

Introduction to Plants

Chapter Planning Guide

Compression guide:
To shorten instruction
because of time limitations,
omit Section 4.

OBJECTIVES	LABS, DEMONSTRATIONS, AND ACTIVITIES	TECHNOLOGY RESOURCES
PACING • 90 min pp. 298–303 Chapter Opener	SE Start-up Activity , p. 299 GENERAL	OSP Parent Letter ■ CD Student Edition on CD-ROM TR Chapter Starter Transparency* CD Guided Reading Audio CD ■ VID Brain Food Video Quiz
Section 1 What Is a Plant? <ul style="list-style-type: none"> Identify four characteristics that all plants share. Describe the four main groups of plants. Explain the origin of plants. 	TE Activity Water Travel in Plants, p. 300 GENERAL TE Group Activity Baby-Powder Cuticle, p. 301 GENERAL TE Activity Life Cycles, p. 301 ADVANCED	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L40 The Main Groups of Plants* CRF SciLinks Activity* GENERAL CD Interactive Explorations CD-ROM Shut Your Trap! GENERAL CD Science Tutor
PACING • 45 min pp. 304–307 Section 2 Seedless Plants <ul style="list-style-type: none"> List three nonvascular plants and three seedless vascular plants. Explain how seedless plants are important to the environment. Describe the relationship between seedless vascular plants and coal. 	TE Activity Identifying Plant Parts, p. 304 GENERAL SE Quick Lab Moss Mass, p. 305 GENERAL CRF Datasheet for Quick Lab* TE Connection Activity Real World, p. 305 GENERAL SE Science in Action Math, Social Studies, and Language Arts Activities, pp. 328–329 GENERAL	OSP Lesson Plans (also in print) TR Bellringer Transparency* CD Science Tutor
PACING • 45 min pp. 308–313 Section 3 Seed Plants <ul style="list-style-type: none"> Describe three ways that seed plants differ from seedless plants. Describe the structure of seeds. Compare angiosperms and gymnosperms. Explain the economic and environmental importance of gymnosperms and angiosperms. 	TE Activity Seed Types, p. 308 GENERAL SE Quick Lab Dissecting Seeds, p. 309 GENERAL TE Group Activity Seed Dispersal, p. 309 GENERAL TE Connection Activity Earth Science, p. 310 ADVANCED SE Skills Practice Lab Travelin' Seeds, p. 776 GENERAL LB EcoLabs & Field Activities The Case of the Ravenous Radish* GENERAL LB Long-Term Projects & Research Ideas Plant Planet ADVANCED	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L41 Two Classes of Angiosperms* TE Internet Activity , p. 312 GENERAL CD Science Tutor
PACING • 90 min pp. 314–321 Section 4 Structures of Seed Plants <ul style="list-style-type: none"> List three functions of roots and three functions of stems. Describe the structure of a leaf. Identify the parts of a flower and their functions. 	TE Demonstration Roots, p. 314 GENERAL TE Group Activity Root Growth, p. 315 BASIC TE Activity Stem Functions, p. 316 BASIC TE Connection Activity History, p. 316 ADVANCED TE Activity Analyzing Tree Rings, p. 317 GENERAL SE School-to-Home Activity Looking at Leaves, p. 318 GENERAL TE Group Activity Leaf Collecting, p. 318 GENERAL SE Model-Making Lab Build a Flower, p. 322 GENERAL SE Skills Practice Lab Leaf Me Alone!, p. 774 GENERAL LB Whiz-Bang Demonstrations Inner Life of - a Leaf* ADVANCED	OSP Lesson Plans (also in print) TR Bellringer Transparency* TR L42 The Structures of a Root* TR L43 Cross Section of a Herbaceous Stem; Cross Section of a Woody Stem* TR L44 The Structure of a Leaf* TR LINK TO PHYSICAL SCIENCE P92 The Electromagnetic Spectrum* TR L45 The Structure of a Flower* VID Lab Videos for Life Science CD Science Tutor

PACING • 90 min

CHAPTER REVIEW, ASSESSMENT, AND STANDARDIZED TEST PREPARATION

- CRF Vocabulary Activity*** **GENERAL**
SE Chapter Review, pp. 324–325 **GENERAL**
CRF Chapter Review* ■ **GENERAL**
CRF Chapter Tests A* ■ **GENERAL**, **B*** **ADVANCED**, **C*** **SPECIAL NEEDS**
SE Standardized Test Preparation, pp. 326–327 **GENERAL**
CRF Standardized Test Preparation* **GENERAL**
CRF Performance-Based Assessment* **GENERAL**
OSP Test Generator, Test Item Listing

Online and Technology Resources



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This CD-ROM package includes:

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

KEY

SE Student Edition
TE Teacher Edition

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

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

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

SKILLS DEVELOPMENT RESOURCES	SECTION REVIEW AND ASSESSMENT	CORRELATIONS
SE Pre-Reading Activity, p. 298 GENERAL OSP Science Puzzlers, Twisters & Teasers GENERAL		National Science Education Standards SAI 1, 2; LS 1c, 3a
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Reading Organizer, p. 300 GENERAL SE Connection to Social Studies Countries and Crops, p. 301 GENERAL TE Support for English Language Learners, p. 301	SE Reading Checks, pp. 301, 302, 303 GENERAL TE Reteaching, p. 302 BASIC TE Quiz, p. 302 GENERAL TE Alternative Assessment, p. 302 ADVANCED SE Section Review,* p. 303 GENERAL CRF Section Quiz* GENERAL	UCP 1, 2, 4; SAI 1, 2; ST 2; HNS 2; LS 1a, 2b, 4c, 5a
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Paired Summarizing, p. 304 GENERAL TE Support for English Language Learners, p. 305 TE Inclusion Strategies, p. 306 ◆ SE Connection to Language Arts Selling Plants, p. 307 GENERAL	SE Reading Checks, pp. 305, 307 GENERAL TE Reteaching, p. 306 BASIC TE Quiz, p. 306 GENERAL TE Alternative Assessment, p. 306 GENERAL TE Homework, p. 306 GENERAL SE Section Review,* p. 307 GENERAL CRF Section Quiz* GENERAL	UCP 1, 2, 3, 4; SAI 1; LS 1a, 1c, 2b, 5c
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Reading Organizer, p. 308 GENERAL TE Inclusion Strategies, p. 311 TE Support for English Language Learners, p. 311 SS Science Skills Science Writing* GENERAL CRF Reinforcement Worksheet Classifying Plants* BASIC CRF Reinforcement Worksheet Drawing Dicots* BASIC	SE Reading Checks, pp. 308, 309, 311, 312, 313 GENERAL TE Homework, p. 310 ADVANCED TE Reteaching, p. 312 BASIC TE Quiz, p. 312 GENERAL TE Alternative Assessment, p. 312 ADVANCED SE Section Review,* p. 313 GENERAL CRF Section Quiz* GENERAL	UCP 1, 2, 4; SAI 1; SPSP 4; LS 1a, 1d, 2b, 2c, 2d, 4b, 4c, 4d, 5b; <i>LabBook</i> : UCP 2, 5; SAI 1, 2; LS 2b
CRF Directed Reading A* BASIC , B* SPECIAL NEEDS IT Interactive Textbook* Struggling Readers CRF Vocabulary and Section Summary* GENERAL SE Reading Strategy Mnemonics, p. 314 GENERAL SE Math Practice Practice with Percentages, p. 315 GENERAL TE Support for English Language Learners, p. 318 SS Science Skills Taking Notes* GENERAL CRF Critical Thinking The Voodoo Lily* ADVANCED	SE Reading Checks, pp. 315, 316, 318, 320 GENERAL TE Homework, p. 319 GENERAL SE Section Review,* p. 321 GENERAL TE Reteaching, p. 320 BASIC TE Quiz, p. 320 GENERAL TE Alternative Assessment, p. 320 GENERAL CRF Section Quiz* GENERAL	UCP 1, 2, 4; SAI 1; SPSP 5; LS 1a, 1d, 2b, 3d, 4c, 5b; <i>Chapter Lab</i> : UCP 1, 2, 5; SAI 1, 2; ST 2; HNS 1, 2; LS 1a, 2a, 2b; <i>LabBook</i> : UCP 1, 5; SAI 1



www.scilinks.org

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



Check out **Current Science** articles and activities by visiting the HRW Web site at go.hrw.com. Just type in the keyword **HL5CS12T**.



Classroom Videos

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



Classroom CD-ROMs

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



Holt Lab Generator CD-ROM

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

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

Section 1

What Is a Plant?

Theophrastus

- Theophrastus (c. 372–287 BCE) was Aristotle's student and one of the first botanists. He wrote two books about plants, *Inquiry into Plants* and *Growth of Plants*. He described the morphology, uses, propagation, and pollination of 500 plants and described sexual reproduction in plants. Theophrastus directed the Lyceum, a school and center of learning in Athens. The Lyceum housed the first botanical garden. Theophrastus's writings were the standard for botanical study until the 16th century.



Carnivorous Plants

- Carnivorous plants photosynthesize and are true plants. They often grow in wetlands, such as marshes, where soil is waterlogged. Bacteria and fungi cannot thrive in these soils, so little organic matter is decomposed to provide minerals to plants. The small invertebrates that carnivorous plants catch provide additional minerals, especially nitrogen. The insects are digested by enzymes secreted by the leaves or by bacteria and fungi living in the cupped leaves of the plant.

Is That a Fact!

- ◆ The leaves of a pitcher plant form tall, narrow cups that hold rainwater. The tip of the plant is colorful and has nectar-secreting glands that attract insects. The insects follow a path of tiny hairs down into the cup, where the walls are smooth. The insects lose their grip and drown.

Section 2

Seedless Plants

Bryophytes

- Bryophytes, which include mosses, hornworts, and liverworts, make up more than 15,000 described species worldwide. Various species tend to be restricted to particular environments because of sensitivities to temperature, light, water availability, and chemical composition of the substrate. So, bryophytes are good indicator species for ecologists and conservation biologists. These experts can characterize an environment by identifying the bryophytes present in an area.

Is That a Fact!

- ◆ Before the invention of flashbulbs and strobe lights for indoor and low-light photography, photographers created an explosive flash of light with a powder. The powder contained spores from club mosses, seedless vascular plants that are related to ferns and horsetails.
- Bryophytes are small and are easy to culture in the lab. Field biologists, however, usually observe bryophytes year-round under natural conditions.



Evolution of Ferns

- Ferns are an ancient group of plants with fossil records dating to the middle of the Devonian period, 408 to 345 million years ago. Nearly all of those early fern groups are now extinct. Few modern fern genera can be traced directly to their Carboniferous ancestors.



Section 3

Seed Plants

The Millennium Seed Bank

- The Royal Botanic Gardens in Kew, England, has launched a project to collect seeds from 24,000 plant species around the world. As many as 50,000 species of plants might become extinct in the next 30 years, but the seed bank will ensure the survival of plants that help stabilize soil and provide food, medicine, and building materials. The collected seeds are dried and stored in subzero temperatures. Scientists believe the seeds will grow even hundreds of years in the future.



The Economic Importance of Plants

- Farming originated thousands of years ago. Today, three of the earliest cultivated crops—wheat, rice, and corn—feed more than half of the people in the world.
- Herbs and spices were valued commodities on ancient trade routes. In medieval times, explorers and merchants brought spices to Europe by camel caravan from east Asia.
- Perfume makers use essential oils from a variety of flowers, including rose, orange, lavender, and jasmine.
- The ancient Egyptians made paper from papyrus reeds. Paper can also be made from nettles, bamboo, cotton, hemp, and other plants. Today, most paper is made from wood pulp.

Is That a Fact!

- ◆ The sea bean (genus *Mucuna*) is one of the largest seed pods in the world. When a sea bean pod falls into a river, it floats to the ocean, where it may travel for thousands of miles before it is washed onto shore.

Section 4

Structures of Seed Plants

Inflorescences

- The cluster of flowers that develops on many plants is called an *inflorescence*, of which there are two types. In a determinate inflorescence, the peduncle, or main axis, terminates in a flower bud, which prevents the peduncle from continued growth. In indeterminate inflorescences, the lower buds open first. As the peduncle continues to grow, the youngest flowers are always at the top. There are several forms of inflorescences, including the following:



- raceme: each flower of the cluster is on a pedicel, or short stem, that extends from the peduncle (snapdragon)
- spike: resembles a raceme but has no pedicels (gladiolus)
- panicle: branched raceme in which each branch has multiple flowers (lilac)
- head: short, dense spike with flowers in a circular mass (dandelion)
- umbel: all the pedicels grow from the same point at the top of the peduncle (onion)

SciLINKS®

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

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

Topic: **Plant Characteristics**
SciLinks code: **HSM1158**

Topic: **Plants with Seeds**
SciLinks code: **HSM1168**

Topic: **How Are Plants Classified?**
SciLinks code: **HSM0763**

Topic: **Structure of Seed Plants**
SciLinks Code: **HSM1467**

Topic: **Seedless Plants**
SciLinks code: **HSM1368**

Overview

Tell students that this chapter will help them learn about plants. The chapter describes the four basic groups of plants. The chapter also discusses the structures of flowering plants.

Assessing Prior Knowledge

Students should be familiar with the following topics:

- cells
- photosynthesis

Identifying Misconceptions

As students learn the material in this chapter, some of them may think that plants get all of their food from soil. Plants do get water and some water-soluble minerals from soil, but the mass of plants—even large plants, such as trees—is derived from the carbon dioxide gas that plants take in from the air for photosynthesis. This carbon dioxide is combined with water to make larger molecules, such as glucose. In turn, glucose is used to make storage molecules, such as sucrose and starch.

Introduction to Plants

The Big Idea

Plants have several common characteristics and can be classified by their structures.

SECTION

- 1 What Is a Plant? 300
- 2 Seedless Plants 304
- 3 Seed Plants 308
- 4 Structures of Seed Plants 314

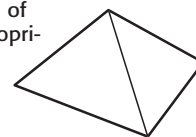
About the PHOTO

In Costa Rica's Monteverde Cloud Forest Preserve, a green coil begins to unfold. It is hidden from all but the most careful observer. The coil looks alien, but it is very much of this Earth. The coil is the leaf of a fern, a plant that grows in moist areas. Soon, the coil will unfold into a lacy, delicate frond.

PRE-READING ACTIVITY

FOLDNOTES

Pyramid Before you read the chapter, create the FoldNote entitled "Pyramid" described in the **Study Skills** section of the Appendix. Label the sides of the pyramid with "Nonvascular plants," "Seedless vascular plants," and "Seed plants." As you read the chapter, define each kind of plant, and write characteristics of each kind of plant on the appropriate pyramid side.



Standards Correlations

National Science Education Standards

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

Chapter Opener

SAI 1, 2; LS 1c, 3a

Section 1 What Is a Plant?

UCP 1, 2, 4; SAI 1, 2; ST 2; HNS 2; LS 1a, 2b, 4c, 5a

Section 2 Seedless Plants

UCP 1, 2, 3, 4; SAI 1; LS 1a, 1c, 2b, 5c

Section 3 Seed Plants

UCP 1, 2, 4; SAI 1; SPSP 4; LS 1a, 1d, 2b, 2c, 2d, 4b, 4c, 4d, 5b; LabBook: UCP 2, 5; SAI 1, 2; LS 2b

Section 4 Structures of Seed Plants

UCP 1, 2, 4; SAI 1; SPSP 5; LS 1a, 1d, 2b, 3d, 4c, 5b; LabBook: UCP 1, 5; SAI 1

Chapter Lab

UCP 1, 2, 5; SAI 1, 2; ST 2; HNS 1, 2; LS 1a, 2a, 2b

Chapter Review

UCP 1, 2, 3, 4; SAI 1; ST 2; SPSP 4, 5; HNS 2; LS 1a, 1c, 1d, 2b, 2c, 2d, 3d, 4b, 4c, 4d, 5a, 5b, 5c



START-UP Activity

Observing Plant Growth

When planting a garden, you bury seeds and water them. What happens to the seeds below the soil? How do seeds grow into plants?

Procedure

1. Fill a clear **2 L soda bottle** to within 8 cm of the top with **moist potting soil**. Your teacher will have already cut off the neck of the bottle.
2. Press **three or four bean seeds** into the soil and against the wall of the bottle. Add enough additional potting soil to increase the depth by 5 cm.
3. Cover the sides of the bottle with **aluminum foil** to keep out light. Leave the top of the bottle uncovered.

4. Water the seeds with about **60 mL of water**, or water them until the soil is moist. Add more water when the soil dries out.
5. Place the bottle in an area that receives sunshine. Check on your seeds each day, and record your observations.

Analysis

1. How many seeds grew?
2. How long did the seeds take to start growing?
3. From where did the seeds most likely get the energy to grow?

START-UP Activity

MATERIALS

FOR EACH GROUP

- aluminum foil
- bean seeds (3–4)
- bottle, soda, clear plastic, with neck cut off, 2 L
- potting soil, moist
- water, 60 mL

Safety Caution: Some students—particularly those who suffer from allergies—may wish to wear protective gloves while handling the soil and seeds. Have students wash their hands when they are finished with the activity.

Teacher's Notes: Cut off the neck of each bottle before distributing bottles to students. Soaking the seeds overnight in advance will decrease the number of days until germination.

Answers

1. Answers may vary. Students may report that not all of their seeds grew.
2. Answers may vary. Germination times vary depending on the seeds used.
3. Sample answer: The seed contains stored food that is used for energy to grow.

Science in Action

ST 2; SPSP 1, 3, 4, 5; HNS 1, 2, 3; LS 1f

Introduction to Plants

CHAPTER STARTER

This Really Happened!

A lone scientist trudges through a remote rain forest. Peering into a steep, narrow canyon, he notices something unusual. On closer inspection, he discovers that it is a species of tree that has survived from the days when *Tyrannosaurus rex* and *Triceratops* walked the Earth! No, this isn't a scene out of *Jurassic Park*. This really happened in an Australian rain forest in 1994. The scientist's name

bank. They grow as tall as 35 m, and their trunks can grow as wide as 1 m. Since the discovery of the trees, scientists at the Royal Botanic Gardens in Sydney, Australia, have been planting seeds of the Wollemi pines and growing seedlings. Some Wollemi pines will be made available to gardeners so they can transform their yards into their own Cretaceous parks.

Chapter Starter Transparency

Use this transparency to help students begin thinking about the world of plants.

CHAPTER RESOURCES

Technology

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

READING SKILLS

Workbooks

- Science Puzzlers, Twisters & Teasers**
 - Introduction to Plants **GENERAL**

Focus

Overview

In this section, students will learn the shared characteristics of plants. Plants make their own food, have a cuticle, reproduce with spores and sex cells, and have cells with cell walls. Finally, students will learn about the four main groups of plants.

 Bellringer

Tell students that there are four major types of plants. Ask them to try to identify those types and to give at least two examples for each one. (Students likely will not classify plants according to the section information. Students may name flowers, trees, weeds, grasses, fruits, and vegetables.)


 Verbal

Motivate

Demonstration — **GENERAL**

Water Travel in Plants Slice a stalk of celery lengthwise to just below the leaves. Place the two halves in separate beakers, each containing a different color of water. Red and blue food colorings work best. Students should be able to see the veins in the leaves change color after the colored liquids have traveled up the stalk.

 Visual

 English Language Learners

What You Will Learn

- Identify four characteristics that all plants share.
- Describe the four main groups of plants.
- Explain the origin of plants.

Vocabulary

nonvascular plant
vascular plant
gymnosperm
angiosperm

READING STRATEGY

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

What Is a Plant?

Imagine spending a day without plants. What would you eat? It would be impossible to make chocolate chip cookies and many other foods.

Without plants, you couldn't eat much. Almost all food is made from plants or from animals that eat plants. Life would be very different without plants!

Plant Characteristics

Plants come in many different shapes and sizes. So, what do cactuses, water lilies, ferns, and all other plants have in common? One plant may seem very different from another. But most plants share certain characteristics.

Photosynthesis

Take a look at **Figure 1**. Do you know why this plant is green? Plant cells contain chlorophyll (KLAWR uh FIL). *Chlorophyll* is a green pigment that captures energy from sunlight. Chlorophyll is found in chloroplasts (KLAWR uh PLASTS). Chloroplasts are organelles found in many plant cells and some protists. Plants use energy from sunlight to make food from carbon dioxide and water. This process is called *photosynthesis* (FOHT oh SIN thuh sis). Because plants make their own food, they are called *producers*.



Cuticles

Most plants live on dry land and need sunlight to live. But why don't plants dry out? Plants are protected by a cuticle. A *cuticle* is a waxy layer that coats most of the surfaces of plants that are exposed to air. The cuticle keeps plants from drying out.

Figure 1 Chlorophyll makes the leaves of this plant green. Chlorophyll helps plants make their own food by capturing energy from sunlight.

CHAPTER RESOURCES

Chapter Resource File

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

Technology

- Transparencies
- Bellringer

Workbooks

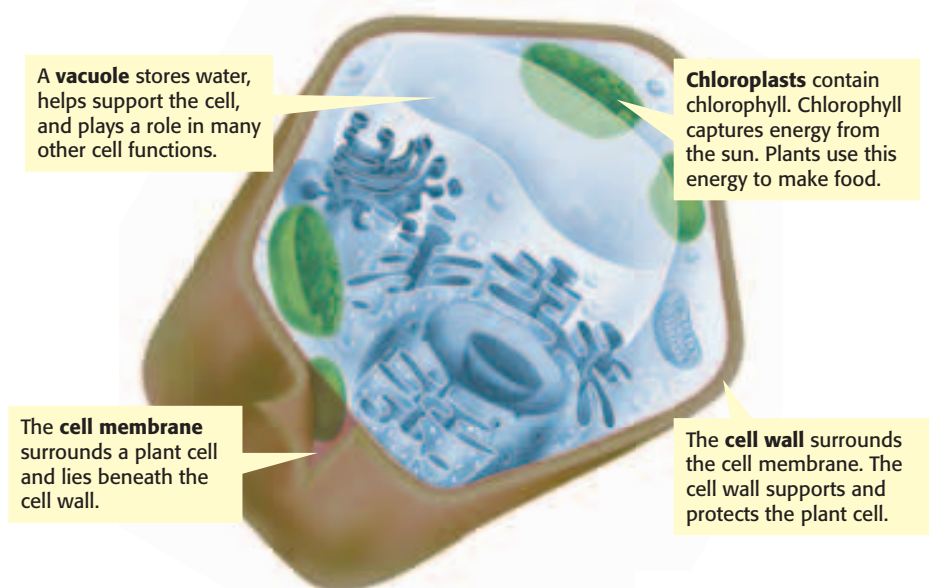
- Interactive Textbook **Struggling Readers**

 Cultural Awareness

GENERAL

Breadnut Ancient Maya and Aztec people made extensive use of the fruit of the breadnut tree. It was boiled and eaten like potatoes or mashed into a gruel and sweetened. Breadnuts were ground, cooked, and mixed with corn to make tortillas. Diluted breadnut sap was fed to babies when their mother's milk was not available. Breadnut leaves were also fed to female animals to increase their milk supply.

Figure 2 Some Structures of a Photosynthetic Plant Cell



Cell Walls

How do plants stay upright? They do not have skeletons like many animals do. Instead, plant cells are surrounded by a rigid cell wall. The cell wall lies outside the cell membrane, as shown in **Figure 2**. Carbohydrates and proteins in the cell wall form a hard material. Cell walls support and protect the plant cell. Some plant cells also have a secondary cell wall that forms after the cell is mature. When this wall has formed, a plant cell cannot grow larger.

Reproduction

Plants have two stages in their life cycle—the sporophyte (SPAWR uh FIET) stage and the gametophyte (guh MEET uh FIET) stage. In the sporophyte stage, plants make spores. In a suitable environment, such as damp soil, the spores of some plants grow. These new plants are called *gametophytes*.

During the gametophyte stage, female gametophytes produce eggs. Male gametophytes produce sperm. Eggs and sperm are sex cells. Sex cells cannot grow directly into new plants. Instead, a sperm must fertilize an egg. The fertilized egg grows into a sporophyte. The sporophyte makes more spores. So, the cycle starts again.

Reading Check How do plants reproduce? (See the Appendix for answers to Reading Checks.)

CONNECTION TO Social Studies

Countries and Crops Without plants, most life on land couldn't survive. But plants are important for more than the survival of living things. Many countries rely on plants for income. Identify five major food crops. Then, find out which countries are the main producers of these crops and how much the countries produce each year. Make a table to show your findings.

SUPPORT FOR

English Language Learners

Reproductive Cycle Having students write summaries can improve their comprehension of text material. After students finish reading about plant reproduction, ask them to summarize the reproductive cycle of plants in their own words in their science journals. Evaluate the summaries for completeness and accuracy of information, as well as appropriate use of language and new terms. **Verbal**

Answer to Connection to Social Studies

Students will likely research crops such as rice, wheat, corn, and soybeans. Students may also study other crops, such as bananas, cacao, and coffee. Students should demonstrate an understanding of where these crops are produced and how much of the crop is produced each year.

Teach

Group ActiViTy — GENERAL

MATERIALS

FOR EACH GROUP

- baby powder
- eyedropper or spoon
- water

Baby-Powder Cuticle Have students work in groups of four. Give each group one set of the materials listed above. Tell students that all but one member of the group should coat the palms of their hands with baby powder. Instruct the remaining member of the group to release a few drops of water on his or her classmates' hands and to record his or her observations. Explain to students that a plant's cuticle forms a similar barrier to keep the plant from losing moisture. Students should wash their hands immediately following this exercise.

Kinesthetic

English Language Learners

ActiViTy — ADVANCED



Life Cycles

Have students compare and contrast the basic life cycle of a plant with the basic life cycles of bacteria and fungi. Ask students to create a series of illustrations that show how all three types of organisms reproduce and to include captions that explain similarities and differences.

Visual/Verbal

Answer to Reading Check

In the sporophyte stage, plants make spores, which grow into gametophytes. The gametophytes produce eggs and sperm. A sperm fertilizes an egg. The fertilized egg grows into a sporophyte.

Close

Reteaching BASIC

Plant Groups Ask students to list the four main groups of plants and to give an example of a plant from each group. Be sure that students understand the characteristics of each plant group. **LS Logical**

Quiz GENERAL

1. How is a plant's size related to its method of transporting water and nutrients? **(Sample answer: Nonvascular plants rely on diffusion, which is efficient only in small plants. Vascular plants have conducting tissues, which enable the plant to be very large.)**
2. What is required for a spore to grow into a new plant? **(It must land in a suitable environment, such as damp soil.)**

Alternative Assessment ADVANCED

Interview Have students interview one another about the characteristics common to all plants. Have students ask, "How do plants make their own food?" "Why are cell walls necessary?" "What is the purpose of the cuticle?" "What are gametophytes and sporophytes, and what roles do they play in a plant's life cycle?" **LS Verbal/Interpersonal**

Plant Classification

Although all plants share basic characteristics, they can be classified into four groups. First, they are classified as nonvascular plants and vascular plants. Vascular plants are further divided into three groups—seedless plants, nonflowering seed plants, and flowering seed plants.

Nonvascular Plants

Mosses, liverworts, and hornworts are nonvascular plants. A **nonvascular plant** is a plant that doesn't have specialized tissues to move water and nutrients through the plant. Nonvascular plants depend on diffusion to move materials from one part of the plant to another. Diffusion is possible because nonvascular plants are small. If nonvascular plants were large, the cells of the plants would not get enough water and nutrients.


Vascular Plants




In the same way that the human body has special tissues to move materials through the body, so do many plants. A plant that has tissues to deliver water and nutrients from one part of the plant to another is called a **vascular plant**. These tissues are called *vascular tissues*. Vascular tissues can move water to any part of a plant. So, vascular plants can be almost any size.

Vascular plants are divided into three groups—seedless plants and two types of seed plants. Seedless vascular plants include ferns, horsetails, and club mosses. Nonflowering seed plants are called **gymnosperms** (JIM noh SPUHRMZ). Flowering seed plants are called **angiosperms** (AN jee oh SPUHRMZ). The four main groups of plants are shown in **Figure 3**.

✓ Reading Check What are the four main groups of plants?

Figure 3 The Main Groups of Plants

Nonvascular plants	
Mosses, liverworts, and hornworts	
	

Vascular plants			
Seedless plants		Seed plants	
Ferns, horsetails, and club mosses		Nonflowering	Flowering
		Gymnosperms	Angiosperms
			

Answer to Reading Check
nonvascular plants, seedless vascular plants, gymnosperms, and angiosperms

The Origin of Plants

Imagine that you traveled back in time about 440 million years. The Earth seems like a strange, bare, and unfriendly place. For one thing, no plants live on land. So, where did plants come from?

Take a look at **Figure 4**. The photo on the left shows a green alga. The photo on the right shows a fern. The green alga may look like a plant, such as a fern, but it isn't a plant. However, green algae and plants have many similarities. Green algae cells and plant cells have the same kind of chlorophyll. They have similar cell walls. Green algae and plants make their own food through photosynthesis. Both store energy in the form of starch. Like plants, green algae have a two-stage life cycle. Because of these similarities, some scientists think that green algae and plants share a common ancestor.

✓ Reading Check What are some characteristics that green algae and plants have in common?



Figure 4 The similarities between a modern green alga (left) and plants, such as ferns (right), suggest that both may have originated from an ancient species of green algae.

SECTION Review

Summary

- All plants make their own food and have cuticles, cell walls, and a two-stage life cycle.
- Plants are first classified into two groups: nonvascular plants and vascular plants. Vascular plants are further divided into seedless plants, gymnosperms, and angiosperms.
- Similarities between green algae and plants suggest they may have a common ancestor.

Using Key Terms

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

1. *nonvascular plants* and *vascular plants*
2. *gymnosperms* and *angiosperms*

Understanding Key Ideas

3. Which of the following plants is nonvascular?
a. ferns c. gymnosperms
b. mosses d. club mosses
4. What are four characteristics that all plants share?
5. What do green algae and plants have in common?
6. Describe the plant life cycle.

Math Skills

7. A plant produced 200,000 spores and one-third as many eggs. How many eggs did the plant produce?

Critical Thinking

8. **Making Inferences** One difference between green algae and plants is that green algae do not have a cuticle. Why don't green algae have a cuticle?
9. **Applying Concepts** Imagine an environment that is very dry and receives a lot of sunlight. Water is found deep below the soil. Which of the four groups of plants could survive in this environment? Explain your answer.

SciLinks Developed and maintained by the National Science Teachers Association

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

Topic: Plant Characteristics;
How Are Plants Classified?

SciLinks code: HSM1158; HSM0763

Answers to Section Review

1. Sample answer: Vascular plants have tissues to move water and nutrients, but nonvascular plants don't have these tissues.
2. Sample answer: Angiosperms have flowers, but gymnosperms don't have flowers.
3. b
4. Sample answer: Plants make their own food, have a cuticle, have cells with cell walls, and have a two-stage life cycle.
5. Sample answer: Plants and green algae both have the same kind of chlorophyll, have a two-stage life cycle, store energy in the form of starch, and have cells with cell walls.
6. Sample answer: Plants make spores in the sporophyte stage. The spores grow into gametophytes. Female gametophytes produce eggs, and male gametophytes produce sperm, which fertilize the eggs. A fertilized egg grows into a sporophyte.
7. $66,667 \text{ eggs } (200,000 \times 1/3 = 66,667 \text{ eggs})$
8. Sample answer: A cuticle protects plants from water loss. But algae live in water, so algae likely do not experience water loss. So, algae can survive without cuticles.
9. Sample answer: Vascular plants can live in a dry environment because they have tissues for transporting water and nutrients. However, seedless vascular plants need moisture, so only gymnosperms and angiosperms could live in the environment.

Answer to Reading Check

Sample answer: Green algae and plant cells have the same kind of chlorophyll, have similar cell walls, and make their own food through photosynthesis. Both store energy in the form of starch and have a two-stage life cycle.

CHAPTER RESOURCES

Chapter Resource File

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

Technology

- Transparencies
 - L40 The Main Groups of Plants
- Interactive Explorations CD-ROM
 - Shut Your Trap! **GENERAL**

Focus

Overview

In this section, students will learn that seedless plants include nonvascular plants (mosses, liverworts, and hornworts) and vascular plants (ferns, horsetails, and club mosses). Finally, students will learn about the importance of these plants to the environment and to humans.

Bellringer

Ask students the following question: “If plants can make their own food, why do people add fertilizer to the soil?” (Sample answer: Fertilizers add minerals to the soil that plants cannot make for themselves.)

Motivate

Activity

GENERAL

Identifying Plant Parts Before students read this section, let them view a moss and a fern. Ask students to compare the two plants. (Sample answer: The moss is much smaller than the fern.) Ask students to identify the sporophyte and gametophyte. (Help students recognize these structures. Depending on the stage of the plant, the sporophyte or gametophyte may not be visible.) **Visual**

What You Will Learn

- List three nonvascular plants and three seedless vascular plants.
- Explain how seedless plants are important to the environment.
- Describe the relationship between seedless vascular plants and coal.

Vocabulary

rhizoid
rhizome

READING STRATEGY

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

rhizoid a rootlike structure in nonvascular plants that holds the plants in place and helps plants get water and nutrients

Seedless Plants

When you think of plants, you probably think of plants, such as trees and flowers, that make seeds. But two groups of plants don't make seeds.

One group of seedless plants is the nonvascular plants—mosses, liverworts, and hornworts. The other group is seedless vascular plants—ferns, horsetails, and club mosses.

Nonvascular Plants

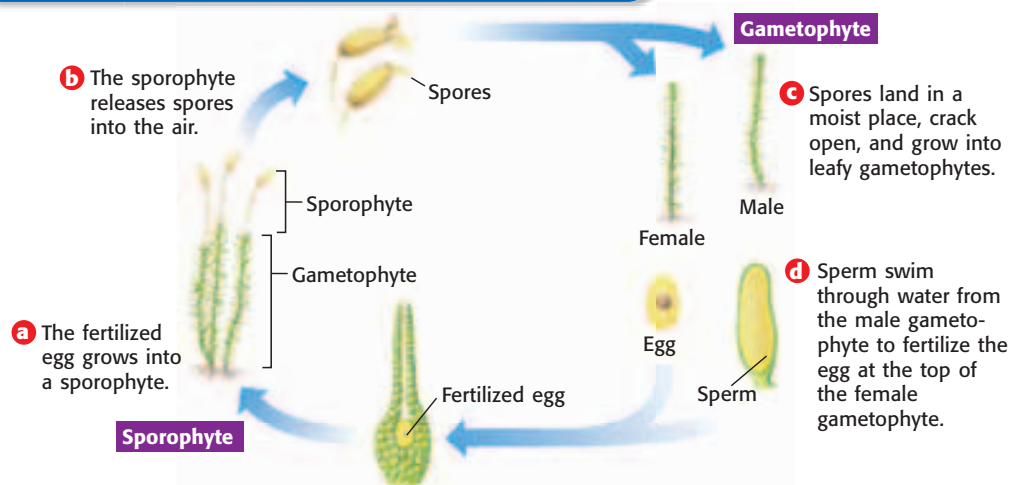
Mosses, liverworts, and hornworts are small. They grow on soil, the bark of trees, and rocks. These plants don't have vascular tissue. So, nonvascular plants usually live in places that are damp. Each cell of the plant must get water from the environment or from a nearby cell.

Mosses, liverworts, and hornworts don't have true stems, roots, or leaves. They do, however, have structures that carry out the activities of stems, roots, and leaves.

Mosses

Mosses often live together in large groups. They cover soil or rocks with a mat of tiny green plants. Mosses have leafy stalks and rhizoids (RIE ZOYDZ). A **rhizoid** is a rootlike structure that holds nonvascular plants in place. Rhizoids help the plants get water and nutrients. As you can see in **Figure 1**, mosses have two stages in their life cycle.

Figure 1 Moss Life Cycle



CHAPTER RESOURCES

Chapter Resource File

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

Technology

- Transparencies
- Bellringer

Workbooks

- Interactive Textbook **Struggling Readers**

CONNECTION to History

ADVANCED



Elizabeth Knight Britton Elizabeth Knight Britton was a botanist when female scientists faced many obstacles. She was the unofficial curator of mosses at Columbia University in New York and published 346 scientific papers between 1881 and 1930. Britton was especially active in the conservation of plants. Have students identify one of her accomplishments in this area and write a magazine article about their findings. **Verbal**

Quick Lab

MATERIALS

FOR EACH GROUP

- balance or scale
- sphagnum moss, dry
- water, in large beaker

Teacher's Notes: It may be helpful to use a dry beaker of predetermined mass to hold the wet moss for weighing.


Answers

- Answers may vary.
- Answers may vary. Students will likely underestimate how much water the moss can absorb.
- Sample answer: The moss could be used to wipe up spills.

CONNECTION Activity

Real World

GENERAL

Sphagnum Moss Sphagnum moss was used during World War I as a dressing for wounds. Its hollow cells enable it to absorb up to 20 times its own weight in fluid. Sphagnum moss was also once used for diapers, lamp wicks, and bedding. Have students research how sphagnum moss is used today. (Sample answer: Sphagnum moss is used as protection for plants during shipping and for potting material.) Have students make posters describing their findings.  **Visual**

Answer to Reading Check

Sample answer: Nonvascular plants are usually the first plants to live in a new environment. They form a thin layer of soil, where new plants can grow. Nonvascular plants also prevent erosion.


Liverworts and Hornworts

Like mosses, liverworts and hornworts are small, nonvascular plants that usually live in damp places. The life cycles of liverworts and hornworts are similar to the life cycle of mosses. The gametophytes of liverworts can be leafy and mosslike or broad and flattened. Hornworts also have broad, flattened gametophytes. Both liverworts and hornworts have rhizoids.

The Importance of Nonvascular Plants

Nonvascular plants have an important role in the environment. They are usually the first plants to live in a new environment, such as newly exposed rock. When these nonvascular plants die, they form a thin layer of soil. New plants can grow in this soil. More nonvascular plants may grow and hold the soil in place. This reduces soil erosion. Some animals eat nonvascular plants. Other animals use these plants for nesting material.

Peat mosses are important to humans. Peat mosses grow in bogs and other wet places. In some places, dead peat mosses have built up over time. This peat can be dried and burned as a fuel. Peat mosses are also used in potting soil.

 **Reading Check** How are nonvascular plants important to the environment? (See the Appendix for answers to Reading Checks.)

Seedless Vascular Plants

Ancient ferns, horsetails, and club mosses grew very tall. Club mosses grew to 40 m in ancient forests. Horsetails once grew to 18 m tall. Some ferns grew to 8 m tall. Today, ferns, horsetails, and club mosses are usually much smaller. But because they have vascular tissue, they are often larger than nonvascular plants. **Figure 2** shows club mosses and horsetails.



Quick Lab

Moss Mass


- Determine the mass of a small sample of **dry sphagnum moss**.
- Observe what happens when you put a small piece of the moss in **water**. Predict what will happen if you put the entire sample in water.
- Place the moss sample in a **large beaker of water** for 10 to 15 minutes.
- Remove the wet moss from the beaker, and determine the mass of the moss.
- How much mass did the moss gain? Compare your result with your prediction.
- What could this plant be used for?

Figure 2 Seedless vascular plants include club mosses (left) and horsetails (right).



SUPPORT FOR

English Language Learners

Sketch the Cycle Students will better understand the importance of nonvascular plants if they sketch what happens when nonvascular plants die. Have pairs of students draw a simple picture showing the benefits to soil, other nonvascular plants, and animals, based on what they have read in this section. Encourage them to add labels for clarity. Check the pictures to be sure they represent all the benefits accurately. Ask students to make corrections if necessary.  **Visual/ Interpersonal**

MISCONCEPTION ALERT

Moss to the North Folklore says that moss grows on the north side of trees. But often, the green alga *Pleurococcus*, not moss, thrives on the moist, shaded (usually north) side of trees, stone walls, and fences.

Close

Reteaching

BASIC

Plant Life Cycles Help students review the life cycles of mosses and ferns. Ask students to come up to the board individually and diagram a single step of the life cycle for each plant. **Visual**

Quiz

GENERAL

1. What is the difference between a rhizoid and a rhizome? (Sample answer: A rhizoid is a rootlike structure that holds a nonvascular plant in place. A rhizome is a horizontal underground stem from which new roots and shoots can grow.)
2. Describe the environmental importance of mosses, liverworts, and hornworts. (Sample answer: They are usually the first plants to live in a new area. When they die, they form a thin layer of soil in which other plants can grow. They also prevent soil erosion, are eaten by some animals, and are used for nesting material.)

Alternative Assessment

GENERAL

Organizational Chart Have students make a chart or Venn diagram that describes the differences and similarities between the seedless nonvascular and seedless vascular plants discussed in this section. Have students present their chart to the class. **Logical/Verbal**

rhizome a horizontal, underground stem that produces new leaves, shoots, and roots

Ferns

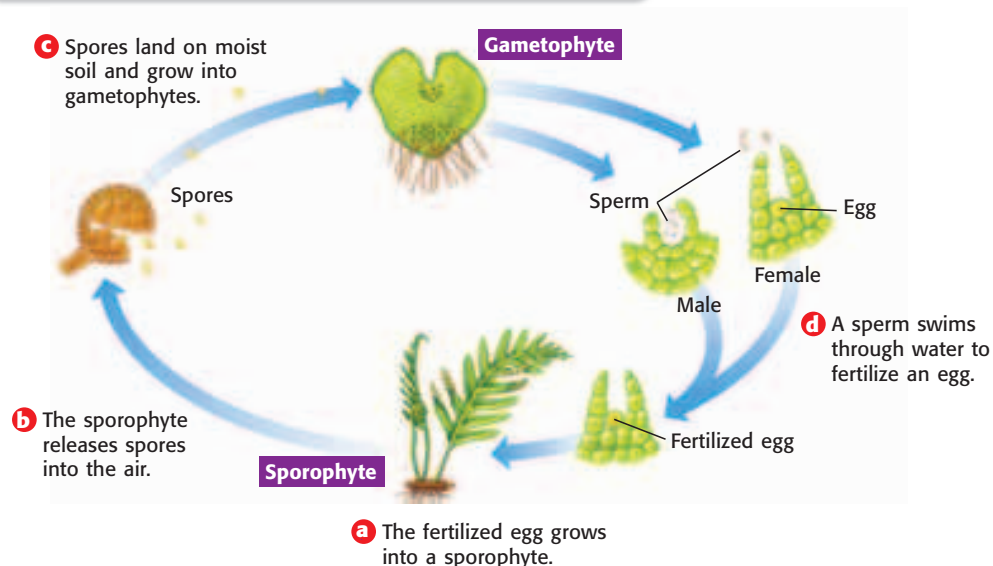
Ferns grow in many places, from the cold Arctic to warm, humid tropical forests. Many ferns are small plants. But some tropical tree ferns grow as tall as 24 m. Most ferns have a rhizome. A **rhizome** is an underground stem from which new leaves and roots grow. At first, fern leaves, or fronds, are tightly coiled. These fronds look like the end of a violin, or fiddle. So, they are called *fiddleheads*. You are probably most familiar with the leafy fern sporophyte. The fern gametophyte is a tiny plant about half the size of one of your fingernails. The fern gametophyte is green and flat. It is usually shaped like a tiny heart. The life cycle of ferns is shown in **Figure 3**.

Horsetails and Club Mosses

Modern horsetails can be as tall as 8 m. But many horsetails are smaller. They usually grow in wet, marshy places. Their stems are hollow and contain silica. The silica gives horsetails a gritty texture. In fact, early American pioneers referred to horsetails as *scouring rushes*. They used horsetails to scrub pots and pans. Horsetails and ferns have similar life cycles.

Club mosses are often about 20 cm tall. They grow in woodlands. Club mosses are not actually mosses. Unlike mosses, club mosses have vascular tissue. The life cycle of club mosses is similar to the fern life cycle.

Figure 3 Fern Life Cycle



INCLUSION Strategies

- Developmentally Delayed
- Visually Impaired
- Learning Disabled

Many students learn best when they use their hands. Have students work in groups of three or four. Assign a sporophyte to each group. Give each group brown and green construction paper and pipe cleaners. Have each group create a model of their assigned sporophyte. **Kinesthetic**

Homework

GENERAL



The Incredible, Edible Fern

Fiddleheads are a delicacy found in the forests of the northeastern United States during the spring. Edible fiddleheads are actually the tightly coiled, emerging fronds of the ostrich fern, *Matteuccia struthiopteris*. Fiddleheads are also available commercially. Have interested students research recipes for fiddleheads or prepare some dishes for the class. **Verbal/Kinesthetic**

The Importance of Seedless Vascular Plants

Seedless vascular plants play important roles in the environment. Ferns, horsetails, and club mosses help form soil. They also help prevent soil erosion. In rocky areas, ferns can play a role in the formation of communities. After lichens and mosses create a layer of soil, ferns may take over. Ferns add to soil depth, which allows other plants to grow.

Ferns and some club mosses are popular houseplants. The fiddleheads of some ferns can be cooked and eaten. Young horsetail shoots and their roots are also edible. Horsetails are used in some dietary supplements, shampoos, and skin-care products.

Seedless vascular plants that lived and died about 300 million years ago are among the most important to humans. The remains of these ancient ferns, horsetails, and club mosses formed coal. Coal is a fossil fuel that humans mine from the Earth's crust. Humans rely on coal for energy.

 **Reading Check** How are seedless vascular plants important to the environment?

CONNECTION TO Language Arts

WRITING SKILL

Selling Plants

Imagine that you work for an advertising agency. Your next assignment is to promote seedless vascular plants. Write an advertisement describing seedless vascular plants and ways people benefit from them. Your advertisement should be exciting and persuasive.

Answers to Section Review

1. Sample answer: A moss plant has a rhizoid, which anchors the plant in soil. A fern has a rhizome, or underground stem, from which new leaves and roots can grow.
2. d
3. Sample answer: Mosses cover soil or rocks with a mat of tiny green plants. Mosses have leafy stalks and rhizoids. The gametophytes of liverworts are leafy and mosslike or broad and flattened. Hornworts also have broad, flattened gametophytes. Most ferns are small, but some tree ferns grow as tall as 24 m. The fern gametophyte is often very small and heart shaped. Horsetails grow in wet, marshy places and have hollow stems that contain silica. Club mosses are often about 20 cm tall and grow in woodlands.
4. Sample answer: The remains of seedless vascular plants that lived about 300 million years ago formed coal.
5. $3,980 \text{ cm}$ ($40 \text{ m} \times 100 \text{ cm/m} = 4,000 \text{ cm}$; $4,000 \text{ cm} - 20 \text{ cm} = 3,980 \text{ cm}$)
6. Sample answer: Mosses, liverworts, and hornworts live in damp areas. If the area dried out, these plants would likely die.
7. Sample answer: Ferns, horsetails, and club mosses need moisture. They may be smaller today because there is less moisture available. Also, competition from other plants might have led to smaller ferns, horsetails, and club mosses.

SECTION Review

Summary

- Nonvascular plants include mosses, liverworts, and hornworts.
- Seedless vascular plants include ferns, horsetails, and club mosses.
- The rhizoids and rhizomes of seedless plants prevent erosion by holding soil in place.
- The remains of seedless vascular plants that lived and died about 300 million years ago formed coal. Humans rely on coal for energy.

Using Key Terms

1. Use each of the following terms in a separate sentence: *rhizoid* and *rhizome*.

Understanding Key Ideas

2. Seedless plants
 - a. help form communities.
 - b. reduce soil erosion.
 - c. add to soil depth.
 - d. All of the above
3. Describe six kinds of seedless plants.
4. What is the relationship between coal and seedless vascular plants?

Math Skills

5. Club mosses once grew as tall as 40 m. Now, they grow no taller than 20 cm. What is the difference in height between ancient and modern club mosses?

Critical Thinking

6. **Making Inferences** Imagine a very damp area. Mosses cover the rocks and trees in this area. Liverworts and hornworts are also very abundant. What might happen if the area dries out? Explain your answer.
7. **Applying Concepts** Modern ferns, horsetails, and club mosses are smaller than they were millions of years ago. Why might these plants be smaller?

SciLINKS®

NSTA

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

Topic: Seedless Plants
SciLinks code: HSM1368

Answer to Reading Check

Sample answer: Seedless vascular plants prevent erosion. They can grow in new soil and add to the soil's depth.

CHAPTER RESOURCES

Chapter Resource File

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

Focus

Overview

Students will learn the characteristics of seed plants and the advantages of seeds over spores. Students will also learn about gymnosperms and angiosperms, as well as the environmental and economic importance of these plants.


 Bellringer

Use the board or an overhead projector to pose the following question to students: "If plants cannot move, how do they disperse their seeds?" (Sample answer: Plants spread their seeds by wind, water, and animals.)

Motivate

Activity

GENERAL

Seed Types Give students gray-stripe sunflower seeds, pumpkin seeds, and wildflower seeds to examine. Tell students to compare the seeds. Ask students how seeds differ from spores. (Sample answer: Seeds contain stored food.) Ask students if they think it would be easier to introduce seed plants or seedless plants to a new plot of land. (Sample answer: If the land is dry, seed plants would be more successful than seedless plants.)  Visual

What You Will Learn

- Describe three ways that seed plants differ from seedless plants.
- Describe the structure of seeds.
- Compare angiosperms and gymnosperms.
- Explain the economic and environmental importance of gymnosperms and angiosperms.

Vocabulary

pollen
pollination

READING STRATEGY

Reading Organizer As you read this section, make a table comparing angiosperms and gymnosperms.

pollen the tiny granules that contain the male gametophyte of seed plants

Figure 1 Dandelion fruits, which each contain a seed, are spread by wind.

Seed Plants

Think about the seed plants that you use during the day. You likely use dozens of seed plants, from the food you eat to the paper you write on.


The two groups of vascular plants that produce seeds are gymnosperms and angiosperms. Gymnosperms are trees and shrubs that do not have flowers or fruit. Angiosperms have flowers and seeds that are protected by fruit.

Characteristics of Seed Plants

As with seedless plants, the life cycle of seed plants alternates between two stages. But seed plants, such as the plant in **Figure 1**, differ from seedless plants in the following ways:

- Seed plants produce seeds. Seeds nourish and protect young sporophytes.
- Unlike the gametophytes of seedless plants, the gametophytes of seed plants do not live independently of the sporophyte. The gametophytes of seed plants are tiny. The gametophytes form within the reproductive structures of the sporophyte.
- The sperm of seedless plants need water to swim to the eggs of female gametophytes. The sperm of seed plants do not need water to reach an egg. Sperm form inside tiny structures called **pollen**. Pollen can be transported by wind or by animals.

These three characteristics of seed plants allow them to live just about anywhere. For this reason, seed plants are the most common plants on Earth today.

 **Reading Check** List three characteristics of seed plants. (See the Appendix for answers to Reading Checks.)



CHAPTER RESOURCES

Chapter Resource File

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

Technology

- Transparencies
- Bellringer

Workbooks

- Interactive Textbook **Struggling Readers**

Answer to Reading Check

Sample answer: Seed plants produce seeds. The gametophytes of seed plants do not live independently of the sporophyte. The sperm of seed plants don't need water to fertilize eggs.

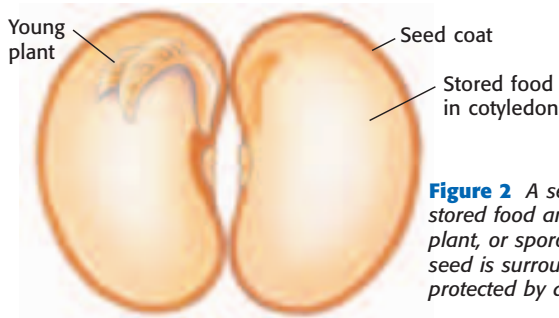


Figure 2 A seed contains stored food and a young plant, or sporophyte. A seed is surrounded and protected by a seed coat.

The Structure of Seeds

A seed forms after fertilization, when sperm and eggs are joined. A seed is made up of three parts, as shown in **Figure 2**. The first part is a young plant, or the sporophyte. The second part is stored food. It is often found in the cotyledons (KAHT uh LEED uhnz), or the seed leaves of the young plant. Finally, a seed coat surrounds and protects the young plant.

Seed plants have some advantages over seedless plants. For example, when a seed begins to grow, the young plant uses the food stored in the seed. The spores of seedless plants don't have stored food to help a new plant grow. Another advantage of seed plants is that seeds can be spread by animals. The spores of seedless plants are usually spread by wind. Animals spread seeds more efficiently than the wind spreads spores.

✓ Reading Check Describe two advantages that seed plants have over seedless plants.

Quick Lab

Dissecting Seeds

1. Soak a **lima bean seed** in **water** overnight. Draw the seed before placing it in the water.
2. Remove the seed from the water. Draw what you see.
3. The seed will likely look wrinkly. This is the seed coat. Use a **toothpick** to gently remove the seed coat from the lima bean seed.
4. Gently separate the halves of the lima bean seed. Draw what you see.
5. What did you see after you split the lima bean seed in half?
6. What part of the seed do you think provides the lima bean plant with the energy to grow?

WEIRD SCIENCE

A large number of plants in the heath-land of South Africa produce seeds that have an *elaiosome*, a very tasty covering—tasty, that is, to ants, which carry seeds into their underground colonies. The ants nibble off the outside covering and then leave the seed alone. The ants plant the seed at just the right depth for it to germinate successfully. Eventually, the seed begins to grow.

CONNECTION TO Environmental Science

WRITING SKILL

Animals That Help Plants

Animals need plants to live, but some plants benefit from animals, too. These plants produce seeds with tough seed coats. An animal's digestive system can wear down these seed coats and speed the growth of a seed. Identify a plant that animals help in this way. Then, find out how being eaten by animals makes it possible for seeds to grow. Write about your findings in your **science journal**.

Teach

Group ACTiViTy — GENERAL

MATERIALS

FOR EACH GROUP

- cotton balls
- fan
- paper, construction
- scissors
- table
- tape, clear or masking

Seed Dispersal Have students shred the cotton balls and place the pieces on a table in front of the fan. Turn on the fan, and have students observe how far the cotton “seeds” travel. Have students wad a strip of tape into a marble-sized ball and attach it to the table. How far does the ball move when subjected to the “wind”? Ask students how they think the seeds in this type of fruit might best be transported. (Sample answer: on an animal's fur) Have students cut a “maple fruit” from construction paper. Have students observe how this “fruit” behaves in the wind.

LS Kinesthetic/Visual

Quick Lab

MATERIALS

FOR EACH GROUP

- lima bean seed
- toothpick
- water

Teacher's Notes: Use lima bean seeds sold in packets for use in gardens. Otherwise, students may not see young sporophytes.

Answers

5. Students will likely see the young sporophyte.
6. Sample answer: Food is stored in the two halves of the seed.

Answer to Reading Check

Sample answer: Seeds have stored food to nourish a young plant while spores do not. Seeds can be spread by animals while spores are spread by wind. Animals spread seeds more efficiently than the wind does.

Discussion — BASIC

Gymnosperms Many students are already familiar with conifers, such as pine trees but may suddenly feel confused when the term *gymnosperm* is introduced. Encourage these students to list the characteristics they have observed in pine trees. (Sample answers: stay green all year; thin, needle-shaped leaves; pine cones) Stress that even though this section provides additional information about gymnosperms, students already know a great deal about them. **LS Verbal**

Using the Figure — GENERAL

Some Common Gymnosperms

Have students work in pairs. Ask students to examine **Figure 3**. Students should take turns summarizing the information in the figure aloud. Their partners should stop them if they find the information confusing or need clarification.

LS Verbal/ Interpersonal

Homework — ADVANCED

Gnetophytes Gnetophytes have many things in common with angiosperms. Some scientists believe that the two are closely related. Ask interested students to research and write a report about the similarities between gnetophytes and angiosperms and about the theories for these similarities. **LS Verbal**

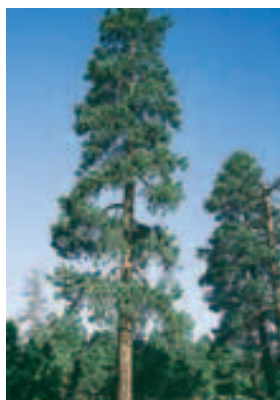
Gymnosperms

Seed plants that do not have flowers or fruit are called *gymnosperms*. Gymnosperm seeds are usually protected by a cone. The four groups of gymnosperms are conifers, ginkgoes, cycads, and gnetophytes (NEE toh FIETS). You can see some gymnosperms in **Figure 3**.

The Importance of Gymnosperms

Conifers are the most economically important gymnosperms. People use conifer wood for building materials and paper products. Pine trees produce a sticky fluid called *resin*. Resin is used to make soap, turpentine, paint, and ink. Some conifers produce an important anticancer drug. Some gnetophytes produce anti-allergy drugs. Conifers, cycads, and ginkgoes are popular in gardens and parks.

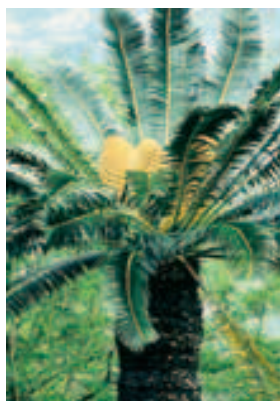
Figure 3 Examples of Gymnosperms



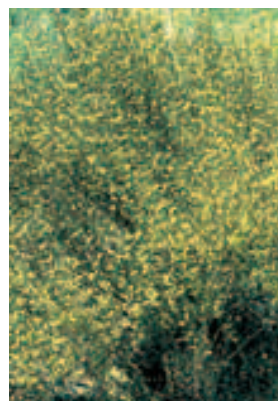
◀ **Conifers** The conifers, such as this ponderosa pine, are the largest group of gymnosperms. There are about 550 species of conifers. Most conifers are evergreens that keep their needle-shaped leaves all year. Conifer seeds develop in cones.



◀ **Ginkgoes** Today, there is only one living species of ginkgo, the ginkgo tree. Ginkgo seeds are not produced in cones. The seeds have fleshy seed coats and are attached directly to the branches of the tree.



◀ **Cycads** The cycads were more common millions of years ago. Today, there are only about 140 species of cycads. These plants grow in the Tropics. Like conifer seeds, cycad seeds develop in cones.



◀ **Gnetophytes** About 70 species of gnetophytes, such as this joint fir, exist today. Many gnetophytes are shrubs that grow in dry areas. The seeds of most gnetophytes develop in cones.

CONNECTION ACTIVITY

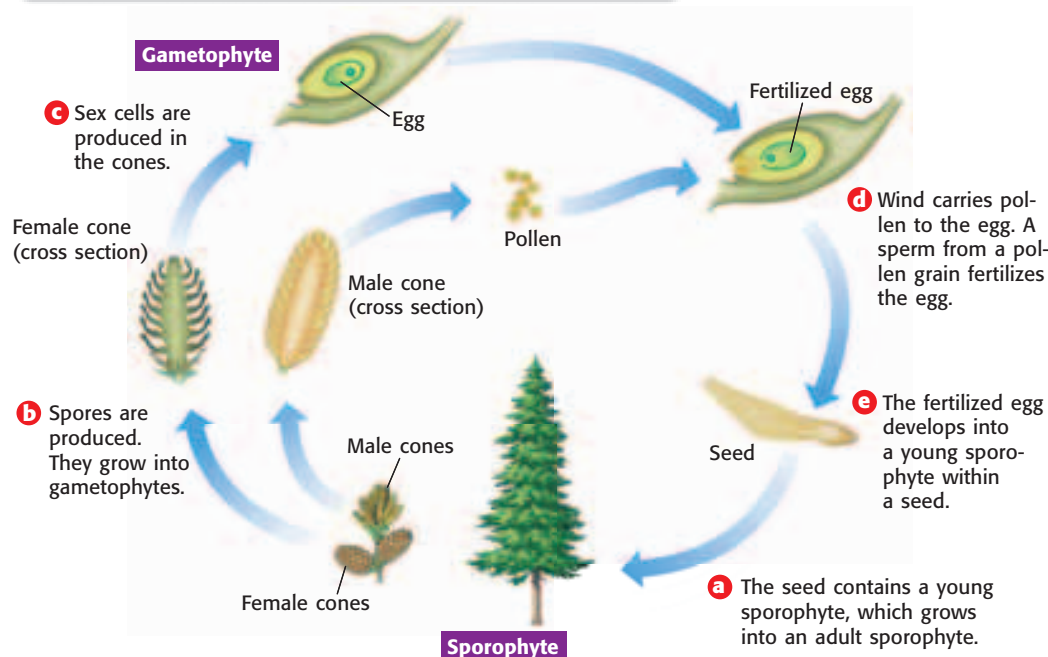
Earth Science — ADVANCED

Growth Rings Geochronology, the interpretation and dating of the geologic record, includes dendrochronology, which is the study of trees' growth rings. Bristlecone pines have been particularly useful in this endeavor because many of them are very old. Ask interested students to research how scientists date trees and use them for geochronology. Ask students to present their findings to the class. **LS Verbal**

WEIRD SCIENCE

When scientists compared radiocarbon dates of bristlecone pines with dates obtained from tree-ring patterns, they discovered that their calibrations for carbon-14 analysis were incorrect. The new data indicated that some wooden artifacts found in Europe were 1,000 years older than originally thought. The bristlecone pines became known as the "trees that rewrote history."

Figure 4 Pine Life Cycle



Gymnosperm Life Cycle

The gymnosperms that are most familiar to you are probably the conifers. The word *conifer* comes from two words that mean “cone-bearing.” Conifers have two kinds of cones—male cones and female cones. The spores of each kind of cone become tiny gametophytes.

The male gametophytes of gymnosperms are found in pollen. Pollen contain sperm. The female gametophytes produce eggs. Wind carries pollen from the male cones to the female cones. This transfer of pollen from the male cones to the female cones is called **pollination**. The female cones can be on the same plant. Or, they can be on a different plant of the same species.

Sperm from pollen fertilize the eggs of the female cone. A fertilized egg develops into a young sporophyte within the female cone. The sporophyte is surrounded by a seed. Eventually, the seed is released. Some cones release seeds right away. Other cones release seeds under special circumstances, such as after forest fires. If conditions are right, the seed will grow. The life cycle of a pine tree is shown in **Figure 4**.

Reading Check Describe the gymnosperm life cycle.

pollination the transfer of pollen from the male reproductive structures to the female structures of seed plants

Discussion GENERAL

Good Fires Ask students what factors they think are necessary for a gymnosperm to germinate. (Sample answers: air, sunlight, water, and soil) Tell students that the cones of jack pines must burn to open. Explain that jack pines were once numerous, but their numbers have been greatly reduced in recent years. Ask students to explain why there are fewer jack pines today. (Sample answer: Today, many forest fires are put out, especially those that are near towns and housing developments.) Tell students that the Kirtland’s warbler nests only in young jack pines, and ask students what they think has happened to the warbler’s population. (Sample answer: If there are fewer jack pines, then there are likely fewer Kirtland’s warblers.)

Verbal

Inclusion Strategies

- Learning Disabled
- Developmentally Delayed
- Hearing Impaired

Transferring learning from the classroom to the real world is important. Ask students to bring to class a piece of an angiosperm and a piece of a gymnosperm. (If students cannot bring pieces of the plants, ask them to bring information about specific angiosperms and gymnosperms.) Place a chart on the board with these headings: *Kind of plant* (if known), *Height*, *Width*, *Description of leaves*, and *Type of plant* (angiosperm or gymnosperm). Ask students to add information to the chart.

Logical/Verbal

SUPPORT FOR

English Language Learners

Paraphrase To reinforce and check comprehension, have students recreate the diagram showing the pine life cycle on this page in their science journals. They should substitute their own words to describe the process. When they have finished, ask them to compare their diagrams in groups of 3 students to ensure accuracy. Spot-check diagrams in each group, and request corrections as necessary. Students should save their diagrams for future reference. **Visual/Verbal/Interpersonal**

Answer to Reading Check

Sample answer: Sperm from the male cone fertilize the eggs of the female cone. A fertilized egg develops into a young sporophyte surrounded by a seed within the female cone. Eventually, seeds are released from the cone.

Close

Reteaching BASIC

Seed Plants Write the following on the board: *gymnosperms*, *angiosperms*, *monocots*, and *dicots*. Ask students to give an example and a description of each. LS Verbal

Quiz GENERAL

- How are gymnosperms and angiosperms different?
(Sample answer: Angiosperms have flowers for reproduction and fruits to protect the seeds. Gymnosperms often have gametophytes and seeds enclosed in cones.)
- How are flowering plants important? (Sample answer: Flowering plants provide land animals with the food they need to survive, either directly or indirectly. Major crops are flowering plants. Flowering plants are also used for building materials and to make clothing, rope, medicines, perfumes, and rubber.)

Alternative Assessment ADVANCED

Concept Mapping Have students organize the following terms into a concept map: *seed plants*, *gymnosperms*, *angiosperms*, *flowers*, *fruits*, *conifers*, *cycads*, *monocots*, *dicots*, *gnetophytes*, and *ginkgoes*. LS Logical/Visual



Figure 5 This bee is on its way to another squash flower, where it will leave some of the pollen it is carrying.

Angiosperms

Vascular plants that produce flowers and fruits are called *angiosperms*. Angiosperms are the most abundant plants today. There are at least 235,000 species of angiosperms. Angiosperms can be found in almost every land ecosystem.

Angiosperm Reproduction

Flowers help angiosperms reproduce. Some angiosperms depend on the wind for pollination. But others have flowers that attract animals. As shown in **Figure 5**, when animals visit different flowers, the animals may carry pollen from flower to flower.

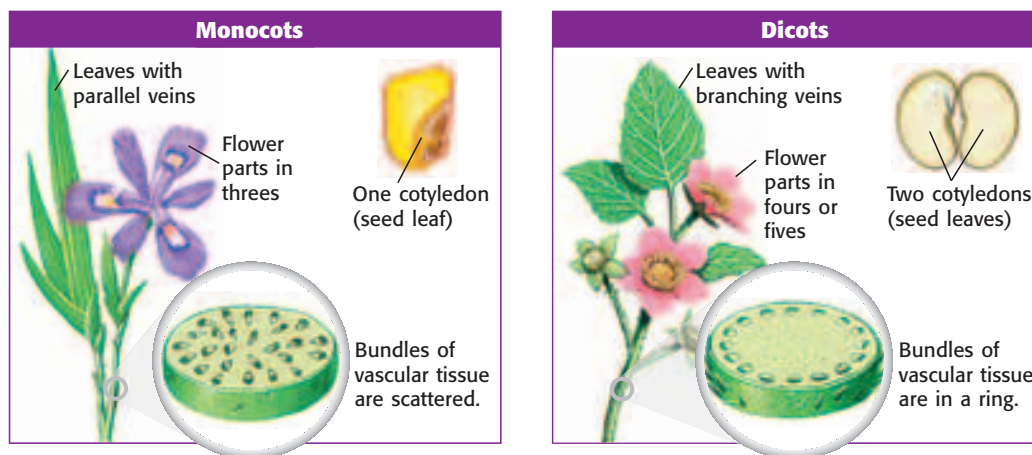
Fruits surround and protect seeds. Some fruits and seeds have structures that help the wind carry them short or long distances. Other fruits attract animals that eat the fruits. The animals discard the seeds away from the plant. Some fruits, such as burrs, are carried from place to place by sticking to the fur of animals.

✓ Reading Check Why do angiosperms have flowers and fruits?

Two Kinds of Angiosperms

Angiosperms are divided into two classes—monocots and dicots. The two classes differ in the number of cotyledons, or seed leaves, their seeds have. Monocot seeds have one cotyledon. Grasses, orchids, onions, lilies, and palms are monocots. Dicots have two cotyledons. Dicots include roses, cactuses, sunflowers, peanuts, and peas. Other differences between monocots and dicots are shown in **Figure 6**.

Figure 6 Two Classes of Angiosperms



Answer to Reading Check

Sample answer: Flowers help angiosperms reproduce. Fruits surround and protect the seeds. Some fruits attract animals, which spread the seeds.

INTERNET ACTIVITY

Essay GENERAL

For an internet activity related to this chapter, have students go to go.hrw.com and type in the keyword **HL5PL1W**.

The Importance of Angiosperms

Flowering plants provide many land animals with the food they need to survive. A field mouse that eats seeds and berries is using flowering plants directly as food. An owl that eats a field mouse is using flowering plants indirectly as food.

People use flowering plants in many ways. Major food crops, such as corn, wheat, and rice, are flowering plants. Some flowering plants, such as oak trees, are used for building materials. Flowering plants, such as cotton and flax, are used to make clothing and rope. Flowering plants are also used to make medicines, rubber, and perfume oils.

 **Reading Check** How are flowering plants important to humans?

INTERNET ACTIVITY

For another activity related to this chapter, go to go.hrw.com and type in the keyword **HL5PL1W**.

SECTION Review

Summary

- Seeds nourish the young sporophyte of seed plants. Seed plant gametophytes rely on the sporophyte. Also, they do not need water for fertilization.
- Seeds nourish a young plant until it can make food by photosynthesis.
- Gymnosperms do not have flowers or fruits. Gymnosperm seeds are usually protected by cones. Gymnosperms are used for building materials, paper, resin, and medicines.
- Angiosperms have flowers and fruits. Angiosperms are used for food, medicines, fibers for clothing, rubber, and building materials.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *pollen* and *pollination*.

Understanding Key Ideas

2. One advantage of seed plants is that
 - a. seed plants grow in few places.
 - b. they can begin photosynthesis as soon as they begin to grow.
 - c. they need water for fertilization.
 - d. young plants are nourished by food stored in the seed.
3. The gametophytes of seed plants
 - a. live independently of the sporophytes.
 - b. are very large.
 - c. are protected in the reproductive structures of the sporophyte.
 - d. None of the above
4. Describe the structure of seeds.
5. Briefly describe the four groups of gymnosperms. Which group is the largest and most economically important?
6. Compare angiosperms and gymnosperms.

Math Skills

7. More than 265,000 species of plants have been discovered. Approximately 235,000 of those species are angiosperms. What percentage of plants are NOT angiosperms?

Critical Thinking

8. **Making Inferences** In what ways are flowers and fruits adaptations that help angiosperms reproduce?
9. **Applying Concepts** An angiosperm lives in a dense rainforest, close to the ground. It receives little wind. Several herbivores live in this area of the rainforest. What are some ways the plant can ensure its seeds are carried throughout the forest?

SciLINKS

NSTA

Developed and maintained by the
National Science Teachers Association

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

Topic: **Plants with Seeds**

SciLinks code: **HSM1168**

Answer to Reading Check

Sample answer: Major food crops are flowering plants. Flowering plants provide building material, are used to make clothing and rope, and are used to make medicines, rubber, and perfume oils.

CHAPTER RESOURCES

Chapter Resource File

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

Technology

- **Transparencies**
- L41 Two Classes of Angiosperms

Workbooks

- **Science Skills**
- **Science Writing** GENERAL

Answers to Section Review

1. Sample answer: Pollen contains the male gametophyte of seed plants. Pollination happens when pollen is transferred from male structures to female structures.
2. d
3. c
4. Sample answer: Seeds are made up of three parts. The first part is the young plant. The second part is stored food, often found in the cotyledons. The third part is the seed coat, which surrounds and protects the young plant.
5. Sample answer: Most conifers are evergreens that have seeds in cones. Cycads grow in the tropics and have seeds in cones. There is only one species of ginkgo, which produces its seeds in fleshy seed coats attached to the branches of the tree. Gnetophytes are often shrubs that grow in dry areas, and most gnetophytes have seeds in cones. Conifers are the largest and most economically important group of gymnosperms.
6. Sample answer: Gymnosperms and angiosperms are both seed plants, but gymnosperms do not have flowers or fruits as angiosperms do. Instead, gymnosperms often have cones.
7. $265,000 - 235,000 = 30,000$ plants; $30,000 \div 265,000 \times 100 = 11.3\%$
8. Sample answer: Flowers attract pollinators, which carry pollen to the flowers. Some flowers are adapted for the wind to spread pollen. Fruits protect the seeds, but fruits also attract animals or stick to animals' fur. Being eaten and sticking to fur both help to spread seeds.
9. Sample answer: The plant does not get much wind to spread its seeds, so it likely relies on animals to spread its seeds. Because there are herbivores in the area, the plant may have sweet fruits to attract the animals. The animals could eat the fruits and spread the seeds.

Focus

Overview



In this section, students will learn about the structures and the functions of a plant's root and shoot systems. Finally, students will learn about the parts of a flower and explain their functions.

Bellringer

Show students a cactus. Point out the spines, and ask students to identify them and explain their purpose. (Sample answer: Cactus spines are modified leaves that help protect the plant from grazing animals.)

Motivate

Demonstration — GENERAL

Roots Bring several plants to class. Gently remove each plant from its pot, and show the roots to the class. Ask students to identify whether each plant has a taproot system or a fibrous root system. Point out any structures that are not roots but are found underground, such as tubers and bulbs (modified stems). Then, ask students to list three functions of roots. (Sample answer: Roots supply plants with water and dissolved minerals. Roots hold plants securely in the soil, and roots store surplus food.)  Visual  English Language Learners

What You Will Learn

- List three functions of roots and three functions of stems.
- Describe the structure of a leaf.
- Identify the parts of a flower and their functions.

Vocabulary

xylem	stamen
phloem	pistil
sepal	ovary
petal	

READING STRATEGY

Mnemonics As you read this section, create a mnemonic device to help you remember the parts of a plant.

xylem the type of tissue in vascular plants that provides support and conducts water and nutrients from the roots

phloem the tissue that conducts food in vascular plants

Figure 1 The roots of these plants provide the plants with water and minerals.

Structures of Seed Plants

You have different body systems that carry out many functions. Plants have systems too—a root system, a shoot system, and a reproductive system.

A plant's root system and shoot system supply the plant with what it needs to survive. The root system is made up of roots. The shoot system includes stems and leaves.

The vascular tissues of the root and shoot systems are connected. There are two kinds of vascular tissue—xylem (ZIE luhm) and phloem (FLOH EM). **Xylem** is vascular tissue that transports water and minerals through the plant. Xylem moves materials from the roots to the shoots. **Phloem** is vascular tissue that transports food molecules to all parts of a plant. Xylem and phloem are found in all parts of vascular plants.

Roots

Most roots are underground, as shown in **Figure 1**. So, many people do not realize how extensive root systems can be. For example, a corn plant that is 2.5 m tall can have roots that grow 2.5 m deep and 1.2 m out and away from the stem!

Root Functions

The following are the three main functions of roots:

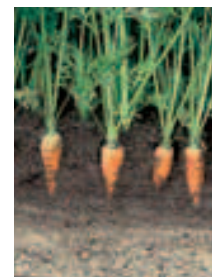
- Roots supply plants with water and dissolved minerals. These materials are absorbed from the soil. The water and minerals are transported to the shoots in the xylem.
- Roots hold plants securely in the soil.
- Roots store surplus food made during photosynthesis. The food is produced in the leaves. Then, it is transported in the phloem to the roots. In the roots, the surplus food is usually stored as sugar or starch.



Onion



Dandelion



Carrots

CHAPTER RESOURCES

Chapter Resource File

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

Technology

- Transparencies
 - Bellringer
 - L42 The Structures of a Root

Workbooks

- Interactive Textbook **Struggling Readers**
- Science Skills
 - Taking Notes **GENERAL**

Is That a Fact!

The deepest roots ever discovered belonged to a wild fig tree in South Africa. The roots had penetrated the soil to a depth of more than 120 m.

Teach

Answer to Math Practice

about 10% ($15,600 + 12,000 = 27,600$
seedless plants; $15,600 + 12,000 +$
 $760 + 235,000 = 263,360$ total plants;
 $27,600 \div 263,360 \times 100 = 10.4\%$)

Group ACTiViTy — BASIC

MATERIALS

FOR EACH GROUP

- bags, plastic, resealable (4)
- ruler, metric
- seed, four varieties, 1 seed each
- towels, paper (4)
- water

Root Growth Have students work in groups of four. Tell students to fold a paper towel in quarters, placing a seed in the fold of the towel. Students should moisten the paper towel thoroughly, but the paper towel should not be dripping. Tell students to place paper towels in a plastic bag. For each day of the next week, have students measure the length of the roots that develop. Students should moisten the paper towel as needed during the week. Students should also observe the roots each day for changes in appearance. Ask students to make a chart of their measurements. Then, ask students the following questions: “What did you notice about the appearance of your roots as they grew?” (Students may notice that the roots grew root hairs or became more numerous. Some students may also note that the tips of the roots seemed slimy.) “Which of your seeds grew the fastest?” (Answers may vary depending on the varieties of seeds used.) At the end of the experiment, consider asking students to plant their seeds in potting soil to see how the roots continue to develop. **K** Kinesthetic

Root Structure

The structures of a root are shown in **Figure 2**. The layer of cells that covers the surface of roots is called the *epidermis*. Some cells of the epidermis extend from the root. These cells, or root hairs, increase the surface area of the root. This surface area helps the root absorb water and minerals. After water and minerals are absorbed by the epidermis, they diffuse into the center of the root, where the vascular tissue is located.

Roots grow longer at their tips. A group of cells called the *root cap* protects the tip of a root. The root cap produces a slimy substance. This substance makes it easier for the root to push through soil as it grows.

Root Systems

There are two kinds of root systems—taproot systems and fibrous root systems. A taproot system has one main root, or a taproot. The taproot grows downward. Many smaller roots branch from the taproot. Taproots can reach water deep underground. Dicots and gymnosperms usually have taproot systems.

A fibrous root system has several roots that spread out from the base of a plant's stem. The roots are usually the same size. Fibrous roots usually get water from close to the soil surface. Monocots usually have fibrous roots.

✓ Reading Check What are two types of root systems? (See the Appendix for answers to Reading Checks.)

MATH PRACTICE

Practice with Percentages

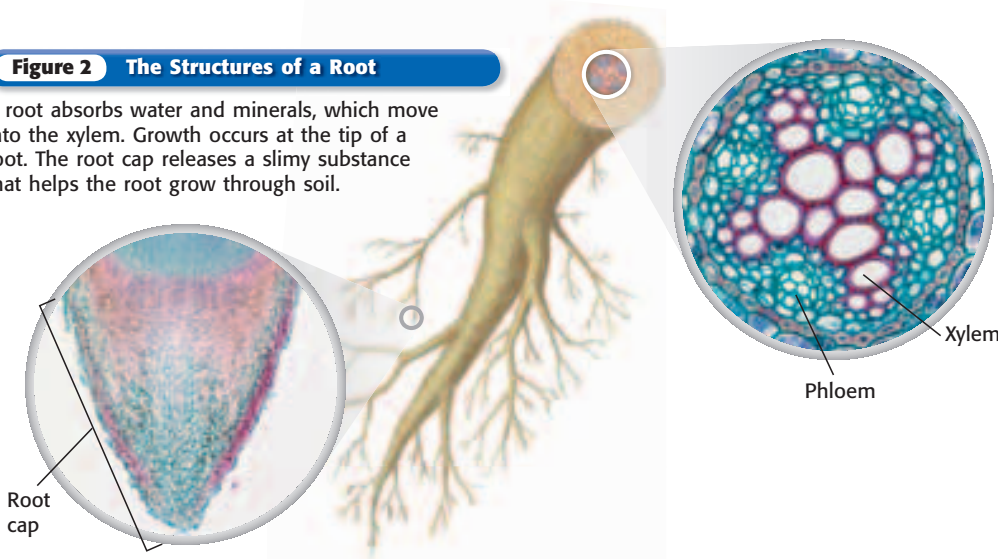
The following table gives an estimate of the number of species in each plant group.

Plant Species	
Plant group	Number of species
Mosses, liverworts, and hornworts	15,600
Ferns, horse-tails, and club mosses	12,000
Gymnosperms	760
Angiosperms	235,000

What percentage of plants do not produce seeds?

Figure 2 The Structures of a Root

A root absorbs water and minerals, which move into the xylem. Growth occurs at the tip of a root. The root cap releases a slimy substance that helps the root grow through soil.



MISCONCEPTION ALERT

Tubers Students may think potatoes are the roots of the potato plant. Though they grow underground, potatoes are not roots. They are modified stems called *tubers*.

Answer to Reading Check

taproot systems and fibrous root systems

Activity

BASIC

Stem Functions Have students draw pictures that illustrate the functions of stems. Tell them to write captions for each illustration. **Visual/Verbal**

CONNECTION Activity

History

ADVANCED

Using Stems The stems of many large aquatic grasses are called *reeds*. After reeds are harvested and dried, they can be used to construct many useful products. For thousands of years, arrows, pens, baskets, musical instruments, furniture, and houses have been made out of reeds. Building boats from reeds is an ancient craft that is still practiced in some places where reeds are plentiful. Ancient Egyptian buildings include friezes of oceangoing ships made of reeds. In the 1960s, a Norwegian explorer named Thor Heyerdahl wondered if a reed ship could have provided ancient peoples with transportation across the Atlantic Ocean. To demonstrate that such a journey was possible, he had Bolivian craftsmen build a traditional reed vessel, the *Ra II*. Ask students to research Heyerdahl and the *Ra II*. Have interested students make a model of Heyerdahl's reed vessel. **Kinesthetic**



Figure 3 The stem, or trunk, of this valley oak keeps the tree upright, which helps leaves get sunlight for photosynthesis.

Stems

Stems vary greatly in shape and size. Stems are usually located above ground. However, many plants have underground stems. The trunk of the valley oak in **Figure 3** is a stem.

Stem Functions

A stem connects a plant's roots to its leaves and flowers. A stem also has the following functions:

- Stems support the plant body. Leaves are arranged along stems or on the ends of stems. This arrangement helps leaves get sunlight for photosynthesis. Stems hold up flowers, which helps pollinators, such as bees, see the flowers.
- Stems transport materials between the root system and the shoot system. Xylem carries water and dissolved minerals from the roots to the leaves and other shoot parts. Phloem carries the food made during photosynthesis to roots and other parts of the plant.
- Some stems store materials. For example, the stems of cactuses and some trees are adapted for water storage.

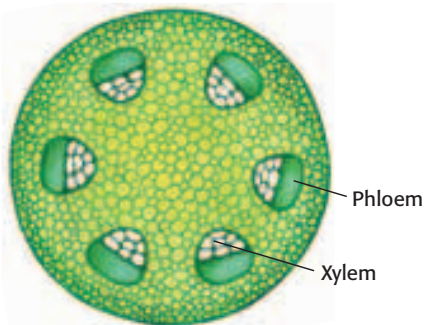
Herbaceous Stems

Many plants have stems that are soft, thin, and flexible. These stems are called *herbaceous stems* (huh- BAY shuhs STEMZ). Examples of plants that have herbaceous stems include wildflowers, such as clovers and poppies. Many crops, such as beans, tomatoes, and corn, have herbaceous stems. A cross section of an herbaceous stem is shown in **Figure 4**.

✓ Reading Check What are herbaceous stems? Give an example of a plant that has an herbaceous stem.

Figure 4 Cross Section of an Herbaceous Stem

Buttercups are just one plant that has herbaceous stems. Wildflowers and many vegetables have soft, thin, and flexible stems.



Is That a Fact!

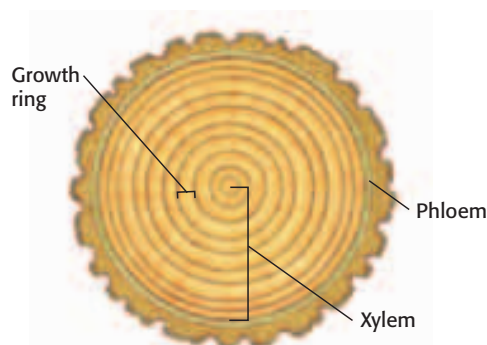
Linen is a fabric woven from the long fibers harvested from the stems of flax plants. Humans have used linen fabrics for over 10,000 years.

Answer to Reading Check

Sample answer: Herbaceous stems are soft, thin, and flexible. Poppies have herbaceous stems.

Figure 5 Cross Section of a Woody Stem

Some plants, such as these trees, have woody stems. Plants that have woody stems usually live for many years. People can use growth rings to estimate the age of a plant.



Woody Stems

Trees and shrubs have rigid stems made of wood and bark. These stems are called *woody stems*. **Figure 5** shows a cross section of a woody stem. Trees or shrubs that live in areas with cold winters have a growing period during the spring and summer. These plants have a dormant period during the winter. At the beginning of each growing period, large xylem cells are produced. As fall approaches, the plants produce smaller xylem cells, which appear darker. In the fall and winter, the plants stop producing new cells. The cycle begins again the next spring. A ring of dark cells surrounding a ring of light cells makes up a growth ring.

Leaves

Leaves vary greatly in shape. They may be round, narrow, heart-shaped, or fan-shaped. Leaves also vary in size. The raffia palm has leaves that may be six times longer than you are tall. The leaves of duckweed, a tiny aquatic plant, are so small that several of the leaves can fit on your fingernail. **Figure 6** shows a poison ivy leaf.

Leaf Functions

The main function of leaves is to make food for the plant. Chloroplasts in the cells of leaves capture energy from sunlight. The leaves also absorb carbon dioxide from the air. The leaves use the captured energy to make food, or sugar, from carbon dioxide and water.



Figure 6 The leaves of poison ivy are very distinctive. They make food to help the plant survive.

ACTIVITY

GENERAL

Analyzing Tree Rings Have students examine preserved cross sections of trees that clearly show growth rings. Ask students to identify the xylem and phloem rings. (Students should recognize that phloem compose the innermost part of bark. Xylem form the growth rings of the center of the stem.) Ask students to measure the width of each ring and to interpret the measurements. Have them take into account the growing conditions in the spring and summer. (Students may recognize dry years and wet years based on these measurements.)

Visual

English Language Learners

WEIRD SCIENCE

Garlic bulbs are fleshy, nutrient-storing structures composed of modified leaves and a stem. Garlic has a pungent flavor and is often used to season foods. Sometimes, garlic is used as a nutritional supplement. At the annual Gilroy Garlic Festival in Gilroy, California, visitors can purchase garlic ice cream and garlic candy.

CHAPTER RESOURCES

Technology



Transparencies

- L42 Cross Section of an Herbaceous Stem; Cross Section of a Woody Stem

Teach, continued

Group Activity — GENERAL

MATERIALS

FOR EACH GROUP

- books, heavy
- leaves
- newspapers
- notebook or index cards
- paper towels
- tape, transparent

Safety Caution: Tell students to avoid plants such as poison ivy and poison oak during this activity. You may want to show students pictures of these plants.

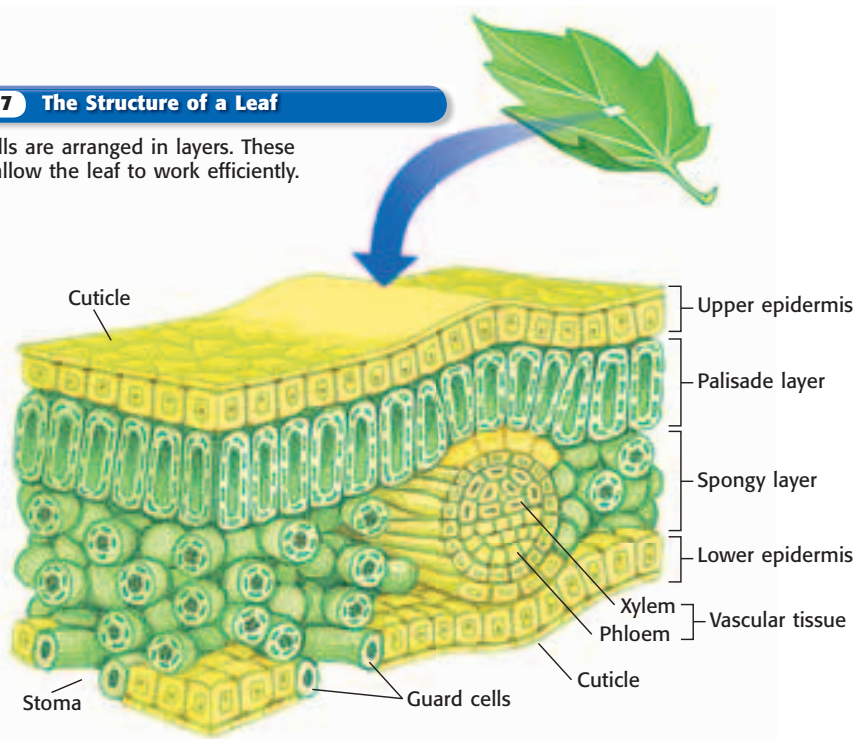
Leaf Collecting Challenge students to see how many different types of leaves they can collect. Students should press the leaves for a few days after collecting them. They can do this by placing each leaf between two paper towels and several sheets of newspaper on each side. Then, students should stack heavy books on top of the leaf. When the leaf is flat and dry, have students tape the leaves to cards or to the pages of a notebook. Have students use reference books to identify the names of the plants from which they collected the leaves. Have students label each leaf with the common name, the scientific name, the date on which the leaf was collected, and the location where the leaf was found.

Kinesthetic

English Language Learners

Figure 7 The Structure of a Leaf

Leaf cells are arranged in layers. These layers allow the leaf to work efficiently.



Leaf Structure

The structure of leaves, shown in **Figure 7**, is related to their main function—photosynthesis. The outer surfaces of a leaf are covered by a cuticle. The cuticle prevents water loss from the leaf. A single layer of cells, the epidermis, lies beneath the cuticle. Light passes through the epidermis. Tiny openings in the epidermis, called *stomata* (singular, *stoma*), let carbon dioxide enter the leaf. Guard cells open and close the stomata.

Most photosynthesis takes place in the middle of a leaf. This part of a leaf often has two layers. Cells in the upper layer, the palisade layer, contain many chloroplasts. Photosynthesis takes place in the chloroplasts. Carbon dioxide moves freely in the space between the cells of the second layer, the spongy layer. Xylem and phloem are also found in the spongy layer.

Reading Check What are the cell layers of a leaf?

Leaf Adaptations

Some leaves have functions other than photosynthesis. For example, the leaves of many cactuses are modified as spines. These spines keep animals from eating the cactuses. The leaves of another plant, the sundew, are modified to catch insects. Sundews grow in soil that does not contain enough nitrogen to meet the plants' needs. By catching and digesting insects, a sundew is able to get enough nitrogen.

SCHOOL to HOME

Looking at Leaves

Leaves are many shapes and sizes. They are also arranged on a stem in many ways. Walk around your home. In your **science journal**, sketch the leaves of the plants you see. Notice how the leaves are arranged on the stem, the shapes of the leaves, and the veins in the leaves. Use a ruler to measure the size of the leaves.

Activity

Answer to Reading Check

epidermis, palisade layer, and spongy layer

SUPPORT FOR

English Language Learners

Plant Structure A cooperative learning strategy will help students process the information in this section. When students have finished reading, place them in groups of 4. In each group, one person is responsible for explaining one part of the plant to the group. Students should note the main ideas presented for each part in a four-column table. Later, invite the groups to contribute to a class table to check for accuracy.

Verbal/Interpersonal

Flowers

Most people admire the beauty of flowers, such as the wildflowers in **Figure 8**. But why do plants have flowers? Flowers are adaptations for sexual reproduction.

Flowers come in many shapes, colors, and fragrances. Brightly colored and fragrant flowers usually rely on animals for pollination. For example, some flowers look and smell like rotting meat. These flowers attract flies. The flies pollinate the flowers. Plants that lack brightly colored flowers and fragrances, such as grasses, depend on the wind to spread pollen.

Many flowers also produce nectar. Nectar is a fluid that contains sugar. Nectar attracts birds and insects. These animals move from flower to flower and drink the nectar. As they do so, they often carry pollen to the flowers.

Sepals and Petals

Flowers usually have the following basic parts: sepals, petals, stamens, and one or more pistils. The flower parts are usually arranged in rings around the central pistil.

Sepals are modified leaves that make up the outermost ring of flower parts and protect the bud. Sepals are often green like other leaves. Sepals cover and protect the flower while it is a bud. As the blossom opens, the sepals fold back. Then, the petals can unfold and become visible. **Petals** are broad, flat, thin leaflike parts of a flower. Petals vary greatly in color and shape. Petals attract insects or other animals to the flower. These animals help plants reproduce by carrying pollen from flower to flower.

sepal in a flower, one of the outermost rings of modified leaves that protect the flower bud

petal one of the ring or rings of the usually brightly colored, leaf-shaped parts of a flower

Figure 8 Many flowers help the plants reproduce by attracting pollinators with bright petals and strong fragrances.



Is That a Fact!

The more water-repellent a leaf is, the healthier it may be, according to some scientists. Dirt, which contains disease-causing microbes, has a stronger attraction to water droplets than to a leaf's surface. When the water rolls off the leaf, so do the dirt and microbes. Water repellency thus helps prevent infection.

CHAPTER RESOURCES

Technology



Transparencies

- L44 The Structure of a Leaf
- **LINK TO PHYSICAL SCIENCE** P92 The Electromagnetic Spectrum

Discussion

GENERAL

Attracting Pollinators Discuss that flowers serve an important purpose for plants. Ask students to read the material about flowers and to consider how the following factors make flowers successful in the plant world: color, shape, and smell. (**Sample answers:** The color of a flower may attract insects. The shape of a flower may be adapted for a specific pollinator, such as a hummingbird. Or the shape may help the flower spread pollen by the wind. The fragrance of a flower is designed to attract pollinators. For example, flies are drawn to bad-smelling flowers.) **LS Verbal**

Homework

GENERAL



Pointy Plants A cactus's spines are modified leaves. Other plants have sharp projections to protect them. Roses have prickles. The hawthorn tree has thorns. Have students write a report about "painful" plant parts. Their report should state whether the projection is a modified leaf or another physical structure.

LS Verbal

CONNECTION to Earth Science

ADVANCED

Electromagnetic Spectrum

Photosynthesis is the process by which plants convert light energy to chemical energy. The light energy that plants use is only a small part of the electromagnetic spectrum. Use the teaching transparency entitled "The Electromagnetic Spectrum" to help students understand that plants use the visible-light portion of the electromagnetic spectrum for photosynthesis.

LS Visual

Close

Reteaching

BASIC

Flower Parts Ask student volunteers to describe a flower part and to draw that part on the board. Continue until students have drawn a complete flower.

 **Visual**

Quiz

GENERAL

- Why do some plants have brightly colored flowers and other plants do not? (Sample answer: Plants with brightly colored flowers usually attract animals for pollination. Plants without showy flowers usually rely on the wind for pollination.)
- Describe the two types of root systems, and list one plant that has each type. (A taproot system has one main root. Carrots have a taproot. Fibrous root systems include many roots of a similar size that grow from the base of the stem. Onions have fibrous roots.)

Alternative Assessment

GENERAL

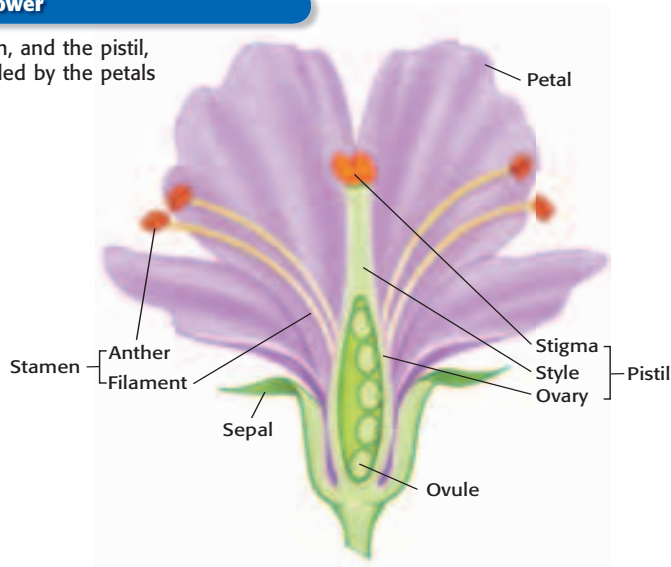
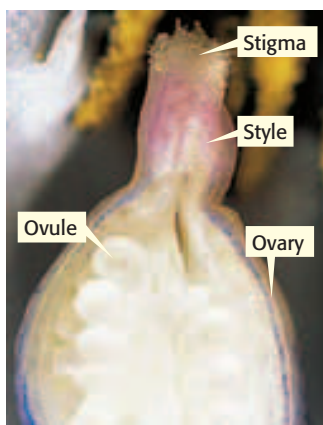
Eating Plants Have students list ingredients for a salad.

(Sample answers: lettuce, tomato, cucumber, carrot, cabbage, broccoli, alfalfa sprouts, and garbanzo beans) Ask students to identify the part of the plant that is eaten. (Sample answer: Lettuce and cabbage come from leaves. Tomato and cucumber are fruits. Carrots are roots. Broccoli are flowers. Alfalfa sprouts are root, stem, and leaf. Garbanzo beans are seeds.)

 **Logical/Verbal**

Figure 9 The Structure of a Flower

The stamens, which produce pollen, and the pistil, which produces eggs, are surrounded by the petals and the sepals.



Stamens and Pistils

As you can see in **Figure 9**, the stamens of flowers are usually found just above the petals. A **stamen** is a male reproductive structure of flowers. Each stamen has a thin stalk called a *filament*. The filament is topped by an anther. Anthers are saclike structures that produce pollen.

Found in the center of most flowers is one or more pistils. A **pistil** is the female reproductive structure of flowers. The tip of the pistil is called the *stigma*. Pollen grains collect on stigmas, which are often sticky or feathery. The long, slender part of the pistil is the style. The rounded base of a pistil that contains one or more ovules is called the **ovary**. Each ovule contains an egg. When the egg is fertilized, the ovule develops into a seed. The ovary develops into a fruit.

 **Reading Check** Describe stamens and pistils. Which are the female parts of a flower? the male parts of a flower?

The Importance of Flowers

Flowers help plants reproduce. Humans also use flowers for many things. Roses and many other flowers are used for floral arrangements. Some flowers, such as artichokes, broccoli, and cauliflower, can be eaten. Other flowers, such as hibiscus and chamomile flowers, are used to make tea. Flowers used as spices include cloves and saffron. Flowers are also used in perfumes, lotions, and shampoos.

Answer to Reading Check

Sample answer: Stamens, which have filaments topped by anthers, are the male reproductive parts of flowers. A pistil is the female part of a flower. A pistil has a stigma, style, and ovary.

SECTION Review

Summary

- Roots supply plants with water and dissolved minerals. They support and anchor plants. Roots also store surplus food made during photosynthesis.
- Stems support the body of a plant. They allow transport of material between the root system and shoot system. Some stems store materials, such as water.
- A leaf has a thin epidermis on its upper and lower surfaces. The epidermis allows sunlight to pass through to the center of the leaf.
- Most photosynthesis takes place in the palisade layer of a leaf. The spongy layer of a leaf allows the movement of carbon dioxide and contains the xylem and phloem.
- The four main parts of a flower are the sepals, the petals, the stamens, and one or more pistils.
- Flowers are usually arranged around the pistil. The ovary of a pistil contains ovules. When the eggs are fertilized, ovules develop into seeds and the ovary becomes a fruit.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *xylem*, *phloem*, *stamen*, and *pistil*.
2. Use each of the following terms in a separate sentence: *sepal*, *petal*, *pistil*, and *ovary*.

Understanding Key Ideas

3. Which of the following flower structures produces pollen?
 - a. pistil
 - b. filament
 - c. anther
 - d. stigma
4. The ____ of a leaf allows carbon dioxide to enter.
 - a. stoma
 - b. epidermis
 - c. palisade layer
 - d. spongy layer
5. Compare xylem and phloem.
6. Describe the internal structure of a leaf.
7. What are the functions of stems?
8. Identify the two types of stems, and briefly describe them.
9. How do people use flowers?

Critical Thinking

10. **Making Inferences** Describe two kinds of root systems. How does the structure of each system help the roots perform their three functions?

11. **Applying Concepts** Pampas grass flowers are found at the top of tall stems, are light-colored, and are unscented. Explain how pampas grass flowers are most likely pollinated.

Interpreting Graphics

Use the table below to answer the questions that follow.

Age of Trees in a Small Forest	
Number of trees	Number of growth rings
5	71
1	73
3	68

12. How many trees are older than 70 years?
13. What is the average age of these trees, in years?

SCILINKS **NSTA**

Developed and maintained by the
National Science Teachers Association

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

Topic: Structure of Seed Plants
SciLinks code: HSM1467

Answers to Section Review

1. Sample answer: Xylem transports water and minerals. Phloem transports food molecules. A stamen is the male reproductive part of a flower. A pistil is the female reproductive structure of a flower.
2. Sample answer: A flower bud is protected by sepals. The petals of a flower attract pollinators. The pistil of a flower is often found at the center of the flower. The ovary of a flower protects the ovules and develops into a fruit.
3. c
4. a

5. Sample answer: Xylem transports water and nutrients from the roots to the shoots. Phloem transports food molecules throughout the plant.
6. Sample answer: A leaf often has two middle layers. The cells of the palisade layer have many chloroplasts. The spongy layer lies beneath the palisade layer and includes the xylem and phloem.
7. Sample answer: Stems support the plant body, transport materials between the root and shoot systems, and store materials.
8. Herbaceous stems are soft, thin, and flexible. Woody stems are rigid and made of wood and bark.
9. Sample answer: Flowers are used for floral arrangements. Some flowers can be eaten, used to make tea, or used as spices. Flowers are also used in perfumes, lotions, and shampoos.
10. Sample answer: A taproot system has one main root, the taproot. Taproots may grow very deep to reach water and minerals. They also hold the plant in the soil. Taproots can also store surplus food, as carrots do. A fibrous root system has several roots of a similar size that spread out from the base of the plant. Fibrous roots may absorb water from the soil surface. Fibrous roots spread out from the stem and hold the plant in place. They also store some surplus food.
11. Sample answer: Pampas grass flowers are pollinated by the wind. They don't have brightly colored petals to attract pollinators, nor do they have a fragrance. Also, they are at the top of a tall stem where they might best catch the wind.
12. 6 trees
13. $5 \times 71 = 355$; $3 \times 68 = 204$;
 $355 + 204 + 73 = 632$;
 $632 \div 9 = 70.2$ years

CHAPTER RESOURCES

Chapter Resource File

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

Technology

- Transparencies
- L45 The Structure of a Flower

Build a Flower

Teacher's Notes

Time Required

One 45-minute class period

Lab Ratings



Teacher Prep

Student Set-Up

Concept Level

Clean Up

MATERIALS

The materials listed on the student page include enough supplies for one student or group of students.

Safety Caution

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



OBJECTIVES

Build a model of a flower.

Explain how the model represents an actual flower.

Describe the basic parts of a flower.

MATERIALS

- art materials such as colored paper, pipe cleaners, beads, and yarn
- card, index, 3 × 5 in.
- glue
- recycled items such as paper plates and cups, yogurt containers, wire, string, buttons, cardboard, and bottles
- scissors
- tape

SAFETY



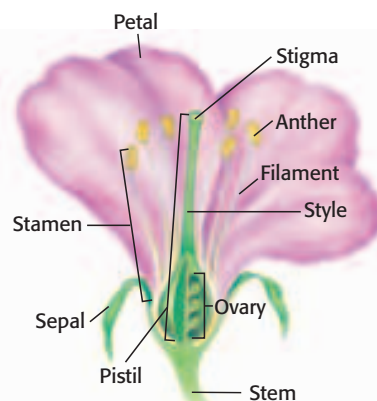
Build a Flower

Scientists often make models in the laboratory. Models help scientists understand processes and structures. Models are especially useful when scientists are trying to understand processes that are too small to be seen easily, such as pollination, or processes that are too large to be examined in a laboratory, such as the growth of a tree. Models also make it possible to examine the structures of objects, such as flowers.

In this activity, you will use your creativity and your understanding of the structure of a flower to make a model of a flower from recycled materials and art supplies.

Procedure

- 1 Draw a flower similar to the one shown in the figure below. This flower has both male and female parts. Not all flowers have this structure. The flowers of many species of plants have only male parts or only female parts, not both.



- 2 Decide which materials you will use to represent each flower part. Then, build a three-dimensional model of a flower that looks like one of the flowers shown on the next page. The model you build should contain each of the following parts: stem, sepals, petals, stamens (anther and filament), and pistil (stigma, style, and ovary).



Holt Lab Generator CD-ROM

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



Jane Lemons
Western Rockingham
Middle School
Madison, North Carolina

CHAPTER RESOURCES

Chapter Resource File

- Datasheet for Chapter Lab
- Lab Notes and Answers

Technology



Classroom Videos

- Lab Video



- Leaf Me Alone!
- Travelin' Seeds



Lily



Tulip



Hibiscus

- 3 After you build your model, draw a key for your flower model on an index card. Label each of the structures represented on your flower.

Analyze the Results

- 1 **Organizing Data** List the structures of a flower, and explain the function of each part.
- 2 **Identifying Patterns** What is the outermost part of your flower? the innermost part of your flower?
- 3 **Analyzing Data** How are your flower model and an actual flower alike? How are they different?

Draw Conclusions

- 4 **Drawing Conclusions** How might your flower attract pollinators? What modifications could you make to your flower to attract a greater number of pollinators?
- 5 **Evaluating Models** Is your model an accurate representation of a flower? Why or why not?
- 6 **Making Predictions** If you based your flower model on a plant species that had flowers that did not have both male and female parts, how would that model be different from your current model?

Applying Your Data

Research flowering plants whose flowers do not have both male and female reproductive parts. Build models of the male flower and the female flower for one of these flowering plants. Then, compare the new models to your original model, which includes both male and female reproductive parts.

Analyze the Results

1. **petal:** the often colorful leaf-shaped part of a flower that attracts pollinators
sepal: the modified leaves that form the base of the flower and that enclose and protect the bud before the flower opens
stem: the main stalk of the plant from which leaves, flowers, and fruits develop; water and nutrients move through the stem between the leaves and roots
pistil: the female reproductive structure of a flower
stigma: the upper tip of the pistil, which receives pollen
style: the stalklike part of the pistil between the stigma and ovary
ovary: the enlarged part of the pistil in which ovules are formed
stamen: the male reproductive structure of flowers
anther: the top of the stamen that produces pollen
filament: the threadlike part of the stamen that holds the anther

2. sepals; pistil

3. Sample answer: My flower model and an actual flower have the same parts: sepals, petals, stamens, and pistils. Unlike real flowers, my flower cannot be pollinated, nor can it produce seeds.

Draw Conclusions

4. Sample answer: My flower will attract pollinators because it has bright petals. I could give my flower a fragrance to attract more pollinators.
5. Sample answer: My flower is accurate in appearance, but it is not accurate in function. My model looks like a flower, but it cannot be pollinated or fertilized.
6. Sample answer: My flower would have only stamen or only pistils if it were modeled after a plant that had flowers without both male and female parts.

CHAPTER RESOURCES

Workbooks



Whiz-Bang Demonstrations

- Inner Life of a Leaf **ADVANCED**



EcoLabs & Field Activities

- The Case of the Ravenous Radish **GENERAL**



Long-Term Projects & Research Ideas

- Plant Planet **ADVANCED**

Applying Your Data

Students should demonstrate an understanding of how flowers with both male and female parts differ from flowers with only male or only female parts. Students' models should reflect this understanding. Some students may also note that in some species, both male and female flowers can be found on one plant, but in other species, they are found on different plants.

Chapter Review

Assignment Guide	
SECTION	QUESTIONS
1	5, 9, 11–12, 14, 19
2	3, 13
3	7
4	1–2, 4, 6, 8, 10, 16–18, 20, 22–25
1 and 4	21
2 and 3	15

ANSWERS

Using Key Terms

1. stamen
2. Xylem
3. rhizome
4. pollen
5. nonvascular plant
6. Phloem

Understanding Key Ideas

7. a
8. d
9. a
10. a
11. Plants make their own food by photosynthesis. Plants also have cuticles. Plant cells have rigid cell walls. Plants have a two-stage life cycle.
12. nonvascular plants, seedless vascular plants, gymnosperms, and angiosperms
13. Mosses, liverworts, and hornworts are nonvascular plants. Ferns, horsetails, and club mosses are seedless vascular plants.

Chapter Review

USING KEY TERMS

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

pistil rhizoid
vascular plant rhizome
xylem phloem
pollen stamen
nonvascular plant

- 1 A ____ is the male part of a flower.
- 2 ____ transports water and nutrients through a plant.
- 3 An underground stem that produces new leaves and roots is called a ____.
- 4 The male gametophytes of flowers are contained in structures called ____.
- 5 A ____ does not have specialized tissues for transporting water.
- 6 ____ transports food through a plant.

UNDERSTANDING KEY IDEAS

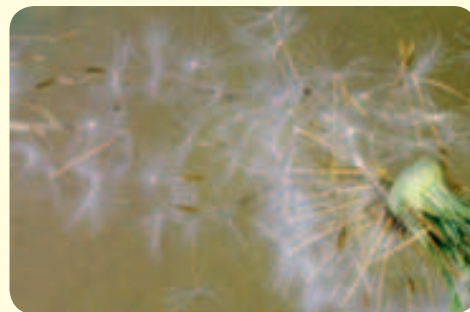
Multiple Choice

- 7 Which of the following statements about angiosperms is NOT true?
 - a. Their seeds are protected by cones.
 - b. They produce seeds.
 - c. They provide animals with food.
 - d. They have flowers.
- 8 Roots
 - a. supply water and nutrients.
 - b. anchor and support a plant.
 - c. store surplus food.
 - d. All of the above

- 9 Which of the following statements about plants and green algae is true?
 - a. Plants and green algae may have a common ancestor.
 - b. Green algae are plants.
 - c. Plants and green algae have cuticles.
 - d. None of the above
- 10 In which part of a leaf does most photosynthesis take place?
 - a. palisade layer c. xylem
 - b. phloem d. epidermis

Short Answer

- 11 List four characteristics that all plants share.
- 12 List the four main groups of plants.
- 13 Name three nonvascular plants and three seedless vascular plants.
- 14 Why do scientists think green algae and plants have a common ancestor?
- 15 How are seedless plants, gymnosperms, and angiosperms important to the environment?
- 16 What are two advantages that seeds have over spores?



14. Sample answer: Plants and green algae have many similarities, so scientists think they are related. Both have the same kind of chlorophyll and cell walls. Both store food in the form of starch, and both have a two-stage life cycle.
15. Sample answer: Nonvascular plants are often the first plants to live in a new environment. They form a thin layer of soil, to which seedless vascular plants add. Seedless plants also prevent soil erosion. Gymnosperms are often found in gardens and parks, and angiosperms provide most of the food that animals need to survive.

16. Sample answer: When a young seed plant begins to grow, it can use stored food in the seed. Spores do not have stored food to help a plant grow. Another advantage is that seeds can be spread by animals, while spores are spread by wind. Animals spread seeds more efficiently than the wind spreads spores.



CRITICAL THINKING

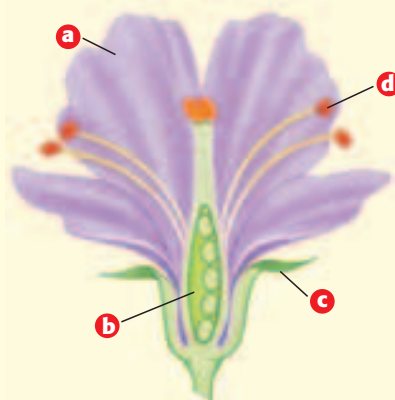
- 17 Concept Mapping** Use the following terms to create a concept map: *flowers, pollen, stamens, ovaries, pistils, stigmas, filaments, anthers, ovules, petals, and sepals.*
- 18 Making Comparisons** Imagine that a seed and a spore are beginning to grow in a deep, dark crack in a rock. Which of the two is more likely to grow into an adult plant? Explain your answer.
- 19 Identifying Relationships** Grass flowers do not have strong fragrances or bright colors. How might these characteristics be related to the way by which grass flowers are pollinated?
- 20 Analyzing Ideas** Plants that are pollinated by wind produce more pollen than plants pollinated by animals do. Why might wind-pollinated plants produce more pollen?
- 21 Applying Concepts** A scientist discovered a new plant. The plant has vascular tissue and produces seeds. It has brightly colored and strongly scented flowers. It also has sweet fruits. Based on this information, which of the four main types of plants did the scientist discover? How is the plant most likely pollinated? How does the plant most likely spread its seeds?

INTERPRETING GRAPHICS

- 22** Look at the cross section of a woody stem below. Use the diagram to determine the age of the tree.



Use the diagram of the flower below to answer the questions that follow.



- 23** Which letter corresponds to the structure in which pollen is produced? What is the name of this structure?
- 24** Which letter corresponds to the structure that contains the ovules? What is the name of this structure?
- 25** Which letter corresponds to the structure that protects the flower bud? What is the name of this structure?

Critical Thinking

- 17.** An answer to this exercise can be found at the end of this book.
- 18.** Sample answer: The seed is more likely to grow than the spore. Because spores do not have stored food, the new plant must begin photosynthesis right away. But the spore and seed are in a deep, dark crack, so the spore is not getting any light for photosynthesis. Because the seed has stored food, the plant can grow in the crack without light for photosynthesis.
- 19.** Sample answer: If grass flowers had bright petals and strong fragrances, they would likely be pollinated by animals. However, because grass flowers do not have these characteristics, they are most likely pollinated by the wind.
- 20.** Sample answer: Animals pollinate plants by travelling from one plant to another. However, the wind may not blow from one plant to another, so wind-pollinated plants produce more pollen. Producing more pollen increases the chance that pollen will be blown onto the female structures of wind-pollinated plants' flowers.
- 21.** Sample answer: The plant is an angiosperm because it has flowers and fruit. Because the plant has brightly colored and strongly scented flowers, it is likely pollinated by animals. The fruits are sweet, so they are likely eaten by animals, and the seeds are dispersed elsewhere by the animals.

CHAPTER RESOURCES

Chapter Resource File

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

Workbooks

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

Interpreting Graphics

- 22.** 10 years
- 23.** d; anther
- 24.** b; ovary
- 25.** c; sepal

Standardized Test Preparation

Teacher's Note

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

MISCONCEPTION ALERT

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

READING

Passage 1

1. B
2. H
3. B

TEST DOCTOR

Question 2: Some students may think the word *species* refers to DNA or genes because members of a species share similar genes and DNA. However, this fact is not in the passage. As the word *species* is used in the passage, it can only mean "group of organisms."

Question 3: Some students may select answer D, but the two items in this answer are part of a single process, not two. Bacteria and a gene gun are the two distinct means of introducing new DNA discussed in the passage. Fungi are not mentioned in the passage.



Standardized Test Preparation

READING

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

Passage 1 Through genetic engineering, scientists are now able to duplicate one organism's DNA and place a certain gene from the DNA into the cells of another species of plant or animal. This technology enables scientists to give plants and animals a new trait that can then be passed on to future generations. There are two methods to introduce new DNA into plant cells. In one method, DNA is first placed inside a special bacterium, which carries the DNA into the plant cell. In the second method, microscopic particles of metal are coated with the new DNA and fired into the plant cells with a device called a *gene gun*.

1. Based on the passage, what does genetic engineering allow scientists to do?
A to breed better plants
B to move genes from one organism to another
C to see a very small object without a microscope
D to grow plants without soil
2. In the passage, what does the word *species* most likely mean?
F DNA
G future generations
H group of organisms
I genes
3. Based on the passage, what are the two most common ways genes are moved to plant cells?
A by bacteria and fungi
B by bacteria and a gene gun
C by fungi and a gene gun
D by particles of metal and a gene gun

Passage 2 The main function of leaves is photosynthesis, or the production of food. However, some leaves have functions other than photosynthesis. For example, the leaves on a cactus plant are modified as spines. These spines discourage animals from eating the cactus. The leaves of another plant, the sundew, are modified to catch insects. Sundews live in areas with nitrogen-poor soil. They don't get enough nitrogen from the soil to meet their needs. So, the plants use their modified leaves to catch insects. Then, the sundews digest the insects to get the nitrogen they need to survive.

1. Based on the passage, which of the following statements about photosynthesis is true?
A Photosynthesis produces modified leaves.
B Photosynthesis is how plants catch insects for food.
C Photosynthesis discourages animals from eating plants.
D Photosynthesis is how plants get food.
2. Based on the passage, what do the modified leaves of cactuses do?
F They discourage animals from eating them.
G They catch insects for nitrogen.
H They function mainly for photosynthesis.
I They help cactuses get enough nitrogen from the soil.
3. Based on the passage, what can be concluded about pitcher plants if they capture insects?
A They grow in areas with nitrogen-poor soil.
B They are trying to discourage animals from eating them.
C They don't need nitrogen from insects to survive.
D They have leaves that are modified as spines.

Passage 2

1. D
2. F
3. A

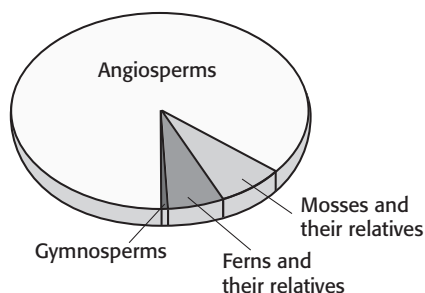
TEST DOCTOR

Question 2: Some students may think that the modified leaves of cactuses catch insects, function for photosynthesis, or help the plants get enough nitrogen. Although all of these things are mentioned in the passage, the spines of cactuses are not designed to catch insects, nor do they contain chlorophyll for photosynthesis. In the passage, sundews need nitrogen from insects, but cactuses are not described as needing nitrogen from insects.

INTERPRETING GRAPHICS

The pie graph below shows the distribution of four types of plants. Use the pie graph below to answer the questions that follow.

Distribution of Plants



- Which of the following types of plants is the least common?
A ferns and their relatives
B mosses and their relatives
C angiosperms
D gymnosperms
- About what percentage of plants are angiosperms?
F 1%
G 10%
H 20%
I 80%
- About what percentage of plants are mosses, ferns, and their relatives?
A 1%
B 10%
C 20%
D 80%
- If there are about 265,000 species of plants, about how many of the species are mosses and relatives of mosses?
F 2,650 species
G 13,250 species
H 26,500 species
I 212,000 species

MATH

Read each question below, and choose the best answer.

- Sophie wants to plant a garden. Her garden is 25 m wide. She puts a row of plants every half meter. Every fifth row is a row of flowers. If the rest of the rows are vegetables, about how many rows of vegetables are in the garden?
A 10 rows
B 25 rows
C 40 rows
D 50 rows
- The area of a garden is 50 m^2 . If the garden is 12 m long, which of the following equations expresses the value of w , the width of the garden?
F $w = 12 \times 50$
G $w = 50 \times 12$
H $w = 50 \div 12$
I $w = 12 \div 12$
- There are 140 species of cycads. If 18% of gymnosperms are cycads, about how many gymnosperms are there?
A 25 gymnosperms
B 165 gymnosperms
C 775 gymnosperms
D 2,520 gymnosperms
- A packet of cabbage seeds that contains enough seeds for two rows costs \$2.00. A packet of carrots that contains enough seeds for three rows costs \$2.25. If Katy wants to plant five rows of cabbage and seven rows of carrots, how much will the seeds cost?
F \$12.75
G \$12.00
H \$8.50
I \$6.00

INTERPRETING GRAPHICS

- D
- I
- C
- H



Question 3: Some students may think that the answer to this question is 10%. However, the question asks for both mosses and their relatives and ferns and their relatives. Together, these two groups comprise about 20% of plants.

MATH

- C
- H
- C
- F



Question 1: Some students may answer 50 rows if they don't notice that every fifth row in the garden is flowers. Other students may answer 10 rows if they calculate the number of rows of flowers instead of the rows of vegetables. Some students may answer 25 rows because the number 25 appears in the question. However, 40 rows is the best answer. You may want to diagram this problem on the board to help students understand it.

Question 3: Some students may answer 25 gymnosperms if they calculate 18% of 140. Other students will answer 165 gymnosperms if they multiply 140 by 1.18. Some students will answer 2,520 if they multiply 140 by 18. However, to find the total number of gymnosperms, students should divide 140 by 0.18, which yields 778. So, the best answer is 775 gymnosperms.

CHAPTER RESOURCES

Chapter Resource File



• Standardized Test Preparation **GENERAL**

State Resources



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

Scientific Debate

Background

The risks of taking herbal supplements can increase when supplements contain more than one ingredient. Steve Bechler, a 23-year-old minor-league baseball player, was a regular user of a weight-loss dietary supplement containing ephedra and caffeine. During spring training with the Baltimore Orioles in 2003, Bechler collapsed and died. After his death, minor league baseball joined professional and college football in banning ephedra use by its athletes.

Science, Technology, and Society

Activity

GENERAL

Have students research plant poaching in your area. Have them identify which plants are being stolen and why, and have them identify steps being taken to control poaching. Ask students to contact local park managers or state and federal natural resources agencies, such as the National Park Service. Other sources of information include the Internet, newspapers, and magazines. Students should make posters about their findings, including pictures of the plants that poachers steal and a description of the plants' habitats.

Science in Action



Scientific Debate

Are Herbal Supplements Safe?

Humans have always used plants for food, for shelter, or for medicine. In fact, one of our most common medicines, aspirin, is similar to a chemical found in the bark of a willow tree. Today, many people still use natural plant products, such as pills or teas, as medicine. These products are often called *herbal supplements*. Echinacea, St. John's wort, and ma huang are just a few examples of the herbal supplements that people use to treat a variety of health problems. People spend billions of dollars on herbal supplements each year. But are herbal supplements safe to use?

Social Studies Activity

Make a poster illustrating a plant used for medicine by native cultures and the health problems the plant is used to treat.



Science, Technology, and Society

Plant Poachers

Imagine you're walking through a swamp. The swamp is full of life. You're surrounded by trees, vines, and water lilies. You can hear frogs singing and mosquitoes buzzing. Then, you notice a ghost orchid hanging from a tree branch. The flower of this orchid looks like a ghost or like a white frog leaping. For some people, this orchid is worth stealing. These people, called *plant poachers*, steal orchids and other plants from the wild. Many plant species and natural areas are threatened by plant theft.

Math Activity

A plant poacher stole 100 plants from a nature preserve. He planned on selling each plant for \$50, but he was caught and was fined \$300 for each plant he stole. What is the difference between the total fine and the total amount of money the plant poacher planned on selling the plants for?

Answer to Social Studies Activity

Students should demonstrate an understanding of the medicinal uses of plants by native cultures in places such as South America and Asia. Students may also research traditional plant use by Native Americans from North America and by ancient Europeans. Posters should include comprehensive information about the plant, how it is used, and what it is used to treat. Some students may also include information about the effectiveness of the plant.

Answer to Math Activity

\$25,000 ($100 \times \$50 = \$5,000$; $100 \times \$300 = \$30,000$; $\$30,000 - \$5,000 = \$25,000$)

Careers

Paul Cox

Ethnobotanist Paul Cox is an ethnobotanist. He travels to remote places to look for plants that can help treat diseases. He seeks the advice of native healers in his search. In Samoan cultures, the healer is one of the most valued members of the community. In 1984, Cox met a 78-year-old Samoan healer named Epenesa. Epenesa understood human anatomy, and she dispensed medicines with great accuracy.

After Cox spent months observing Epenesa, she gave him her treatment for yellow fever. Cox brought the yellow-fever remedy to the United States. In 1986, researchers at the National Cancer Institute found that the plant contains a virus-fighting chemical called *prostratin*, which may have potential as a treatment for AIDS.

When two of the Samoan healers that Cox observed died in 1993, generations of medical knowledge was lost with them. The healers' deaths show the urgency of recording this knowledge before all of the healers are gone. Cox and other ethnobotanists work hard to gather knowledge from healers before their knowledge is lost.



Language Arts ACTiViTy

WRITING SKILL

Imagine that you are a healer. Write a letter to an ethnobotanist describing some of the plants you use to treat diseases.



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Careers

Background

Some biologists estimate that there are 235,000 species of flowering plants in the world. Of these, less than half of 1% have been studied for their potential medicinal qualities. Because there are so many species, efficient strategies are necessary to find the plants most likely to have medicinal value. One strategy used by ethnobotanists is to assume that if native people use a local plant for medicine, then the plant probably has some medicinal value. Many ethnobotanists seek out native healers or shamans. Ethnobotanists hope to acquire the knowledge that has taken the shamans years to accumulate. With these insights, the researchers can then decide which plants they should collect and study.

Some of the most useful drugs developed from plants used by indigenous peoples include aspirin, for reducing pain and inflammation; codeine, for decreasing pain and suppressing coughs; and quinine, for combating malaria.

Answer to Language Arts Activity

In their letters, students should demonstrate an understanding of how important native healers are to ethnobotanists. Students should also demonstrate an understanding of the fact that although native cultures may seem primitive, the knowledge that many native healers have is actually very sophisticated. In some cases, this knowledge may rival that of modern medicine.