Section 1

The Plant Kingdom

Reading Preview

Key Concepts

- What characteristics do all plants share?
- What do plants need to live successfully on land?
- How do nonvascular plants and vascular plants differ?
- What are the different stages of a plant's life cycle?

Key Terms

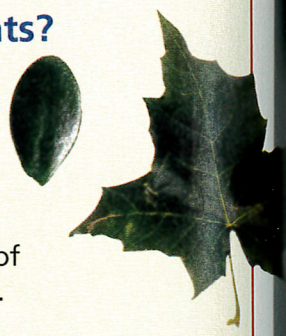
- cuticle
- vascular tissue
- zygote
- nonvascular plant
- vascular plant
- sporophyte
- gametophyte

Target Reading Skill

Building Vocabulary A definition states the meaning of a word or phrase by telling about its most important feature or function. After you read the section, reread the paragraphs that contain definitions of Key Terms. Use all the information you have learned to write a definition of each Key Term in your own words.

Lab zone **Discover Activity**

What Do Leaves Reveal About Plants?



1. Your teacher will give you two leaves from plants that grow in two very different environments: a desert and an area with average rainfall.
2. Carefully observe the color, size, shape, and texture of the leaves. Touch the surfaces of each leaf. Examine each leaf with a hand lens. Record your observations in your notebook.
3. When you have finished, wash your hands thoroughly with soap and water.

Think It Over

Inferring Use your observations to determine which plant lives in the desert and which does not. Explain.

There are some very strange plants in the world. There are plants that trap animals, plants that bloom only once every thirty years, and plants with flowers that smell like rotting meat. You probably don't see such unusual plants every day. But you probably do see plants every day. You encounter plants whenever you see moss on a tree trunk, run across a lawn, or pick ripe tomatoes from a garden. And all plants, both the unfamiliar and the familiar, have a lot in common.

What Is a Plant?

Members of the plant kingdom share several characteristics. **Nearly all plants are autotrophs, organisms that produce their own food. All plants are eukaryotes that contain many cells. In addition, all plant cells are surrounded by cell walls.**

Plants are autotrophs. You can think of a plant as a sun-powered, food-making factory. Sunlight provides the energy for this food-making process, photosynthesis.

You don't need a microscope to see plants because they are multicellular. Like many other multicellular organisms, plant cells are organized into tissues. Recall that tissues are groups of similar cells that perform a specific function. Plants vary greatly in size. Both the tiniest moss and the tallest redwood tree are plants.

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If you were to look at a plant's cells under a microscope, you would see that plants are eukaryotes. But unlike the cells of some other eukaryotes, a plant's cells are enclosed by a cell wall. Within a cell are chloroplasts and a vacuole, which is a large storage sac for water, wastes, food, and other substances.

Adaptations for Living on Land

Most plants live on land. How is living on land different from living in water? Imagine multicellular green algae floating in the ocean. The algae obtain water and other materials directly from the water around them. The water holds their bodies up toward sunlight. When algae reproduce, sperm cells can swim to egg cells.

Now imagine plants living on land. What adaptations must they have to meet their needs without water all around them? **For plants to survive on land, they must have ways to obtain water and other nutrients from their surroundings, retain water, transport materials in their bodies, support their bodies, and reproduce.**

Obtaining Water and Other Nutrients

Recall that all organisms need water to survive. Obtaining water is easy for algae because water surrounds them. To live on land, though, plants need adaptations for obtaining water from the soil. Plants must also have ways of obtaining other nutrients from the soil.

Reading Checkpoint **Why is obtaining water easy for algae?**

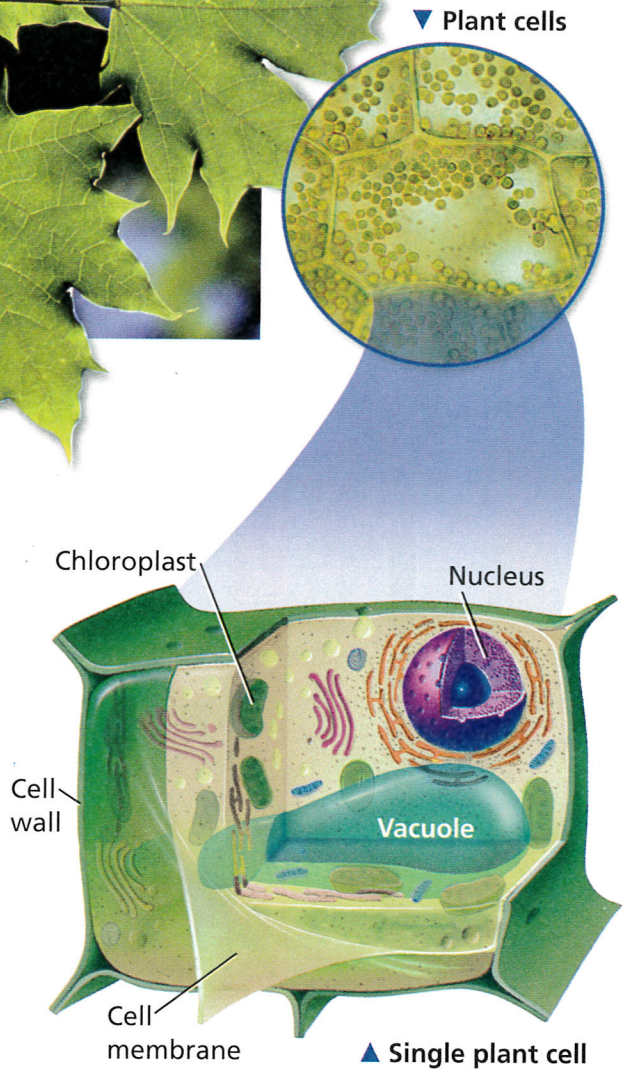
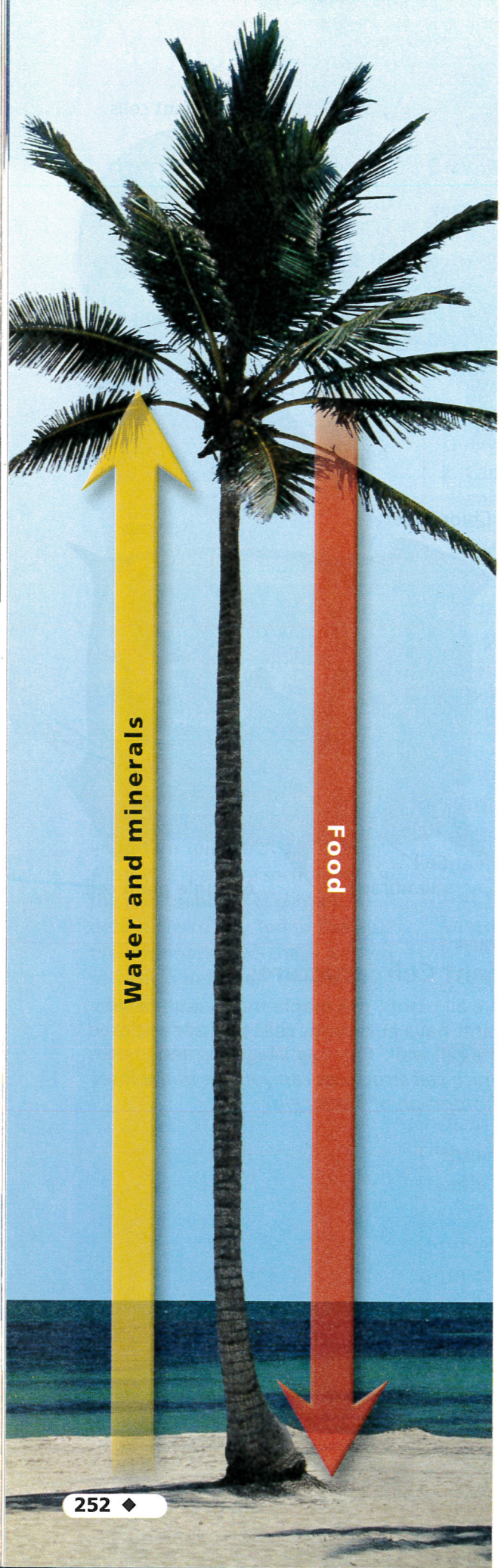


FIGURE 1
Plant Cell Structures

Like all plants, this maple tree is multicellular. Plants have eukaryotic cells that are enclosed by a cell wall. **Relating Diagrams and Photos** *Which cell structures can you see in the inset photograph of plant cells?*



Retaining Water Plants must have ways of holding onto the water they obtain. Otherwise, they could easily dry out due to evaporation. When there is more water in plant cells than in the air, the water leaves the plant and enters the air. One adaptation that helps a plant reduce water loss is a waxy, waterproof layer called the **cuticle** that covers the leaves of most plants.

Transporting Materials A plant needs to transport water, minerals, food, and other materials from one part of its body to another. In general, water and minerals are taken up by the bottom part of the plant, while food is made in the top part. But all of the plant's cells need water, minerals, and food.

In small plants, materials can simply move from one cell to the next. But larger plants need a more efficient way to transport materials farther, from one part of the plant to another. These plants have transport tissue called vascular tissue. **Vascular tissue** is a system of tubelike structures inside a plant through which water, minerals, and food move.

Support A plant on land must support its own body. It's easier for small, low-growing plants to support themselves. But for larger plants to survive, the plant's food-making parts must be exposed to as much sunlight as possible. Rigid cell walls and vascular tissue strengthen and support the large bodies of these plants.

Reproduction All plants undergo sexual reproduction that involves fertilization, the joining of a sperm cell with an egg cell. The fertilized egg is called a **zygote.** For algae and some plants, fertilization can only occur if there is water in the environment. This is because the sperm cells of these plants swim through the water to the egg cells. Other plants, however, have an adaptation that makes it possible for fertilization to occur in dry environments.

Reading Checkpoint **Why do plants need adaptations to prevent water loss?**

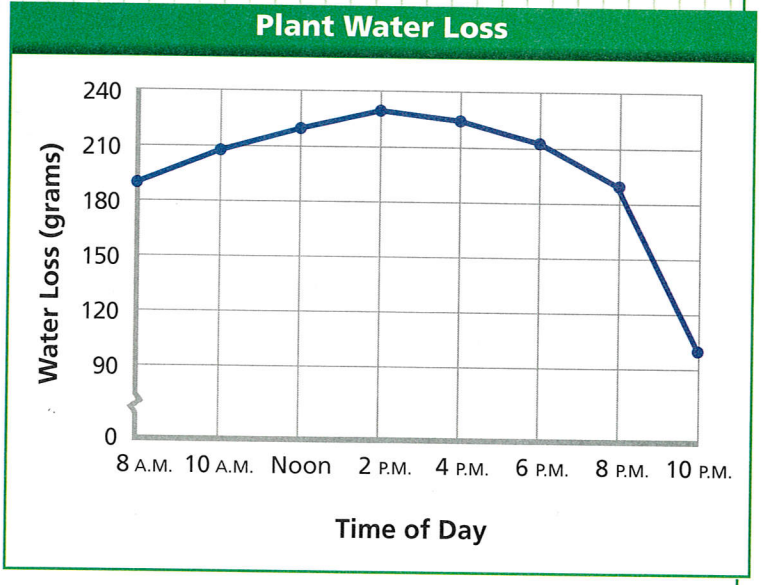
FIGURE 2
Transport and Support
For this tall coconut palm to survive, it must transport water, minerals, and food over long distances. It must also support its body so its leaves are exposed to sunlight.

Math Analyzing Data

Water Loss in Plants

The graph shows how much water a certain plant loses during the hours shown.

1. **Reading Graphs** What variable is plotted along each axis?
2. **Interpreting Data** According to the graph, during what part of the day did the plant lose the most water? The least water?
3. **Drawing Conclusions** What could account for the pattern of water loss shown?
4. **Predicting** How would you expect the graph to look from 10 P.M. to 8 A.M.? Explain your reasoning.



Classifying Plants

Hundreds of thousands of plant species exist in the world today. **Scientists informally group plants into two major groups—nonvascular plants and vascular plants.**

Nonvascular Plants Plants that lack a well-developed system of tubes for transporting water and other materials are known as **nonvascular plants.** Nonvascular plants are low-growing and do not have roots for absorbing water from the ground. Instead, they obtain water and materials directly from their surroundings. The materials then simply pass from cell to cell. This means that materials do not travel very far or very quickly. This slow method of transport helps explain why most nonvascular plants live in damp, shady places.

Most nonvascular plants have only thin cell walls to provide support. This is one reason why these plants cannot grow more than a few centimeters tall.

Vascular Plants Plants with true vascular tissue are called **vascular plants.** Vascular plants are better suited to life in dry areas than are nonvascular plants. Their well-developed vascular tissue solves the problem of transport, moving materials quickly and efficiently throughout the plant's body.

Vascular tissue also provides strength, stability, and support to a plant. Thus, vascular plants are able to grow quite tall.

Rock containing two plant fossils ▶

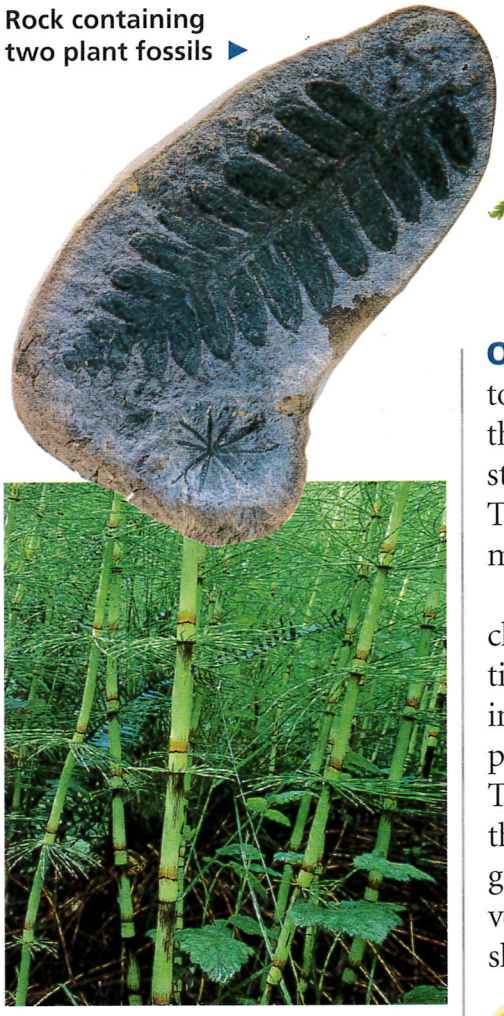


FIGURE 3
Ancient and Modern Plants
Fossils of ancient plants help scientists understand the origin of plants. These fossils are of two plants that lived about 300 million years ago. Notice the similarities between the fossils and modern-day horsetails (above) and ferns (top right).

Origin of Plants Which organisms were the ancestors of today's plants? In search of answers, biologists studied fossils, the traces of ancient life forms preserved in rock and other substances. The oldest plant fossils are about 400 million years old. The fossils show that even at that early date, plants already had many adaptations for life on land, including vascular tissue.

Better clues to the origin of plants came from comparing the chemicals in modern plants to those in other organisms. In particular, biologists studied the green pigment chlorophyll, found in the chloroplasts of plants, algae, and some bacteria. Land plants and green algae contain the same forms of chlorophyll. This evidence led biologists to infer that ancient green algae were the ancestors of today's land plants. Further comparisons of genetic material clearly showed that plants and green algae are very closely related. In fact, some scientists think that green algae should be classified in the plant kingdom.

Reading Checkpoint **What are the most likely ancestors of today's plants?**

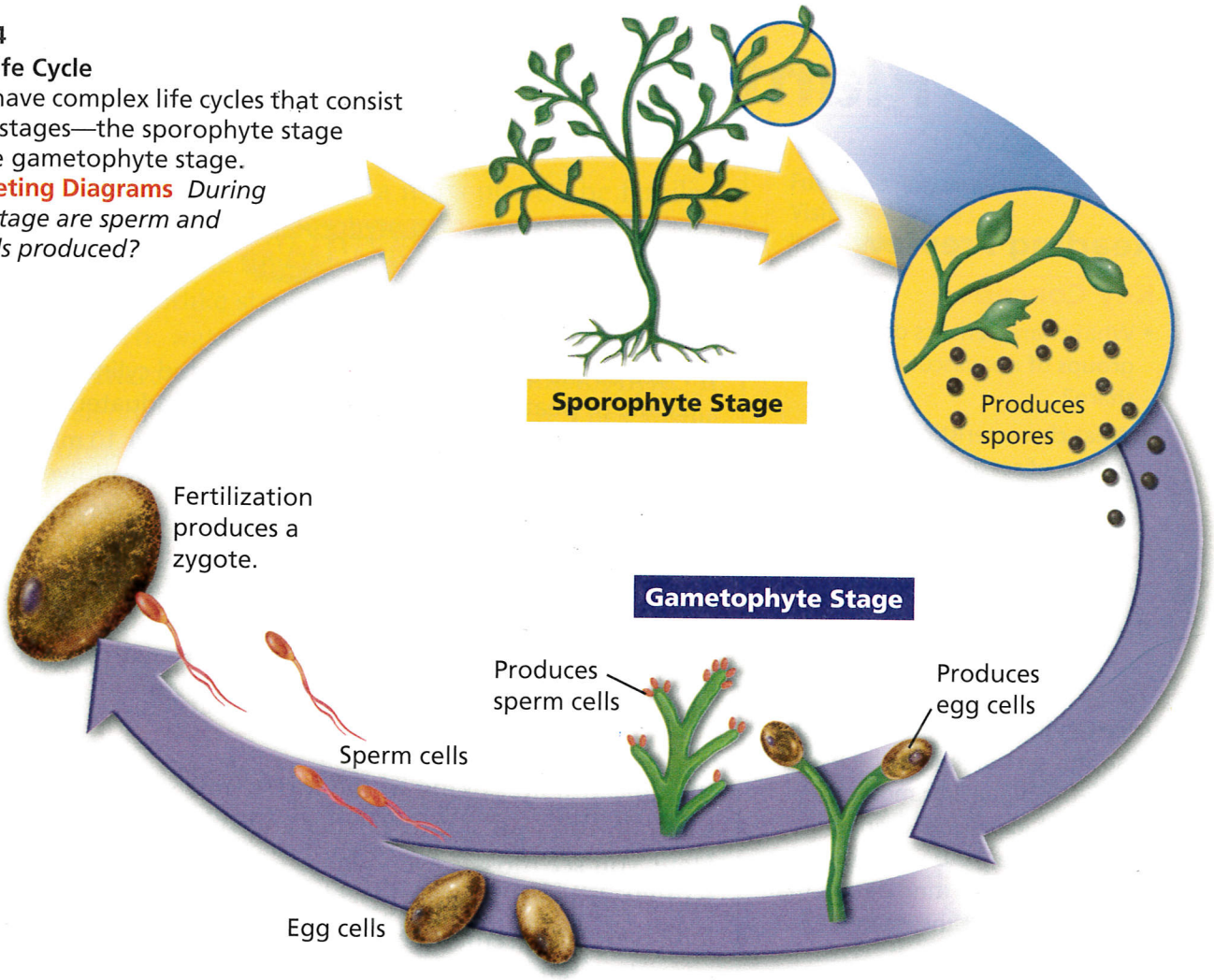
Complex Life Cycles

Plants have complex life cycles that include two different stages, the sporophyte stage and the gametophyte stage. In the **sporophyte** (SPOH ruh fyt) stage, the plant produces spores, tiny cells that can grow into new organisms. A spore develops into the plant's other stage, called the gametophyte. In the **gametophyte** (guh MEE tuh fyt) stage, the plant produces two kinds of sex cells: sperm cells and egg cells.

Figure 4 shows a typical plant life cycle. A sperm cell and egg cell join to form a zygote. The zygote then develops into a sporophyte. The sporophyte produces spores, which develop into the gametophyte. Then the gametophyte produces sperm cells and egg cells, and the cycle starts again. The sporophyte of a plant usually looks quite different from the gametophyte.

Reading Checkpoint **During which stage does a plant produce spores?**

FIGURE 4
Plant Life Cycle
Plants have complex life cycles that consist of two stages—the sporophyte stage and the gametophyte stage.
Interpreting Diagrams *During which stage are sperm and egg cells produced?*



Section 1 Assessment

Target Reading Skill **Building Vocabulary**
Use your sentences to help you answer the questions below.

Reviewing Key Concepts

1. a. **Listing** List three characteristics of plants.
   b. **Comparing and Contrasting** Describe three ways that plant cells differ from the cells of some other eukaryotes.
   c. **Predicting** How might a plant cell be affected if it lacked chloroplasts?
2. a. **Identifying** What are five adaptations that plants need to survive on land?
   b. **Inferring** Why is a cuticle a useful adaptation in plants but not in algae?
3. a. **Reviewing** How do vascular plants differ from nonvascular plants?
   b. **Explaining** Explain why vascular plants are better suited to life in dry areas.
   c. **Classifying** Would you expect a tall desert plant to be a vascular plant? Explain.
4. a. **Describing** What are the two major stages of a plant's life cycle?
   b. **Sequencing** Describe in order the major events in the life cycle of a plant, starting with a zygote.

Writing in Science

Video Script You are narrating a video called *Living on Land*, which is written from the perspective of a plant. Write a one-page script for your narration. Be sure to discuss the challenges that life on land poses for plants and how they meet their needs.