

Gymnosperms and Angiosperms

Reading Preview

Key Concepts

- What are the characteristics of gymnosperms and how do they reproduce?
- What are the characteristics of angiosperms and their flowers?
- How do angiosperms reproduce?
- What are the two types of angiosperms?

Key Terms

- gymnosperm • cone • ovule
- pollination • angiosperm
- flower • sepal • petal
- stamen • pistil • ovary
- fruit • monocot • dicot

Target Reading Skill

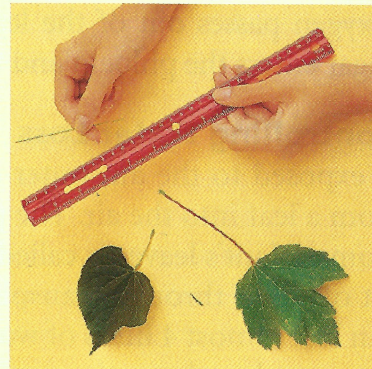
Building Vocabulary Using a word in a sentence helps you think about how best to explain the word. After you read the section, reread the paragraphs that contain definitions of Key Terms. Use all the information you have learned to write a meaningful sentence using each Key Term.

Lab
zone

Discover Activity

Are All Leaves Alike?

1. Your teacher will give you a hand lens, a ruler, and the leaves from some seed plants.
2. Using the hand lens, examine each leaf. Sketch each leaf in your notebook.
3. Measure the length and width of each leaf. Record your measurements in your notebook.



Think It Over

Classifying Divide the leaves into two groups on the basis of your observations. Explain why you grouped the leaves as you did.

Here's a question for you: What do pine cones and apples have in common? The answer is that they are both the parts of plants that contain seeds. Plants that produce seeds are known as seed plants. Pine trees and apple trees are both seed plants but belong to two different groups—gymnosperms and angiosperms.

Gymnosperms

Pine trees belong to the group of seed plants known as gymnosperms. A **gymnosperm** (JIM nuh spurm) is a seed plant that produces naked seeds. The seeds of gymnosperms are referred to as “naked” because they are not enclosed by a protective fruit.

Every gymnosperm produces naked seeds. In addition, many gymnosperms have needle-like or scalelike leaves, and deep-growing root systems. Gymnosperms are the oldest type of seed plant. According to fossil evidence, gymnosperms first appeared on Earth about 360 million years ago. Fossils also indicate that there were many more species of gymnosperms on Earth in the past than there are today. Four groups of gymnosperms exist today.

Go Online

SCILINKSSM NSTA

For: Links on gymnosperms
Visit: www.SciLinks.org
Web Code: scn-0152

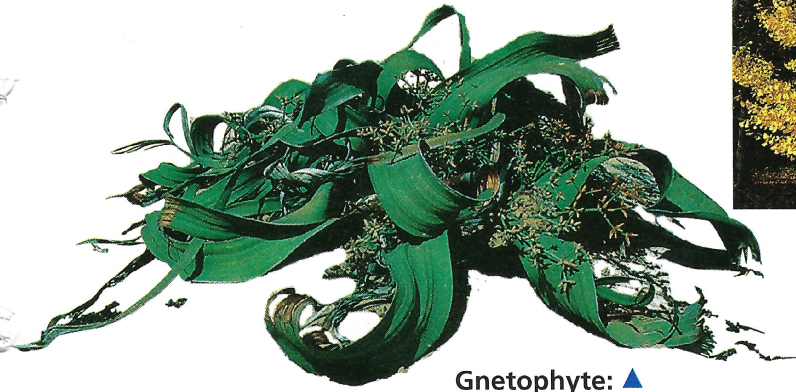
FIGURE 18

Types of Gymnosperms

Gymnosperms are the oldest seed plants. Cycads, conifers, ginkgoes, and gnetophytes are the only groups that exist today.



Ginkgo: ▲
Ginkgo biloba



Gnetophyte: ▲
Welwitschia

Cycads About 175 million years ago, the majority of plants were cycads. Today, cycads (SY kadz) grow mainly in tropical and subtropical areas. Cycads look like palm trees with cones. A cycad cone can grow as large as a football.



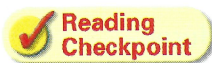
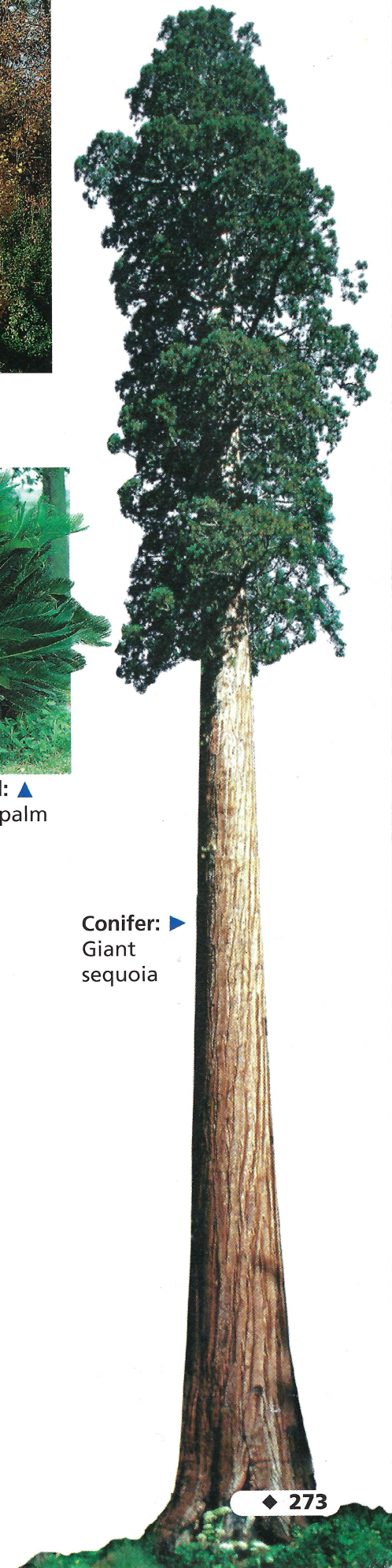
Cycad: ▲
Sago palm

Conifers Conifers (KAHN uh furz), or cone-bearing plants, are the largest and most diverse group of gymnosperms today. Most conifers, such as pines, sequoias, and junipers, are evergreens—plants that keep their leaves, or needles, year-round. When needles drop off, they are replaced by new ones.

Ginkgoes Ginkgoes (GING kohz) also grew hundreds of millions of years ago, but today, only one species of ginkgo, *Ginkgo biloba*, exists. It probably survived only because the Chinese and Japanese cared for it in their gardens. Today, ginkgo trees are planted along city streets because they can tolerate air pollution.

Gnetophytes Gnetophytes (NEE tuh fyts) live in hot deserts and in tropical rain forests. Some gnetophytes are trees, some are shrubs, and others are vines. The *Welwitschia* shown in Figure 18 grows in the deserts of West Africa and can live for more than 1,000 years.

Conifer: ►
Giant sequoia



Reading
Checkpoint

What are the four types of gymnosperms?

Reproduction in Gymnosperms

Most gymnosperms have reproductive structures called **cones**. Cones are covered with scales. Most gymnosperms produce two types of cones: male cones and female cones. Usually, a single plant produces both male and female cones. In some types of gymnosperms, however, individual trees produce either male cones or female cones. A few types of gymnosperms produce no cones at all.

In Figure 19, you can see the male and female cones of a Ponderosa pine. Male cones produce tiny grains of pollen—the male gametophyte. Pollen contains the cells that will later become sperm cells. Each scale on a male cone produces thousands of pollen grains.


The female gametophyte develops in structures called ovules. An **ovule** (OH vyool) is a structure that contains an egg cell. Female cones contain at least one ovule at the base of each scale. After fertilization occurs, the ovule develops into a seed.

You can follow the process of gymnosperm reproduction in Figure 19. **First, pollen falls from a male cone onto a female cone. In time, a sperm cell and an egg cell join together in an ovule on the female cone.** After fertilization occurs, the seed develops on the scale of the female cone.

Lab zone Try This Activity

The Scoop on Cones

In this activity, you will observe the structure of a female cone.

1.  Use a hand lens to look closely at the female cone. Gently shake the cone over a piece of white paper. Observe what happens.
2. Break off one scale from the cone. Examine its base. If the scale contains a seed, remove the seed.
3. With a hand lens, examine the seed from Step 2 or examine a seed that fell on the paper in Step 1.
4. Wash your hands.

Inferring How does the structure of the cone protect the seeds?

Pollination The transfer of pollen from a male reproductive structure to a female reproductive structure is called **pollination**. In gymnosperms, wind often carries the pollen from the male cones to the female cones. The pollen collects in a sticky substance produced by each ovule.

Fertilization Once pollination has occurred, the ovule closes and seals in the pollen. The scales also close, and a sperm cell fertilizes an egg cell inside each ovule. The fertilized egg then develops into the embryo part of the seed.

Seed Development Female cones remain on the tree while the seeds mature. As the seeds develop, the female cone increases in size. It can take up to two years for the seeds of some gymnosperms to mature. Male cones, however, usually fall off the tree after they have shed their pollen.

Seed Dispersal When the seeds are mature, the scales open. The wind shakes the seeds out of the cone and carries them away. Only a few seeds will land in suitable places and grow into new plants.



Reading
Checkpoint

What is pollen and where is it produced?

FIGURE 19

The Life Cycle of a Gymnosperm

Ponderosa pines have a typical life cycle for a gymnosperm. Follow the steps of pollination, fertilization, seed development, and dispersal in the pine tree.

Interpreting Diagrams *Where do the pine seeds develop?*

- 1** A pine tree produces male and female cones.

- 2 A** A male cone produces pollen grains, which contain cells that will mature into sperm cells.

- 2 B** Each scale on a female cone has two ovules at its base.

- 3** In time, two egg cells form inside each ovule.

- 4** The wind scatters pollen grains. Some become trapped in a sticky substance produced by the ovule.

- 5** The ovule closes, and a pollen grain produces a tube that grows into the ovule. A sperm cell moves through the tube and fertilizes the egg cell.

- 7** Wind disperses the pine seeds. A seed grows into a seedling and then into a tree.

- 6** The ovule develops into a seed. The fertilized egg becomes the seed's embryo. Other parts of the ovule develop into the seed coat and the seed's stored food.

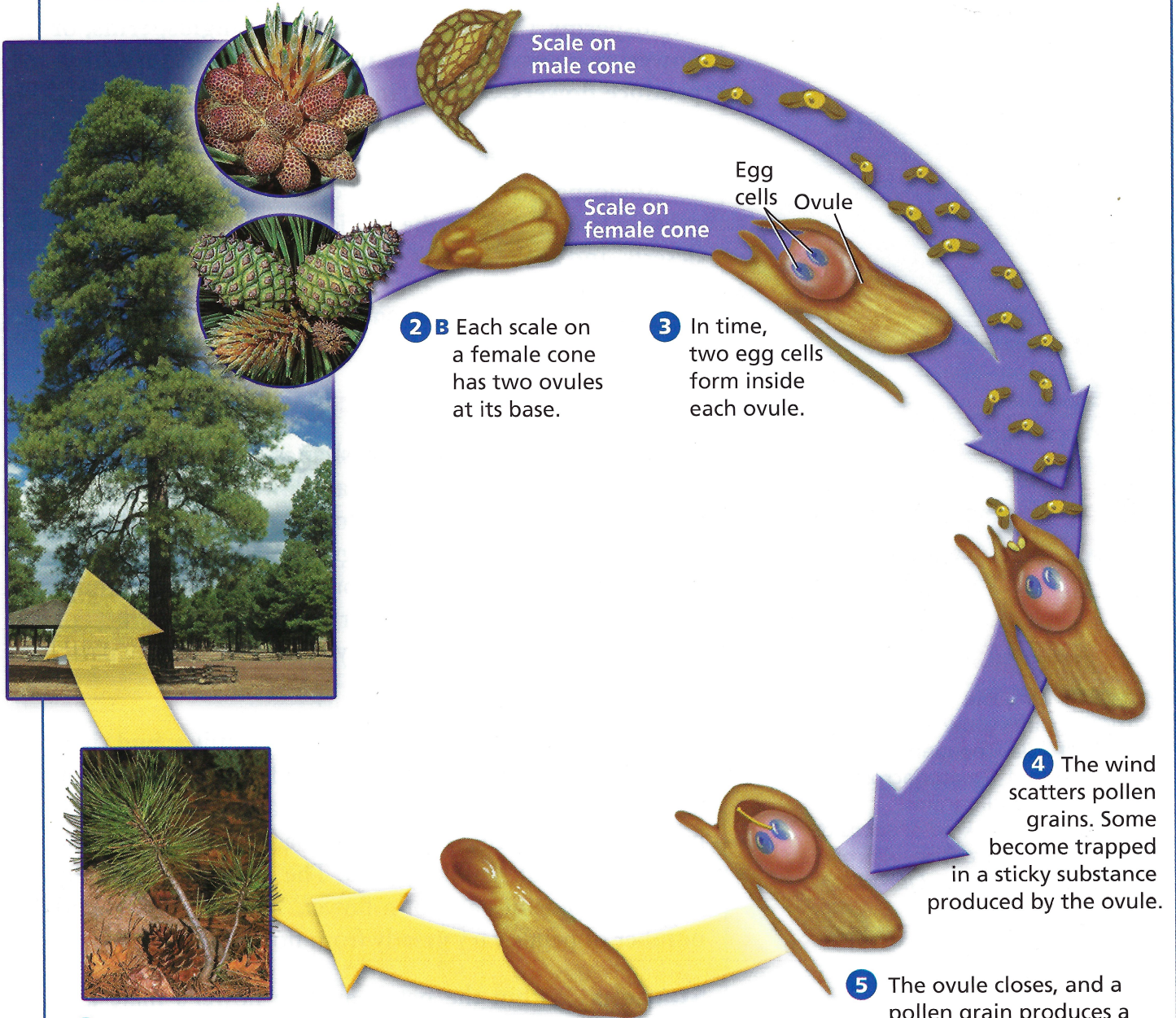




FIGURE 20 Rafflesia

Rafflesia plants grow in the jungles of Southeast Asia. The giant flowers measure about 1 meter across and weigh about 7 kilograms!

Classifying What kind of seeds do Rafflesia plants produce—uncovered seeds or seeds enclosed in fruits?

Angiosperms

You probably associate the word *flower* with a sweet-smelling plant growing in a garden. You certainly wouldn't think of something that smells like rotting meat. But that's exactly what the corpse flower, or rafflesia, smells like. You won't be seeing rafflesia in your local florist shop any time soon.

Rafflesia belongs to the group of seed plants known as **angiosperms** (AN jee uh spurmz). **All angiosperms, or flowering plants, share two important traits. First, they produce flowers. Second, in contrast to gymnosperms, which produce uncovered seeds, angiosperms produce seeds that are enclosed in fruits.**

Angiosperms live almost everywhere on Earth. They grow in frozen areas in the Arctic, tropical jungles, barren deserts, and at the ocean's edge.



Reading Checkpoint

Where do angiosperms live?

The Structure of Flowers

Flowers come in all sorts of shapes, sizes, and colors. **But, despite their differences, all flowers have the same function—reproduction.** A flower is the reproductive structure of an angiosperm. Figure 21 shows the parts of a typical flower. As you read about the parts, keep in mind that some flowers lack one or more of the parts. For example, some flowers have only male reproductive parts, and some flowers lack petals.

Sepals and Petals When a flower is still a bud, it is enclosed by leaflike structures called **sepals** (SEE pulz). Sepals protect the developing flower and are often green in color. When the sepals fold back, they reveal the flower's colorful, leaflike **petals**. The petals are generally the most colorful parts of a flower. The shape, size, and number of petals vary greatly from flower to flower.

Stamens Within the petals are the flower's male and female reproductive parts. The **stamens** (STAY munz) are the male reproductive parts. Locate the stamens inside the flower in Figure 21. The thin stalk of the stamen is called the filament. Pollen is produced in the anther, at the top of the filament.

FIGURE 21

The Structure of a Flower

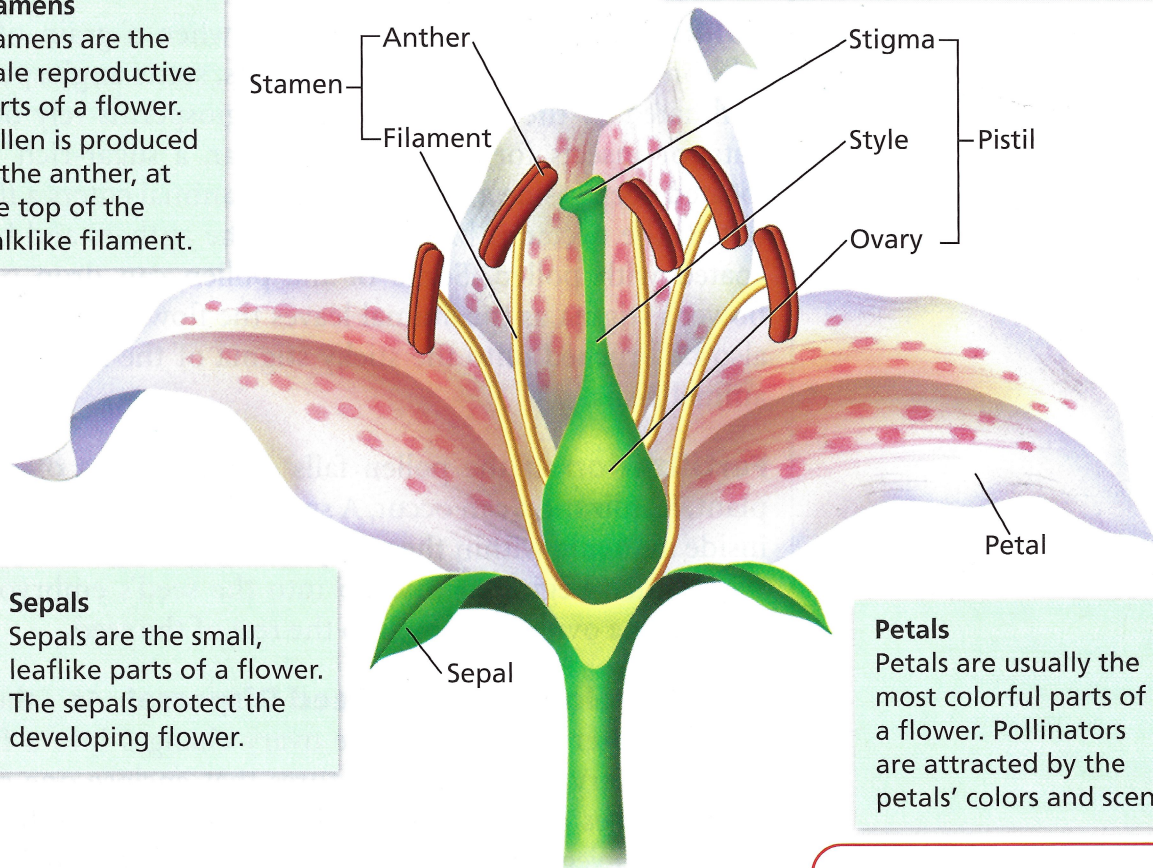
Like most flowers, this lily contains both male and female reproductive structures.

Stamens

Stamens are the male reproductive parts of a flower. Pollen is produced in the anther, at the top of the stalklike filament.

Pistils

Pistils are the female reproductive parts of a flower. A pistil consists of a sticky stigma, a slender tube called the style, and a hollow structure, called the ovary, at the base.



Sepals

Sepals are the small, leaflike parts of a flower. The sepals protect the developing flower.

Petals

Petals are usually the most colorful parts of a flower. Pollinators are attracted by the petals' colors and scent.

Pistils The female parts, or **pistils** (PIS tulz), are found in the center of most flowers. Some flowers have two or more pistils; others have only one. The sticky tip of the pistil is called the stigma. A slender tube, called a style, connects the stigma to a hollow structure at the base of the flower. This hollow structure is the **ovary**, which protects the seeds as they develop. An ovary contains one or more ovules.

Pollinators The colors and shapes of most petals and the scents produced by most flowers attract insects and other animals. These organisms ensure that pollination occurs. Pollinators include birds, bats, and insects such as bees and flies. The rafflesia flower you read about at the beginning of the section is pollinated by flies. The flies are attracted by the strong smell of rotting meat.

Go **Online**
active art

For: The Structure of a Flower activity
Visit: PHSchool.com
Web Code: cep-1053



What are the male and female parts of a flower?

Reproduction in Angiosperms

You can follow the process of angiosperm reproduction in Figure 23. First, pollen falls on a flower's stigma. In time, the sperm cell and egg cell join together in the flower's ovule. The zygote develops into the embryo part of the seed.

Pollination A flower is pollinated when a grain of pollen falls on the stigma. Like gymnosperms, some angiosperms are pollinated by the wind. But most angiosperms rely on birds, bats, or insects for pollination. Nectar, a sugar-rich food, is located deep inside a flower. When an animal enters a flower to obtain the nectar, it brushes against the anthers and becomes coated with pollen. Some of the pollen can drop onto the flower's stigma as the animal leaves the flower. The pollen can also be brushed onto the sticky stigma of the next flower the animal visits.

Fertilization If the pollen falls on the stigma of a similar plant, fertilization can occur. A sperm cell joins with an egg cell inside an ovule within the ovary at the base of the flower. The zygote then begins to develop into the seed's embryo. Other parts of the ovule develop into the rest of the seed.

Fruit Development and Seed Dispersal As the seed develops after fertilization, the ovary changes into a **fruit**—a ripened ovary and other structures that enclose one or more seeds. Apples and cherries are fruits. So are many foods you usually call vegetables, such as tomatoes and squash. Fruits are the means by which angiosperm seeds are dispersed. Animals that eat fruits help to disperse their seeds.



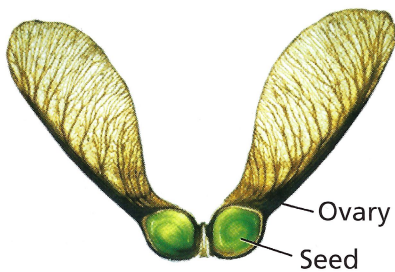
**Reading
Checkpoint**

What flower part develops into a fruit?

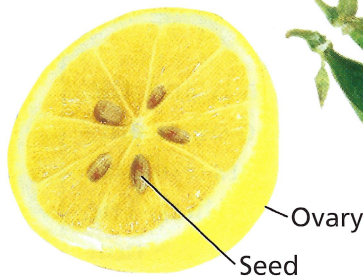
FIGURE 22

Fruits

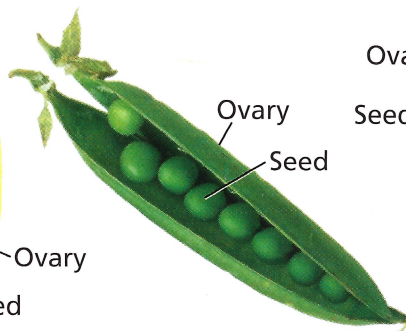
The seeds of angiosperms are enclosed in fruits, which protect and help disperse the seeds.



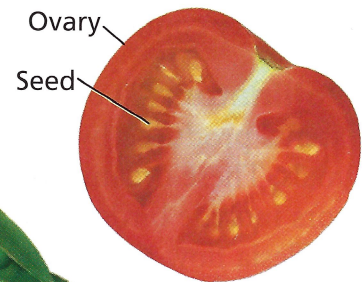
▲ Maple



▲ Lemon



▲ Pea



▲ Tomato

FIGURE 23

The Life Cycle of an Angiosperm

All angiosperms have a similar life cycle. Follow the steps of pollination, fertilization, seed development, and dispersal in this apple tree.

Interpreting Diagrams What plant part does the ovule develop into?

1 An apple tree produces flowers.

2 A The cells in the anther produce pollen grains.

3 Pollen grains are trapped on the stigma.

2 B Inside the ovary, an egg cell is produced in each ovule.

4 The pollen grain produces a pollen tube that grows into the ovule. A sperm cell moves through the pollen tube and fertilizes the egg cell.

6 The ovary and other structures develop into a fruit that encloses the seeds. The fruit helps in seed dispersal.

5 The ovule develops into a seed. The fertilized egg becomes the seed's embryo. Other parts of the ovule develop into the seed coat and the seed's stored food.

7 A seed grows into a new plant.

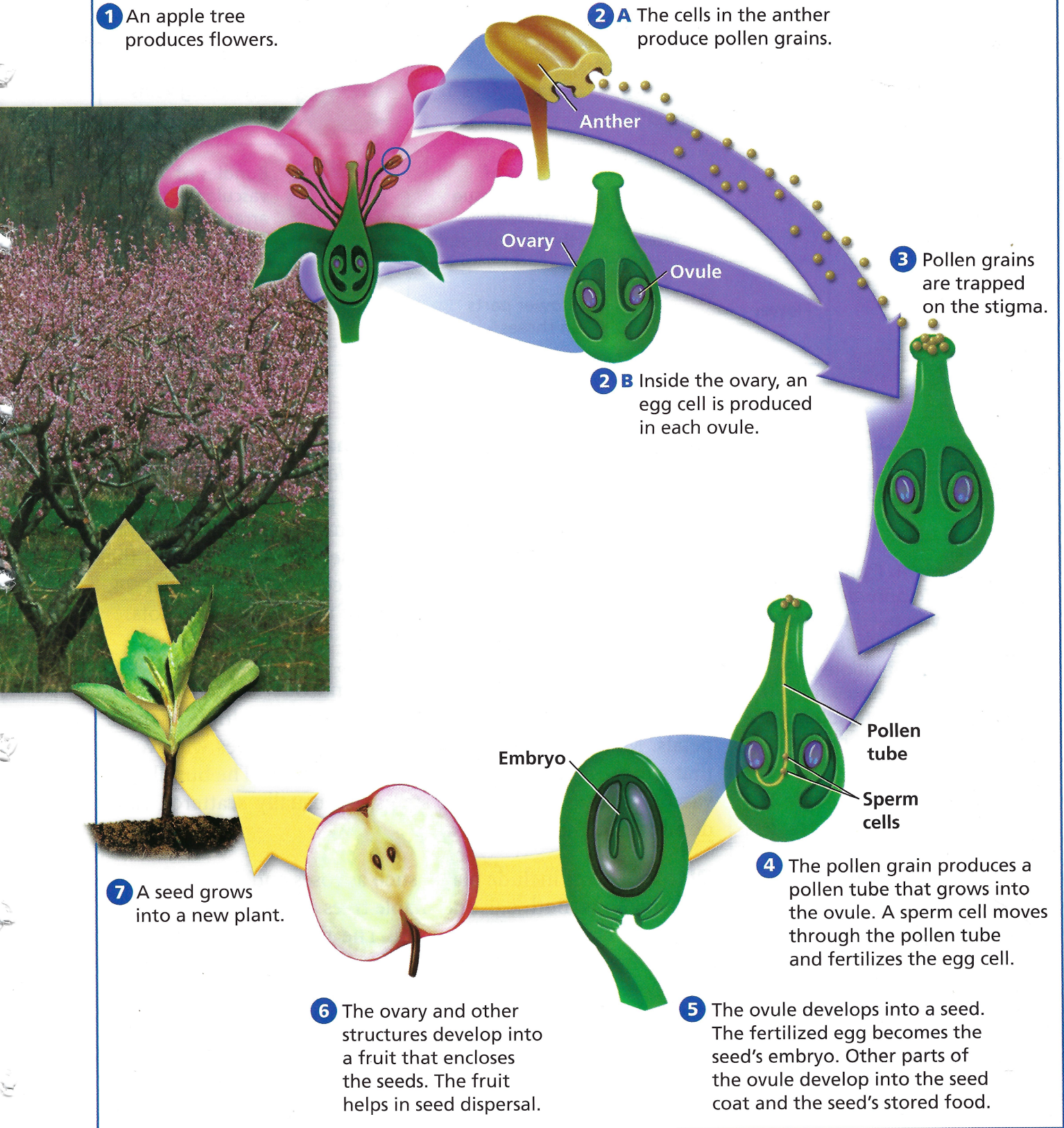



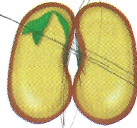
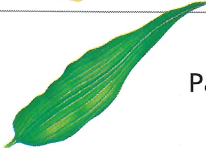

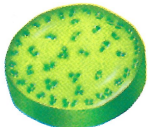



FIGURE 24

Monocots and Dicots

Monocots and dicots differ in the number of cotyledons, the pattern of veins and vascular tissue, and the number of petals.

Interpreting Tables

How do monocot and dicot leaves differ?

Comparing Monocots and Dicots		
Plant Part	Monocots	Dicots
Seed	 One cotyledon	 Two cotyledons
Leaf	 Parallel veins	 Branching veins
Stem	 Bundles of vascular tissue scattered throughout stem	 Bundles of vascular tissue arranged in a ring
Flower	 Flower parts in threes	 Flower parts in fours or fives

Math Skills

Multiples

Is a flower with 6 petals a monocot? To answer this question, you need to determine if 6 is a multiple of 3. A number is a multiple of 3 if there is a nonzero whole number that, when multiplied by 3, gives you that number.

In this case, 6 is a multiple of 3 because you can multiply 2 (a nonzero whole number) by 3 to get 6.

$$2 \times 3 = 6$$

Therefore, a flower with 6 petals is a monocot. Other multiples of 3 include 9 and 12.

Practice Problem Which of these numbers are multiples of 4?

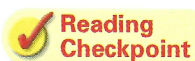
6, 10, 12, 16

Types of Angiosperms

Angiosperms are divided into two major groups: monocots and dicots. “Cot” is short for *cotyledon*. Recall that in some seeds, the cotyledon, or seed leaf, provides food for the embryo. *Mono* means “one” and *di* means “two.” **Monocots** are angiosperms that have only one seed leaf. **Dicots**, on the other hand, produce seeds with two seed leaves. In Figure 24, you can compare the characteristics of monocots and dicots.

Monocots Grasses, including corn, wheat, and rice, and plants such as lilies and tulips are monocots. The flowers of a monocot usually have either three petals or a multiple of three petals. Monocots usually have long, slender leaves with veins that run parallel to one another like train rails. The bundles of vascular tissue in monocot stems are usually scattered randomly throughout the stem.

Dicots Dicots include plants such as roses and violets, as well as dandelions. Both oak and maple trees are dicots, as are food plants such as beans and apples. The flowers of dicots often have either four or five petals or multiples of these numbers. The leaves are usually wide, with veins that branch many times. Dicot stems usually have bundles of vascular tissue arranged in a ring.



Reading Checkpoint

How do the petals of monocots and dicots differ in number?

Seed Plants in Everyday Life

Products from seed plants are all around you. Gymnosperms, especially conifers, provide useful products such as paper and the lumber used to build homes. Conifers are also used to produce turpentine, the rayon fibers in clothes, and the rosin used by baseball pitchers, gymnasts, and musicians.

Angiosperms are an important source of food, clothing, and medicine for other organisms. Plant-eating animals eat various parts of flowering plants, including stems, leaves, and flowers. People eat vegetables, fruits, and cereals, all of which are angiosperms. People also make clothing and other products from angiosperms. For example, cotton fibers come from cotton plants. The sap of rubber trees is used to make rubber for tires and other products. The wood of maple, cherry, and oak trees is often used to make furniture.



**Reading
Checkpoint**

What are two products made from gymnosperms?



FIGURE 25

Food From Seed Plants

The cucumbers, tomatoes, and spinach in this salad are all angiosperms.

Section 4 Assessment

Target Reading Skill Building Vocabulary

Use your sentences to help you answer the questions below.

Reviewing Key Concepts

- a. Listing** What characteristics do all gymnosperms share? What other characteristics do many gymnosperms have?

b. Describing What is a cone? What role do cones play in gymnosperm reproduction?

c. Sequencing Briefly describe the steps in the reproduction of a gymnosperm.
- a. Reviewing** What two characteristics do all angiosperms share?

b. Identifying What is the function of an angiosperm's flowers?
- a. Reviewing** On what part of a flower must pollen land for pollination to occur?

b. Sequencing Briefly describe the steps in the reproduction of an angiosperm, from pollination to seed dispersal.

- a. Listing** Name the two major groups of angiosperms.

b. Comparing and Contrasting How do the seeds, leaves, stems, and flowers of these two groups differ?

c. Classifying A plant's leaves have parallel veins, and each of its flowers has six petals. To which group does it belong? Explain.

Math Practice

- 5. Multiples** Which of the following numbers are multiples of 3? Which of the numbers are multiples of 4?

5, 6, 8, 10, 12, 15

- 6. Multiples** Suppose you found a flower with 12 petals. Would you know from the number of petals whether the flower is a monocot or a dicot? Explain.