



TIMELINE

Human Body Systems

Like a finely tuned machine, your body is made up of many systems that work together. Your lungs take in oxygen. Your brain reacts to things you see, hear, and smell and sends signals through your nervous system that cause you to react to those things. Your digestive system converts the food you eat into energy that the cells of your body can use. And those are just a few things that your body can do!

In this unit, you will study the systems of your body. You'll discover how the parts of your body work together.



**Around
3000 BCE**

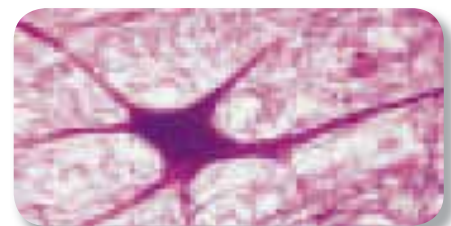
Ancient Egyptian doctors are the first to study the human body scientifically.

1824

Jean Louis Prevost and Jean Batiste Dumas prove that sperm is essential for fertilization.

1766

Albrecht von Haller determines that nerves control muscle movement and that all nerves are connected to the spinal cord or to the brain.



1940

During World War II in Italy, Rita Levi-Montalcini is forced to leave her work at a medical school laboratory because she is Jewish. She sets up a laboratory in her bedroom and studies the development of the nervous system.





**Around
500 BCE**

Indian surgeon
Susrata performs
operations to
remove cataracts.

1492

Christopher
Columbus
lands in the
West Indies.

1543

Andreas Vesalius
publishes the
first complete
description of
the structure of
the human body.

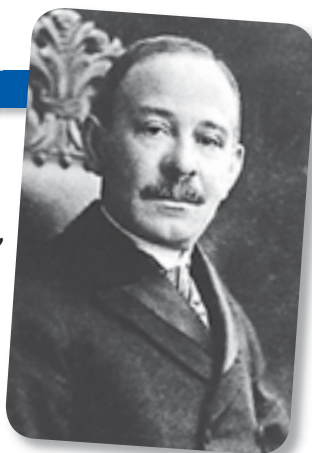
1616

William Harvey discovers
that blood circulates
and that the
heart acts
as a pump.



1893

Daniel Hale Williams, an
African American surgeon,
becomes the first person
to repair a tear in the
pericardium, the sac
around the heart.



1922

Frederick Banting,
Charles Best, and
John McLeod
discover insulin.

1930

Karl Landsteiner receives a Nobel
Prize for his discovery of the
four human blood types.



1982

Dr. William DeVries
implants an artificial
heart in Barney Clark.

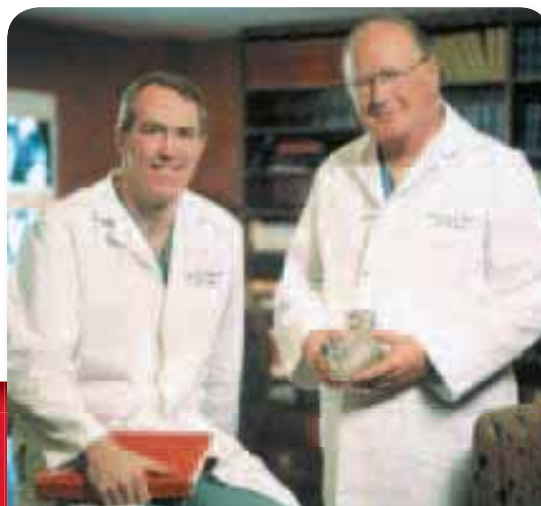


1998

The first successful hand
transplant is performed
in France.

2001

Drs. Laman A. Gray, Jr. and Robert D. Dowling at
Jewish Hospital in Louisville, Kentucky, implant
the first self-contained mechanical human heart.



Body Organization and Structure

Chapter Planning Guide

Compression guide:
To shorten instruction
because of time limitations,
omit Section 1.

OBJECTIVES	LABS, DEMONSTRATIONS, AND ACTIVITIES	TECHNOLOGY RESOURCES
PACING • 90 min pp. 578–583 Chapter Opener	SE Start-up Activity , p. 579 GENERAL	OSP Parent Letter ■ CD Student Edition on CD-ROM CD Guided Reading Audio CD ■ TR Chapter Starter Transparency* VID Brain Food Video Quiz
Section 1 Body Organization <ul style="list-style-type: none"> Describe how tissues, organs, and organ systems are related. List 11 organ systems. Identify how organ systems work together to maintain homeostasis. 	TE Connection Activity History , p. 581 ADVANCED	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L78 Organ Systems* CRF SciLinks Activity* GENERAL CD Science Tutor
PACING • 45 min pp. 584–587 Section 2 The Skeletal System <ul style="list-style-type: none"> Identify the major organs of the skeletal system. Describe four functions of bones. Describe three joints. List three injuries and two diseases that affect bones and joints. 	TE Activity Locating Bones , p. 584 GENERAL SE Quick Lab Pickled Bones , p. 585 ♦ GENERAL CRF Datasheet for Quick Lab*	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L79 The Skeleton* TR LINK TO PHYSICAL SCIENCE P31 Machines Change the Size and/or Direction of a Force* CD Science Tutor
PACING • 45 min pp. 588–591 Section 3 The Muscular System <ul style="list-style-type: none"> List three kinds of muscle tissue. Describe how skeletal muscles move bones. Compare aerobic exercise with resistance exercise. Describe two muscular system injuries. 	TE Group Activity Poster Project , p. 588 GENERAL SE School-to-Home Activity Power in Pairs , p. 589 GENERAL SE Connection to Chemistry Muscle Function , p. 590 GENERAL SE Inquiry Lab Muscles at Work , p. 794 ♦ GENERAL CRF Datasheet for LabBook* LB Inquiry Labs On a Wing and a Layer* ♦ GENERAL	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L80 A Pair of Muscles in the Arm* CD Science Tutor
PACING • 90 min pp. 592–595 Section 4 The Integumentary System <ul style="list-style-type: none"> List four functions of skin. Describe the two layers of skin. Describe the structure and function of hair and nails. Describe two kinds of damage that can affect skin. 	TE Activity Measuring Temperature , p. 593 ♦ GENERAL TE Connection Activity Real World , p. 594 GENERAL SE Skills Practice Lab Seeing Is Believing , p. 596 GENERAL CRF Datasheet for Chapter Lab* SE Science in Action Math, Social Studies, and Language Arts Activities , pp. 602–603 GENERAL LB Long-Term Projects & Research Ideas Mapping the Human Body* ADVANCED	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L81 Structures of the Skin* VID Lab Videos for Life Science TE Internet Activity , p. 593 GENERAL CD Science Tutor

PACING • 90 min

CHAPTER REVIEW, ASSESSMENT, AND STANDARDIZED TEST PREPARATION

- CRF Vocabulary Activity*** **GENERAL**
SE Chapter Review, pp. 598–599 **GENERAL**
CRF Chapter Review* ■ **GENERAL**
CRF Chapter Tests A* ■ **GENERAL**, **B*** **ADVANCED**, **C*** **SPECIAL NEEDS**
SE Standardized Test Preparation, pp. 600–601 **GENERAL**
CRF Standardized Test Preparation* **GENERAL**
CRF Performance-Based Assessment* **GENERAL**
OSP Test Generator, Test Item Listing

Online and Technology Resources



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- Customizable Lesson Plans
- Printable Worksheets
- ExamView® Test Generator
- Interactive Teacher's Edition
- Holt PuzzlePro®
- Holt PowerPoint® Resources

KEY

SE Student Edition
TE Teacher Edition

CRF Chapter Resource File
OSP One-Stop Planner
LB Lab Bank
TR Transparencies

SS Science Skills Worksheets
MS Math Skills for Science Worksheets
CD CD or CD-ROM
VID Classroom Video/DVD

IT Interactive Textbook
* Also on One-Stop Planner
◆ Requires advance prep
■ Also available in Spanish

SKILLS DEVELOPMENT RESOURCES	SECTION REVIEW AND ASSESSMENT	CORRELATIONS
SE Pre-Reading Activity, p. 578 GENERAL OSP Science Puzzlers, Twisters & Teasers GENERAL		National Science Education Standards UCP 1, 3, 4, 5; SAI 1, 2; SPSP 1; LS 1d, 1e, 3a, 3b
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Reading Organizer, p. 580 GENERAL TE Reading Strategy Prediction Guide, p. 581 BASIC TE Support for English Language Learners, p. 581 TE Inclusion Strategies, p. 582	SE Reading Checks, pp. 581, 582 GENERAL TE Reteaching, p. 582 BASIC TE Quiz, p. 582 GENERAL TE Alternative Assessment, p. 582 GENERAL SE Section Review*, p. 583 GENERAL CRF Section Quiz* GENERAL	UCP 1, 3, 4; LS 1a, 1d, 3a
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Reading Organizer, p. 584 GENERAL TE Support for English Language Learners, p. 585 SE Connection to Environmental Science Bones from the Ocean, p. 586 GENERAL MS Math Skills for Science Mechanical Advantage* GENERAL CRF Reinforcement Worksheet The Hipbone's Connected to the... BASIC	SE Reading Checks, pp. 585, 586 GENERAL TE Reteaching, p. 586 BASIC TE Quiz, p. 586 GENERAL SE Section Review*, p. 587 GENERAL TE Alternative Assessment, p. 587 GENERAL CRF Section Quiz* GENERAL	UCP 2, 3, 5; SAI 1; SPSP 1, 4; LS 1d, 1e
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Discussion, p. 588 GENERAL TE Support for English Language Learners, p. 589 SE Math Practice Runner's Time, p. 591 GENERAL MS Math Skills for Science The Unit Factor and Dimensional Analysis* GENERAL CRF Reinforcement Worksheet Muscle Map* BASIC	SE Reading Checks, pp. 589, 591 GENERAL TE Reteaching, p. 590 BASIC TE Quiz, p. 590 GENERAL TE Alternative Assessment, p. 590 GENERAL TE Homework, p. 590 ADVANCED SE Section Review*, p. 591 GENERAL CRF Section Quiz* GENERAL	UCP 1, 2, 3, 4; SAI 1, 2; SPSP 1; LS 1d, 1e; <i>LabBook</i> : UCP 3; SAI 1, 2; LS 1a, 1d, 1e, 3b
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Paired Summarizing, p. 592 GENERAL TE Support for English Language Learners, p. 593 TE Inclusion Strategies, p. 593 SE Connection to Social Studies Using Hair, p. 594 GENERAL CRF Critical Thinking The Tissue Engineering Debate* ADVANCED	SE Reading Checks, pp. 593, 594 GENERAL TE Reteaching, p. 594 BASIC TE Quiz, p. 594 GENERAL TE Alternative Assessment, p. 594 ADVANCED SE Section Review*, p. 595 GENERAL CRF Section Quiz* GENERAL	UCP 3, 5; SAI 2; SPSP 1; LS 1c, 1d, 1e, 1f, 3a, 3b; <i>Chapter Lab</i> : UCP 1, 2, 3, 5; SAI 1, 2; SPSP 1; LS 1d



www.scilinks.org

Maintained by the National Science Teachers Association. See Chapter Enrichment pages that follow for a complete list of topics.



Check out **Current Science** articles and activities by visiting the HRW Web site at go.hrw.com. Just type in the keyword HL5CS22T.



Classroom Videos

- **Lab Videos** demonstrate the chapter lab.
- **Brain Food Video Quizzes** help students review the chapter material.



Classroom CD-ROMs

- **Guided Reading Audio CD** (Also in Spanish)
- **Interactive Explorations**
- **Virtual Investigations**
- **Visual Concepts**
- **Science Tutor**



Holt Lab Generator CD-ROM

Search for any lab by topic, standard, difficulty level, or time. Edit any lab to fit your needs, or create your own labs. Use the Lab Materials QuickList software to customize your lab materials list.

Visual Resources

CHAPTER STARTER
TRANSPARENCY

Body Organization and Structure CHAPTER STARTER

This Really Happened!

On April 14, 1912, at 11:40 a.m., the British steamship *Thyonic*, the largest and most luxurious steamship ever built, struck an iceberg. Jack Thayer, a 17-year-old from Pennsylvania, felt the impact in his cabin and went on deck to see what had happened. To his horror, he found that the ship was sinking and that there were not enough lifeboats for the 2,207 passengers and crew. Jack watched as the last of the lifeboats, filled with women and children, were launched just before the ship slid beneath the icy water. Jack jumped. The pain of the cold felt like knives stabbing every inch of his body. He swam to an overturned lifeboat and climbed on.

Under normal circumstances, our bodies are able to maintain a constant internal temperature. Read on to find out about how our bodies work.

Jack Thayer was among the survivors who were able to keep themselves dry enough to survive until help arrived, at 4 a.m. An estimated 1,500 people died. Even those who were wearing life jackets couldn't survive the extreme temperature of the water. The freezing water caused their body systems to fail. Breathing became difficult, and muscles no longer functioned. Finally, they lost consciousness, and their hearts stopped.

The water around the *Thyonic* was just too cold for human survival.



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BELLINGER
TRANSPARENCIES

Body Organization and Structure BELLINGER TRANSPARENCY

Section: Body Organization

Match the body system in the first column with the correct function in the second column.

- | | |
|-----------------------|--------------------------|
| 1. respiratory system | a. regulates body fluids |
| 2. muscular system | b. breaks down food |
| 3. digestive system | c. pumps blood |
| 4. circulatory system | d. absorbs oxygen |
| 5. endocrine system | e. moves bones |

Record your answers in your science journal.

Section: The Skeletal System

Brainstorm some problems you would have if you lacked bones. Do you know any kinds of animals that don't have bones? Do you know of any animals that wear their "skeletons" on the outside of their bodies?

Record your answers in your science journal.

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TEACHING TRANSPARENCIES

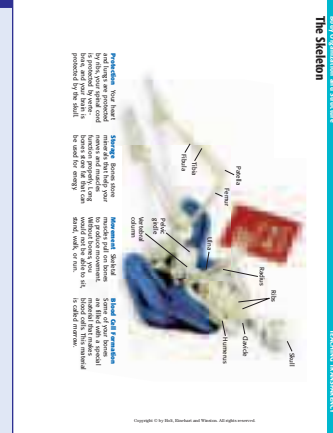
Body Organization and Structure

Organ Systems



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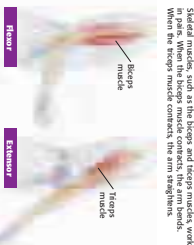
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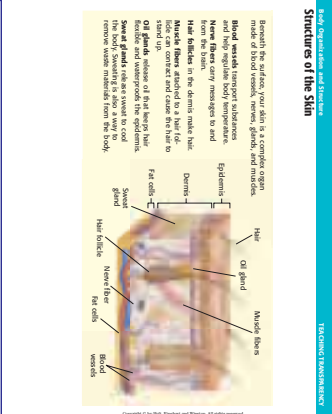
TEACHING TRANSPARENCIES

A Pair of Muscles in the Arm



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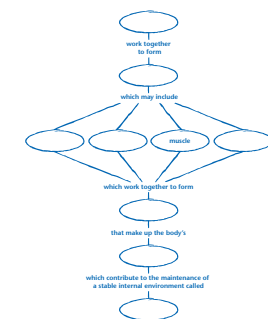
Chapter: Work, Machines, and Energy

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CONCEPT MAPPING
TRANSPARENCY

Body Organization and Structure CONCEPT MAPPING TRANSPARENCY

Use the following terms to complete the concept map below:
connective, nervous, homeostasis, organs, epithelial, tissue, organ systems, cells



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Planning Resources

LESSON PLANS

Lesson Plan

SAMPLE

Section: Waves

Pacing
Regular Schedule: with lab(s) 2 days without lab(s) 1 day
Block Schedule: with lab(s) 1 1/2 days without lab(s) 1 day

Objectives

1. Relate the seven properties of life to a living organism.
2. Describe seven theories that can help you to organize what you learn about biology.
3. Identify the tiny structures that make up all living organisms.
4. Differentiate between reproduction and heredity and between metabolism and homeostasis.

National Science Education Standards Covered

- 1. **Unifying Concepts and Processes:** Cells have particular structures that underlie their functions.
- 2. **Life Science:** Most cell functions involve chemical reactions.
- 3. **Life Science:** Cells store and use information to guide their functions.
- 4. **Life Science:** Cells can differentiate and form complete multicellular organisms.
- 5. **Life Science:** Cells evolve over time.
- 6. **Life Science:** The great diversity of organisms is the result of more than 3.5 billion years of evolution.
- 7. **Life Science:** Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms as well as for the striking molecular similarities observed among the diverse species of living organisms.
- 8. **Life Science:** The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent from common ancestors.
- 9. **Life Science:** The energy for life primarily comes from the sun.
- 10. **Life Science:** The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism.
- 11. **Life Science:** Matter and energy flow through different levels of organization of living systems—cells, organs, communities—and between living systems and the physical environment, chemical elements are recycled in different ways.
- 12. **Life Science:** Organisms have behavioral responses to internal changes and to external stimuli.

PARENT LETTER

SAMPLE

Dear Parent,

Your son's or daughter's science class will soon begin exploring the chapter entitled "The World of Physical Science." In this chapter, students will learn about how the scientific method applies to the world of physical science and the role of physical science in the world. By the end of the chapter, students should demonstrate a clear understanding of the chapter's main ideas and be able to discuss the following topics:

1. physical science is the study of energy and matter (Section 1)
2. the role of physical science in the world around them (Section 1)
3. careers that rely on physical science (Section 1)
4. the steps used in the scientific method (Section 2)
5. examples of technology (Section 2)
6. how the scientific method is used to answer questions and solve problems (Section 2)
7. how our knowledge of science changes over time (Section 2)
8. how models represent real objects or systems (Section 3)
9. examples of different ways models are used in science (Section 3)
10. the importance of the International System of Units (Section 4)
11. the appropriate units to use for particular measurements (Section 4)
12. how area and density are derived quantities (Section 4)

Questions to Ask Along the Way

You can help your son or daughter learn about these topics by asking interesting questions such as the following:

- What are some surprising careers that use physical science?
- What is a characteristic of a good hypothesis?
- When is a good idea to use a model?
- Why do Americans measure things in inches and yards and meters?

ALSO IN SPANISH

TEST ITEM LISTING

TEST ITEM LISTING

SAMPLE

The World of Science

MULTIPLE CHOICE

1. A variation of matter is that
 - a. they are large enough to see.
 - b. they do not exist exactly like the things they model.
 - c. they are smaller than the things they model.
 - d. they model continuous things.
 Answer: b Difficulty: 1 Section: 3 Objective: 2
2. The length 10 m is equal to
 - a. 100 mm.
 - b. 100 cm.
 - c. 10,000 mm.
 - d. both (b) and (c).
 Answer: d Difficulty: 1 Section: 3 Objective: 2
3. To be valid, a hypothesis must be
 - a. testable.
 - b. supported by evidence.
 - c. made into a law.
 - d. both (a) and (b).
 Answer: d Difficulty: 1 Section: 3 Objective: 2
4. The statement "Matter has a mass on the order of 10⁻²⁷ kg" is an example of (a)
 - a. law.
 - b. hypothesis.
 - c. observation.
 - d. prediction.
 Answer: b Difficulty: 1 Section: 3 Objective: 2
5. A hypothesis is often developed out of
 - a. observations.
 - b. experiments.
 - c. laws.
 - d. both (a) and (b).
 Answer: d Difficulty: 1 Section: 3 Objective: 2
6. How many milliliters are in 0.5 L?
 - a. 500 mL.
 - b. 5,000 mL.
 - c. 50,000 mL.
 - d. 500,000 mL.
 Answer: a Difficulty: 1 Section: 3 Objective: 2
7. A map of Seattle is an example of a
 - a. law.
 - b. theory.
 - c. model.
 - d. unit.
 Answer: c Difficulty: 1 Section: 3 Objective: 2
8. A lab has the safety team shown below. These teams mean that you should wear
 - a. safety goggles and a lab apron.
 - b. safety goggles, a lab apron, and gloves.
 - c. safety goggles and a lab apron.
 - d. safety goggles, a lab apron, and gloves.
 Answer: b Difficulty: 1 Section: 3 Objective: 2
9. The rate of conservation of mass says the total mass before a chemical change is
 - a. more than the total mass after the change.
 - b. less than the total mass after the change.
 - c. the same as the total mass after the change.
 - d. not the same as the total mass after the change.
 Answer: c Difficulty: 1 Section: 3 Objective: 2
10. In which of the following areas might you find a geometer at work?
 - a. studying the chemistry of rocks.
 - b. studying the atmosphere.
 - c. studying the behavior of matter.
 - d. studying the behavior of matter.
 Answer: b Difficulty: 1 Section: 3 Objective: 2

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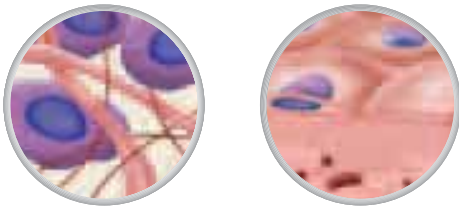
This Chapter Enrichment provides relevant and interesting information to expand and enhance your presentation of the chapter material.

Section 1

Body Organization

Tissues

- Tissues differ from each other in terms of the shape and size of cells, the amount and kind of material between the cells, and the special functions the tissues perform to maintain proper functioning of the body.



- Connective tissue is the most abundant tissue in the body. It displays the most variety in form and type. All connective tissue, however, can be classified into one of four types: dense connective tissue (cartilage and bone), loose connective tissue (found beneath the skin and around nerves, blood vessels, and organs), liquid connective tissue (blood and lymph), and adipose tissue (where the body stores energy as droplets of fat).
- Although bone is considerably harder than other body tissues, it accounts for only about 14% of a person's total body weight.

Section 2

The Skeletal System

The Human Skeleton

- The skeleton provides support for soft tissue. Also, it regulates body minerals and produces both red and white blood cells. There are typically 206 bones in the adult human body, but extra bones, particularly those in the hands and feet, can increase that number. The number of bones in children varies with age.
- The skeleton forms from more than 800 centers of ossification. All of the bony elements are generally not completely united to form an adult skeleton until a person reaches his or her mid-20s.

- The skeletons of male and female humans are slightly different. The most pronounced differences are in the pelvis. A female's pelvis is adapted for childbearing and thus has a larger pelvic inlet. Women who are malnourished during childhood typically do not develop the wider pelvis, which can make natural childbirth dangerous or even fatal for them.
- An individual's age can be determined by looking at the skeleton alone. A younger individual's dentition and bone fusion patterns indicate his or her age. In adults, age determination is more difficult because one must rely solely on signs of skeletal deterioration.



Bones

- Each bone is surrounded by a strong fibrous covering called a *periosteum*. Articular surfaces are covered in cartilage.
- Bones are made of three types of cells: osteoblasts, osteocytes, and osteoclasts. Osteoblasts are bone-producing cells. Osteocytes are bone-maintaining cells. Osteoclasts are bone-destroying cells.
- For its weight, bone is 5 times as strong as steel.

Joints

- Doctors typically classify joints by structure rather than movement. The three types of joint structures are called *fibrous*, *cartilaginous*, and *synovial*. Fibrous joints (such as those in the skull) are immovable joints in which a fibrous tissue or a hyaline cartilage connects the bones. Cartilaginous joints (such as those in the rib cage) are slightly moveable joints in which cartilage connects the bones. Synovial joints (such as the knee) are freely moving joints in which synovial membranes cover the cartilage and ligaments connecting the bone.



Section 3

The Muscular System

Skeletal Muscles

- There are more than 600 skeletal muscles in the human body. They are often organized into the following groups: muscles of the head and the neck, muscles of the trunk, muscles of the upper limbs, and muscles of the lower limbs.



Types of Muscle Cells

- When observed through a microscope, the three types of muscles are clearly identifiable. Cells of smooth muscles have a long, tapered shape; no clearly defined striations; and a large central nucleus. Skeletal muscle cells are long and tapered and characterized by distinct light- and dark-colored bands. Each cell has multiple nuclei because several skeletal muscle cells merge, and the cell membranes become indistinct. The cells of cardiac muscle have one or more nuclei and have an irregular, branched shape.

Section 4

The Integumentary System

Skin

- One square inch of skin can hold as many as 650 sweat glands, 20 blood vessels, and more than 1,000 nerve endings.
- Each person has a unique series of ridges and indentations called *fingerprints* on the tips of his or her fingers. No two people have the same fingerprints. Fingerprints help the fingers to grip slippery surfaces. Each person also has unique patterns on the tips of his or her toes.

Is That a Fact!

- More than three-fourths of the dust in some homes is made up of dead skin cells!

Hair and Nails

- Only mammals have true hair. All mammals have hair somewhere on their bodies.
- The body's most visible signs of aging occur in the integumentary system. Skin becomes thin, dry, wrinkled, and less supple. Dark-colored age spots may develop. Hair turns gray or white and may begin to fall out. Hair follicles decrease in number. Sweat glands become less active, so older people are less tolerant to extremely hot weather.
- Hair that is kept short grows an average of 2 cm per month. Growth slows to about 1 cm per month when hair reaches about 30 cm long. Fingernails grow about 2 cm each year. The fastest-growing nail is on the middle finger. Fingernails grow three to four times as quickly as toenails do.



SciLINKS®

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SciLinks is maintained by the National Science Teachers Association to provide you and your students with interesting, up-to-date links that will enrich your classroom presentation of the chapter.

Visit www.scilinks.org and enter the SciLinks code for more information about the topic listed.

Topic: **Tissues and Organs**
SciLinks code: **HSM1530**

Topic: **Muscular System**
SciLinks code: **HSM1008**

Topic: **Body Systems**
SciLinks code: **HSM0184**

Topic: **Integumentary System**
SciLinks code: **HSM0803**

Topic: **Skeletal System**
SciLinks code: **HSM1399**

Overview

Tell students that this chapter will help them learn about human body systems. In particular, the chapter will introduce students to the skeletal, muscular, and integumentary systems.

Assessing Prior Knowledge

Students should be familiar with the following topics:

- cells
- body organization

Identifying Misconceptions

As students learn the material in this chapter, some of them may be confused about the concept of homeostasis. Students should understand that homeostasis is a state in which the internal environment of the human body is stable. Help students understand that because the external environment is always changing, the human body must adjust to these changes to maintain homeostasis within the body. Students should also understand that all cells in the body play a role in homeostasis, but because there are many kinds of cells, no single cell has to do all of the jobs necessary for homeostasis.

Body Organization and Structure

The Big Idea

The human body is composed of major systems that have differing functions, but all of the systems work together to maintain homeostasis.

SECTION

- 1 Body Organization 580
- 2 The Skeletal System. 584
- 3 The Muscular System 588
- 4 The Integumentary System . . . 592

About the



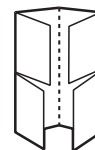
Lance Armstrong has won the Tour de France several times. These victories are especially remarkable because he was diagnosed with cancer in 1996. But with medicine and hard work, he grew strong enough to win one of the toughest events in all of sports.

PRE-READING ACTIVITY

FOLDNOTES

Four-Corner Fold

Before you read the chapter, create the FoldNote entitled "Four-Corner Fold" described in the **Study Skills** section of the Appendix. Label the flaps of the four-corner fold with "The skeletal system," "The muscular system," and "The integumentary system." Write what you know about each topic under the appropriate flap. As you read the chapter, add other information that you learn.



Standards Correlations

National Science Education Standards

The following codes indicate the National Science Education Standards that correlate to this chapter. The full text of the standards is at the front of the book.

Chapter Opener

UCP 1, 3, 4, 5; SAI 1, 2; SPSP 1; LS 1d, 1e, 3a, 3b

Section 1 Body Organization

UCP 1, 3, 4; LS 1a, 1d, 3a

Section 2 The Skeletal System

UCP 2, 3, 5; SAI 1; SPSP 1, 4; LS 1d, 1e

Section 3 The Muscular System

UCP 1, 2, 3, 4; SAI 1, 2; SPSP 1; LS 1d, 1e; LabBook: UCP 3; SAI 1, 2; LS 1a, 1d, 1e, 3b

Section 4 The Integumentary System

UCP 3, 5; SAI 2; SPSP 1; LS 1c, 1d, 1e, 1f, 3a, 3b

Chapter Lab

UCP 1, 2, 3, 5; SAI 1, 2; SPSP 1; LS 1d

Chapter Review

UCP 1, 2, 3, 4, 5; SAI 1, 2; SPSP 1, 4; LS 1a, 1c, 1d, 1e, 1f, 3a, 3b

Science in Action

UCP 1, 5; ST 1, 2; SPSP 1, 4, 5; LS 1d, 1e



START-UP Activity

Too Cold for Comfort

Your nervous system sends you messages about your body. For example, if someone steps on your toe, your nervous system sends you a message. The pain you feel is a message that tells you to move your toe to safety. Try this exercise to watch your nervous system in action.

Procedure

1. Hold a few pieces of ice in one hand. Allow the melting water to drip into a dish. Hold the ice until the cold is uncomfortable. Then, release the ice into the dish.
2. Compare the hand that held the ice with your other hand. Describe the changes you see.

Analysis

1. What message did you receive from your nervous system while you held the ice?
2. How quickly did the cold hand return to normal?
3. What organ systems do you think helped restore your hand to normal?
4. Think of a time when your nervous system sent you a message, such as an uncomfortable feeling of heat, cold, or pain. How did your body react?

START-UP Activity

MATERIALS

FOR EACH GROUP

- dish, waterproof
- ice

Safety Caution: Students should clean up the water that results from the melting ice, especially if it drips onto the floor.

Answers

1. Answers may vary, but students should feel discomfort that is intense enough to make them want to drop the ice.
2. Answers may vary. Students' hands will return to normal at varying rates, but most students should answer that it took a few minutes.
3. Students should recognize that the integumentary, circulatory, and cardiovascular systems played roles in returning their hands to normal. Point out that the redness reflects an increased blood supply to the cold area. By bringing warmth to the hand, the blood helps to restore the hand to normal.
4. Answers may vary, but students should recognize that the nervous system detected the discomfort and sent signals to other body systems to respond. Some students may note that they jerked away from the discomfort.

Body Organization and Structure

CHAPTER STARTER

This Really Happened!

On April 14, 1912, at 11:40 a.m., the British steamship *Titanic*, the largest and most luxurious steamship ever built, struck an iceberg. Jack Thayer, a 17-year-old from Pennsylvania, felt the impact in his cabin and went on deck to see what had happened. To his horror, he found that the ship was sinking and that there were not enough lifeboats for the 2,207 passengers and crew. Jack watched as the last of the lifeboats, filled with women and children, were launched. Just before the ship slid beneath the icy water, Jack jumped. The pain of the cold felt like knives stabbing every inch of his body. He swam to an overturned lifeboat and climbed on.

Jack Thayer was among the survivors who were able to keep themselves dry enough to survive until help arrived, at 4 a.m. An estimated 1,500 people died. Even those who were wearing life jackets couldn't survive the extreme temperature of the water. The freezing water caused their body systems to fail. Breathing became difficult, and muscles no longer functioned. Finally, they lost consciousness and their hearts stopped.

The water around the *Titanic* was just too cold for human survival.

Under normal circumstances, our bodies are able to maintain a constant internal temperature. Read on to find out about this and other interesting information on how our bodies work.

Chapter Starter Transparency

Use this transparency to help students begin thinking about human body systems.

CHAPTER RESOURCES

Technology

- Transparencies**
 - Chapter Starter Transparency
- Student Edition on CD-ROM**
- Guided Reading Audio CD**
 - English or Spanish
- Classroom Videos**
 - Brain Food Video Quiz

READING
SKILLS

Workbooks

- Science Puzzlers, Twisters & Teasers**
 - Body Organization and Structure **GENERAL**

Focus

Overview

This section introduces the basic organization of the human body. Students will learn about the four major tissues of the body and that the body's organs are arranged by function into 11 organ systems.



Bellringer

Write the names of the following organ systems on the board or an overhead projector: *respiratory system*, *muscular system*, *digestive system*, *cardiovascular system*, and *endocrine system*. Then, write the following functions: *to pump blood*, *to enable movement*, *to send out chemical messages*, *to absorb oxygen*, and *to break down food*. Ask students to match each organ system with its correct function. (The **respiratory system** absorbs oxygen. The **muscular system** enables movement. The **digestive system** breaks down food. The **cardiovascular system** pumps blood. The **endocrine system** sends out chemical messages.)

What You Will Learn

- Describe how tissues, organs, and organ systems are related.
- List 11 organ systems.
- Identify how organ systems work together to maintain homeostasis.

Vocabulary

homeostasis organ
tissue

READING STRATEGY

Reading Organizer As you read this section, make a concept map by using the terms above.

homeostasis the maintenance of a constant internal state in a changing environment

tissue a group of similar cells that perform a common function

Body Organization

Imagine jumping into a lake. At first, your body feels very cold. You may even shiver. But eventually you get used to the cold water. How?

Your body gets used to cold water because it returns to *homeostasis*. **Homeostasis** (HOH mee OH STAY sis) is the maintenance of a stable internal environment in the body. When you jump into a lake, homeostasis helps your body adapt to the cold water.

Cells, Tissues, and Organs

Maintaining homeostasis is not easy. Your internal environment is always changing. Your cells need nutrients and oxygen to survive. Your cells need wastes removed. If homeostasis is disrupted, cells may not get the materials they need. So, cells may be damaged or may die.

Cells Form Tissues

Your cells must do many jobs to maintain homeostasis. But, each of your cells does not have to do all of those jobs. Just as each person on a soccer team has a role during a game, each cell in your body has a job in maintaining homeostasis. Your cells are organized into groups. A group of similar cells working together forms a **tissue**. Your body has four main kinds of tissue. The four kinds of tissue are shown in **Figure 1**.

Figure 1 Four Kinds of Tissue



Epithelial tissue covers and protects underlying tissue. When you look at the surface of your skin, you see epithelial tissue. The cells form a continuous sheet.

Nervous tissue sends electrical signals through the body. It is found in the brain, nerves, and sense organs.

CHAPTER RESOURCES

Chapter Resource File

- Lesson Plan
- Directed Reading A **BASIC**
- Directed Reading B **SPECIAL NEEDS**

Technology

- Transparencies
- Bellringer

Workbooks

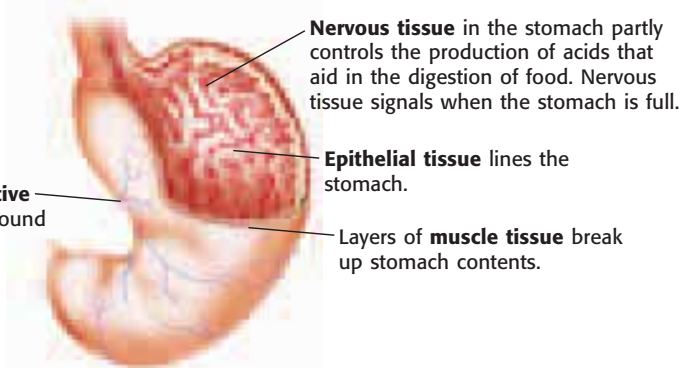
- Interactive Textbook **Struggling Readers**

Is That a Fact!

The Pompeii worm, *Alvinella pompejana*, can survive a temperature difference of 60°C between its head and its tail! Scientists theorize that a coating of furry bacteria living on the worm's back allows the worm to endure such extreme temperature differences.

Figure 2 Organization of the Stomach

The stomach is an organ. The four kinds of tissue work together so that the stomach can carry out digestion.



Blood and another **connective tissue** called *collagen* are found in the wall of the stomach.

Nervous tissue in the stomach partly controls the production of acids that aid in the digestion of food. Nervous tissue signals when the stomach is full.

Epithelial tissue lines the stomach.

Layers of **muscle tissue** break up stomach contents.

Tissues Form Organs

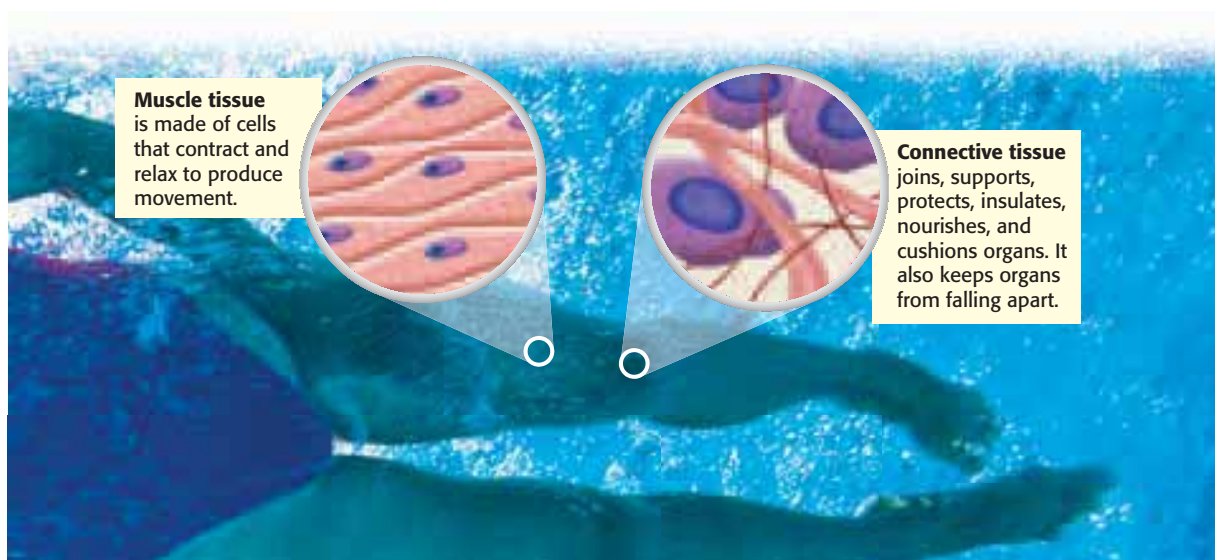
One kind of tissue alone cannot do all of the things that several kinds of tissue working together can do. Two or more tissues working together form an **organ**. Your stomach, shown in **Figure 2**, uses all four kinds of tissue to carry out digestion.

organ a collection of tissues that carry out a specialized function of the body

Organs Form Systems

Your stomach does a lot to help you digest your food. But the stomach doesn't do it all. Your stomach works with other organs, such as the small and large intestines, to digest your food. Organs that work together make up an *organ system*.

Reading Check How is the stomach part of an organ system? (See the Appendix for answers to Reading Checks.)



Muscle tissue is made of cells that contract and relax to produce movement.

Connective tissue joins, supports, protects, insulates, nourishes, and cushions organs. It also keeps organs from falling apart.

CONNECTION ACTIVITY

History

ADVANCED

Organ Transplants The first transplant of a human heart was performed in Cape Town, South Africa, on December 3, 1967, by Dr. Christiaan Barnard and a team of 30 physicians. Have interested students research when other organs, such as kidneys, livers, and lungs, were first transplanted. Have students make posters about their findings. **Visual**

Answer to Reading Check

The stomach works with other organs, such as the small and large intestines, to digest food.

Motivate

Discussion

GENERAL

Homeostasis Before students read this section, ask them to relate what they know about how different animals adjust to outside temperatures. (Most students will likely relate how ectotherms and endotherms adjust body temperature.) Ask students how the idea of homeostasis fits into what they know about animals and temperature regulation. (Students should recognize that temperature regulation is a function of homeostasis.) **Logical/Verbal**

Teach



READING STRATEGY

BASIC

Prediction Guide Before students read the pages that describe the body's tissues and organs, ask whether each of the following statements is true or false.

- Homeostasis is the body's ability to maintain a stable internal environment. (true)
- The human body has four main types of tissues. (true)
- An organ is a group of tissues that work together. (true)

Verbal

SUPPORT FOR

English Language Learners

Homeostasis Students may need some additional help with vocabulary connected to homeostasis. Before students read this section, elicit synonyms for the following terms: *get used to*, *stable*, *internal*, *adapt*, *disrupted*, *role*. Allow students to consult dictionaries if needed. Write the terms and student synonyms on the board for student reference as they read. **Visual/Auditory/Verbal**

Close

Reteaching

BASIC

Organizing Information To help students understand and identify the 11 major organ systems of the body, have them make a table with the following headings: "Name of organ system," "Function(s)," and "Main organs." Have students use the table to review the information presented on these pages.

Logical

Quiz

GENERAL

Ask students whether each of the following statements is true or false. Have students correct false statements.

1. Homeostasis is the maintenance of a stable internal environment. (true)
2. Epithelial tissue sends electrical signals throughout the body. (false; *Nervous tissue sends electrical signals throughout the body and epithelial tissue covers and protects underlying tissue.*)
3. Blood is a type of connective tissue. (true)

Alternative Assessment

GENERAL

Organ Systems In their **science journal**, have students describe three of the organ systems introduced in this section. Have them describe the functions and primary organs of each system and include drawings of each system. **Verbal**

Working Together

Your body's 11 major organ systems, shown in **Figure 3**, work together to maintain homeostasis. For example, the cardiovascular system, which includes the heart, blood, and blood vessels, works with the respiratory system, which includes the lungs. The cardiovascular system picks up oxygen from the lungs and carries the oxygen to cells in the body. These cells produce carbon dioxide, which the cardiovascular system returns to the respiratory system. The respiratory system expels the carbon dioxide.

Reading Check Give an example of how organ systems work together in the body.

Figure 3 Organ Systems



Integumentary System Your skin, hair, and nails protect the tissue that lies beneath them.



Muscular System Your muscular system works with the skeletal system to help you move.



Skeletal System Your bones provide a frame to support and protect your body parts.



Cardiovascular System Your heart pumps blood through all of your blood vessels.



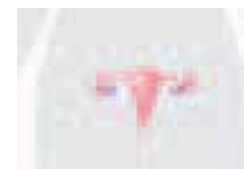
Respiratory System Your lungs absorb oxygen and release carbon dioxide.



Urinary System Your urinary system removes wastes from the blood and regulates your body's fluids.



Male Reproductive System The male reproductive system produces and delivers sperm.



Female Reproductive System The female reproductive system produces eggs and nourishes and protects the fetus.

INCLUSION Strategies

- **Attention Deficit Disorder**
- **Visually Impaired**
- **Developmentally Delayed**

Kinesthetic activities can help students learn more easily. Ask 10 students to hold signs identifying each student as an organ system (exclude the reproductive system). Ask the students to step forward if their system is involved in the following activities: snoring (*respiratory and muscular*), sweating (*lymphatic and integumentary*),

jumping in fear (*muscular, skeletal, nervous, and endocrine*), drinking (*muscular, digestive, and urinary*), eating an apple (*digestive and muscular*), and running (*muscular, skeletal, circulatory, cardiovascular, and respiratory*). You may want to tell students that some body systems, such as the nervous system and the endocrine system, play a role in nearly all of the body's functions.

Kinesthetic/Visual



Nervous System Your nervous system receives and sends electrical messages throughout your body.



Digestive System Your digestive system breaks down the food you eat into nutrients that your body can absorb.



Lymphatic System The lymphatic system returns leaked fluids to blood vessels and helps get rid of bacteria and viruses.



Endocrine System Your glands send out chemical messages. Ovaries and testes are part of this system.

Answers to Section Review

1. Sample answer: Homeostasis is maintained by cells, tissues, and organs.
2. c
3. integumentary system, muscular system, skeletal system, cardiovascular system, respiratory system, urinary system, reproductive system, nervous system, digestive system, lymphatic system, and endocrine system
4. about 11% ($22 \text{ bones} \div 206 \text{ bones} \times 100 = 10.7\%$)
5. Sample answer: The nervous system sends messages to Tanya's muscular system to bite into the hamburger. Tanya's jaws, which are part of the skeletal system, help grind up the food. The food moves into Tanya's stomach, which is part of her digestive system. The digestive system breaks down the food, and the cardiovascular system picks up nutrients from the digestive system to take throughout the body.
6. Sample answer: The body would be unable to maintain homeostasis because the cells of the body would have too many jobs to do. The cells likely would not be able to do all of these jobs.

SECTION Review

Summary

- A group of cells that work together is a tissue. Tissues form organs. Organs that work together form organ systems.
- There are four kinds of tissue in the human body.
- There are 11 major organ systems in the human body.
- Organ systems work together to help the body maintain homeostasis.

Using Key Terms

1. Use the following terms in the same sentence: *homeostasis*, *tissue*, and *organ*.

Understanding Key Ideas

2. Which of the following statements describes how tissues, organs, and organ systems are related?
 - a. Organs form tissues, which form organ systems.
 - b. Organ systems form organs, which form tissues.
 - c. Tissues form organs, which form organ systems.
 - d. None of the above
3. List the 11 organ systems.

Math Skills

4. The human skeleton has 206 bones. The human skull has 22 bones. What percentage of human bones are skull bones?

Critical Thinking

5. **Applying Concepts** Tanya went to a restaurant and ate a hamburger. Describe how Tanya used five organ systems to eat and digest her hamburger.
6. **Predicting Consequences** Predict what might happen if the human body did not have specialized cells, tissues, organs, and organ systems to maintain homeostasis.

SciLINKS Developed and maintained by the National Science Teachers Association

For a variety of links related to this chapter, go to www.scilinks.org

Topic: **Tissues and Organs; Body Systems**

SciLinks code: **HSM1530; HSM0184**

Answer to Reading Check

Sample answer: The cardiovascular and respiratory systems; The respiratory system draws in oxygen which the cardiovascular system transports to every cell in the body. The cardiovascular system also carries the carbon dioxide (which cells produce) to the respiratory system. The respiratory system then expels the carbon dioxide from the body.

CHAPTER RESOURCES

Chapter Resource File

- Section Quiz **GENERAL**
- Section Review **GENERAL**
- Vocabulary and Section Summary **GENERAL**
- SciLinks Activity **GENERAL**

Technology

- Transparencies
- L78 Organ Systems

Focus

Overview

This section introduces the skeletal system and describes the functions of bones. The section also illustrates the internal structure of bones and three types of joints.

Bellringer

Have students brainstorm problems that they would have if they lacked bones. (Students should understand that they would have no defined structure, mineral storage, organ protection, blood cells, or mobility.)

Motivate

Activity

GENERAL

Locating Bones Review with students that the skeletal system supports the body and protects delicate body parts. Encourage students to press the skin in various parts of their body to describe any parts of their body where they cannot feel their bones. (Answers may vary but should include the abdomen, nose, and ears.) As you point to various parts of the body, ask students what organs the bones protect. (Sample answers: The skull protects the brain. The ribs protect the heart and lungs.) **K** Kinesthetic/Visual

What You Will Learn

- Identify the major organs of the skeletal system.
- Describe four functions of bones.
- Describe three joints.
- List three injuries and two diseases that affect bones and joints.

Vocabulary

skeletal system
joint

READING STRATEGY

Reading Organizer As you read this section, create an outline of the section. Use the headings from the section in your outline.

skeletal system the organ system whose primary function is to support and protect the body and to allow the body to move

Protection Your heart and lungs are protected by ribs, your spinal cord is protected by vertebrae, and your brain is protected by the skull.

Storage Bones store minerals that help your nerves and muscles function properly. Long bones store fat that can be used for energy.

Movement Skeletal muscles pull on bones to produce movement. Without bones, you would not be able to sit, stand, walk, or run.

Blood Cell Formation Some of your bones are filled with a special material that makes blood cells. This material is called *marrow*.

The Skeletal System

When you hear the word *skeleton*, you may think of the remains of something that has died. But your skeleton is not dead. It is very much alive.

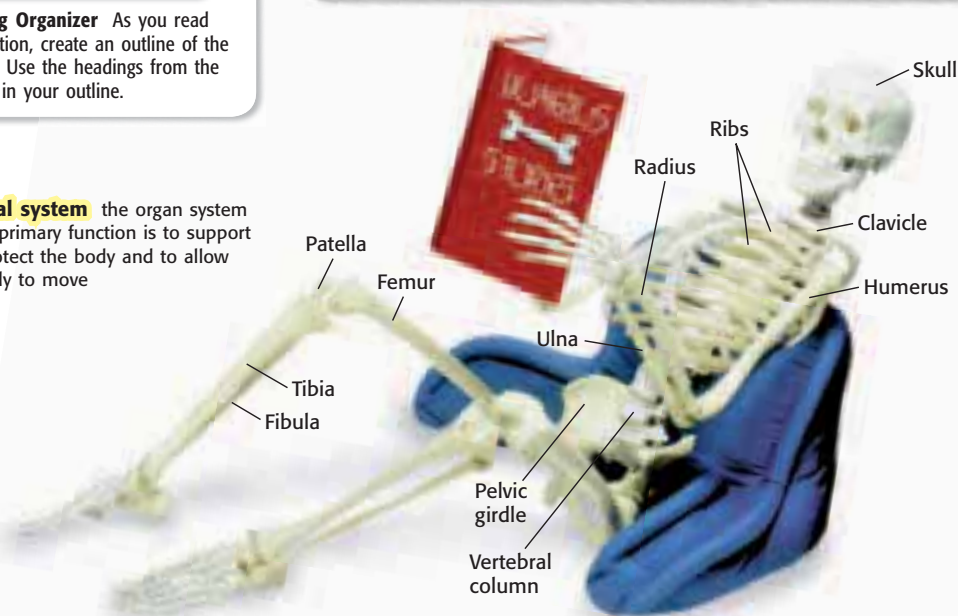
You may think your bones are dry and brittle. But they are alive and active. Bones, cartilage, and the connective tissue that holds bones together make up your **skeletal system**.

Bones

The average adult human skeleton has 206 bones. Bones help support and protect parts of your body. They work with your muscles so you can move. Bones also help your body maintain homeostasis by storing minerals and making blood cells.

Figure 1 shows the functions of your skeleton.

Figure 1 The Skeleton



CHAPTER RESOURCES

Chapter Resource File

- Lesson Plan
- Directed Reading A **BASIC**
- Directed Reading B **SPECIAL NEEDS**

Technology

- Transparencies
 - Bellringer
 - L79 The Skeleton

Workbooks

- Interactive Textbook **Struggling Readers**



Q: Why didn't the skeleton cross the road?

A: It didn't have the guts.

SUPPORT FOR

English Language Learners

Bone Dissection Ask a local butcher to cut a long bone from a pig, a cow, or a sheep in half lengthwise to expose the bone's internal structure. If a bone is not available from a butcher, obtain a preserved long bone from a biological supply house. Point out to students the parts shown in the diagram on this page. As you point out the features, write the vocabulary on the board and model its correct pronunciation, having students repeat. **Visual/Verbal/Auditory**

Quick Lab

MATERIALS

FOR EACH GROUP

- chicken bone, clean
- jar of vinegar

Safety Caution: Remind students to review all safety cautions and icons before beginning this lab activity.

Answers

3. Sample answer: The bone becomes more flexible.
4. Sample answer: The bone has become weaker. Because it is no longer rigid, it will not be able to provide the support and protection it once did.
5. Sample answer: The hard minerals in the chicken bone dissolved in the vinegar.

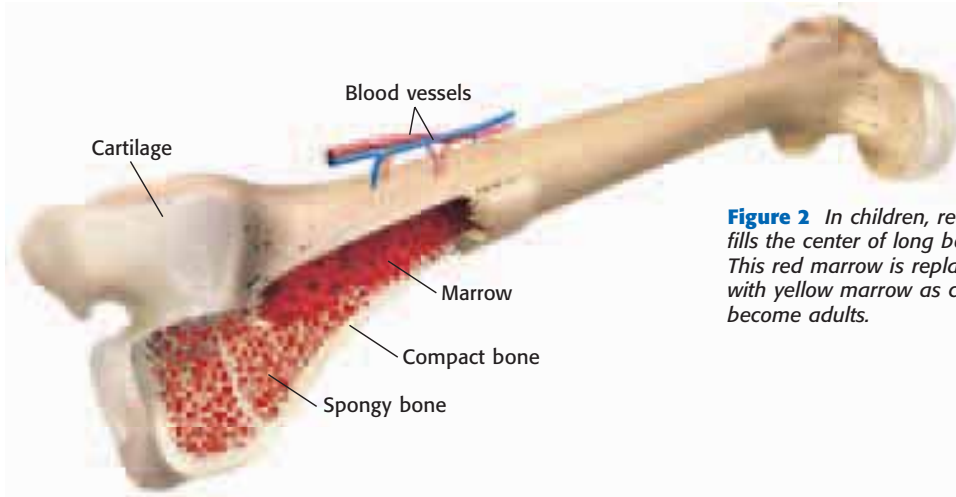


Figure 2 In children, red marrow fills the center of long bones. This red marrow is replaced with yellow marrow as children become adults.

Bone Structure

A bone may seem lifeless. But a bone is a living organ made of several different tissues. Bone is made of connective tissue and minerals. These minerals are deposited by living cells called *osteoblasts* (AHS tee oh BLASTS).

If you look inside a bone, you will notice two kinds of bone tissue. If the bone tissue does not have any visible open spaces, it is called *compact bone*. Compact bone is rigid and dense. Tiny canals within compact bone contain small blood vessels. Bone tissue that has many open spaces is called *spongy bone*. Spongy bone provides most of the strength and support for a bone.

Bones contain a soft tissue called *marrow*. There are two types of marrow. Red marrow produces both red and white blood cells. Yellow marrow, found in the central cavity of long bones, stores fat. **Figure 2** shows a cross section of a long bone, the femur.

Bone Growth

Did you know that most of your skeleton used to be soft and rubbery? Most bones start out as a flexible tissue called *cartilage*. When you were born, you didn't have much true bone. But as you grew, most of the cartilage was replaced by bone. During childhood, most bones still have growth plates of cartilage. These growth plates provide a place for bones to continue to grow.

Feel the end of your nose. Or bend the top of your ear. These areas are two places where cartilage is never replaced by bone. These areas stay flexible.

✓ Reading Check How do bones grow? (See the Appendix for answers to Reading Checks.)

Cultural Awareness

GENERAL



El Día de los Muertos

On November 2 each year, people across Mexico celebrate El Día de los Muertos (the Day of the Dead). They set up elaborate shrines that are often decorated with figures of skeletons depicting a deceased person's job when the person was alive. Have interested students write a research paper on this holiday and share their findings with the class. **Verbal**

Answer to Reading Check

Sample answer: As people grow, most of the cartilage that they start out with is replaced with bone.

Teach, continued

Discussion

GENERAL

Joints After students read about the different kinds of joints, ask them the following questions.

- What kind of joint do you use when you bend your knee? (*hinge joint*)
- What kind of joint moves when you swing your arm back and forth? (*ball-and-socket joint*) Name another location in your body where this type of joint is located. (*hip*)

LS Verbal

Close

Reteaching

BASIC

Skeletal System Have students work in pairs to review the functions of the skeletal system. Students should stop each other if a concept is confusing or if they need clarification.

LS Interpersonal

Quiz

GENERAL

1. What is the difference between compact bone and spongy bone? (*Sample answer: Compact bone has no visible, open spaces. Spongy bone has many visible spaces.*)
2. Where in the body are ball-and-socket joints found? (*hip and shoulder*) Where are hinge joints? (*knee*) Where are gliding joints? (*wrist and ankle*)

Figure 3 Three Joints

Gliding Joint

Gliding joints allow bones in the hand and wrist to glide over one another and give some flexibility to the area.



Ball-and-Socket Joint

As a video-game joystick lets you move your character all around, the shoulder lets your arm move freely in all directions.



Hinge Joint

As a hinge allows a door to open and close, the knee enables you to flex and extend your lower leg.



Joints

A place where two or more bones meet is called a **joint**. Your joints allow your body to move when your muscles contract. Some joints, such as fixed joints, allow little or no movement. Many of the joints in the skull are fixed joints. Other joints, such as your shoulder, allow a lot of movement. Joints can be classified based on how the bones in a joint move. For example, your shoulder is a ball-and-socket joint. Three joints are shown in **Figure 3**.

Joints are held together by *ligaments* (LIG uh muhnts). Ligaments are strong elastic bands of connective tissue. They connect the bones in a joint. Also, cartilage covers the ends of many bones. Cartilage helps cushion the area in a joint where bones meet.

✓ Reading Check Describe the basic structure of joints.

CONNECTION TO Environmental Science

WRITING SKILL

Bones from the Ocean Sometimes, a bone or joint may become so damaged that it needs to be repaired or replaced with surgery. Often, replacement parts are made from a metal, such as titanium. However, some scientists have discovered that coral skeletons from coral reefs in the ocean can be used to replace human bone. Research bone surgery. Identify why doctors use metals such as titanium. Then, identify the advantages that coral may offer. Write a report discussing your findings.

Answer to Reading Check

Sample answer: Joints are held together by ligaments. Cartilage cushions the area in a joint where bones meet.

Answer to Connection to Environmental Science

Answers may vary. Students should understand that titanium is a relatively nonreactive metal, so it is used for bone replacement. Students should also demonstrate an understanding that coral easily binds to existing bone. You may want to ask students to examine the impact of coral bone replacement on the environment.

Skeletal System Injuries and Diseases

Sometimes, parts of the skeletal system are injured. As shown in **Figure 4**, bones may be fractured, or broken. Joints can also be injured. A dislocated joint is a joint in which one or more bones have been moved out of place. Another joint injury, called a *sprain*, happens if a ligament is stretched too far or torn.

There are also diseases of the skeletal system. *Osteoporosis* (AHS tee OH puh ROH sis) is a disease that causes bones to become less dense. Bones become weak and break more easily. Age and poor eating habits can make it more likely for people to develop osteoporosis. Other bone diseases affect the marrow or make bones soft. A disease that affects the joints is called *arthritis* (ahr THRIET is). Arthritis is painful. Joints may swell or stiffen. As they get older, some people are more likely to have some types of arthritis.



Figure 4 This X ray shows that the two bones of the forearm have been fractured, or broken.

Alternative Assessment

GENERAL



Bone Essays Have students write an essay about bones. Essays should address what bones do, how they are specialized, and how they are joined. **Verbal**

Answers to Section Review

1. Sample answer: The skeletal system includes bones, cartilage, and connective tissue, and it provides support to the body.
2. c
3. Sample answer: Bones protect organs. Bones store materials that help nerves and muscles function properly. Along with skeletal muscles, bones make it possible to move. Finally, marrow in bones produces blood cells.
4. gliding joints, hinge joints, and ball-and-socket joints
5. Sample answer: Osteoporosis is a disease that causes bones to become less dense. Bones become weak and break more easily. Arthritis is a painful joint disease that causes joints to swell or stiffen.
6. $14 \text{ days} (6 \text{ weeks} \times 7 \text{ days/week} = 42 \text{ days}; 42 \text{ days} \times 1/3 = 14 \text{ days})$
7. Sample answer: Children are still growing, so they need more blood cells as their bodies get bigger. After children become adults, they don't need as many new blood cells, so long bones store fat instead.
8. Sample answer: Growth plates are places where bones continue to grow. If children did not have growth plates, their bones would not continue to grow.

SECTION Review

Summary

- The skeletal system includes bones, cartilage, and the connective tissue that connects bones.
- Bones protect the body, store minerals, allow movement, and make blood cells.
- Joints are places where two or more bones meet.
- Skeletal system injuries include fractures, dislocations, and sprains. Skeletal system diseases include osteoporosis and arthritis.

Using Key Terms

1. In your own words, write a definition for the term *skeletal system*.

Understanding Key Ideas

2. Which of the following is NOT an organ of the skeletal system?
 - a. bone
 - b. cartilage
 - c. muscle
 - d. None of the above
3. Describe four functions of bones.
4. What are three joints?
5. Describe two diseases that affect the skeletal system.

Math Skills

6. A broken bone usually heals in about six weeks. A mild sprain takes one-third as long to heal. In days, about how long does it take a mild sprain to heal?

Critical Thinking

7. **Identifying Relationships** Red bone marrow produces blood cells. Children have red bone marrow in their long bones, while adults have yellow bone marrow, which stores fat. Why might adults and children have different kinds of marrow?
8. **Predicting Consequences** What might happen if children's bones didn't have growth plates of cartilage?

SciLINKS **NSTA**

Developed and maintained by the National Science Teachers Association

For a variety of links related to this chapter, go to www.scilinks.org

Topic: **Skeletal System**

SciLinks code: **HSM1399**

CONNECTION to Physical Science

GENERAL

Levers Students may be surprised to learn that their arms and legs are machines. Human limbs are levers, and levers are the simplest kind of machine. Levers allow people to apply, increase, and change the direction of force. Use the teaching transparency titled "Machines Change the Size and/or Direction of a Force" to illustrate this point. **Visual**

CHAPTER RESOURCES

Chapter Resource File

- Section Quiz **GENERAL**
- Section Review **GENERAL**
- Vocabulary and Section Summary **GENERAL**
- Reinforcement Worksheet **BASIC**

Technology

- **Transparencies**
 - **LINK TO PHYSICAL SCIENCE** P31 Machines Change the Size and/or Direction of a Force

Workbooks

- **Math Skills for Science**
 - Mechanical Advantage **GENERAL**

Focus

Overview

This section introduces students to the major parts of the muscular system and describes three types of muscle. This section also describes movement, aerobic exercise, and resistance exercise. The section discusses muscular system injuries and ways to prevent them.

Bellringer

On the board or an overhead projector, write the following: "List at least five parts of your body that you use to drink a glass of water." (Sample answer: fingers, hand, arm, lips, and tongue) Remind students that their muscles control all of the parts that they use to drink water—including their eyes, which they use to see the glass.

Motivate

Group Activity — GENERAL

Poster Project Have students create a poster illustrating the three types of muscle. Students should include information about where the muscle is found, what it looks like, and whether it is involuntary or voluntary. Have students present their posters to the class.

 Verbal/Visual

What You Will Learn

- List three kinds of muscle tissue.
- Describe how skeletal muscles move bones.
- Compare aerobic exercise with resistance exercise.
- Describe two muscular system injuries.

Vocabulary

muscular system

READING STRATEGY

Discussion Read this section silently. Write down questions that you have about this section. Discuss your questions in a small group.

The Muscular System

Have you ever tried to sit still, without moving any muscles at all, for one minute? It's impossible! Somewhere in your body, muscles are always working.

Your heart is a muscle. Muscles make you breathe. And muscles hold you upright. If all of your muscles rested at the same time, you would collapse. The **muscular system** is made up of the muscles that let you move.

Kinds of Muscle

Figure 1 shows the three kinds of muscle in your body. *Smooth muscle* is found in the digestive tract and in the walls of blood vessels. *Cardiac muscle* is found only in your heart. *Skeletal muscle* is attached to your bones for movement. Skeletal muscle also helps protect your inner organs.

Muscle action can be voluntary or involuntary. Muscle action that is under your control is *voluntary*. Muscle action that is not under your control is *involuntary*. Smooth muscle and cardiac muscle are involuntary muscles. Skeletal muscles can be both voluntary and involuntary muscles. For example, you can blink your eyes anytime you want to. But your eyes will also blink automatically.

Figure 1 Three Kinds of Muscle



CHAPTER RESOURCES

Chapter Resource File

- Lesson Plan
- Directed Reading A **BASIC**
- Directed Reading B **SPECIAL NEEDS**

Technology

- Transparencies
 - Bellringer
 - L80 A Pair of Muscles in the Arm

Workbooks

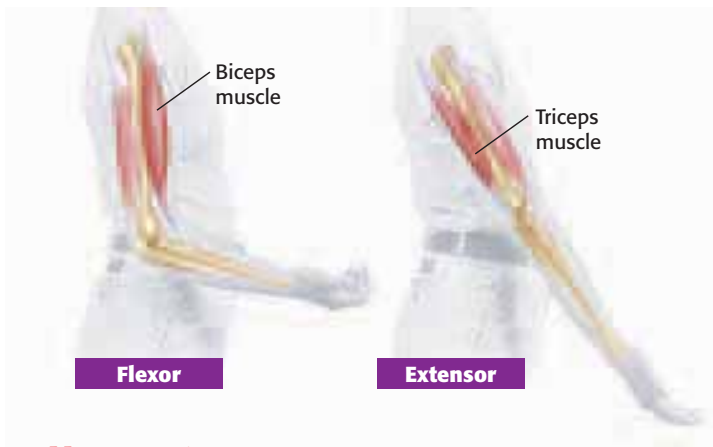
- Interactive Textbook **Struggling Readers**

Is That a Fact!

Horses can sleep standing up. Their legs can support their weight on their bones without the use of muscles. When horses fall asleep and their muscles relax, their leg bones lock in place underneath them and hold them upright for the duration of their nap.

Figure 2 A Pair of Muscles in the Arm

Skeletal muscles, such as the biceps and triceps muscles, work in pairs. When the biceps muscle contracts, the arm bends. When the triceps muscle contracts, the arm straightens.



Movement

Skeletal muscles can make hundreds of movements. You can see many of these movements by watching a dancer, a swimmer, or even someone smiling or frowning. When you want to move, signals travel from your brain to your skeletal muscle cells. The muscle cells then contract, or get shorter.

Muscles Attach to Bones

Strands of tough connective tissue connect your skeletal muscles to your bones. These strands are called *tendons*. When a muscle that connects two bones gets shorter, the bones are pulled closer to each other. For example, tendons attach the biceps muscle to a bone in your shoulder and to a bone in your forearm. When the biceps muscle contracts, your forearm bends toward your shoulder.

Muscles Work in Pairs

Your skeletal muscles often work in pairs. Usually, one muscle in the pair bends part of the body. The other muscle straightens part of the body. A muscle that bends part of your body is called a *flexor* (FLEKS uhr). A muscle that straightens part of your body is an *extensor* (ek STEN suhr). As shown in **Figure 2**, the biceps muscle of the arm is a flexor. The triceps muscle of the arm is an extensor.

✓ Reading Check Describe how muscles work in pairs. (See the Appendix for answers to Reading Checks.)

muscular system the organ system whose primary function is movement and flexibility

SCHOOL to HOME

Power in Pairs

Ask a parent or guardian to sit in a chair and place a hand palm up under the edge of a table. Tell your parent to apply gentle upward pressure. Feel the front and back of your parent's upper arm. Next, ask your parent to push down on top of the table. Feel your parent's arm again. What did you notice about the muscles in your parent's arm when he or she was pressing up? pushing down?

ACTIVITY

Answer to Reading Check

Sample answer: One muscle, the flexor, bends part of the body. Another muscle, the extensor, straightens part of the body.

Answer to School-to-Home Activity

Sample answer: While my parent pushes down, the muscles in the back of my parent's arm contract, and while my parent pushes up, the muscles in the front of the arm contract.

SUPPORT FOR

English Language Learners

Muscles To reinforce the concepts of flexor and extensor, ask a volunteer to come to the front of the class. Provide one red and one white index card to the other students. Tell them to raise the red card and say *extensor* when they see extensor movement. They should raise the white card and say *flexor* when they see flexor movement. Have the volunteer perform actions one at a time such as stand on one foot, raise his or her hand, and so on. Check to make sure students are answering correctly. Explain correct responses, if necessary. **Visual/Kinesthetic**

CONNECTION to Real World

ADVANCED



Polio In the early 1900s, tens of thousands of people, mostly children, were stricken with polio, a viral disease that paralyzes muscles. Often, polio would leave its victims unable to walk or move. An Australian nurse, Sister Elizabeth Kenny, treated patients by using flexible hot wraps and exercise instead of immobilizing casts. Using her treatments, patients avoided paralysis. Largely because Kenny had no formal medical education, the doctors and hospital administrators of the time fought against her practices. Eventually, her successes became well known, and her contributions began the field of physical therapy. Have students research Kenny's story and the opposition that she faced. Have them give a report to the class. **Verbal**

Close

Reteaching

BASIC

Exercise Ask students to demonstrate different resistance and aerobic exercises. Then, ask students to explain the benefits of each exercise. Make sure students have warmed up before their demonstrations.

KS Kinesthetic

Quiz

GENERAL

1. What is the difference between voluntary muscle action and involuntary muscle action? **(Sample answer: Voluntary muscle action is action that you can control. Involuntary muscle action is not under your control.)**
2. What kind of muscle bends part of your body? **(flexor)**
What kind of muscle straightens part of your body? **(extensor)**
3. What are the risks of using anabolic steroids? **(Anabolic steroids can damage the heart, liver, and kidneys and can cause high blood pressure. They can cause bones to stop growing.)**

Alternative Assessment

GENERAL

Crossword Puzzle Have students work in groups of four. Have groups make crossword puzzles using the vocabulary terms and other important terms in this section. Have groups exchange puzzles with each other.

English Language Learners

KS Verbal



Figure 3 This girl is strengthening her heart and improving her endurance by doing aerobic exercise. This boy is doing resistance exercise to build strong muscles.



Use It or Lose It

What happens when someone wears a cast for a broken arm? Skeletal muscles around the broken bone become smaller and weaker. The muscles weaken because they are not exercised. Exercised muscles are stronger and larger. Strong muscles can help other organs, too. For example, contracting muscles squeeze blood vessels. This action increases blood flow without needing more work from the heart.

Certain exercises can give muscles more strength and endurance. More endurance lets muscles work longer without getting tired. Two kinds of exercise can increase muscle strength and endurance. They are resistance exercise and aerobic exercise. You can see an example of each kind in **Figure 3**.

Resistance Exercise

Resistance exercise is a great way to strengthen skeletal muscles. During resistance exercise, people work against the resistance, or weight, of an object. Some resistance exercises, such as curl-ups, use your own weight for resistance.

Aerobic Exercise

Steady, moderately intense activity is called *aerobic exercise*. Jogging, cycling, skating, swimming, and walking are aerobic exercises. This kind of exercise can increase muscle strength. However, aerobic exercise mostly strengthens the heart and increases endurance.

CONNECTION TO Chemistry

Muscle Function Body chemistry is very important for healthy muscle function. Spasms or cramps happen if too much sweating, poor diet, or illness causes a chemical imbalance in muscles. Identify three chemicals that the body needs for muscles to work properly. Make a poster explaining how people can make sure that they have enough of each chemical.

Activity

Homework

ADVANCED



Injuries For one month, have students read the sports section in a local newspaper or look for articles in sports magazines about injuries sustained by athletes. Ask students to identify and count the types of injuries, such as sprains and strains. Have students compile their information on bar graphs in which they record the kinds of injuries on the x-axis and the number of injuries on the y-axis.

KS Logical

Answer to Connection to Chemistry


Students should discuss the importance of minerals, such as magnesium, calcium, potassium, and sodium, to muscle function. Students should identify important dietary sources of these minerals.

Muscle Injury

Any exercise program should be started slowly. Starting slowly means you are less likely to get hurt. You should also warm up for exercise. A *strain* is an injury in which a muscle or tendon is overstretched or torn. Strains often happen because a muscle has not been warmed up. Strains also happen when muscles are worked too hard.

People who exercise too much can hurt their tendons. The body can't repair an injured tendon before the next exercise session. So, the tendon becomes inflamed. This condition is called *tendinitis*. Often, a long rest is needed for the injured tendon to heal.

Some people try to make their muscles stronger by taking drugs. These drugs are called *anabolic steroids* (A nuh BAH lik STER oidz). They can cause long-term health problems. Anabolic steroids can damage the heart, liver, and kidneys. They can also cause high blood pressure. If taken before the skeleton is mature, anabolic steroids can cause bones to stop growing.

 **Reading Check** What are the risks of using anabolic steroids?

MATH PRACTICE

Runner's Time

Jan has decided to enter a 5 km road race. She now runs 5 km in 30 min. She would like to decrease her time by 15% before the race. What will her time be when she reaches her goal?

Answer to Math Practice

25 min, 30 s ($30 \text{ min} \times 0.85 = 25.5 \text{ min}$)

Answers to Section Review

1. Sample answer: The muscular system is the group of muscles that allow people to move.
2. a
3. Sample answer: Smooth muscle is found in the digestive tract and in the walls of blood vessels. Cardiac muscle is found only in the heart. Skeletal muscle is attached to bones for movement.
4. Sample answer: Curl-ups are a resistance exercise. Jogging is an aerobic exercise.
5. Sample answer: A strain is an injury in which a muscle or tendon is overstretched or torn. Tendinitis is a condition in which a tendon becomes inflamed when the body doesn't have enough time to repair the tendon between exercise sessions.
6. 87.5 s ($35 \text{ curl-ups} \times 2.5 \text{ curl-ups/s} = 87.5 \text{ s}$)
7. Sample answer: An extensor in the back of my arm straightens out my arm as I reach for the book. Flexors in my hand let me close my fingers on the book, and a flexor in my arm bends my arm as I pick up the book.
8. Sample answer: As the heart gets stronger, the heart likely will pump more blood with each beat. The heart will not need to work as hard to pump the same amount of blood. So, heart rate will likely decrease.

SECTION Review

Summary

- The three kinds of muscle tissue are smooth muscle, cardiac muscle, and skeletal muscle.
- Skeletal muscles work in pairs. Skeletal muscles contract to move bones.
- Resistance exercise improves muscle strength. Aerobic exercise improves heart strength and muscle endurance.
- Strains are injuries that affect muscles and tendons. Tendinitis affects tendons.

Using Key Terms

1. In your own words, write a definition for the term *muscular system*.

Understanding Key Ideas

2. Muscles
 - a. work in pairs.
 - b. move bones by relaxing.
 - c. get smaller when exercised.
 - d. All of the above
3. Describe three kinds of muscle.
4. List two kinds of exercise. Give an example of each.
5. Describe two muscular system injuries.

Math Skills

6. If Trey can do one curl-up every 2.5 s, about how long will it take him to do 35 curl-ups?

Critical Thinking

7. **Applying Concepts** Describe some of the muscle action needed to pick up a book. Include flexors and extensors in your description.
8. **Predicting Consequences** If aerobic exercise improves heart strength, what likely happens to heart rate as the heart gets stronger? Explain your answer.

SciLINKS®

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For a variety of links related to this chapter, go to www.scilinks.org

Topic: Muscular System

SciLinks code: HSM1008

Answer to Reading Check

Sample answer: Anabolic steroids can damage the heart, liver, and kidneys. They can also cause high blood pressure. Anabolic steroids can cause bones to stop growing.

CHAPTER RESOURCES

Chapter Resource File

- Section Quiz **GENERAL**
- Section Review **GENERAL**
- Vocabulary and Section Summary **GENERAL**
- Reinforcement Worksheet **BASIC**

Workbooks

- Math Skills for Science
 - The Unit Factor and Dimensional Analysis **GENERAL**

Focus

Overview

This section introduces students to the major functions of the integumentary system and describes the major parts of skin and their functions. Students will also learn about common skin injuries.

Bellringer

Write the following questions on the board or an overhead projector: “When do you see dogs panting?” (Sample answer: on hot days or after they have run) “Why do you think dogs pant?” (Sample answer: Dogs don’t sweat the way humans do. Dogs pant to regulate their body temperature.)

Motivate

Discussion

GENERAL

Homeostasis Relay the following story to students: “More than 200 years ago, Dr. Charles Blagden tested how mammals regulate body temperature. He spent 45 min in a room with an uncooked steak. The temperature in the room measured 126°C (260°F).” Ask students what they think happened to Dr. Blagden and the steak. (Dr. Blagden emerged from the room unharmed, but the steak was cooking! Living people and mammals can regulate their body temperature.)

Logical

What You Will Learn

- List four functions of skin.
- Describe the two layers of skin.
- Describe the structure and function of hair and nails.
- Describe two kinds of damage that can affect skin.

Vocabulary

integumentary system
epidermis
dermis

READING STRATEGY

Paired Summarizing Read this section silently. In pairs, take turns summarizing the material. Stop to discuss ideas that seem confusing.

integumentary system the organ system that forms a protective covering on the outside of the body

The Integumentary System

What part of your body has to be partly dead to keep you alive? Here are some clues: It comes in many colors, it is the largest organ in the body, and it is showing right now!

Did you guess your skin? If you did, you guessed correctly. Your skin, hair, and nails make up your **integumentary system** (in TEG yoo MEN tuhr ee SIS tuhm). The integumentary system covers your body and helps you maintain homeostasis.

Functions of Skin

Why do you need skin? Here are four good reasons:

- Skin protects you by keeping water in your body and foreign particles out of your body.
- Skin keeps you in touch with the outside world. Nerve endings in your skin let you feel things around you.
- Skin helps regulate your body temperature. Small organs in the skin called *sweat glands* make sweat. Sweat is a salty liquid that flows to the surface of the skin. As sweat evaporates, the skin cools.
- Skin helps get rid of wastes. Several kinds of waste chemicals can be removed in sweat.

As shown in **Figure 1**, skin comes in many colors. Skin color is determined by a chemical called *melanin*. If a lot of melanin is present, skin is very dark. If little melanin is present, skin is very light. Melanin absorbs ultraviolet light from the sun. So, melanin reduces damage that can lead to skin cancer. However, all skin, even dark skin, is vulnerable to cancer. Skin should be protected from sunlight whenever possible.

Figure 1 Variety in skin color is caused by the pigment melanin. The amount of melanin varies from person to person.



CHAPTER RESOURCES

Chapter Resource File



- Lesson Plan
- Directed Reading A **BASIC**
- Directed Reading B **SPECIAL NEEDS**

Technology



- Transparencies
- Bellringer
- L81 Structures of the Skin

Workbooks



- Interactive Textbook **Struggling Readers**

Is That a Fact!

In an average adult, the skin has a surface area of about 2 m² and has a mass of about 4 kg. The skin on the human body varies in thickness from about 5 mm on the soles of the feet to about 0.5 mm on the eyelids.

Figure 2 Structures of the Skin

Beneath the surface, your skin is a complex organ made of blood vessels, nerves, glands, and muscles.

Blood vessels transport substances and help regulate body temperature.

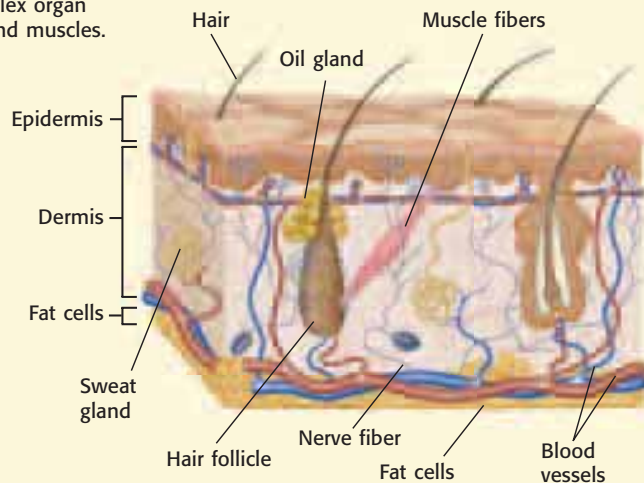
Nerve fibers carry messages to and from the brain.

Hair follicles in the dermis make hair.

Muscle fibers attached to a hair follicle can contract and cause the hair to stand up.

Oil glands release oil that keeps hair flexible and waterproofs the epidermis.

Sweat glands release sweat to cool the body. Sweating is also a way to remove waste materials from the body.



Layers of Skin

Skin is the largest organ of your body. In fact, the skin of an adult covers an area of about 2 m^2 ! However, there is more to skin than meets the eye. Skin has two main layers: the epidermis (EP uh DUHR mis) and the dermis. The **epidermis** is the outermost layer of skin. You see the epidermis when you look at your skin. The thicker layer of skin that lies beneath the epidermis is the **dermis**.

Epidermis

The epidermis is made of epithelial tissue. Even though the epidermis has many layers of cells, it is as thick as only two sheets of paper over most of the body. It is thicker on the palms of your hands and on the soles of your feet. Most cells in the epidermis are dead. These cells are filled with a protein called *keratin*. Keratin helps make the skin tough.

Dermis

The dermis lies beneath the epidermis. The dermis has many fibers made of a protein called *collagen*. These fibers provide strength. They also let skin bend without tearing. The dermis contains many small structures, as shown in **Figure 2**.

✓ Reading Check Describe the dermis. How does it differ from the epidermis? (See the Appendix for answers to Reading Checks.)

epidermis the surface layer of cells on a plant or animal

dermis the layer of skin below the epidermis



SUPPORT FOR

English Language Learners

Skin Form and Function Students may not be able to associate skin's parts with functions solely through language. Ask them to copy the structures of the skin diagram in their science journal four times, including the labels. Then, have them label each diagram for one function of the skin: protection, sensation, regulation of body temperature, and disposal of waste. For each diagram, have students use a highlighter to show which parts of the skin perform which functions. **LS Visual/Logical**

INCLUSION Strategies

- Learning Disabled
- Developmentally Delayed
- Hearing Impaired

Students can often better retain information if they create a visual image. Have students work in groups of four. Give each group a sheet of poster board. Have students divide the poster board into four sections and draw memory clues to help them remember the four functions of the skin. **LS Visual**

ActiVity

GENERAL

MATERIALS

FOR EACH GROUP

- clock or watch
- cotton balls
- fan
- thermometers, Celsius (2)
- water at room temperature

Measuring Temperature Have students work in groups of four students. Have students wrap the bulb of each thermometer with a cotton ball and then wet one of the cotton balls. Have students record the beginning temperature of each thermometer and then hold both thermometers in front of a fan. Students should record the temperature of each thermometer every minute for 5 min. Ask students: "How do the temperatures of the thermometers differ?" (Sample answer: The thermometer with the wet cotton has a lower temperature.) "Why?" (Sample answer: Evaporation lowers the temperature.) "How does this process relate to what happens when you sweat?" (Sample answer: As sweat evaporates from the body, the skin becomes cooler.) **LS Kinesthetic**

INTERNET ActiVity Brochure

GENERAL

For an internet activity related to this chapter, have students go to **go.hrw.com** and type in the keyword **HL5BD1W**.

Answer to Reading Check

The dermis is the layer of skin that lies beneath the epidermis. The dermis is composed of a protein called *collagen*, while the epidermis contains *keratin*.

Close

Reteaching BASIC

Hair and Nails Ask students to relate the functions of hair and nails. Then, ask students to describe how hair and nails form. LS **Verbal**

Quiz GENERAL

1. What are four functions of skin? (to keep moisture in and foreign particles out, to provide information about the outside world, to help regulate body temperature, and to remove wastes)
2. Describe the two layers of skin. (The epidermis is the outermost layer of skin and contains epithelial tissue and mostly dead cells. The dermis lies beneath the epidermis and contains collagen.)

Alternative Assessment ADVANCED



Skin Art Have students make a colorful drawing of a cross section of skin. Have students make their drawings from memory and label and describe the function of blood vessels, nerve fibers, muscle fibers, hair follicles, oil glands, and sweat glands.

LS **Visual**



Hair

Figure 3 A hair is made up of layers of dead, tightly packed, keratin-filled cells. In nails, new cells are produced in the nail root, just beneath the lunula. The new cells push older cells toward the outer edge of the nail.



Hair and Nails

Hair and nails are important parts of the integumentary system. Like skin, hair and nails are made of living and dead cells. **Figure 3** shows hair and nails.

A hair forms at the bottom of a tiny sac called a *hair follicle*. The hair grows as new cells are added at the hair follicle. Older cells get pushed upward. The only living cells in a hair are in the hair follicle. Like skin, hair gets its color from melanin.

Hair helps protect skin from ultraviolet light. Hair also keeps particles, such as dust and insects, out of your eyes and nose. In most mammals, hair helps regulate body temperature. A tiny muscle attached to the hair follicle contracts. If the follicle contains a hair, the hair stands up. The lifted hairs work like a sweater. They trap warm air around the body.

A nail grows from living cells in the *nail root* at the base of the nail. As new cells form, the nail grows longer. Nails protect the tips of your fingers and toes. So, your fingers and toes can be soft and sensitive for a keen sense of touch.

✓ **Reading Check** Describe how nails grow.

Skin Injuries

Skin is often damaged. Fortunately, your skin can repair itself, as shown in **Figure 4**. Some damage to skin is very serious. Damage to the genetic material in skin cells can cause skin cancer. Skin may also be affected by hormones that cause oil glands in skin to make too much oil. This oil combines with dead skin cells and bacteria to clog hair follicles. The result is acne. Proper cleansing can help but often cannot prevent this problem.

CONNECTION TO Social Studies

WRITING SKILL

Using Hair Many traditional cultures use animal hair to make products, such as rugs and blankets. Identify a culture that uses animal hair. In your **science journal**, write a report describing how the culture uses animal hair.

CONNECTION *ActiVity* GENERAL



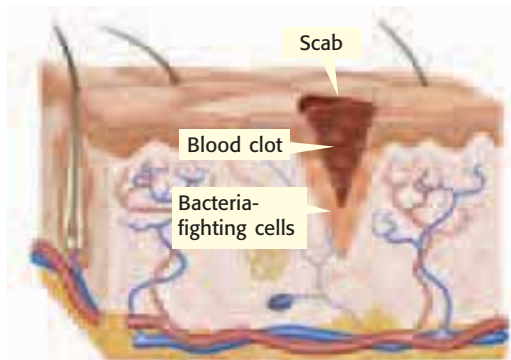
Protection from the Sun Skin cancer is the most common kind of cancer. Hundreds of thousands of new cases of skin cancer are reported each year. Ask interested students to research ways people can prevent skin cancer. Have students create informative brochures about their findings. LS **Verbal/Visual**

Answer to Reading Check

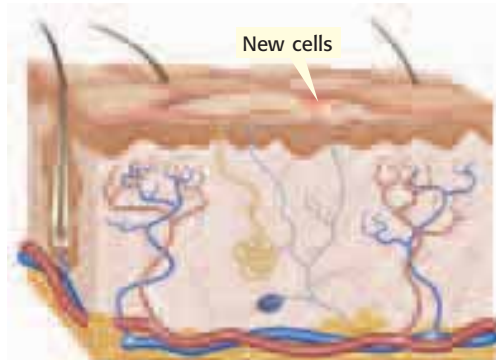
Sample answer: A nail grows from living cells in the nail root at the base of the nail. As new cells form, the nail grows longer.

Figure 4 How Skin Heals

- 1 A blood clot forms over a cut to stop bleeding and to keep bacteria from entering the wound. Bacteria-fighting cells then come to the area to kill bacteria.



- 2 Damaged cells are replaced through cell division. Eventually, all that is left on the surface is a scar.



SECTION Review

Summary

- Skin keeps water in the body, keeps foreign particles out of the body, lets people feel things around them, regulates temperature, and removes wastes.
- The two layers of skin are the epidermis and the dermis.
- Hair grows from hair follicles. Nails grow from nail roots.
- Skin may develop skin cancer. Acne may develop if skin produces too much oil.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *integumentary system*, *epidermis*, and *dermis*.

Understanding Key Ideas

2. Which of the following is NOT a function of skin?
- a. to regulate body temperature
 - b. to keep water in the body
 - c. to move your body
 - d. to get rid of wastes
3. Describe the two layers of skin.
4. How do hair and nails develop?
5. Describe how a cut heals.

Math Skills

6. On average, hair grows 0.3 mm per day. How many millimeters does hair grow in 30 days? in a year?

Critical Thinking

7. **Making Inferences** Why do you feel pain when you pull on your hair or nails, but not when you cut them?
8. **Analyzing Ideas** The epidermis on the palms of your hands and on the soles of your feet is thicker than it is anywhere else on your body. Why might this skin need to be thicker?

SciLINKS
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For a variety of links related to this chapter, go to www.scilinks.org

Topic: Integumentary System
SciLinks code: HSM0803

Answers to Section Review

1. Sample answer: The integumentary system is the organ system that forms a protective covering over the body. The epidermis is the outer layer of skin. The dermis lies beneath the epidermis.
2. c
3. Sample answer: The epidermis is the outermost layer of skin. It is made of epithelial tissue. Most of the cells of the epidermis are dead cells that contain keratin. The dermis lies beneath the epidermis and contains sweat glands, hair follicles, nerve fibers, muscle fibers, and blood vessels. The dermis also contains collagen.
4. Sample answer: A hair grows as new cells are added in the hair follicle, which is where the only living cells are located. Nails grow from living cells in the nail root at the base of the nail.
5. Sample answer: A blood clot forms over a cut to stop bleeding and to keep bacteria out of the cut. Bacteria-fighting cells come to the area to kill bacteria. Damaged skin cells are replaced through cell division. Eventually, all that is left is a scar.
6. 9 mm ($0.3 \text{ mm/day} \times 30 \text{ days} = 9 \text{ mm}$); 109.5 mm ($0.3 \text{ mm/day} \times 365 \text{ days} = 109.5 \text{ mm}$)
7. Sample answer: Except in the hair follicle and in the nail root, hair and nails are made of dead cells, so cutting them does not hurt. Pulling on them, however, affects the living areas of hair and nails in the dermis, where nerve fibers are located.
8. Sample answer: The epidermis forms a protective covering of dead cells. The hands and the feet are areas that are often used, so the epidermis in these areas needs to be thicker for better protection.

CHAPTER RESOURCES

Chapter Resource File

- Section Quiz **GENERAL**
- Section Review **GENERAL**
- Vocabulary and Section Summary **GENERAL**
- Critical Thinking **ADVANCED**

Seeing Is Believing

Teacher's Notes

Time Required

One 45-minute class period and 5 to 10 minutes every other day for 2 weeks

Lab Ratings



Teacher Prep

Student Set-Up

Concept Level

Clean Up

MATERIALS

The materials listed on the student page are enough for 1–2 students. This lab may be done with several different types of marking methods. The fingernail is very hard and is not very porous. Marking the nail permanently is a challenge. A permanent marker, such as a laundry-marking pen, may need to be refreshed only once a day. Fingernail polish may be an acceptable alternative. Acrylic paint may also be used.

Safety Caution

Remind students to review all safety cautions and icons before beginning this lab activity.



Skills Practice Lab



OBJECTIVES

Measure nail growth over time.

Draw a graph of nail growth.

MATERIALS

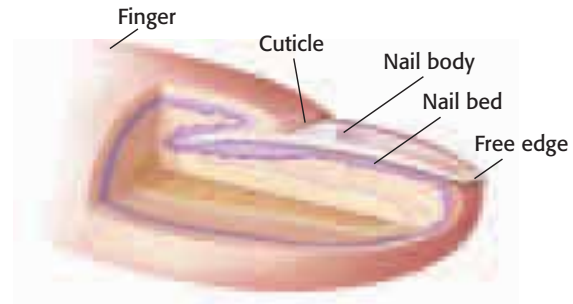
- graph paper (optional)
- metric ruler
- permanent marker

SAFETY



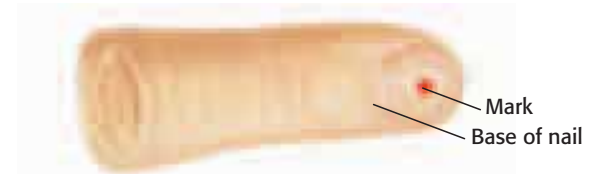
Seeing Is Believing

Like your hair and skin, fingernails are part of your body's integumentary system. Nails, shown in the figure below, are a modification of the outer layer of the skin. Nails grow from the nail bed and will grow continuously throughout your life. In this activity, you will measure the rate at which fingernails grow.



Procedure

- 1 Use a permanent marker to mark the center of the nail bed on your right index finger, as shown in the figure below.
Caution: Do not get ink on your clothing.



- 2 Measure from the mark to the base of your nail. Record the measurement, and label the measurement "Day 1."
- 3 Repeat steps 1 and 2 for your left index finger.
- 4 Let your fingernails grow for 2 days. Normal daily activity will not wash away the mark completely, but you may need to freshen the mark.
- 5 Measure the distance from the mark on your nail to the base of your nail. Record this distance, and label the measurement "Day 3."



Holt Lab Generator CD-ROM

Search for any lab by topic, standard, difficulty level, or time. Edit any lab to fit your needs, or create your own labs. Use the Lab Materials QuickList software to customize your lab materials list.



Kathy LaRoe
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CHAPTER RESOURCES

Chapter Resource File

- Datasheet for Chapter Lab
- Lab Notes and Answers

Technology

- Classroom Videos
- Lab Video



- Muscles at Work



Lab Notes

Few topics are as important to students as gaining knowledge and understanding of their own body. As they develop, students can't help but observe how they are changing physically. In this lab, students witness the growth of their own fingernails.

Tell students that the graphed data shown in this lab are only an example and will not be the same as their own data.

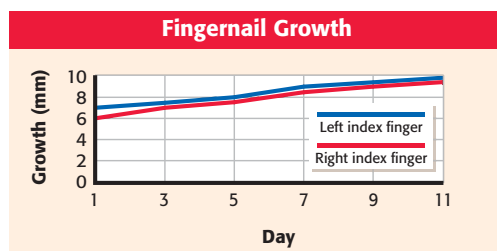
Analyze the Results

1. Answers may vary. Many students may note that rates of growth vary.
2. Answers may vary. Some students will answer that their nails did not grow at a constant rate.

Draw Conclusions

3. The nails of the dominant hand grow faster than those of the other hand. Damage to the nail root can affect how quickly a nail grows. Also, circulation to the area affects growth. If one hand receives poor circulation, the nail will grow at a slower rate.
4. Some students may note differences in nail growth. While these differences likely are not related to height, they are related to nutrition. Someone who does not have enough of certain minerals, such as calcium and magnesium, in his or her diet will have slower nail growth. Nail growth is also affected by age, time of year, and gender. Nail growth slows as people get older. Nails grow faster in the summer than they do in the winter. Often, men's nails grow faster than women's nails do.

- 6 Continue measuring and recording the growth of your nails every other day for 2 weeks. Refresh the mark as necessary. You may continue to file or trim your nails as usual throughout the course of the lab.
- 7 After you have completed your measurements, use them to create a graph similar to the graph below.



Analyze the Results

- 1 **Describing Events** Did the nail on one hand grow faster than the nail on the other hand?
- 2 **Examining Data** Did your nails grow at a constant rate, or did your nails grow more quickly at certain times?



Draw Conclusions

- 3 **Making Predictions** If one nail grew more quickly than the other nail, what might explain the difference in growth?
- 4 **Analyzing Graphs** Compare your graph with the graphs of your classmates. Do you notice any differences in the graphs based on gender or physical characteristics, such as height? If so, describe the difference.

Applying Your Data

Do additional research to find out how nails are important to you. Also, identify how nails can be used to indicate a person's health or nutrition. Based on what you learn, describe how your nail growth indicates your health or nutrition.

Applying Your Data

Students should discover that the appearance of a nail can reflect the health of an individual. Abnormalities in color, such as white, yellow, or red nail beds, can indicate serious problems such as liver, lung, and heart diseases. Other problems indicated by nail appearance are bacterial or fungal infections of the nails and poor nutrition.

CHAPTER RESOURCES

Workbooks



Inquiry Labs

- On a Wing and a Layer **GENERAL**



Long-Term Projects & Research Ideas

- Mapping the Human Body **ADVANCED**

Chapter Review

Assignment Guide

SECTION	QUESTIONS
1	2, 5, 7, 13, 17
2	1, 6, 12, 14, 18, 20–21
3	8, 10–11, 15
4	3–4, 9, 16, 19, 23–27
2 and 3	22

ANSWERS

Using Key Terms

1. joint
2. Homeostasis
3. epidermis
4. integumentary system
5. organ
6. skeletal system

Understanding Key Ideas

7. c
8. c
9. a
10. d
11. Sample answer: Muscles are connected to bones by tendons. When a muscle that connects two bones contracts, the bones are pulled closer together. Muscles often work in pairs.
12. Sample answer: The skeletal system includes the bones, cartilage, and connective tissue, whose primary function is to support the body. The skeletal system protects organs, stores minerals, allows movement, and produces blood cells.

Chapter Review

USING KEY TERMS

Complete each of the following sentences by choosing the correct term from the word bank.

homeostasis organ
joint skeletal system
tissue muscular system
epidermis dermis
integumentary system

- 1 A(n) ____ is a place where two or more bones meet.
- 2 ____ is the maintenance of a stable internal environment.
- 3 The outermost layer of skin is the ____.
- 4 The organ system that includes skin, hair, and nails is the ____.
- 5 A(n) ____ is made up of two or more tissues working together.
- 6 The ____ supports and protects the body, stores minerals, and allows movement.

UNDERSTANDING KEY IDEAS

Multiple Choice

- 7 Which of the following lists shows the way in which the body is organized?
 - a. cells, organs, organ systems, tissues
 - b. tissues, cells, organs, organ systems
 - c. cells, tissues, organs, organ systems
 - d. cells, tissues, organ systems, organs

- 8 Which muscle tissue can be both voluntary and involuntary?
 - a. smooth muscle
 - b. cardiac muscle
 - c. skeletal muscle
 - d. All of the above
- 9 The integumentary system
 - a. helps regulate body temperature.
 - b. helps the body move.
 - c. stores minerals.
 - d. None of the above
- 10 Muscles
 - a. work in pairs.
 - b. can be voluntary or involuntary.
 - c. become stronger if exercised.
 - d. All of the above

Short Answer

- 11 How do muscles move bones?
- 12 Describe the skeletal system, and list four functions of bones.
- 13 Give an example of how organ systems work together.
- 14 List three injuries and two diseases that affect the skeletal system.



13. Sample answer: Your muscular system works with your skeletal system to help you move.
14. fractures, dislocations, sprains, osteoporosis, and arthritis



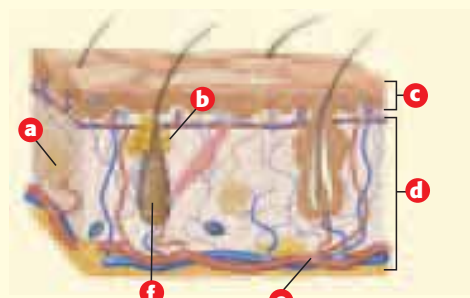
- 15 Compare aerobic exercise and resistance exercise.
- 16 What are two kinds of damage that may affect skin?

CRITICAL THINKING

- 17 **Concept Mapping** Use the following terms to create a concept map: *tissues, muscle tissue, connective tissue, cells, organ systems, organs, epithelial tissue, and nervous tissue.*
- 18 **Making Comparisons** Compare the shapes of the bones of the human skull with the shapes of the bones of the human leg. How do the shapes differ? Why are the shapes important?
- 19 **Making Inferences** Compare your elbows and fingertips in terms of the texture and sensitivity of the skin on these parts of your body. Why might the skin on these body parts differ?
- 20 **Making Inferences** Imagine that you are building a robot. Your robot will have a skeleton similar to a human skeleton. If the robot needs to be able to move a limb in all directions, what kind of joint would be needed? Explain your answer.
- 21 **Analyzing Ideas** Human bones are dense and are often filled with marrow. But many bones of birds are hollow. Why might birds have hollow bones?
- 22 **Identifying Relationships** Why might some muscles fail to work properly if a bone is broken?

INTERPRETING GRAPHICS

Use the cross section of skin below to answer the questions that follow.



- 23 What is d called? What substance is most abundant in this layer?
- 24 What is the name and function of a?
- 25 What is the name and function of b?
- 26 Which letter corresponds to the part of the skin that is made up of epithelial tissue that contains dead cells?
- 27 Which letter corresponds to the part of the skin from which hair grows? What is this part called?



15. Sample answer: Aerobic exercise is steady, moderately intense activity that improves endurance. Resistance exercise strengthens skeletal muscles. During resistance exercise, muscles work against resistance, or weight.
16. Sample answer: Damage to genetic material in skin cells can cause skin cancer. If oil glands in skin produce too much oil, hair follicles may be clogged, which causes acne.

CHAPTER RESOURCES

Chapter Resource File

- Chapter Review **GENERAL**
- Chapter Test A **GENERAL**
- Chapter Test B **ADVANCED**
- Chapter Test C **SPECIAL NEEDS**
- Vocabulary Activity **GENERAL**

Workbooks

- Study Guide
- Study Guide is also available in Spanish.

Critical Thinking

17. An answer to this exercise can be found at the end of this book.
18. Sample answer: Leg bones are long and skinny, while skull bones are thin and wide. Many skull bones are curved. Leg bones enable walking and standing, while skull bones are designed to protect the brain.
19. Sample answer: The skin on the elbows is thin, loose, and sometimes rough. The skin on the fingertips is thicker, but more sensitive to touch. The skin on elbows allows elbows to bend because it is loose and can stretch. The skin on the fingers is important for the sense of touch.
20. Sample answer: The robot would need a ball-and-socket joint. A ball-and-socket joint allows movement in all directions.
21. Sample answer: Dense bones that are filled with marrow weigh more than hollow bones. Because most birds fly, they need lighter bones. So, birds' bones are hollow.
22. Sample answer: If a bone is broken, flexors or extensors likely will not work properly. These muscles will not be able to pull on a bone in the way that they do when a bone is not broken. Also, if the area where the muscle attaches is damaged, the ability of the muscle to pull on the bone may be affected.

Interpreting Graphics

23. dermis; collagen
24. Sample answer: Sweat glands release sweat to cool the body.
25. Sample answer: Oil glands release oil to keep hair flexible and to waterproof the epidermis.
26. c
27. f; hair follicle

Standardized Test Preparation

Teacher's Note

To provide practice under more realistic testing conditions, give students 20 minutes to answer all of the questions in this Standardized Test Preparation.

MISCONCEPTION ALERT

Answers to the standardized test preparation can help you identify student misconceptions and misunderstandings.

READING

Passage 1

1. C
2. F
3. B



TEST DOCTOR

Question 2: Some students may answer that a skin graft is skin made of plastic because plastic bandages are discussed in the passage. Some students may think that a skin graft is damaged skin that has been removed, but it is undamaged skin that has been removed to replace damaged skin. Finally, some students may think that a skin graft is burned skin because burns are mentioned in the passage.



Standardized Test Preparation

READING

Read the passages below. Then, answer the questions that follow each passage.

Passage 1 Sometimes, doctors perform a skin graft to transfer some of a person's healthy skin to an area where skin has been damaged. Doctors perform skin grafts because skin is often the best "bandage" for a wound. Like cloth or plastic bandages, skin protects the wound. Skin allows the wound to breathe. Unlike cloth or plastic bandages, skin can regenerate itself as it covers a wound. But sometimes a person's skin is so severely damaged (by burns, for example) that the person doesn't have enough skin to spare.

1. Based on the passage, what can skin do that manufactured bandages can't do?
 - A Skin can protect a wound.
 - B Skin can stop more skin from being damaged.
 - C Skin can regenerate itself.
 - D Skin can prevent burns.
2. In the passage, what does the term *skin graft* most likely mean?
 - F a piece of skin transplanted from one part of the body to another
 - G a piece of skin made of plastic
 - H a piece of damaged skin that has been removed from the body
 - I burned skin
3. Based on the passage, why might a severe burn victim not receive a skin graft?
 - A Manufactured bandages are better.
 - B He or she doesn't have enough healthy skin.
 - C There isn't enough damaged skin to repair.
 - D Skin is the best bandage for a wound.

Passage 2 Making sure that your body maintains homeostasis is not an easy task. The task is difficult because your internal environment is always changing. Your body must do many different jobs to maintain homeostasis. Each cell in your body has a specific job in maintaining homeostasis. Your cells are organized into groups. A group of similar cells working together forms a tissue. Your body has four main kinds of tissue—epithelial tissue, connective tissue, muscle tissue, and nervous tissue. These tissues work together to form organs, which help maintain homeostasis.

1. Based on the passage, which of the following statements about tissues is true?
 - A Tissues do not help maintain homeostasis.
 - B Tissues form organ systems.
 - C Tissues are changing because the body's internal environment is always changing.
 - D There are four kinds of tissue.
2. According to the passage, which of the following statements about homeostasis is true?
 - F It is easy for the body to maintain homeostasis.
 - G The body must do different jobs to maintain homeostasis.
 - H Your internal environment rarely changes.
 - I Organs and organ systems do not help maintain homeostasis.
3. Which of the following statements about cells is false?
 - A Cells are organized into different groups.
 - B Cells form tissues.
 - C Cells work together.
 - D Cells don't maintain homeostasis.

Passage 2

1. D
2. G
3. D

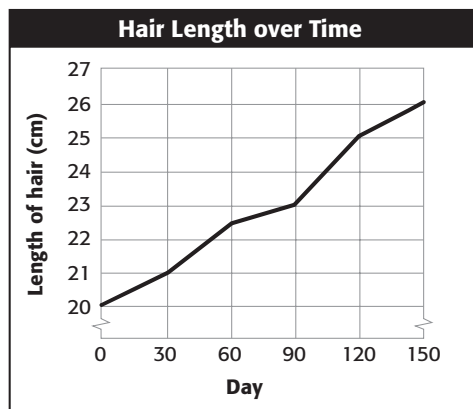


TEST DOCTOR

Question 1: Some students may answer that tissues do not help maintain homeostasis. However, because all cells in the body have a role in homeostasis, so do tissues. Some students may answer that tissues form organ systems, but tissues form organs. Some students may answer that tissues are always changing, but this is not mentioned in the passage.

INTERPRETING GRAPHICS

The line graph below shows hair growth over time. Use the graph to answer the questions that follow.



- How long was the hair on day 60?
A 20.0 cm
B 21.0 cm
C 22.5 cm
D 23.0 cm
- On which day was hair length 23 cm?
F day 60
G day 90
H day 120
I day 150
- From day 0 to day 150, what is the average amount that hair grows every 30 days?
A 0.5 cm
B 1.2 cm
C 1.5 cm
D 2.0 cm
- Based on the average amount of hair growth per 30-day period, how long would it take the hair to grow another 3.6 cm?
F 30 days
G 60 days
H 90 days
I 120 days

MATH

Read each question below, and choose the best answer.

- About 40% of a person's mass is muscle tissue. If Max has a mass of 40 kg, about how much muscle tissue does he have?
A 16 kg
B 20 kg
C 24 kg
D 30 kg
- When running, an adult inhales about 72 L of air per minute. That amount is 12 times the amount that an adult needs while resting. How much air does an adult inhale while resting?
F 6 L/min
G 12 L/min
H 60 L/min
I 64 L/min
- Maggie likes to do bench presses, a resistance exercise. She bench presses 10 kg. If Maggie added 2 kg every 2 weeks, how long would it take her to reach 20 kg?
A 4 weeks
B 5 weeks
C 10 weeks
D 12 weeks
- A box of 25 bandages costs \$4.00. A roll of tape costs \$1.50. Troy needs 125 bandages and 3 rolls of tape for a first-aid kit. Which of the following equations shows the cost of first-aid supplies, x ?
F $x = (125 \times 4.00) + (3 \times 1.50)$
G $x = (25 \times 4.00) + (3 \times 1.50)$
H $x = [(25 \times 4.00) \div 125] + (3 \times 1.50)$
I $x = [(125 \div 25) \times 4.00] + (3 \times 1.50)$
- Stephen wants to run a 10 K race. Right now, he can run 5 K. What is the percentage increase from 5 K to 10 K?
A 50%
B 100%
C 200%
D 500%

INTERPRETING GRAPHICS

- C
- G
- B
- H



TEST DOCTOR

Question 3: Students can calculate average hair growth by examining the total hair growth (6 cm) and the number of 30-day periods (5). In calculating the average growth, students should find that hair grows about 1.2 cm every 30 days ($6 \text{ cm} \div 5 = 1.2 \text{ cm}$). If students round their answers, they may incorrectly answer 1.0 cm or 1.5 cm.

MATH

- A
- F
- C
- I
- B



TEST DOCTOR

Question 2: Students may answer 12 L because the number 12 is introduced in the question. Students may answer 60 L if they subtract 12 from 72 L. Students may answer 64 L if they assume that people need 12% less air rather than 12 times less air.

Question 5: To find percentage increase, students must find the difference between 10 K and 5 K, divide it by 5 K, and multiply by 100. If students divide 5 K by 10 K, they will get the incorrect answer of 50%. If they divide 10 K by 5 K, they will get the incorrect answer of 200%. Finding the difference between 10 K and 5 K and multiplying the answer by 100 without dividing first will yield the incorrect answer of 500%.

Standardized Test Preparation

CHAPTER RESOURCES

Chapter Resource File



• Standardized Test Preparation **GENERAL**

State Resources



For specific resources for your state, visit go.hrw.com and type in the keyword **HSMSTR**.

Science in Action

Weird Science

Background

The way that a wound heals when engineered skin is used is far better than the way that a wound heals when engineered skin is not used—more scar tissue forms. Scar tissue is weaker and more brittle than the skin that the scar tissue replaces. Scar tissue does not stretch and grow, which is a particularly difficult problem for children suffering from burns. Engineered skin also helps reduce the disfigurement associated with scarring. One significant limitation of the engineered skin is that when it is new, it lacks sweat glands. Patients who have large skin grafts need to be cautious about overexercising and exposure to the sun.

Science, Technology, and Society

Activity

GENERAL

Have students model having a prosthetic hand by using a clothespin to pick up papers, hold a pencil to write their name, and tie their shoes. Have them discuss how it feels, and have them try to imagine what having an artificial hand would be like. Then, ask students to brainstorm ways that they might improve their “prosthetic hand” (the clothespin).

Weird Science

Engineered Skin

Your skin is your first line of defense against the outside world. Your skin keeps you safe from dehydration and infection, helps regulate body temperature, and helps remove some wastes. But what happens if a large portion of skin is damaged? Skin may not be able to function properly. For someone who has a serious burn, a doctor often uses skin from an undamaged part of the person's body to repair the damaged skin. But some burn victims don't have enough undamaged skin to spare. Doctors have discovered ways to engineer skin that can be used in place of human skin.

Math Activity

A doctor repaired 0.35 m^2 of an adult patient's skin with engineered skin. If an adult has about 2 m^2 of skin, what percentage of the patient's skin was repaired?



Science, Technology, and Society

Beating the Odds

Sometimes, people are born without limbs or lose limbs in accidents. Many of these people have prostheses (prahs THEE SEEZ), or human-made replacements for the body parts. Until recently, many of these prostheses made it more difficult for many people to participate in physical activities, such as sports. But new designs have led to lighter, more comfortable prostheses that move the way that a human limb does. These new designs have allowed athletes with physical disabilities to compete at higher levels.

Social Studies Activity

Research the use of prostheses throughout history. Create a timeline showing major advances in prosthesis use and design.

Answer to Math Activity

17.5% ($0.35 \text{ m}^2 \div 2 \text{ m}^2 \times 100 = 17.5\%$)

Answer to Social Studies Activity

Students' timelines should display an understanding of how modern technology has improved prosthesis design. Timelines should include the use of wooden prostheses, expand into the use of metal and the development of plastics and other synthetics in prosthesis construction, and discuss modern ergonomic designs.

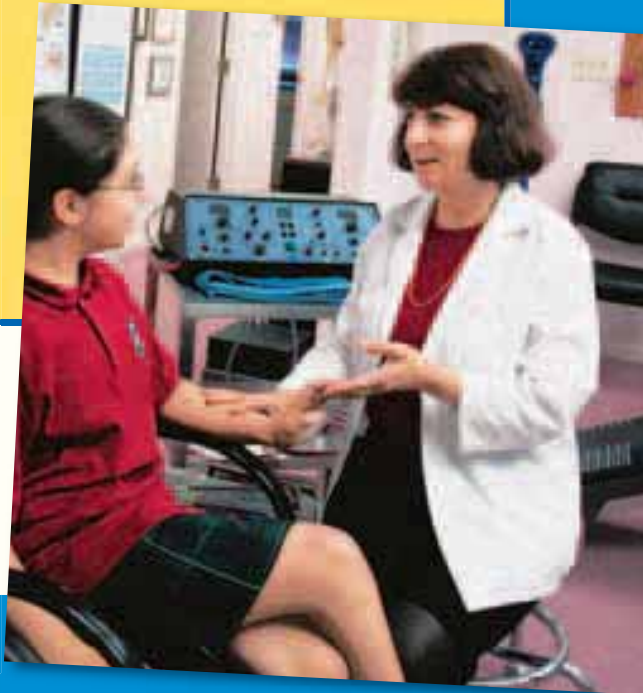
Careers

Zahra Beheshti

Physical Therapist A physical therapist is a licensed professional who helps people recover from injuries by using hands-on treatment instead of medicines. Dr. Zahra Beheshti is a physical therapist at the Princeton Physical Therapy Center in New Jersey. She often helps athletes who suffer from sports injuries.

After an injury, a person may go through a process called *rehabilitation* to regain the use of the injured body part. The most common mistake made by athletes is that they play sports before completely recovering from injuries. Dr. Beheshti explains, "Going back to their usual pre-injury routine could result in another injury."

Dr. Beheshti also teaches patients about preventing future sports injuries. "Most injuries happen when an individual engages in strenuous activities without a proper warm-up or cool-down period." Being a physical therapist is rewarding work. Dr. Beheshti says, "I get a lot of satisfaction when treating patients and see them regain their function and independence and return to their normal life."



Language Arts Activity

WRITING SKILL Interview a physical therapist who works in or near your community. Write a newspaper article about your interview.



To learn more about these Science in Action topics, visit go.hrw.com and type in the keyword **HL5BD1F**.



Check out Current Science® articles related to this chapter by visiting go.hrw.com. Just type in the keyword **HL5CS22**.

Careers

Teaching Strategy—BASIC

Invite a local physical therapist to the classroom. Ask the physical therapist to bring some of the tools that he or she uses to treat injuries. Ask the physical therapist to demonstrate each tool by having student volunteers participate in a physical therapy exercise. Ask the physical therapist to describe how each exercise helps someone recover from an injury and explain about how long recovery will take.

Answer to Language Arts Activity

Students should be able to relate the importance of physical therapy as told to them by the physical therapist who was interviewed. Students should also be able to relate some reasons that people require physical therapy.