminated, you can become sick. Toxic substances build up and damage organs. If not corrected, serious illness or death occurs.

Figure 19-11 shows how the urinary system functions as a part of the excretory system. The organs of your urinary system are excretory organs. Your urinary system is made up of tubules that rid your blood of wastes produced by the metabolism of nutrients. This system also controls blood volume by removing excess water produced by body cells. A specific amount of water in blood is important to maintain normal blood pressure, the movement of gases, and excretion of solid wastes. Your urinary system also balances specific concentrations of certain salts and water that must be present for cell activities to take place.

What You’ll Learn

- How to distinguish between the excretory and urinary systems
- How to describe how your kidneys work
- What happens when urinary organs don’t work

Vocabulary

- kidney
- bladder
- ureter
- urethra

Why It’s Important

- The urinary system helps clean your blood.

Section 19-2

The Excretory System

Functions of the Excretory System

Just as wastes, in the form of sewage or garbage, are removed from your home, your body also eliminates wastes by means of your excretory system. Undigested material is eliminated by your digestive system. The waste gas, carbon dioxide, is eliminated through the combined efforts of your circulatory and respiratory systems. Some salts are eliminated when you sweat. Together, these systems function as a part of your excretory system. If wastes aren’t eliminated, you can become sick. Toxic substances build up and damage organs. If not corrected, serious illness or death occurs.

Figure 19-11 shows how the urinary system functions as a part of the excretory system. The organs of your urinary system are excretory organs. Your urinary system is made up of tubules that rid your blood of wastes produced by the metabolism of nutrients. This system also controls blood volume by removing excess water produced by body cells. A specific amount of water in blood is important to maintain normal blood pressure, the movement of gases, and excretion of solid wastes. Your urinary system also balances specific concentrations of certain salts and water that must be present for cell activities to take place.

What You’ll Learn

- How to distinguish between the excretory and urinary systems
- How to describe how your kidneys work
- What happens when urinary organs don’t work

Vocabulary

- kidney
- bladder
- ureter
- urethra

Why It’s Important

- The urinary system helps clean your blood.

Section 19-2

The Excretory System

Functions of the Excretory System

Just as wastes, in the form of sewage or garbage, are removed from your home, your body also eliminates wastes by means of your excretory system. Undigested material is eliminated by your digestive system. The waste gas, carbon dioxide, is eliminated through the combined efforts of your circulatory and respiratory systems. Some salts are eliminated when you sweat. Together, these systems function as a part of your excretory system. If wastes aren’t eliminated, you can become sick. Toxic substances build up and damage organs. If not corrected, serious illness or death occurs.

Figure 19-11 shows how the urinary system functions as a part of the excretory system. The organs of your urinary system are excretory organs. Your urinary system is made up of tubules that rid your blood of wastes produced by the metabolism of nutrients. This system also controls blood volume by removing excess water produced by body cells. A specific amount of water in blood is important to maintain normal blood pressure, the movement of gases, and excretion of solid wastes. Your urinary system also balances specific concentrations of certain salts and water that must be present for cell activities to take place.

What You’ll Learn

- How to distinguish between the excretory and urinary systems
- How to describe how your kidneys work
- What happens when urinary organs don’t work

Vocabulary

- kidney
- bladder
- ureter
- urethra

Why It’s Important

- The urinary system helps clean your blood.

Section 19-2

The Excretory System

Functions of the Excretory System

Just as wastes, in the form of sewage or garbage, are removed from your home, your body also eliminates wastes by means of your excretory system. Undigested material is eliminated by your digestive system. The waste gas, carbon dioxide, is eliminated through the combined efforts of your circulatory and respiratory systems. Some salts are eliminated when you sweat. Together, these systems function as a part of your excretory system. If wastes aren’t eliminated, you can become sick. Toxic substances build up and damage organs. If not corrected, serious illness or death occurs.

Figure 19-11 shows how the urinary system functions as a part of the excretory system. The organs of your urinary system are excretory organs. Your urinary system is made up of tubules that rid your blood of wastes produced by the metabolism of nutrients. This system also controls blood volume by removing excess water produced by body cells. A specific amount of water in blood is important to maintain normal blood pressure, the movement of gases, and excretion of solid wastes. Your urinary system also balances specific concentrations of certain salts and water that must be present for cell activities to take place.

What You’ll Learn

- How to distinguish between the excretory and urinary systems
- How to describe how your kidneys work
- What happens when urinary organs don’t work

Vocabulary

- kidney
- bladder
- ureter
- urethra

Why It’s Important

- The urinary system helps clean your blood.

CC

Career CONNECTION

Professional scuba divers are paid for dives to specific purposes. Professional divers work for the military, the government, and commercial agencies. A military diver may look for a hidden bomb under the sea. A commercial diver may work on an oil platform. Law enforcement agencies use divers to look for missing bodies or weapons.

The following Teacher Classroom Resources can be used with Section 19-2:

- Reproducible Masters
- Activity Worksheets, pp. 105-106, 108
- Enrichment, p. 54
- Multicultural Connections, pp. 37–38

Reinforcement, p. 54

Study Guide, pp. 75-76

Transparencies

Teaching Transparency 38 B

CA Science Content Standards

Page 533: 5a, 5b

Chapter 19 RESPIRATION AND EXCRETION

VISUAL Learning

Ask students to look closely at the photograph of the scuba diver and equipment. Ask students why they think the diver might be carrying an extra regulator. In case the diver runs out of air, the divers can share air from another person’s tank.

Teaching Strategies

Have students research and report on the cause and treatment of decompression illness (the bends).

Thinking Critically

1. The air in their lungs would increase, causing great pain.

2. Most people have a natural positive buoyancy. Therefore, a weight belt is needed to achieve negative buoyancy for the diver to sink below the water surface.

Resource Manager

The following Teacher Classroom Resources can be used with Section 19-2:

- Reproducible Masters
- Activity Worksheets, pp. 105-106, 108
- Enrichment, p. 54
- Multicultural Connections, pp. 37–38

Reinforcement, p. 54

Study Guide, pp. 75-76

Transparencies

Teaching Transparency 38 B

CA Science Content Standards

Page 533: 5a, 5b

Chapter 19 RESPIRATION AND EXCRETION
**Chapter 19: Respiration and Excretion**

**Organs of the Urinary System**

The major organs of your urinary system, as shown in Figure 19-12, are two bean-shaped kidneys. Kidneys are located on the back wall of the abdomen at about waist level. The kidneys filter blood that has collected wastes from cells. All of your blood passes through your kidneys many times a day. In Figure 19-12, you can see that blood enters the kidneys through a large artery and leaves through a large vein.

**The Filtering Unit**

Each kidney is made up of about 1 million nephrons (NEF raunz), the tiny filtering units of the kidney. Each nephron has a cuplike structure and a duct. Blood moves from the renal artery to capillaries in the cuplike structure. Water, sugar, salt, and wastes from your blood pass into the cuplike structure. From there, the liquid is squeezed into a narrow tubule. Capillaries that surround the tubule seaborb most of the water, sugar, and salt and return it to the blood. These capillaries merge to form small veins. The small veins merge to form the renal veins, which return purified blood to your main circulatory system. The liquid left behind flows into collecting tubules in each kidney. This waste liquid, or urine, contains excess water, salts, and other wastes not reabsorbed by the body. The average adult produces about 1 L of urine per day.

**Urine Collection and Release**

The urine in each collecting tubule drains into a funnel-shaped area of each kidney that leads to the ureters (YER ut urz). Ureters are tubes that lead from each kidney to the bladder. The bladder is an elastic, muscular organ that holds urine until it leaves the body. Figure 19-13 shows how the shape of the cells that make up the lining of the bladder changes with the amount of urine stored in it. A tube called the urethra (you REE thruh) carries urine from the bladder to the outside of the body.

**Other Water Loss**

Other parts of the excretory system also help your body maintain proper fluid levels. In addition to losing salt, an adult loses about 0.5 L of water each day through perspiration. When air is exhaled, you also lose water. When you see your breath on a cold day or breathe on a cold windowpane, you see this moisture. Each day, about 350 mL of water are removed from your body through your respiratory system. A small amount of water also is expelled with the undigested material that passes out of your digestive system.

---

**Internet Addresses**

For Internet tips, see Glencoe’s Science Web Site at www.glencoe.com/sec/science/ca for more information about how kidneys work.

**Caption Answer**

**Figure 19-12**

Have students trace the pathway of the blood to, through, and from the kidney.

**Quick Demo**

Set up a diffusion experiment using a cellophane bag with a colored sugar solution placed in a container of water.

**Content Background**

The amount of urine that is secreted by the body is affected by the amount of water or salt that is ingested. Drinking large amounts of water increases urine output. Eating lots of salty foods decreases urine output.

---

**MiniLab**

**Modeling Kidney Function**

**Materials**

- dirt (2 T), 8-ounce plastic cup (2), funnel, filter paper, tap water

**Teaching Strategies**

Troubleshooting: Moisten filter paper before filtering the dirty water so that the paper adheres to the funnel.

**Analysis**

The filter removes the dirt and particles. Only the liquid goes through. The filter is like a nephron, through which all liquid passes. The nephrons keep waste from passing through.

**Using an Analogy**

In the filtering model constructed in the above activity, have students infer what each part (muddy water, filter, clear water) represents within the human body.

---

**Across the Curriculum**

**Mathematics**

Calculate the ratio of body weight to amount of urine excreted. If a 11-kg child excretes 600 mL, what would you expect a 45-kg person to excrete? 2455 mL. However, the amount is actually only about 1500 mL. The amount excreted by children is greater in proportion to their weight.
**Problem Solving**

Kidneys function to conserve water. If they did not conserve our body fluids, we would have to drink many gallons of water each day in order to survive. See annons on student page for percentages.

**Think Critically**

1. ingested liquids
2. Less water would be taken in and more water would be lost; the skin.

**Correcting Misconceptions**

Students often do not recognize the need for drinking adequate amounts of water each day. Water is necessary for the proper functioning of the kidneys. Water leaves our bodies through perspiration from the skin, through water vapor in exhaled breath, and in urine.

**Enrichment**

**Logical-Mathematical**

Adult kidneys weigh only about 170 g each. The kidneys of an average adult process about 1600 L of liquid per day, most of which is recycled. Have students calculate how many liters an adult’s kidneys process in a year, in a decade, and in 75 years. $584,000 L; 5,840,000 L; 43,800,000 L.

**Analyzing Water Gain and Loss**

Cell activity and body functions depend on water. The balance of water must be maintained. Table A shows the major sources by which body water is gained. Table B lists the major sources by which body water is lost.

**Table A**

<table>
<thead>
<tr>
<th>Major Sources by which Body Water Is Gained</th>
<th>Amount (mL)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine</td>
<td>1500</td>
<td>60</td>
</tr>
<tr>
<td>Skins</td>
<td>500</td>
<td>20</td>
</tr>
<tr>
<td>Lungs</td>
<td>350</td>
<td>14</td>
</tr>
<tr>
<td>Feces</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>2500</td>
<td></td>
</tr>
</tbody>
</table>

**Table B**

<table>
<thead>
<tr>
<th>Major Sources by which Body Water Is Lost</th>
<th>Amount (mL)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urine</td>
<td>1500</td>
<td>60</td>
</tr>
<tr>
<td>Skin</td>
<td>500</td>
<td>20</td>
</tr>
<tr>
<td>Lungs</td>
<td>350</td>
<td>14</td>
</tr>
<tr>
<td>Feces</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>2500</td>
<td></td>
</tr>
</tbody>
</table>

**Think Critically**

1. What is the greatest source of liquids gained by your body?
2. How would the percentages of water gained and lost change in a person who was working in extremely warm temperatures? What organ of the body would be the greatest contributor to water loss?

If too little water is in the blood, more of the hormone is released by your hypothalamus and more water is returned to the blood. The amount of urine excreted decreases. At the same time, your brain sends a signal that causes you to feel thirsty. You drink liquids to quench this thirst. Figure 19-15 illustrates the different sources of fluid intake and output within your body.

**Diseases and Disorders**

What happens when someone’s urinary organs don’t work properly? Waste products that are not removed build up and act as poisons in body cells. Water that normally is removed from body tissues accumulates and causes swelling of the ankles and feet. Sometimes, fluids also can build up around the heart. The heart must work harder to move less blood to the lungs. Without exertion, an imbalance of salts may occur. The body responds by trying to restore this balance. If the balance is not restored, the kidneys and other organs can be damaged.

**Making an Analogy**

Ask students to write an essay in which they compare a kidney to a recycling center. Have them consider substances that can be reused and those that cannot be recycled.

**Guided Reading Strategy**

Four-Corner Discussion This strategy encourages the class to debate a complex issue. Make four signs: Strongly Agree, Agree, Disagree, Strongly Disagree. Place one sign in each corner of the room. Write on the chalkboard a statement that will elicit reactions from students. Have the students respond on paper to the statement. After several minutes, direct them to move to the corner with the sign that most closely reflects their opinions. in the corners, students share responses. Each group then selects a spokesperson to report the opinions of the group. After all groups have reported, open the floor for debate. Allow students who have changed their opinions to change corners. Have students conduct a four-corner discussion about the causes of respiratory diseases.

**Visual-Spatial**

Use an anatomical model or chart and have students trace the flow of blood through the urinary system and explain the functions of each organ.

**Four-Corner Discussion**

A statement is written on the board. Students agree or disagree. If they disagree, they move to the corner with the opposite sign. After a few minutes, the students return to their original positions.

**Extension**

For students who have mastered this section, use the Reinforcement and Enrichment masters.

**Enrichment**

Interpersonal Have students research the advances made in dialysis machines and procedures. Discuss what changes might occur to a person’s lifestyle when he or she needs to undergo dialysis. What activity restrictions result from the need for dialysis treatment?

3 Assess

**Check for Understanding**

**Checklist**

- Visual-Spatial Use an anatomical model or chart and have students trace the flow of blood through the urinary system and explain the functions of each organ.

**Reteach**

- Visual-Spatial Have students prepare a basic diagram of the sequence of organs involved in the processing of liquid wastes in the body.

**Extension**

For students who have mastered this section, use the Reinforcement and Enrichment masters.
Dialysis

Persons who have damaged kidneys may need to have their blood filtered by an artificial kidney machine in a process called dialysis (di AL uh sus). During dialysis, blood from an artery is pumped through tubing that is bathed in a salt solution similar to blood plasma. Waste materials diffuse from the tube containing blood and are washed away by the salt solutions. The cleaned blood is returned to a vein. A person with only one kidney can still function normally. An alternative dialysis treatment is pictured in Figure 19-16. 

The urinary system is a purifying unit for the circulatory system. Wastes are filtered from blood as it passes through the kidneys. Some water, salts, and nutrients are reabsorbed to maintain homeostasis. Waste materials, dissolved in water, are eliminated from the body. This system helps to maintain the health of cells and, therefore, the entire body.

**Section Assessment**

1. Describe the functions of the urinary system.
2. Explain how the kidneys remove wastes and keep fluids and salts in balance.
3. Compare the excretory and urinary systems.
4. Think Critically: Explain why reabsorption of certain materials in the kidneys is important.
5. **Skill Builder**
   - **Concept Mapping** Using a network flow concept map, compare the excretory functions of the kidneys and the lungs. If you need help, refer to Concept Mapping in the Skill Handbook on page 679.
   - **Using Computers**
     - All 5 L of blood in the body pass through the kidneys in approximately five minutes. Calculate the average rate of flow through the kidneys in liters per minute.
   - **Using Math** 5 liters per 5 minutes = 1 liter per minute rate of flow.
CHAPTER 19 RESPIRATION AND EXCRETION

preview

Linguistic Have students try to answer the questions in their science journals. Use student answers as a source for discussion throughout the chapter.

Review

Interpersonal Have students answer the questions on separate pieces of paper and compare their answers with those of other students in the class.

reTeach

Visual-Spatial Have students look at the illustrations on these pages. Ask them to describe details that support the main ideas of the chapter found in the statement for each illustration.

Out of Time?

Auditory-Musical If time does not permit teaching the entire chapter, use the information on these pages along with the chapter audiocassettes to present the material in a condensed format.

Chapter 19 Reviewing Main Ideas

1 THE RESPIRATORY SYSTEM

Your respiratory system helps take oxygen into your lungs and body cells and helps you remove carbon dioxide. Inhaled air passes through the nasal cavity, pharynx, larynx, trachea, bronchi, and bronchioles and into the alveoli of the lungs. The mechanism of breathing results in part from the diaphragm’s movement, which changes the pressure within the lungs. Why does the trachea have cartilage but the esophagus does not?

DISEASES AND DISORDERS

Many serious respiratory problems are related to smoking. In addition to smoking, polluted air and coal dust have also been associated with diseases such as chronic bronchitis, emphysema, lung cancer, and asthma. Which respiratory disease is the third leading cause of death in men and women in the United States?

Career

Dr. Benjamin Carson is a surgeon at Johns Hopkins Hospital. Dr. Carson says that operating on a patient is like if you were a tightrope walker. If you are experienced, walking the rope isn’t frightening, but if you haven’t done it before, it can be scary. Dr. Carson admits that operating is sometimes taxing—especially when you do it for 16 hours at a stretch. Dr. Carson encourages young people to ask themselves, “What have I always been good at?” and to ask other people what they see that you’re good at. What problems of the respiratory system and excretory system could require surgery?

Connections

Dr. Benjamin Carson, surgeon

19-2 The Excretory System

Your urinary system is made up of organs that rid your blood of wastes produced by the metabolism of nutrients. It also controls blood volume by removing excess water produced by body cells. Kidneys are the major organs of the urinary system. They filter wastes from your body and keep sodium, water, and other chemicals in balance. When kidneys fail to work, dialysis may be used. In addition to the urinary system, parts of the digestive, circulatory, and respiratory systems work together as the excretory system. How do the kidneys maintain homeostasis?

Connections

Dr. Benjamin Carson, surgeon

Assessment

Portfolio Encourage students to place in their portfolios one or two items of what they consider to be their best work. Examples include:

• Using Math, p. 528
• Activity 19-1, pp. 530-531
• MiniLab, p. 537

Performance Additional performance assessments may be found in Performance Assessment and Science Integration Activities. Performance Task Assessment Lists and rubrics for evaluating these activities can be found in Glencoe’s Performance Assessment in the Science Classroom.

Answers to Questions

Section 19-1 The Respiratory System The trachea must remain open for air to enter through it, the esophagus is soft and does not need to be open except when food is moving through it. Problems will vary. Possible problems could include removing lung cancer cells, kidney transplants, and opening blocked nasal passages of chronic sinusitis.
## Chapter 19 Assessment

### Using Vocabulary

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>alveoli</td>
<td>Tiny air sacs in the lungs.</td>
</tr>
<tr>
<td>asthma</td>
<td>Condition causing inflammation of the airways.</td>
</tr>
<tr>
<td>bladder</td>
<td>Storage organ for urine.</td>
</tr>
<tr>
<td>bronchi</td>
<td>Large airways that divide and branch into smaller ones.</td>
</tr>
<tr>
<td>chronic</td>
<td>Long-term.</td>
</tr>
<tr>
<td>diaphragm</td>
<td>Muscle that separates the chest and abdominal cavities.</td>
</tr>
<tr>
<td>epiglottis</td>
<td>Lid that covers the entrance to the trachea.</td>
</tr>
<tr>
<td>nephrons</td>
<td>Functional units of the kidneys.</td>
</tr>
<tr>
<td>respiratory system</td>
<td>System for gas exchange.</td>
</tr>
<tr>
<td>urine</td>
<td>Fluid excreted by the kidneys.</td>
</tr>
</tbody>
</table>

### Checking Concepts

1. The circle graph should reflect the kidney filtration process by showing the amounts of water, salts, sugar, and wastes filtered and the amounts of oxygen and carbon dioxide transported by the blood. These will likely be large amounts, since kidneys perform these functions. Glucose will be filtered only up to a certain level, since too much glucose would cause osmotic problems. Glucose will be reabsorbed by the blood after it passes through the kidneys. Therefore, the circle graph should show the following amounts:
   - **Amount moving through kidney to be filtered**
     - Water: 125 L
     - Salt: 350 g
     - Urea: 1 g
     - Glucose: 50 g
   - **Amount excreted in urine**
     - Water: 1 L
     - Salt: 10 g
     - Urea: 1 g
     - Glucose: 0 g

### Thinking Critically

1. In order for the kidneys to function properly, they must receive a sufficient amount of blood flow. If the blood flow is insufficient, the kidneys will not be able to filter the blood effectively, which can lead to retention of waste products. Therefore, the blood flow through the kidneys should be sufficient to ensure that the filtration process can take place. It is not possible to determine the exact amount of blood flow required, but we can infer that it should be in the normal range for healthy kidneys. Therefore, statement 5 is correct.

### Materials Filtered by the Kidneys

<table>
<thead>
<tr>
<th>Substance</th>
<th>Amount Moving Through Kidney to Be Filtered</th>
<th>Amount Excreted in Urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>125 L</td>
<td>1 L</td>
</tr>
<tr>
<td>Salt</td>
<td>350 g</td>
<td>10 g</td>
</tr>
<tr>
<td>Urea</td>
<td>1 g</td>
<td>1 g</td>
</tr>
<tr>
<td>Glucose</td>
<td>50 g</td>
<td>0 g</td>
</tr>
</tbody>
</table>

### Thinking Critically

2. Recognizing Cause and Effect: Discuss how lack of oxygen is related to lack of energy. Hypoxia: Hypoxia is the num-

### Test-Taking Tip

Survey the Surroundings: Find out what the conditions will be for taking the test. Will the test be timed? Will you be allowed to take a break? Know these things in advance so that you can practice taking tests under the same conditions.

### Test Practice

21. The circle graph should show that dry season occupying 11° of the circle; in-

### Reproducible Masters

Chapter Review, pp. 72-73

### Test Practice

21. The Test-Taking Tip was written by The Princeton Review, the nation’s leader in test preparation.

### Developing Skills

21. The circle graph should show that the dry season occupies 11° of the circle; in-

### Bonus Question

What happens to the dissolved nutrients in the blood that pass through the kidneys? They are filtered, but re-

### Assessment Resources

Glencoe Technology

- Chapter Review Software
- Computer Test Bank
- Mindjogger Videoquiz

342 Chapter 19 Respiration and Excretion

### Assessment

The Test Practice Workbook provides students with practice in the format, concepts, and critical-thinking skills tested in standardized exams.

### Reproducible Masters

Chapter Review, pp. 77-78

Performance Assessment, p. 537

Assessment, pp. 73-76