UNIT 1 Introduction

Researcher with Nassau grouper

Giant panda cub with caretaker at Wolong Nature Reserve in China

Ecological survey of mountain eucalyptus

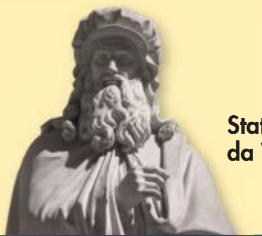
UNIT 1

DISCOVERIES IN SCIENCE

Milestones in Biology

1489

Leonardo da Vinci applies architectural techniques to anatomical drawing. His detailed drawings of the human skull revolutionize scientific illustration.



Statue of Leonardo da Vinci in Italy

1811

At 12 years old, Mary Anning, a British fossil collector, discovers the first complete fossil skeleton of an ichthyosaur. Other scientists use her discoveries to support the theory that fossils are evidence of extinct species.

1898

Marie Curie, a scientist born in Poland, demonstrates that isotopes of certain elements, such as radium and polonium, are the source of radioactive energy in radioactive rocks.

Marie Curie in her laboratory

1910

Alex Carrel publishes a paper reporting his success in using cold storage to preserve blood vessels for long periods of time before transplanting them. His work, related to developing organ-transplant processes, earns him the Nobel Prize in physiology or medicine in 1912.

1918–1919

An influenza epidemic kills between 20 million and 40 million people worldwide. In less than a year, about 675,000 Americans die of the disease, 10 times the number of Americans who died in World War I.

1927

George Washington Carver, American inventor and botanist, patents a process for making paints from soybean extracts.

George Washington Carver

1971

Louis Leaky sponsors Biruté Mary Galdikas to study the orangutans of Borneo. In 1975, Galdikas begins publishing articles about her observations of orangutan behavior. Many articles and lectures follow. Her work helps educate the public about the need to preserve wild habitats.

1996

David Ho is recognized as *Time* magazine's Man of the Year for his pioneering work developing "cocktails" of medicines that fight HIV.

David Ho

Mason wasp with prey

BIOLOGY CAREER

Forensic Scientist

Wayne Moorehead

Wayne Moorehead is a forensic scientist. Forensic scientists use scientific processes to investigate legal matters. Moorehead works with the Trace Evidence and Fire Division of the Orange County Sheriff–Coroner Crime Laboratory in California. He specializes in forensic microscopy, trace evidence, and the analysis of explosives, fire debris, and unusual evidence. Moorehead enjoys his work, especially using critical thinking to answer questions about crimes.

Moorehead traces his interest in forensic science back to his childhood, when he enjoyed using a chemistry set and microscope and reading forensic science books. He still collects books in his field.

Moorehead enjoys using forensic science in criminal investigations but considers his greatest accomplishment to be teaching forensic science to high school students, college students, professors, and the public.

Yellow crinoid and reef fish on a coral reef

Chapter Planner 1

Biology and You

	Standards	Teach Key Ideas
CHAPTER OPENER, pp. 4–5 (15 min.)	*National Science Education Standards*	
SECTION 1 The Nature of Science, pp. 7–9 (45 min.) ❯ Scientific Thought ❯ Universal Laws ❯ Science and Ethics ❯ Why Study Science?	UCP1, UCP2, PS4, ST2, SPSP1, SPSP6, HNS1, HNS2	
SECTION 2 Scientific Methods, pp. 10–13 (45 min.) ❯ Beginning a Scientific Investigation ❯ Scientific Experiments ❯ Scientific Theories	UCP2, SI1, SI2, ST2, SPSP6, HNS1, HNS2	**Bellringer Transparency** **Transparencies** A3 Scientific Processes • Concept Map of Scientific Processes **Visual Concepts** Scientific Method • Hypothesis • Controlled Experiment and Variable • Independent and Dependent Variables • Comparing Theories and Laws
SECTION 3 Tools and Techniques, pp. 14–16 (90 min.) ❯ Measurement Systems ❯ Lab Techniques ❯ Safety	UCP2, UCP3, SI1, SI2, ST1, SPSP1, SPSP5	**Bellringer Transparency** **Transparencies** A6 SI Base Units • A7 Some SI Prefixes • A8 SI Units **Visual Concepts** Types of Microscopes • Parts of a Microscope • Magnification and Resolution
SECTION 4 What is Biology?, pp. 17–21 (45 min.) ❯ The Study of Life ❯ Characteristics of Living Things	LSCell 1, LSCell 2, LSCell 3, LSCell 4, LSCell 6, LSGene 1, LSEvol 1, LSEvol 2, LSEvol 4, LSInter 3, LSInter 5, LSMat 2, LSMat 3, LSMat 4, LSBeh 2, UCP1, UCP5, ESS1, ST2, SPSP1, SPSP3, SPSP6, HNS1	**Bellringer Transparency** **Transparencies** A1 The Seven Properties of Life **Visual Concepts** Biology • Unifying Themes of Biology • Heredity • Evolution

See also PowerPoint® Resources

Chapter Review and Assessment Resources

- SE Super Summary, p. 22
- SE Chapter Review, p. 23
- SE Standardized Test Prep, p. 25
- Review Resources
- Chapter Tests A and B
- Holt Online Assessment

CHAPTER Fast Track *Thorough instruction will require the times shown.*

Basic Learners

- TE Textbook Overview, p. 7
- TE Dependent and Independent Variables, p. 11
- TE Bias Has Many Meanings, p. 12
- TE Types of Microscopes, p. 15
- Directed Reading Worksheets*
- Active Reading Worksheets*
- Lab Manuals, Level A*
- Study Guide* ■
- Note-taking Workbook*
- Special Needs Activities and Modified Tests*

Advanced Learners

- TE Ethics and Funding, p. 8
- TE The pH Scale, p. 11
- Critical Thinking Worksheets*
- Concept Mapping Worksheets*
- Science Skills Worksheets*
- Lab Datasheets, Level C*

Key
SE Student Edition
TE Teacher's Edition
Chapter Resource File
Workbook
Transparency
CD or CD-ROM
* Datasheet or blackline master available
■ Also available in Spanish

All resources listed below are also available on the Teacher's One-Stop Planner.

Why It Matters	Hands-On	Skills Development	Assessment
Build student motivation with resources about high-interest applications.	SE **Inquiry Lab** Make a Prediction, p. 5*■	TE **Reading Toolbox** Assessing Prior Knowledge, p. 4 SE **Reading Toolbox,** p. 6	
	SE **Quick Lab** Evaluate a Scientific Claim, p. 9*■ **Inquiry Lab** Storing Heat*	SE **Reading Toolbox** Everyday Words in Science, p. 9 TE **Reading Toolbox** Everyday Words in Science, p. 9	SE **Section Review** TE **Formative Assessment** **Spanish Assessment***■ **Section Quiz**■
TE **Demonstration** Making Predictions, p. 10 TE **Statistical Tools,** p. 12 TE **Scientists and Detectives,** p. 13	SE **Quick Lab** The pH of Common Substances, p. 11*■	TE **Reading Toolbox** Hypothesis or Theory?, p. 12 SE **Reading Toolbox** Hypothesis or Theory?, p. 12	SE **Section Review** TE **Formative Assessment** **Spanish Assessment***■ **Section Quiz**■
TE **Demonstration** Measuring, p. 14	SE **Quick Lab** Practice Staining Techniques, p. 15*■ SE **Skills Practice Lab** SI Units, p. 20*■	SE **Reading Toolbox** Idea Wheel, p. 16 TE **Reading Toolbox** Idea Wheel, p. 16	SE **Section Review** TE **Formative Assessment** **Spanish Assessment***■ **Section Quiz**■
TE **Demonstration** Alive or Not?, p. 17 TE **Career Development,** p. 18 SE **Biology in the World,** p. 18	**Quick Lab** Comparing Living and Nonliving Things*	TE **Reading Toolbox** Visual Literacy, p. 18	SE **Section Review** TE **Formative Assessment** **Spanish Assessment***■ **Section Quiz**■
	See also Lab Generator		**See also Holt Online Assessment Resources**

Resources for Differentiated Instruction■

English Learners
- TE Vocabulary, p. 8
- TE Measurements, Units, and Quantities, p. 14
- Directed Reading Worksheets*
- Active Reading Worksheets*
- Lab Manuals, Level A*
- Study Guide*■
- Note-taking Workbook*
- Multilingual Glossary

Struggling Readers
- TE Textbook Overview, p. 7
- TE Vocabulary, p. 8
- TE Bias Has Many Meanings, p. 12
- Directed Reading Worksheets*
- Active Reading Worksheets*
- Lab Manuals, Level A*
- Study Guide*
- Note-taking Workbook*
- Special Needs Activities and Modified Tests*

Special Education Students
- Directed Reading Worksheets*
- Active Reading Worksheets*
- Lab Manuals, Level A*
- Study Guide*■
- Note-taking Workbook*
- Special Needs Activities and Modified Tests*

Alternative Assessment
- Science Skills Worksheets*
- Section Quizzes*■
- Chapter Tests A, B, and C*■

Chapter 1

Overview

The purpose of this chapter is to present the nature of scientific thought and scientific methods. SI measurement and lab safety are presented in the context of the tools and techniques that scientists use in scientific research. The chapter closes with a discussion of the basic properties of life.

READING TOOLBOX

Assessing Prior Knowledge Students should understand the following concepts:

- science in daily life
- metric measurement

Visual Literacy Tell students that young puffins are fed fish by their parents several times a day. Adult puffins dive into the ocean water to catch fish. While underwater, they use their wings to swim. Puffins have specialized beaks that enable them to catch and carry many fish for each visit to the nest. They spend the winter in the open ocean far from land. Ask students what characteristics a young puffin would need to leave its nest. (Sample answers are strong wings, waterproof feathers, and fishing skills.)

Chapter 1 Biology and You

Preview

Why It Matters

Biology, the study of life, directly applies to your health, life, and future in ways as simple as making daily food choices or as complex as deciding which career to pursue.

Chapter Correlations *National Science Education Standards*

LSCell 1 Cells have particular structures that underlie their functions.

LSCell 2 Most cell functions involve chemical reaction.

LSCell 3 Cells store and use information to guide their functions.

LSCell 4 Cell functions are regulated.

LSCell 6 Cells can differentiate and form complete multicellular organisms.

LSGene 1 In all organisms, the instructions for specifying the characteristics of the organisms are carried in DNA.

LSEvol 1 Species evolve over time.

LSEvol 2 The great diversity of organisms is the result of more than 3.5 billion years of evolution.

LSEvol 4 The millions of difference species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors.

LSInter 3 Organisms both cooperate and compete in ecosystems.

LSInter 5 Human beings live within the world's ecosystems.

LSMat 2 The energy for life primarily derives from the sun.

LSMat 3 The chemical bonds of food molecules contain energy.

LSMat 4 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.

LSBeh 2 Organisms have behavioral responses to internal changes and to external stimuli.

UCP1 Systems, order, and organization

Scientists rely on tools to make accurate measurements. This tool is called a *Vernier caliper.* It was invented in 1631 by the French scientist Pierre Vernier. Now, there is a street in Paris named after him.

InquiryLab

15 min

Make a Prediction

Making predictions is an important part of scientific thought. To make a prediction, you use observations to foretell what will happen in a given situation. In this lab, you will practice making predictions.

Procedure

1. Open a **Petri dish with agar,** and streak your finger across the agar.
2. Replace the lid, and seal it with **tape.** Label the dish with your name and the number "1."
3. Seal the **second Petri dish with agar** without removing the lid. Label this Petri dish with your name and the number "2."
4. Write a prediction about what will happen in each dish. Store your dishes as your teacher directs. Record your observations.

Analysis

1. **Restate** your prediction.
2. **List** the evidence that you can cite to support your prediction.
3. **Explain** whether you would change your testing method or your prediction if you did not obtain the results that you predicted.
4. **Evaluate** the importance of obtaining a result that does not support your prediction.

InquiryLab

Teacher's Notes Agar plates can be purchased from science supply companies, or you can prepare your own. Be sure that there is a nutrient and energy source in the agar solution. Luria Broth (LB) is commonly used as a rich nutrient source. Dish 2 should be taped closed to avoid contamination.

Materials

- LB agar plates (2)
- permanent marker

Answers to Analysis

1. Students may predict that bacteria will grow on the agar plate they touched.
2. Students may have previous knowledge that bacteria are found on human skin.
3. You would change your prediction unless there was a flaw with the testing method.
4. Any result of a scientific experiment is important because the observer learns something whether the result supports or contradicts the prediction.

UCP2 Evidence, models, and explanation
UCP3 Change, constancy, and measurement
UCP5 Form and function
SI1 Abilities necessary to do scientific inquiry
SI2 Understandings about scientific inquiry
PS4 Motions and forces
ESS1 Energy in the earth system
ST1 Abilities of technological design
ST2 Understandings about science and technology
SPSP1 Personal and community health
SPSP3 Natural resources
SPSP5 Natural and human-induced hazards
SPSP6 Science and technology in local, national, and global challenges
HNS1 Science as a human endeavor
HNS2 Nature of scientific knowledge

READING TOOLBOX

Using Words

See table below.

Using Language

1. A hypothesis is a testable prediction. A theory is a general explanation for a broad range of data.
2. Accept any hypothesis that can be tested. Sample answer: The chicken crossed the road because there was food on the other side.

Using Graphic Organizers

See graphic below.

READING TOOLBOX

These reading tools can help you learn the material in this chapter. For more information on how to use these and other tools, see **Appendix: Reading and Study Skills.**

Using Words

Everyday Words in Science Many words that we use every day have special meanings in science. For example, "matter" in everyday use is an issue or problem. In science, matter is the substance of which all things are made.

Your Turn Make a table like the one shown here.

1. Before you read, write in your own words the everyday meaning of the terms in the table.
2. As you read, fill in the science meaning for the terms in the table.

Everyday Words in Science

Word	Everyday Meaning	Science Meaning
theory		
reproduction		
control		
conclude		

Using Language

Hypothesis or Theory? In everyday language, there is little difference between a *hypothesis* and a *theory*. But in science, the meanings of these words are more distinct. A *hypothesis* is a specific, testable prediction for a limited set of conditions. A *theory* is a general explanation for a broad range of data. A theory can include hypotheses that have been tested and can also be used to generate new hypotheses. The strongest scientific theories explain the broadest range of data and incorporate many well-tested hypotheses.

Your Turn Use what you have learned about the difference between a hypothesis and a theory to answer the following questions.

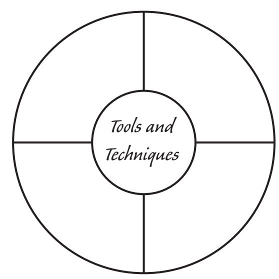
1. What is the difference between a hypothesis and a theory?
2. Propose a testable hypothesis to explain why the chicken crossed the road.

Using Graphic Organizers

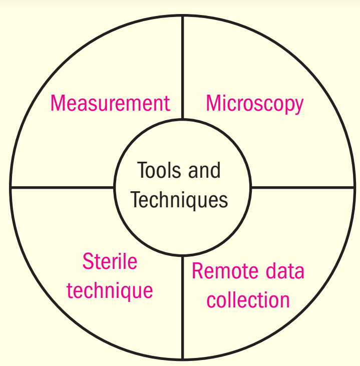
Idea Wheel An idea wheel is an effective type of visual organization. Ideas in science can be divided up into topics around a central, or main, idea.

Your Turn Create an idea wheel like the one shown here to help you organize your notes about tools and techniques used in science.

1. Draw a circle. Draw a larger circle around the first circle.
2. Divide the ring between the circles into sections by drawing lines from the center circle to the outer circle.
3. Write the main idea *Tools and Techniques* in the smaller circle.
4. Label each section of the ring with a topic that falls under the main idea.
5. In each section of the ring, include notes about each topic.



Word	Everyday Meaning	Science Meaning
theory	a guess	ideas supported by a large body of evidence
reproduction	a likeness or copy	the process of producing offspring
control	be in charge of	standard for comparison in an experiment
conclude	to finish or end	to infer on the basis of evidence



Section 1

The Nature of Science

Key Ideas	Key Terms	Why It Matters
❯ How can someone practice scientific thought? ❯ What are universal laws in science? ❯ How do ethics apply to science? ❯ Why should someone who is not planning to become a scientist study science?	skepticism	Thinking like a scientist helps you solve problems and think critically about the world around you.

The goal of science is to help us understand the natural world and improve people's lives. Thinking like a scientist can help you solve problems and think critically about your world.

Scientific Thought

❯ **Scientific thought involves making observations, using evidence to draw conclusions, being skeptical about ideas, and being open to change when new discoveries are made.**

Questioning Ideas Scientists carefully observe the world. They then ask questions about what they observe. Often, the questions that they ask lead to even more questions. This process is the cornerstone of scientific thought. Scientific thought also requires **skepticism**—a questioning and often doubtful attitude. Scientists question everything. They require evidence, not opinions, to support ideas. Many great discoveries have been made when scientists doubted conventional wisdom. For example, people once thought that stress caused stomach ulcers. However, a group of researchers found the bacteria *Helicobacter pylori* in the stomachs of people with ulcers. Studies confirmed that the bacteria, shown in **Figure 1**, caused ulcers.

Discovery and Change As scientists challenge old claims and make new discoveries, they change the way that people view the world. Many scientific discoveries lead to new technologies and medical treatments. For example, discovering that bacteria cause stomach ulcers led to prescribing antibiotics for patients with ulcers. Through the ongoing cycle of challenge and discovery, scientific knowledge grows.

skepticism a habit of mind in which a person questions the validity of accepted ideas

***Helicobacter pylori* bacterium**

Figure 1 Doctors once thought that stress caused stomach ulcers. However, in 1982, scientists discovered that *Helicobacter pylori* bacteria were the actual cause.

Section 1

❯ Focus

This section discusses the characteristics of scientific thinking and the role of ethics and universal laws in science.

Bellringer

Use the Bellringer transparency to prepare students for this section.

❯ Teach

Demonstration

Asking Questions Show students a photo that people claim is Bigfoot or the Loch Ness Monster. (These images are easily found on the Internet.) Discuss what students know about the photo. Remind students that scientists use evidence that is reproducible and verifiable to give credibility to their arguments. Then, have small groups of students work together to describe how they would evaluate the existence of the organism in the picture. Have groups share their ideas with the class. LS **Logical**

Differentiated Instruction

Basic Learners/Struggling Readers

Textbook Overview Tell students that the text headings generally provide a skeleton for outlining the chapter. Key Ideas are highlighted in bold and new terms are defined in context and in the margin. Give students five minutes to leaf through the chapter, and then ask: "Where do you find the Key Terms for a section?" (on the first page of the section, on the summary page for the chapter, and in the margins of the section) "Where do you find the answers to the Key Ideas questions for each section?" (They are shown in bold in the text.) Ask students to locate the answers to the reading checks. (They can be found at the back of the book.) LS **Verbal**

Teach, *continued*

Teaching Key Ideas

Science Ethics Tell students that many scientific organizations establish guidelines for ethical behavior. For example, the American Association for the Advancement of Science (AAAS) publishes several books and articles on the issue. Many university science departments also have their own ethical guidelines. Ask students what key issues they would include in a set of ethical guidelines for their science class. **LS Interpersonal**

Teaching Key Ideas

Research Gone Awry Ask students to relay any story in the media that is an example of a breach of scientific ethics. The scenario can be real or fictional. Have the student tell the class what part of the guidelines were compromised and why. (Most stories center on economic pressures, i.e. drug development and clinical trials.) Discuss the importance of ethical behavior and how it protects the public. **LS Verbal**

Figure 2 All objects in the universe, from birds to stars, are affected by gravity. Birds must overcome gravity to fly. Stars are formed when gravity pulls a mass of gases together.

ACADEMIC VOCABULARY

aspect the way in which an idea or situation is viewed

SCILINKS.
www.scilinks.org
Topic: Scientific Discoveries
Code: HX81356

Universal Laws

Science is governed by truths that are valid everywhere in the universe. These truths are called *universal laws*. Though branches of science address different aspects of the natural world, universal laws such as the law of gravity, the law of conservation of energy, and the laws of planetary motion apply to all branches of science and to every person. A biologist studying the flight of the bird in **Figure 2** is studying how animals have adapted to overcome the force of gravity. A biologist studying the habits of nocturnal animals is studying the way that animal behavior has adapted to take advantage of the regular pattern of day and night caused by Earth's rotation on its axis.

Science and Ethics

Ethics are a system of moral principles and values. **Because scientific experimentation and discovery can have serious ethical implications, scientific investigations require ethical behavior.** Scientists performing investigations must report only accurate data and be willing to allow their peers to review their work. All scientists rely on the work of other scientists. If the data or claims of one scientist are misleading or false, many other scientists may waste time and resources conducting investigations that are based on that unethical work.

Many other people also rely on scientists to be ethical. For example, if a scientist falsely claims to have discovered a cure for diabetes, people with diabetes may change how they manage their condition to take advantage of the discovery. Because the findings are false, the people relying on the discovery could be in danger.

Scientists must also obey laws and behave ethically with people involved in scientific investigations. Ethical scientists adhere to strict guidelines to ensure that no one involved in medical experiments is coerced, exploited, or involuntarily exposed to a known danger.

Reading Check ***Why is it important that scientific investigations be done ethically? (See the Appendix for answers to Reading Checks.)***

Differentiated Instruction

Advanced Learners/GATE

Ethics and Funding To help students understand the financial pressures that often create ethics violations, have students research a biotech company in the local area. Students should create a profile for a company that interests them. The profile should include: area of research, sources of funding, and regulatory control. If the company is publicly traded, have students research its stock price over the last ten years and how stock price is influenced by discoveries. **LS Verbal/Logical**

English Learners/Struggling Readers

Vocabulary Have students begin a vocabulary notebook or vocabulary flash cards. Tell them to include the Key Terms and any other terms that are unfamiliar in each section. Have them use their own words to write definitions for the terms. Suggest that they also include diagrams and pictures when helpful. Allow time for students to share the information in their notebooks or flashcards with a partner who can make suggestions for improvement. **LS Verbal**

Data

QuickLab

15 min

Evaluate a Scientific Claim

As a consumer, you need to make wise decisions. Often, your buying choices depend on evaluating claims made by the manufacturer. Are the claims accurate? What can you really expect from the products?

Analysis

1. CRITICAL THINKING **Evaluating Conclusions** Suppose that two television commercials claim that their own product is the fastest-acting acne medicine. Design a strategy that could be used to compare the brands. How would you compare their effectiveness?
2. CRITICAL THINKING **Determining the Validity of a Claim** New automobiles are sold with a window sticker displaying the expected miles per gallon. Are these manufacturers' estimates realistic and repeatable by consumers? How would you find out?

Why Study Science?

Scientific thinking is not just for scientists. The same critical-thinking process that scientists use is a tool that you can use in your everyday life. **An understanding of science can help you take better care of your health, be a wiser consumer, and become a better-informed citizen.** For example, you may read an article claiming that riding a bike for 30 minutes a week can lower your blood pressure. How will you know if the claim is accurate? You can investigate the claim by using scientific thought. Ask questions about the claim, be skeptical about what you read, and be ready for discovery and change.

You can also use science to improve the world around you. You may see a problem in your town, such as a struggling recycling program or a dangerous crosswalk. You can investigate these problems with skepticism and creativity to discover helpful solutions. By applying scientific thinking to these problems, you can help yourself and your community.

READING TOOLBOX

Everyday Words in Science In your own words, write the everyday meaning for the word *law*. How does the everyday meaning compare to the science meaning of *law*?

Section 1 Review

KEY IDEAS

1. **Describe** the processes involved in practicing good scientific thought.
2. **Identify** two universal laws.
3. **Explain** how ethics apply to science.
4. **Relate** how science has already helped you in your everyday life.

CRITICAL THINKING

5. **Making Inferences** Most animals have solid bones. However, most birds have bones with hollow spaces. Explain how this feature of birds is related to one of the universal laws.
6. **Evaluating Claims** Two brands of yeast claim to produce a fast-rising dough. Design a strategy that could be used to compare the brands. What would you measure?

WRITING FOR SCIENCE

7. **Persuasive Writing** Write a letter to a younger brother or sister explaining the importance of studying science. Give at least three reasons to support your explanation.

Answers to Section Review

1. Scientific thought involves making observations, using evidence to draw conclusions, being skeptical about ideas, and being open to change when new discoveries are made.
2. the law of gravity, the law of conservation of energy, or the laws of planetary motion
3. Because scientific experimentation and discovery can have serious ethical implications, scientific investigations require ethical behavior.
4. Sample answer: Science is behind the technologies that students use to get to school and to keep themselves healthy.
5. Birds have hollow bones making them lighter. Having less mass makes flying easier, because the birds can more easily overcome the force of gravity.
6. Strategies should include measuring how fast the dough rises.
7. The sample letter should include some of the following ideas: The same critical thinking that scientists use is a tool that should be used in everyday life. An understanding of science can help you take better care of your health, become a wiser consumer, and become a better-informed citizen.

QuickLab

Teacher's Notes Consider providing appropriate print ads for students to review before they do this lab.

Answers to Analysis

1. Students should offer a logical method to compare the products that includes controlled conditions for making a comparison.
2. Students should research the test conditions used by car manufacturers. Their procedures should then offer a logical way to test the listed gas mileage of a car.

READING TOOLBOX

Everyday Words in Science **law** a rule that, when broken, results in a specific punishment; **law** a statement that never varies under certain conditions

Close

Formative Assessment

Which of the following would not be considered unethical?

A. adjusting data to show a trend (Incorrect. Adjusting data to meet predetermined results is unethical behavior.)

B. increasing the number of experimental trials (Correct! More trials provide more data, which leads to greater confidence in the conclusions.)

C. limiting access to a discovery (Incorrect. Ethical science behavior involves making all data available for peer review.)

D. using the data of other scientists as your own (Incorrect. Plagiarism is certainly unethical behavior.)

Section 2

Focus

This section describes the events of a scientific investigation. The case study reveals the stages common to all scientific research. The need to consider bias is also discussed.

Bellringer
Use the Bellringer transparency to prepare students for this section.

Teach

Demonstration

Making Predictions Have students observe two chicken eggs labeled *1* and *2* (one boiled and one raw). Ask students to predict what will happen if you drop the eggs. Discuss reasons for their predictions. Then, drop the eggs as students watch. Ask students if their predictions were accurate.
LS Logical

Section 2

Scientific Methods

Key Ideas	Key Terms	Why It Matters
How do scientific investigations begin? What are two types of experiments that scientists can use to test hypotheses? What is the difference between a theory and a hypothesis?	observation hypothesis experiment control group theory	Scientific thinking can help you understand and analyze information that you come across in your daily life.

All scientists have a certain way of investigating the world. Studying an actual scientific investigation is an exciting way to learn how science is done. Our story begins with a population of Canada geese.

Beginning a Scientific Investigation

For many years, the number of Canada geese around Chicago, shown in **Figure 3,** had been rising rapidly. Scientist Charles Paine of the Max McGraw Wildlife Foundation was studying this population growth when he noticed that the number of geese was no longer increasing. Why was the population boom over?

Making Observations **Most scientific investigations begin with observations that lead to questions.** **Observation** is the act of noting or perceiving objects or events by using the senses. Scientists must use both direct and indirect observation to study the world around them. Many things, like the Canada geese, can be seen. This means they can be directly observed. Other things, like the force of gravity, cannot be seen. Gravity is observed indirectly by observing the effects of gravity on objects that can be directly observed.

Formulating a Hypothesis To find out what was happening to the population of Canada geese, Paine needed to form a hypothesis. A **hypothesis** is a possible explanation that can be tested by observation or experimentation. Hypotheses are not guesses. Possible hypotheses to explain Paine's observations included these:

- The geese were being killed by predators.
- Many of the geese had become infertile.
- The geese were migrating out of the area.

Figure 3 Chicago's Canada goose population had risen rapidly for several years. After making observations, Charles Paine discovered that the population was now increasing by only about 1% per year.

Key Resources

Transparencies
A3 Scientific Processes

Visual Concepts
Scientific Method
Hypothesis
Controlled Experiment and Variable
Independent and Dependent Variables
Comparing Theories and Laws

MISCONCEPTION ALERT

Hypotheses Students often equate a hypothesis with a guess. Emphasize that a hypothesis must have some foundation in scientific fact and that it often stems both from observations and from prior knowledge. A hypothesis is an explanation that can be tested through specific and reproducible observations. Hypotheses are an initial part of formulating strategies for studying a problem. Scientists continually modify their hypotheses to accommodate new data.

Hands-On

QuickLab

15 min

The pH of Common Substances

You can use pH indicator paper to determine the pH of various solutions. The pH indicator paper changes color when it is exposed to a solution. The change in color indicates how acidic or basic the solution is.

Procedure

1. Make a data table with three columns. Add these headings: "Solution," "Predicted pH," and "Measured pH." Make a row for **five solutions** to be tested.
2. Predict the pH (acid or base) of each solution, and record your predictions in your data table.
3. **Test** each solution with **pH paper,** and record the results in the appropriate row in your data table.

Analysis

1. **Summarize** your findings in two sentences.
2. **Compare** your results with those of the rest of the class. Explain any differences.
3. **List** the scientific methods that you followed in doing this activity.
4. CRITICAL THINKING **Analyzing Results** Were the predictions that you made correct? Explain any differences between your predictions and your results.

Scientific Experiments

An **experiment** is a procedure that is carried out under controlled conditions to test a hypothesis. **Scientists conduct controlled experiments or perform studies in order to test a hypothesis.**

Controlled Experiments A controlled experiment is a procedure that tests one factor at a time and that uses a control group and an experimental group. A **control group** serves as a standard of comparison because the group receives no experimental treatment. Experimental groups are identical to the control group except for one factor, or *variable.* The single factor that scientists change in an experiment is called the *independent variable.* Factors that may change in response to the independent variable are called *dependent variables.* Scientists analyze changes to the dependent variables to understand how the independent variable affects the system that they are studying.

Study Without Experimentation There are often cases in which experiments are not possible or not ethical. For example, researchers are trying to find out if the bacteria that cause dental plaque also contribute to heart disease. It is not ethical to ask a group of people not to brush their teeth for years in order to find out if they will develop heart disease. Instead, researchers look for connections in data gathered from patients who have heart disease. However, many factors can contribute to heart disease. Researchers try to reduce the number of variables that may affect their data. For example, smoking leads to heart disease. If a person who has heart disease smokes and has dental plaque, determining which factor caused the patient's heart disease is impossible.

observation the process of obtaining information by using the senses

hypothesis a testable idea or explanation that leads to scientific investigation

experiment a procedure that is carried out under controlled conditions to discover, demonstrate, or test a fact, theory, or general truth

control group in an experiment, a group that serves as a standard of comparison with another group to which the control group is identical except for one factor

SCILINKS.
www.scilinks.org
Topic: Scientific Investigations
Code: HX81358

Differentiated Instruction

Advanced Learners/GATE

The pH Scale Have students find out what the numbers in the pH scale represent. (The numbers are a measure of the relative hydrogen ion concentration of a solution. As a solution becomes more acidic, the hydronium ion concentration increases while the hydroxide ion concentration decreases. As a solution becomes more basic, the hydronium ion concentration decreases as the hydroxide ion concentration increases.) LS **Verbal**

Basic Learners

Dependent and Independent Variables To help students understand the cause and effect relationships between variables, ask them to determine the independent variables in the following examples. 1. An experiment to determine how length of day affects plant growth. (length of daylight) 2. An experiment to determine how temperature affects bacterial growth. (temperature) 3. An experiment to determine how a drug's dosage affects heart rate. (drug dosage) 4. An experiment to determine how drug dosage affects recovery rate for an infection. (drug dosage)

Teach, *continued*

QuickLab

Teacher's Notes Put the "mystery" solutions in containers labeled *1, 2, 3, 4,* and *5.* Use dilute solutions.

Safety Caution Prepare ammonia solution under ventilated hood. Warn students not to inhale fumes from solutions. Students should avoid getting the liquids on their hands. Students should wash their hands after the lab. All the solutions can safely be put into school drainage systems.

Materials
- containers (5)
- 4:1 solution of apple juice and water, labeled as *1*
- 4:1 solution of orange juice and water, labeled as *2*
- 4:1 solution of household ammonia and water, labeled as *3*
- 4:1 solution of dish detergent and water, labeled as *4*
- distilled water labeled as *5*
- wide range pH paper

Answers to Analysis

1. Solutions 1 and 2 are acidic, 3 and 4 are basic. Solution 5 is neutral.
2. Explanations might include human error, differences in color interpretation, and contamination of the solutions.
3. predicting, experimenting, recording data, drawing conclusions
4. Explanations might include different students' perceptions of the substances.

Teach, *continued*

Teaching Key Ideas

The Scientific Process Have students perform the following activity and identify the stage of the scientific method at each step. (1) have students record the number of times they breathe in one minute; (observing) (2) have them suggest how exercise might affect this number; (forming a hypothesis) (3) ask students to note the number of breaths they think they will take in one minute after they have jogged in place for one minute; (making predictions) (4) instruct students to carry out the exercise and then immediately record the number of breaths they take; (verifying predictions) (5) ask students to suggest a connection between exercise and their rate of breathing; (drawing conclusions) Then, ask students if the experiment was quantitative or qualitative. (quantitative) **LS Logical**

READING TOOLBOX

Hypothesis or Theory? Hypotheses: many of the geese are infertile; the geese are being killed by predators; the geese are migrating out of the area; the eggs were being eaten by predators. The last hypothesis was supported by evidence. **LS Verbal**

Answers to Caption Questions

Figure 4: Coyotes probably control the goose population by eating the eggs.

theory a system of ideas that explains many related observations and is supported by a large body of evidence acquired through scientific investigation

READING TOOLBOX

Hypothesis or Theory? List the hypotheses that were proposed to explain the decrease in Canada geese in Chicago. Identify which hypothesis was supported by evidence.

Analyzing Results To test his hypothesis, Paine put radio collars on the adult Canada geese. He tracked the geese and learned that very few of the adult geese were being killed by predators. The results of an experiment may support a hypothesis or prove that a hypothesis is not true. After Paine analyzed his results, he had to change his hypothesis. Paine now hypothesized that the eggs, not the adult geese, were being eaten by predators. He discussed his ideas with his colleague Stan Gehrt, who was studying predators in the Chicago area. Gehrt had recently discovered an amazing fact: Chicago was home to about 2,000 coyotes! Gehrt had observed that coyotes, such as the one in **Figure 4,** sometimes ate the eggs of Canada geese.

Drawing Conclusions and Verifying Results Scientists draw conclusions that explain the results of their experiments. Working together, Paine and Gehrt concluded that urban coyotes were controlling the Canada goose population by eating the eggs. How could Paine and Gehrt verify their conclusions? Scientists verify their conclusions by conducting experiments and studies many times. They also check to see if other scientists have found similar results. In this case, urban coyotes have been found in many large cities. Paine and Gehrt could try to find out if these coyotes also eat goose eggs.

Considering Bias Scientists are human and have particular points of view, or biases. Scientists work hard to prevent bias from affecting their work, but bias can still influence an experiment. Also, a conflict of interest could affect a scientific study. For example, an investigation funded by a company may be biased in favor of that company's products or services. For this reason, you should view all scientific claims in their context and question them. Remember that skepticism is an important part of scientific thought, even when considering research done by qualified scientists.

Figure 4 Coyotes like this one have adapted to city life. **How do coyotes most likely control Chicago's Canada goose population?**

Why It Matters

Statistical Tools Ask students to describe how to analyze data. Emphasize that scientists use mathematical and statistical tools (mean, median, and mode) to describe and compare data. It is possible to compare both quantitative and qualitative data using mathematics and statistics. Arguments provided by scientists would be much weaker if it were not for the integration of math.

Differentiated Instruction

Basic Learners/Struggling Readers

Bias Has Many Meanings Help students understand that the word *bias* has several definitions and can be used as a noun, adjective, verb, and adverb. Ask students to use a dictionary to look up the word *bias* and to write sentences using each of the meanings of the word. Scientific bias results from introducing error into a study by consciously or unconsciously favoring an outcome. Ask students how the methods of science attempt to reduce the effects of bias. (Use of a control group provides a standard for comparison, use of multiple trials reduces the risk of error, peer review of discoveries provides objective oversight.) **LS Verbal**

Scientific Theories

When related hypotheses are well supported and explain a great amount of data, these hypotheses may be put together to form a **theory.** **The main difference between a theory and a hypothesis is that a hypothesis is a specific, testable prediction for a limited set of conditions and a theory is a general explanation for a broad range of data.** Some examples of scientific theories include the quantum theory, the cell theory, and the theory of evolution. As you study science, remember that the word *theory* is used very differently by scientists and by the general public. People may say, "It's just a theory," suggesting that an idea is untested, but scientists view a theory as a highly tested, generally accepted principle that explains a vast number of observations and experimental data.

Constructing a Theory **Figure 5** summarizes the steps in the development of a theory. Constructing a theory often involves considering contrasting ideas and conflicting hypotheses. Argument, disagreement, and unresolved questions are a healthy part of scientific research. Scientists routinely evaluate and critique one another's work. Once a scientist completes an investigation, he or she often writes a report for publication in a scientific journal. Before publication, the research report is reviewed by other scientists. These reviewers ensure that the investigation was carried out with the appropriate controls, methods, and data analysis. The reviewers also check that the conclusions reached by the author are justified by the data obtained. Publishing an investigation allows other scientists to use the information to form their hypotheses. They can also repeat the investigations and confirm the validity of the conclusions.

If the results of an experiment can be reproduced many times, the scientific research may help develop a new theory. However, the possibility always remains that future evidence will cause a scientific theory to be revised or even rejected. Challenging old theories is how scientific understanding grows.

Reading Check *How does the scientific use of the word* theory *differ from how it is used by the general public?*

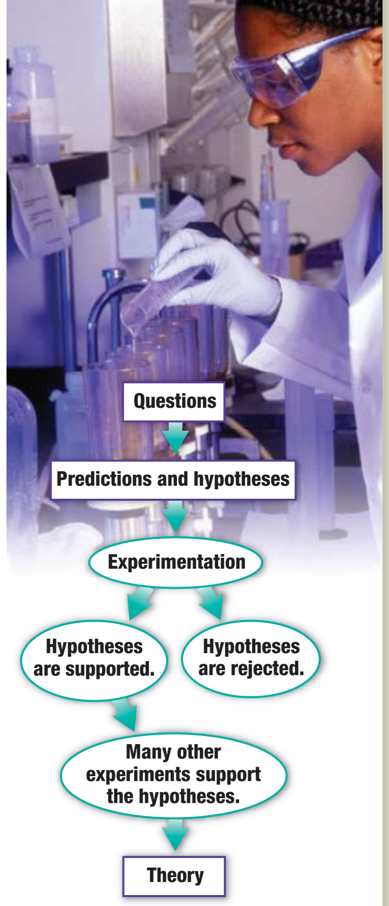


Figure 5 Scientists build theories from questions, predictions, hypotheses, and experimental results. **How can an experiment lead to a theory?**

Section 2 Review

KEY IDEAS

1. **Summarize** the processes that scientists often use when beginning scientific investigations.
2. **Describe** two ways that scientists test hypotheses.
3. **Explain** the difference between a hypothesis and a theory.

CRITICAL THINKING

4. **Analyzing Methods** Provide one example of a case in which an experiment would not be possible and one example in which an experiment would not be ethical.
5. **Forming Hypotheses** A friend notices that her dog is getting thinner even though she has not changed how much she feeds him. Propose three testable hypotheses to explain the dog's weight loss.

METHODS OF SCIENCE

6. **Designing an Experiment** Suppose that Paine had hypothesized that the Canada geese in Chicago were not reproducing at a normal rate. What experiment could he use to test whether the geese in Chicago were less fertile than geese elsewhere?

Why It Matters

Scientists and Detectives Tell students that scientists and detectives use many of the same skills. Ask students who watch crime shows on TV to compare the processes used by scientists with those used by detectives on the shows. (Sample answer: Scientists reject hypotheses that are not supported by observation and detectives reject suspects that are not implicated by evidence.) **LS Logical**

Answers to Caption Questions

Figure 5: If the results of an experiment support the hypothesis and many other experiments support the same hypothesis, the hypothesis may lead to a theory.

Close

Formative Assessment

According to the scientific method, what should you do after you state a question?

A. experiment (Incorrect. Before you can experiment, you must form a hypothesis.)
B. state your theory (Incorrect. Theories must be based on experimental results that can be reproduced.)
C. make predictions and hypotheses (Correct!)
D. draw conclusions (Incorrect. You must collect data before you can draw conclusions.)

Answers to Section Review

1. Most scientific investigations begin with observations that lead to questions.
2. Scientists conduct controlled experiments or perform studies in order to test a hypothesis.
3. A hypothesis is a possible explanation that can be tested by observation or experimentation. A theory explains a set of related hypotheses that have been tested and confirmed by scientists.
4. Sample answer: It would not be possible to perform an experiment on the Earth's core. It would not be ethical to give people AIDS in order to test a cure.
5. The dog is more active than it had been. Another animal is eating the dog's food. The dog is sick.
6. He could bring in several pairs of male and female geese from several other cities, keeping the geese from each city separate from the geese from other cities. In a controlled setting, he could have medical experts examine all the geese to look for differences in hormone levels. Then, he could let the geese try to reproduce. If the geese from Chicago had fewer offspring and lower hormone levels than the other geese, the data might indicate that the geese in Chicago are less fertile.

Section 3

Focus

This section introduces the tools and techniques scientists use, including measurement systems, common lab practices, and laboratory safety procedures.

Bellringer

Use the Bellringer transparency to prepare students for this section.

Teach

Demonstration

Measuring Have each student use the span of his or her outstretched hand from the tip of the little finger to the tip of the thumb to measure the length of a long object such as a table or chalkboard. Students should report their measurements in *hands*. Tell them to estimate any "partial hands" in finger widths. Then, have students compare their measurements. (Measurements will vary.) Ask students why the measurements differ. (The sizes of their hands differ.) Discuss with students why using a standard system of measurement in science is important. **LS Kinesthetic**

go.hrw.com
interact online

Students can interact with SI relationships by going to go.hrw.com and typing in the keyword HX8BIOF6.

Answers to Caption Questions

Figure 6: There are 1,000 pennies in $10.

Section 3

Tools and Techniques

Key Ideas	Key Terms	Why It Matters
❯ Why do scientists use SI units for measurement? ❯ What are some tools and techniques that scientists use in the laboratory? ❯ What can you do to stay safe during an investigation?	SI	Understanding the tools and techniques that scientists use can help you work safely and effectively in the lab.

Scientists use various units of measurements, tools, and lab techniques to help them make observations and gather and record data.

Measurement Systems

Measurements taken by scientists are expressed in the International System of Units (**SI**), which is the official name of the metric system. ❯ **The International System of Units is used by all scientists because scientists need to share a common measurement system. SI is also preferred by scientists because it is scaled in multiples of 10, which makes the system easy to use.** Like the U.S. monetary system, SI is a decimal system, so all relationships between SI units are based on powers of 10. Most SI units have a prefix that indicates the relationship of that unit to a base unit. For example, the SI base unit for length is the meter. The prefix *kilo-* means 1,000. Thus, a kilometer is equal to 1,000 meters. **Figure 6** shows other common SI units.

❯ **Reading Check** *How are prefixes used in names of SI units?*

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interact online
Keyword: HX8BIOF6

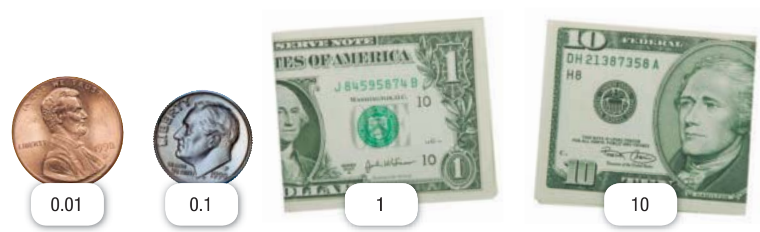


Figure 6 How many dimes are in a dollar? The question is easy to answer because our monetary system, like SI, is built on powers of 10. ❯ **How many pennies are there in $10?**

Common SI Units

Prefix	Factor	Volume	Length	Mass
kilo-	1,000	1 kiloliter = 1,000 L	1 kilometer = 1,000 m	1 kilogram = 1,000 g
—	1	1 liter (L)	1 meter (m)	1 gram (g)
centi-	0.01	1 centiliter = 0.01 L	1 centimeter = 0.01 m	1 centigram = 0.01 g
milli-	0.001	1 milliliter = 0.001 L	1 millimeter = 0.001 m	1 millligram = 0.001 g

Key Resources

Transparencies

A6 SI Base Units

A7 Some SI Prefixes

A8 SI Units

Visual Concepts

Types of Microscopes

Parts of a Microscope

Magnification and Resolution

Differentiated Instruction

English Learners

Measurements, Units, and Quantities Help students understand the difference between measurements, units, and quantities. Have a tape measurer, a measuring cup, and balance to use as props in discussing quantities. Then, proceed to describe the relationships. Five centimeters is a measurement. Centimeter is a unit. Length is a quantity. Ask students to determine the quantity and unit from the following measurements: 50 mL (volume, milliliter), 4.0 mg (mass, microgram), 53 cm^3 (volume, cubic centimeters), 25 km^2 (area, square kilometers). **LS Verbal**

Hands-On

QuickLab

15 min

Practice Staining Techniques

The parts (organelles) of a typical cell are mostly transparent. In a technique called *staining,* color is added to cell parts to help identify and distinguish them.

Procedure

1. Use **forceps** to remove a thin layer of **onion skin,** and place it in the center of a **glass slide.** Add a **drop of water,** and place a **coverslip** over the specimen.
2. Examine the onion skin with a **light microscope.** Draw what you see.
3. Place a **drop of iodine stain** along one edge of the coverslip. Touch a piece of **paper towel** to the opposite edge to draw the water. When the skin is stained, examine it with the microscope.

Analysis

1. **Describe** how the stain affected the onion skin.
2. CRITICAL THINKING **Analyzing Information** What is the advantage of using the paper to draw the stain across the field of view?

Lab Techniques

In the lab, scientists always keep detailed and accurate notes and perform precise measurements. Many scientists also use specialized tools, such as microscopes, and specialized procedures, such as sterile technique.

Microscopy Many organisms, such as bacteria, are too small to see with the unaided eye. Microscopes help magnify these organisms. Two common kinds of microscopes are light microscopes and electron microscopes. In a light microscope, light passes through one or more lenses to produce an enlarged image of an object. An electron microscope forms an image of an object by using a beam of electrons to magnify extremely small objects.

Sterile Technique Scientists who study cells need to be able to grow cells in a controlled setting. Because bacteria live everywhere on Earth, scientists must use sterile technique when growing cells. Sterile technique is a method of keeping unwanted microorganisms out of a lab to minimize the risk of contamination. The tools of sterile technique include an autoclave for sterilizing equipment, sterilized dishes and pipets, a laminar-flow hood, and latex gloves.

Collecting Data Remotely As electronic technology has advanced, more tools have become available for scientists to use. Remote tracking devices to attach to released animals, data collected from satellites, and technology based on the global positioning system (GPS) have enabled scientists to conduct investigations that would have been impossible just a few decades ago.

Reading Check *When might sterile technique be used in a lab?*

SI the International System of Units, which is the measurement system that is accepted by scientists worldwide

Academic Vocabulary

technique a way of doing something

SCILINKS.
www.scilinks.org
Topic: History of Standard Units
Code: HX80747

QuickLab

Teacher's Notes Iodine stains skin and clothing. Make sure students wear disposable gloves, goggles, and a lab apron for this lab.

Materials

- forceps
- onion skin
- microscope slides
- coverslips
- iodine solution with dropper
- paper towel
- water
- microscope

Answers to Analysis

1. The stain darkened the nucleus and the cell wall, making these cell parts easier to observe.
2. Because you don't shift the specimen by lifting the coverslip, the specimen remains in view.

Teaching Key Ideas

Tools of the Trade Organize a collection of commonly used biology equipment. Identify each piece with an index card. Have students determine the function of each piece of equipment. For measuring devices, ask students to list the type of quantity measured and the units for the measurement. (For example, a graduated cylinder is used to measure volume. The volume measurement is most likely milliliters. Forceps are used to pickup and manipulate small objects.) LS **Verbal**

Differentiated Instruction

Basic Learners

Types of Microscopes Tell students that resolution is an important characteristic of a microscope. Resolution is the minimum distance between two points that can be distinguished. With a light microscope, as the magnification increases, more detail can be seen, but that after a certain magnification, the resolution decreases. The object being viewed becomes blurry, and detail is lost. Electron microscopes have much better resolution at high magnification, so scientists use these microscopes to view very small objects. The disadvantages of an electron microscope are that the image is black and white and the specimen must be dead. If possible, show students examples of the images produced by light microscopes and different types of electron microscopes, such as TEMs and SEMs. LS **Verbal**

Teach, *continued*

Teaching Key Ideas

Safety Contract Ask students and their parents to read, sign and date a safety contract that states they understand the safety precautions discussed in the text. Have the students return the signed copy, and keep it in a safe place.
LS Intrapersonal

READING TOOLBOX

Idea Wheel Details for each heading follow:

Measurement
- SI as the accepted system
- prefixes determine relative quantity

Microscopy
- view extremely small objects

Sterile technique
- prevents contamination that could distort experimental results

Remote data collection
- based on GPS technology

Close

Formative Assessment

Which of the following is a unit of volume?

A. centimeter (Incorrect. A centimeter is a unit of length.)
B. milliliter (Correct!)
C. gram (Incorrect. A gram is a unit of mass.)
D. kilometer (Incorrect. A kilometer is a unit of length.)

Figure 7 Using proper safety equipment is necessary during every scientific investigation. For example, this scientist must use a special suit to protect his skin from the extreme heat coming from this volcano vent.

READING TOOLBOX

Idea Wheel Complete the idea wheel that you started at the beginning of the chapter. Fill in the outer sections of the wheel with details about the tools and techniques used in science.

Safety

As you can see in **Figure 7**, studying science is exciting, but it can also be dangerous. **Scientists must use caution when working in the lab or doing field research to avoid dangers such as chemical burns, exposure to radiation, exposure to infectious disease, animal bites, or poisonous plants.** Here are some guidelines for working safely in the lab:

- Listen carefully to your teacher, and follow all instructions.
- Read your lab procedure carefully before beginning the lab.
- Do not take any shortcuts in your lab procedure.
- Always wear your safety goggles and any other needed safety equipment when working in the lab.
- Measure chemicals precisely.
- Never taste or smell any materials or chemicals that you use in a lab unless your teacher instructs you to do so.
- Do not use any damaged or defective equipment.
- Keep your lab area clean and free from clutter.
- When you place something onto the lab bench, make sure that the object sits securely on the bench and will not fall or tip over.
- Pay attention to where you are walking.
- If you are working outside, be aware of your surroundings. Avoid poisonous plants and animals that live in the area. Wear sunscreen and a hat that shades your neck and ears.

Accidents If an accident does occur, remain calm. Make sure that you are safe and that no one else is in danger. Then, inform your teacher right away. Follow all of the instructions that your teacher gives you. Know the location and proper operation of all lab safety equipment before it is needed. A review of lab safety equipment before labs begin can save valuable time if an accident happens in your lab. For more information about lab safety and how to respond to accidents in the lab, read *Lab Safety* at the front of this book.

Reading Check ***List at least five actions that you can take in the laboratory to ensure your safety.***

Section 3 Review

KEY IDEAS

1. **Explain** why scientists use SI units for measurement.
2. **Describe** two kinds of microscopes.
3. **Summarize** the steps that you should take if an accident occurs in the lab.

CRITICAL THINKING

4. **Inferring Conclusions** In general, measurement systems that are based on powers of 10 are the easiest for people to use. Infer why these systems are easiest to use.
5. **Analyzing Information** Why is reading the lab procedure before starting an experiment considered an important part of lab safety?

MATH SKILLS

6. **Performing Conversions** A scientist pours 3.48 milliliters (mL) of hydrochloric acid into a beaker. How many liters of hydrochloric acid did the scientist pour into the beaker?

Answers to Section Review

1. Scientists use SI measurements so that they all use a common system. Also, it is the easiest system to use because SI is scaled in multiples of 10.
2. In a light microscope, light passes through one or more lenses to produce an enlarged image of a specimen. An electron microscope also forms an image of a specimen but uses a beam of electrons rather than light.
3. If an accident does occur, remain calm. Make sure that you are safe and that no one else is in danger. Then, inform your teacher right away. Follow all the instructions that your teacher gives you.
4. Sample answer: Our system of math is built in base ten so it is very easy to multiply and divide by factors of ten.
5. By reading the procedure, the experimenter becomes familiar and comfortable with the steps of the lab, and reduces the chance of accidentally making a mistake that could cause harm.
6. 0.00348 L

Section 4

What Is Biology?

Key Ideas	Key Terms		Why It Matters
What are some of the branches of biology? What are seven characteristics that all living things share?	biology cell homeostasis metabolism	reproduction heredity evolution	All living things on Earth are tied together by common traits and rely on one another for their common survival.

The giant sequoia shown in **Figure 8** is very different from the man standing below it. But both organisms have much in common. Studying living organisms is what the science of biology is all about.

The Study of Life

Biology is the study of life. Life is extremely diverse. It would be impossible for one person to become an expert in all aspects of biology, so scientists specialize. There are many branches of biology. **Biology includes biochemistry, ecology, cell biology, genetics, evolutionary theory, microbiology, botany, zoology, and physiology.** Biochemistry is the study of the chemistry of life. Ecology is the study of how organisms interact with each other and with their environment. The study of life on the cellular level is called cell biology. Genetics is the study of how organisms pass traits to their offspring. Evolutionary theory is the study of changes in types of organisms over time. The study of microscopic organisms is called microbiology. The study of plants is called botany. Zoology is the study of animals. Physiology is the study of the human body. As you read, you will learn about each of these fields. You will also have the opportunity to practice techniques that are used in careers in each of these fields.

biology the scientific study of living organisms and their interactions with the environment

Figure 8 Both the man and the sequoia tree that he is standing on are living organisms. Which branches of biology would study both humans and trees?

Section 4

Focus

This section describes those characteristics that are shared by all living things.

Bellringer

Use the Bellringer transparency to prepare students for this section.

Teach

Demonstration

Alive or Not? Show students a variety of objects and ask them to state whether each is *alive, not alive was alive*, or *never was alive*. Objects you might use include a live plant, a dead leaf, a piece of natural cork, fire, a rock, a bottle of water, a synthetic sponge, and a natural sponge. Challenge students to defend the characteristics they used to determine their answers. **LS Logical**

Answers to Caption Questions

Figure 8: Biochemistry, ecology, cell biology, genetics, and evolutionary theory are branches of biology that would study both humans and trees.

Key Resources

Transparencies
A1 The Seven Properties of Life

Visual Concepts
Biology
Unifying Themes of Biology
Heredity
Evolution

Teach, *continued*

Why It Matters

Teacher's Notes Field biologists study living things and their relationship to their environment and they work to understand how humans affect organisms. Many use sophisticated technology, such as remote-sensing satellite imagery. They may spend much of their time on a computer analyzing data when they are not working in the field. By studying organisms in their natural habitat, biologists can hopefully gather enough information about various species to protect them from extinction. **LS Verbal**

READING TOOLBOX

Visual Literacy Help students identify the activities each scientist in the picture might be doing. Discuss how the activities relate to the job of the biologist. Ask students whether they would like to work in the conditions shown.

Answer to Research

Many field biologists work in government agencies as wildlife biologists, entomologists, range managers, pollution control experts, toxicologists, soil scientists, and naturalists. Others do consulting work, teach, and write for technical journals.

Properties of Life

All living organisms share certain properties. **The seven properties of life are cellular organization, homeostasis, metabolism, responsiveness, reproduction, heredity, and growth.** Life is characterized by the presence of all seven properties at some stage in an organism's life.

Cellular Organization A cell is the smallest unit capable of all life functions. A **cell** is a highly organized, tiny structure that is enclosed in a thin covering called a *membrane*. The basic structure of cells is the same in all organisms.

Why It Matters

Biology in the Wild

A biologist who studies organisms in their natural habitat is called a field biologist. These scientists study life in every kind of habitat. They may tag polar bears near the North Pole or climb into caves deep underground. By studying organisms in their natural habitat, field biologists can learn about life in the wild.

Hanging Around for Science

Sometimes, field biologists hang around in interesting places. Scientists who study the biology of cave-dwelling organisms are called speleologists. This scientist is hanging over a cave called the Well of the Birds. This sinkhole is more than 200 meters deep and growing.

Life Under Water This marine biologist has to go underwater to study manatees in their habitat. Manatees are an endangered species. Scientists hope that by learning about manatees, we may be able to prevent the extinction of this species.

Research Use library or Internet sources to learn more about jobs that are available for field biologists.

Why It Matters

Career Development Interviews with scientists often describe that their interests in science came from a supportive teacher or inspirational speaker. Bring in outside speakers when possible to expose students to people who work in science. Make career development a part of your monthly schedule and students will thank you for it! Make it a point to have speakers discuss the value of teams and working together to achieve stated goals. **LS Interpersonal**

Homeostasis All living organisms must maintain a stable internal environment in order to function properly. The maintenance of stable internal conditions in spite of changes in the external environment is called **homeostasis.**

Metabolism Living things carry out many chemical reactions in order to obtain energy. **Metabolism** is the sum of all of the chemical reactions carried out in an organism. Almost all of the energy used by living things originally comes from sunlight. Plants, algae, and some bacteria capture this energy and use it to make molecules. These molecules serve as the source of energy, or food, for other organisms.

Responsiveness In addition to maintaining a stable internal environment, living organisms also respond to their external environment. Plants bend toward sunlight. Birds fluff their feathers to insulate their bodies during cold weather. Students, shown in **Figure 9,** also respond to their environment.

Reproduction Most living things can reproduce. **Reproduction** is the process by which organisms make more of their own kind from one generation to the next. Because no organism lives forever, reproduction is an essential part of life.

Heredity When an organism reproduces, it passes on its own traits to its offspring in a process known as **heredity.** Heredity is the reason that children tend to look like their parents. Inherited characteristics change over generations. This process is called **evolution.**

Growth All living organisms grow . Some one-celled organisms only grow briefly, during the time that they are reproducing. Other living things, like the giant sequoia, grow for thousands of years and reach an enormous size. As organisms grow, many change. This process is called *development.* Frogs begin as eggs, develop into tadpoles, and eventually develop into frogs. Development differs from evolution because development refers to change in a single individual during that individual's life.

Reading Check *How is heredity related to evolution?*

Figure 9 These students are responding to the rain by using raincoats. **Can you think of a way that you have responded to your environment today?**

cell in biology, the smallest unit that can perform all life processes

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

metabolism the sum of all chemical processes that occur in an organism

reproduction the process of producing offspring

heredity the passing of genetic traits from parent to offspring

evolution the process of change by which new species develop from preexisting species over time

Section 4 Review

KEY IDEAS

1. **Explain** what biology is.
2. **Describe** nine fields that are part of the science of biology.
3. **Name** the basic unit of life.
4. **Discuss** the seven properties all living organisms share.
5. **Define** homeostasis.

CRITICAL THINKING

6. **Recognizing Verifiable Facts** If you find an object that seems alive, how might you determine if the object is indeed an organism?
7. **Elaborating** Give an example of one way that you are interdependent on another type of organism.
8. **Analyzing Information** Relate five of the characteristics of life to an organism familiar to you.

ALTERNATIVE ASSESSMENT

9. **Interview a Biologist** Choose a field of biology that interests you. Locate a biologist working in that field, and conduct an interview by phone or e-mail. Ask the biologist how he or she became interested in his or her field and what the scientist's work is like. Report your findings to the class.

Teaching Key Ideas

Homeostasis Ask students how humans maintain a constant body temperature. (Sample answers are sweating, shivering, wearing clothing, and physical activity.) To illustrate the maintenance of a human's body temperature, ask a volunteer to have his or her body temperature monitored before and immediately after vigorous exercise. Human body temperature fluctuates based on activity. **LS Verbal**

Answer to Caption Question

Figure 9: Students' answers will vary based on their daily activities.

Close

Formative Assessment

Which of the following is not a property of an individual organism?

A. evolution (Correct. Individual organisms do not evolve. Species do.)
B. metabolism (Incorrect. Organisms must convert molecules into energy.)
C. heredity (Incorrect. Organisms express the combination of their parent's genetic composition.)
D. homeostasis (Incorrect. Organisms must maintain a stable internal environment.)

Answers to Section Review

1. Biology is the study of living things.
2. Biology includes biochemistry, ecology, cell biology, genetics, evolutionary theory, microbiology, botany, zoology, and physiology.
3. the cell
4. cellular organization, reproduction and heredity, metabolism, homeostasis, growth, and responsiveness
5. Homeostasis is the ability to maintain a stable internal environment in spite of changes in the external environment.
6. Students might test for the characteristics of living organisms.
7. Students may mention that they depend on other organisms for food.
8. Students may relate the characteristics of life to a pet such as a dog, saying that the dog is composed of cells, is able to reproduce with other dogs, requires food, can pass on its genes to its offspring, and depends on other organisms to survive.
9. Interviews will vary depending on whom students interview.

Lab

Time Required
One 45-minute lab period

Ratings
EASY → HARD

Teacher Prep: 1
Concept Level: 1
Student Setup: 2
Clean Up: 1

Safety Caution
Remind students to wear heat-protective gloves when handling the heat lamp. Do not use the heat lamp near water.

Tips and Tricks
Before the lab begins, review the use of the balance and graduated cylinders. Have half the students do the first part of the lab while the other half does the second part. Switch after 15–25 minutes. You may wish to have students record their cumulative data in a data table on the board. Have students calculate the mean of each range of measurement. Dispose of solutions, broken glass, and sand in the designated containers.

Skills Practice

Chapter 1 Lab

Objectives
- Express measurements in SI units.
- Read a thermometer.
- Measure liquid volume by using a graduated cylinder.
- Measure mass by using a balance.
- Determine the density (mass-to-volume ratio) of two liquids.

Materials
- graduated cylinder, 100 mL
- sand, light colored, 75 mL
- cups, plastic, (2)
- sand, dark colored, 75 mL
- thermometers, Celsius, alcohol filled (2)
- gloves, heat resistant
- ring stand or lamp support
- light source
- stopwatch or clock
- balance
- corn oil, 25 mL
- water, 25 mL
- cup, clear plastic
- graph paper

Safety

SI Units

Most scientists use SI units for all of the measurements that they take. In this lab, you will practice making measurements in SI units.

Procedure

Measure Sand Temperature

1. In your lab report, prepare a data table similar to the table below.
2. Put on safety goggles, gloves, and a lab apron. Using a graduated cylinder, measure 75 mL of light-colored sand, and pour it into one of the small plastic cups. Repeat this procedure with the dark-colored sand and another plastic cup.
3. Level the sand by placing the cup on your desk and sliding the cup back and forth. Insert one thermometer into each cup.
4. Using a ring stand or lamp support, position the lamp approximately 9 cm from the top of the sand, as shown in the figure. Make sure that the lamp is evenly positioned between the two cups.
5. Before turning on the lamp, record in your data table the initial temperature of each cup of sand.
6. **CAUTION: Wear heat-resistant gloves when handling the lamp. The lamp will become very hot and may burn you.** Note the time or start the stopwatch when you turn on the lamp. The lamp will become hot and warm the sand. Check the temperature of the sand in each container at 1-minute intervals for 10 minutes. In your data table, record the temperature of the sand after each minute.

Sand Temperature

Time (min)	Dark-colored sand	Light-colored sand
Start		
1		
2		
3		
4		
5		

30 min

Compare the Density of Oil and Water

7. In your lab report, prepare a data table similar to the Density of Two Liquids table.
8. Label one clean plastic cup "Oil," and label another "Water." Using a balance, measure the mass of each plastic cup, and record the value in your data table.
9. Put on an apron. Using a clean graduated cylinder, measure 25 mL of corn oil, and pour it into the plastic cup labeled "Oil." Using a balance, measure the mass of the plastic cup containing the corn oil, and record the mass in your data table.
10. Repeat step 9 with water and the plastic cup labeled "Water."
11. To find the mass of the oil, subtract the mass of the empty cup from the mass of the cup and the oil together.
12. To find the density of the oil, divide the mass of the oil by the volume of the oil, as shown in the equation below.

$$\text{Density of oil} = \frac{\text{mass of oil}}{\text{volume of oil}} = \_\_\_\_\_\_ \text{ g/mL}$$

13. Repeat steps 11 and 12 to find the mass and density of water.
14. Combine the oil and water in the clear cup, and record your observations in your lab report.
15. Clean up your materials according to your teacher's instructions. Wash your hands before leaving the lab.

Density of Two Liquids	
a. Mass of empty oil cup	g
b. Mass of empty water cup	g
c. Mass of cup and oil	g
d. Mass of cup and water	g
e. Volume of oil	25 ml
f. Volume of water	25 ml
Calculating Actual Mass	
Oil Item c – Item a =	g
Water Item d – Item b =	g
g. Density of oil	g/ml
h. Density of water	g/ml

Analyze and Conclude

1. **Graphing Data** Use graph paper or a graphing calculator to graph the data that you collected in the first part of the lab. Plot time on the *x*-axis and temperature on the *y*-axis.
2. SCIENTIFIC METHODS **Interpreting Data** Based on your graph, what is the relationship between color and heat absorption?
3. **Inferring Conclusions** How might the color of the clothes that you wear affect how warm you are on a sunny day?
4. SCIENTIFIC METHODS **Making Systematic Observations** In the second part of the lab, what did you observe when you combined the oil and water? Relate your observation to the densities that you calculated.
5. SCIENTIFIC METHODS **Using Evidence to Make Explanations** What could you infer about the value for the density of ice if you observe it floating in water?

Extensions

6. **Understanding Relationships** How would your calculated density values be affected if you misread the volume measurement on the graduated cylinder?
7. **Experimental Design** Pumice is a volcanic rock that has a density less than 1.00 g/cm^3. How would you prove this density if you did not have a balance to weigh the pumice? (Hint: The density of water is 1.00 g/cm^3.)

Answers to Analyze and Conclude

1. Students' graphs should show that temperature rises with time.
2. The dark sand absorbs more heat than the light sand does.
3. Wearing light-colored clothing will keep students cooler than wearing dark-colored clothing because light-colored material does not absorb as much heat as dark-colored material does.
4. The oil floated on the water. Therefore, oil is less dense than water.
5. Ice is less dense than water.

Answers to Extensions

6. If the recorded values were too high, then the calculated density would be too low. If the recorded values were too low, then the calculated density would be too high.
7. You could show that the density of pumice was less than that of water by floating some pumice on water.

Key Resources

- Holt Lab Generator
- Lab Datasheet (Levels A, B, C)
- Holt Science Biology Video Labs
- Virtual Investigations

Chapter 1

SUPER SUMMARY

Have students connect the major concepts in this chapter through an interactive Super Summary. Visit **go.hrw.com** and type in the keyword **HX8BIOS** to access the Super Summary for this chapter.

Reteaching Key Ideas

Observing and Questioning Have students study the photo of the coyote in this chapter. List questions they have about coyotes in urban environments. Have students identify questions that could be answered through scientific investigation. **LS Logical**

Scientific Investigation Have students design an experiment to test the hypothesis that the skin of an apple protects the apple from drying out. **LS Logical**

Metric Measurement Have students convert 6 kilometers into meters (6,000 m) and then centimeters (600,000 cm). Next, have students convert 6 miles into feet (there are 5,280 feet in 1 mile, so 6 mi = 31,680 ft) and then into inches (380,160 in). Ask students why scientists use the metric system. **LS Logical**

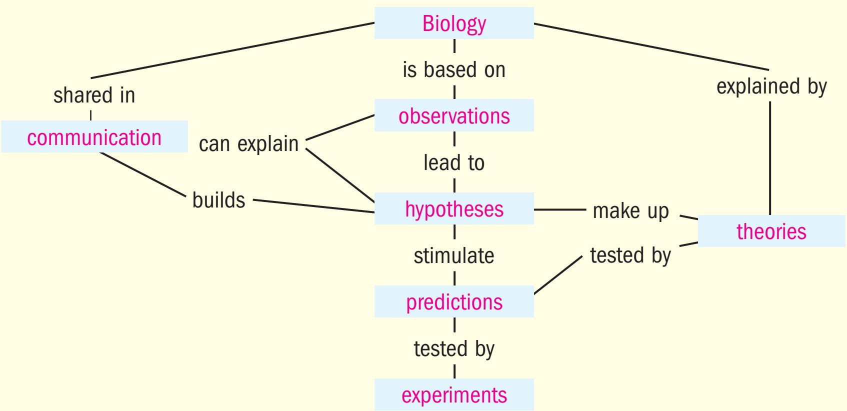
Characteristics of Life Point out a living thing and a nonliving thing in the classroom. Have students draw a graphic organizer to compare and contrast the two using the characteristics of living things discussed in the chapter. **LS Visual**

Chapter 1 Summary

go.hrw.com
SUPER SUMMARY
Keyword: HX8BIOS

Key Ideas	Key Terms
1 The Nature of Science › Scientific thought involves making observations, using evidence to draw conclusions, being skeptical about ideas, and being open to change when new discoveries are made. › Science is governed by truths that are valid everywhere in the universe. These truths are called *universal laws*. › Scientific investigations require ethical behavior. › An understanding of science can help you take better care of your health, be a wiser consumer, and become a better-informed citizen.	**skepticism** (4)
2 Scientific Methods › Most scientific investigations begin with observations that lead to questions. › Scientists can conduct controlled experiments and qualitative studies in order to test a hypothesis. › The main difference between a theory and a hypothesis is that a hypothesis is a specific, testable prediction for a limited set of conditions and a theory is a general explanation for a broad range of data.	**observation** (10) **hypothesis** (10) **experiment** (11) **control group** (11) **theory** (13)
3 Tools and Techniques › The International System of Units (SI) is used by all scientists because scientists need to share a common measurement system. SI is scaled in multiples of 10, which makes the system easy to use. › In the lab, scientists always keep detailed and accurate notes and perform precise measurements. Many scientists also use specialized tools, such as microscopes, and specialized procedures, such as sterile technique. › Scientists must use caution when working in the lab or doing field research to avoid dangers such as chemical burns, exposure to radiation, exposure to infectious disease, animal bites, or poisonous plants.	**SI** (14)
4 What Is Biology? › Biology includes biochemistry, ecology, cell biology, genetics, evolutionary theory, microbiology, botany, zoology, and physiology. › The seven properties of life are cellular organization, homeostasis, metabolism, responsiveness, reproduction, heredity, and growth.	**biology** (17) **cell** (18) **homeostasis** (19) **metabolism** (19) **reproduction** (19) **heredity** (19) **evolution** (19)

Answer to Concept Map
The following is one possible answer to Chapter Review question 2.



Chapter 1 Review

READING TOOLBOX

1. **Hypothesis or Theory?** Write a statement that summarizes the difference between a hypothesis and a theory.
2. **Concept Mapping** Make a concept map that outlines scientific investigations in biology. Try to include the following words: ***biology, observation, communication, hypotheses, predictions, experiments,*** and ***theories.***

Using Key Terms

Use each of the following terms in a separate sentence.

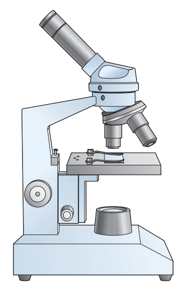
3. *skepticism*
4. *control group*

For each pair of terms, explain how the meanings of the terms differ.

5. *hypothesis* and *theory*
6. *homeostasis* and *metabolism*
7. *reproduction* and *heredity*

Understanding Key Ideas

8. To support claims, scientists require
   - **a.** evidence.
   - **b.** opinions.
   - **c.** technology.
   - **d.** photographs.
9. Though scientists study the world from differing perspectives, what must all scientists take into account?
   - **a.** universal laws
   - **b.** animal behavior
   - **c.** temperature differences
   - **d.** the importance of biology
10. Which of the following observations is qualitative, described in words rather than numbers?
    - **a.** surveying the size of the goose population
    - **b.** observing the nocturnal behavior of coyote populations
    - **c.** recording the date when goose migration begins every year
    - **d.** counting the number of goose nests that are robbed of eggs in an area
11. What is true of all hypotheses?
    - **a.** They are true.
    - **b.** They are false.
    - **c.** They are testable.
    - **d.** They are indisputable.
12. In an experiment, what happens to the control group?
    - **a.** It receives no experimental treatment.
    - **b.** It receives experimental treatment last.
    - **c.** It receives experimental treatment first.
    - **d.** It receives more experimental treatments than the other groups.
13. Which of the following units of measure would be most appropriate for determining the mass of an apple?
    - **a.** gram
    - **b.** kilogram
    - **c.** milligram
    - **d.** centigram
14. How does a microscope help scientists observe objects?
    - **a.** It measures objects.
    - **b.** It magnifies images.
    - **c.** It performs calculations.
    - **d.** It stains transparent objects.



15. Some toads that live in a hot, dry environment bury themselves in the soil during the day. What characteristic of living things does this behavior describe?
    - **a.** heredity
    - **b.** reproduction
    - **c.** metabolism
    - **d.** responsiveness

Explaining Key Ideas

16. **Summarize** the four key steps to practicing good scientific thought.
17. **Explain** why the study of science is important.
18. **Infer** why scientists try to limit the number of independent variables in an experiment.
19. **Identify** 10 things that you can do to stay safe during scientific investigations.

Assignment Guide

Section	Questions
1	3, 8, 9, 16, 17, 20, 21, 22, 23
2	1, 2, 4, 5, 10, 11, 12, 18, 25, 26, 27
3	13, 14, 19, 24, 29

Review

Reading Toolbox

1. A hypothesis is a possible explanation that forms the basis for a scientific investigation; a theory is an explanation for a broad range of data.
2. See previous page for answer to concept map.

Using Key Terms

3. Scientific thought involves having *skepticism* about ideas.
4. A *control group* is a group in an experiment that receives no experimental treatment.
5. A *hypothesis* is a specific, testable prediction for a limited set of conditions. A *theory* is a general explanation for a broad range of data.
6. *Homeostasis* is the ability to maintain a stable internal environment in spite of changes in the external environment. *Metabolism* is the sum total of all the chemical reactions that are carried out in an organism.
7. *Reproduction* is the process by which organisms make more of their own kind from one generation to the next. When an organism reproduces, it passes on its own traits to its offspring in a process known as *heredity*.

Understanding Key Ideas

8. a **9.** a **10.** b **11.** c
12. a **13.** a **14.** b **15.** d

Explaining Key Ideas

16. making detailed observations, making inferences based on evidence, viewing conclusions with skepticism, and being open to change when new discoveries are made
17. Science improves people's lives and helps them think critically about the world around them.
18. Scientists try to limit the number of independent variables so that they can determine the relationship between variables. If there are many independent variables, it is difficult to determine how independent variables affect dependent variables.

19. Wear safety goggles and other safety equipment when working in the lab. Listen carefully to your teacher, and follow all instructions. Do not take shortcuts in your lab procedure. Measure chemicals precisely. Read the lab procedure carefully before beginning an experiment. Think about the consequences of every lab action before doing it. Keep your lab area clean and free from clutter. Make sure equipment sits securely on the lab bench so it will not fall or tip over. Pay attention to where you are walking, be aware of your surroundings. Avoid the poisonous plants and animals that live in the area. When working outdoors, wear sunscreen and a hat that shades your neck and ears.

Using Science Graphics

20. a 21. d 22. c

Critical Thinking

23. Students may describe how the chemical reactions that occur during photosynthesis are an example of the law of conservation of matter. Students could also apply this law to the relationships between producers, consumers, and decomposers in an ecosystem.

24. The development of the microscope enabled scientists to observe very small organisms such as bacteria. When scientists discovered that bacteria are found on any surface, they developed sterilization techniques so that their lab equipment would not be contaminated.

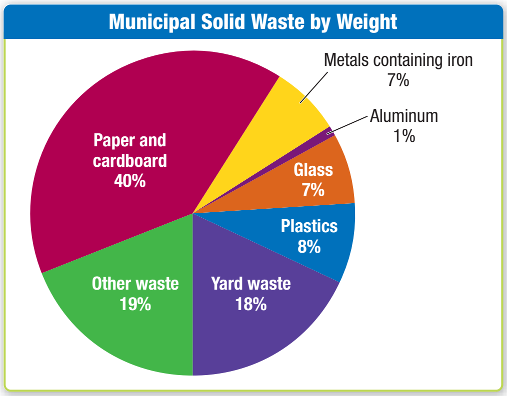
25. Blind peer review eliminates the chance of bias on the part of the reviewers.

Technology Skills

26. Students should demonstrate an understanding of the differences between theories, laws, and hypotheses. In addition, students should be able to describe the scientific value of theories, laws, and hypotheses.

Using Science Graphics

This diagram shows a breakdown of the types of municipal solid waste, by weight, generated in the United States. Use the chart and your knowledge of science to answer the following questions.



20. According to the diagram, which makes up the greatest proportion of waste?
a. paper and cardboard
b. metals containing iron
c. yard waste, glass, and plastics
d. other waste

21. If each type of solid waste were recycled, which type would have the biggest impact on conserving trees?
a. aluminum
b. glass
c. plastics
d. paper and cardboard

22. Which of these types of waste could be turned into compost?
a. glass
b. plastics
c. yard wastes
d. metal containing iron

Critical Thinking

23. Forming Reasoned Opinions The law of conservation of matter states that matter cannot be created or destroyed. How does this universal law relate to biology?

24. Recognizing Relationships The development of science and technology is closely linked. Explain how the invention of the microscope led to the development of the sterile technique. List at least one other technology that most likely resulted from the invention of the microscope.

25. Inferring Relationships The most rigorous form of peer review is blind peer review, in which the scientists reviewing the work do not know the identity of the scientists who authored the work. Why might blind peer review be more rigorous than other forms of peer review?

Technology Skills

26. Computer Presentation Find out more about the differences between theories, laws, and hypotheses. Create a computer presentation that uses examples and illustrations to show the differences between each.

Methods of Science

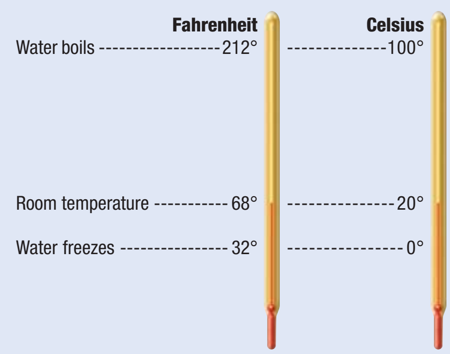
27. Analyzing Methods Scientists collect both quantitative and qualitative data. Quantitative data can be expressed in numbers. Qualitative data must be expressed in words. If you were observing a pride of lions, what are some examples of quantitative and qualitative data that you could collect?

Alternative Assessment

28. Homeostasis Display Research five ways that your body maintains homeostasis. Then, create a poster-board display that illustrates how each of these responses functions.

Math Skills

29. Estimating The diagram below shows the relationship between the Fahrenheit and the Celsius temperature scales. If the air temperature is 60°F, estimate the air temperature in Celsius.



Methods of Science

27. Quantitative data could include how many lions are in the pride, how much they eat, and how many offspring they have. Qualitative data could include a description of their hunting behavior or descriptions of individual appearance.

Alternative Assessment

28. Students could illustrate how any of the organ systems help maintain homeostasis.

Math Skills

29. The air temperature would be about 15°C.

Chapter 1 Standardized Test Prep

TEST TIP When faced with similar answers on multiple-choice questions, define the answer choices and then use that definition to narrow down the choices.

Science Concepts

1. A scientist is investigating a new treatment for a disease that affects thousands of people. Many people with this disease volunteer to be part of the study. Which of the following is an ethical concern that the scientist must address before conducting the study?

- **A** The scientist must ensure that the treatment will be effective.
- **B** The scientist must ensure that the study's results will not be shared with other scientists.
- **C** The scientist must inform the volunteers about the potential dangers of participating in the study.
- **D** The scientist must demonstrate the treatment on him or herself.

2. Which of the following is an example of scientific skepticism?

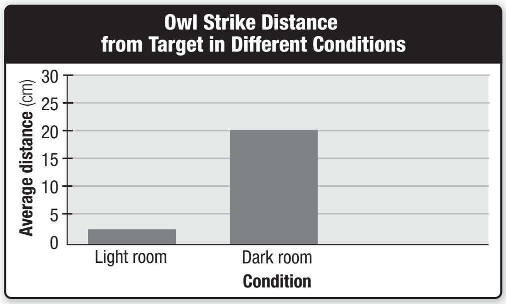
- **F** A scientist investigates how a universal law affects many fields of study.
- **G** A scientist falsely claims to have discovered a cure for diabetes.
- **H** A scientist conducts an experiment that supports the conclusions of another scientist.
- **J** A scientist questions another scientist's conclusions and develops an experiment to test an alternative hypothesis.

Math Skills

3. Calculate The strength of a light microscope is determined by multiplying the strength of the eyepiece by the strength of the objective lens. Light microscopes often have several objective lenses. Suppose that a microscope has an eyepiece that magnifies by 10 and two objective lenses, one that magnifies by 10 and one that magnifies by 40. Calculate the total magnification for each objective lens used with the eyepiece.

Using Science Graphics

Use the diagram to answer the following question.



4. In which room does an owl strike a target most accurately?

A dark room	**C** heated room
B light room	**D** dark and lighted room

Use the diagram to answer the following question.

5. Which of the following words most accurately reflects the use of the term *theory* in the newspaper headline above?

F law	**H** hypothesis
G fact	**J** experiment

Writing Skills

6. Evaluating Statements Write a short paragraph that expresses your opinion on the following statement: "The lengthy drug-approval process costs hundreds of lives every year. Doctors have a moral obligation to provide potentially life-saving drugs to terminally ill patients, even if the drugs have not been scientifically tested."

Answers

1. C **2.** J

3. 10 × 10 = 100; 10 × 40 = 400;

4. B **5.** H

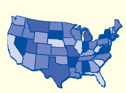
6. Students' opinions should reflect a well-reasoned thought process. Students should recognize that proper testing of drugs before human use is an important part of ethical medical research.

TEST DOCTOR

Question 1 **A.** Incorrect. The purpose of experiment is to test the effectiveness of the treatment. **B.** Incorrect. Scientists share data to come to the solution more quickly than if they were working alone. **C.** Correct. In any treatment there will be risks but the participants must be fully informed of the most likely risks before they willingly proceed. **D.** Incorrect. Scientists are not obligated to demonstrate treatments on themselves.

Question 2 **F.** Incorrect. The scientist does not doubt the law but gives it further support by broadening its application. **G.** Incorrect. This scientist is acting unethically by misleading the public with lies **H.** Incorrect. This scientist is adding strength to the original experiment by reproducing the original results. **J.** Correct. This scientist is expressing doubt over another scientist's claims and is designing an experiment to test another explanation for the data that was gathered.

State Resources



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

Test Practice with Guided Reading Development