SECTION 3

Seed Plants

Key Concept Seed plants produce seeds and are categorized as gymnosperms or angiosperms.

What You Will Learn

- Seed plants differ from seedless plants in three main ways.
- A seed is composed of a young plant, a food source, and an outer coating.
- Gymnosperms and angiosperms have different patterns of sexual reproduction.
- Gymnosperms and angiosperms are economically and environmentally important.

Why It Matters

Humans use seed plants as a source of food and as a source of clothing and construction materials.

Vocabulary

- pollen
- pollination

READING STRATEGY

Graphic Organizer In your **Science Journal,** create a Venn Diagram that compares various characteristics of the two groups of vascular plants that produce seeds.

pollen (PAHL uhn) the tiny granules that contain the male gametophytes of 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

Like seedless plants, seed plants have a life cycle that 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.

Standards Check **List three characteristics that seed plants share.** 7.2.a, 7.5.f

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

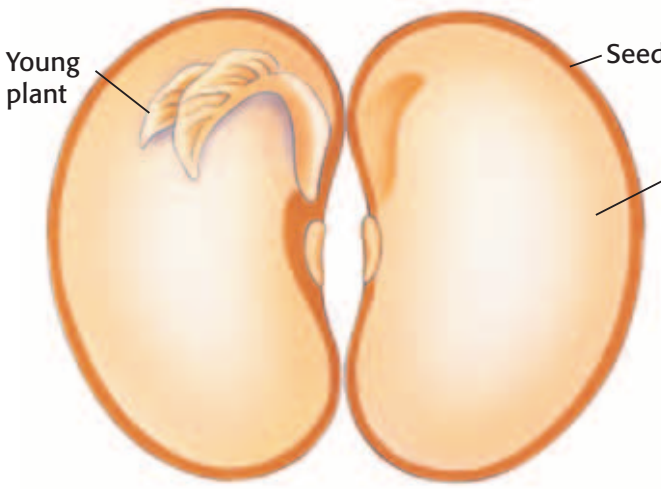


Figure 2 *A seed contains stored food and a young plant, or sporophyte. A seed is surrounded and protected by a seed coat.* ***Why do seeds contain stored food?***

The Structure of Seeds

A seed forms after fertilization, when sperm and eggs are joined. A seed is made up of three parts, as **Figure 2** shows. 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 often spread seeds more efficiently than the wind spreads spores.

Standards Check **After which process does a seed form?** 7.2.a

7.2.a Students know the differences between the life cycles and reproduction methods of sexual and asexual organisms.
7.5.f Students know the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit.

Quick Lab

Dissecting Seeds

7.5.f
7.7.c

1. Draw a **lima bean seed.** Then, soak the lima bean seed in **water** overnight.
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 and label what you see.
5. With gloves on, place a drop of **iodine** on one half of the lima bean. Describe what happens.
6. What structures did you see after you split the lima bean seed in half? How do these structures rely on one another?
7. Iodine changes from a rusty red color to dark blue in the presence of starch. Explain what the iodine test indicated about the seed.
8. What part of the seed do you think provides the lima bean plant with the energy to grow?

15 min

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**

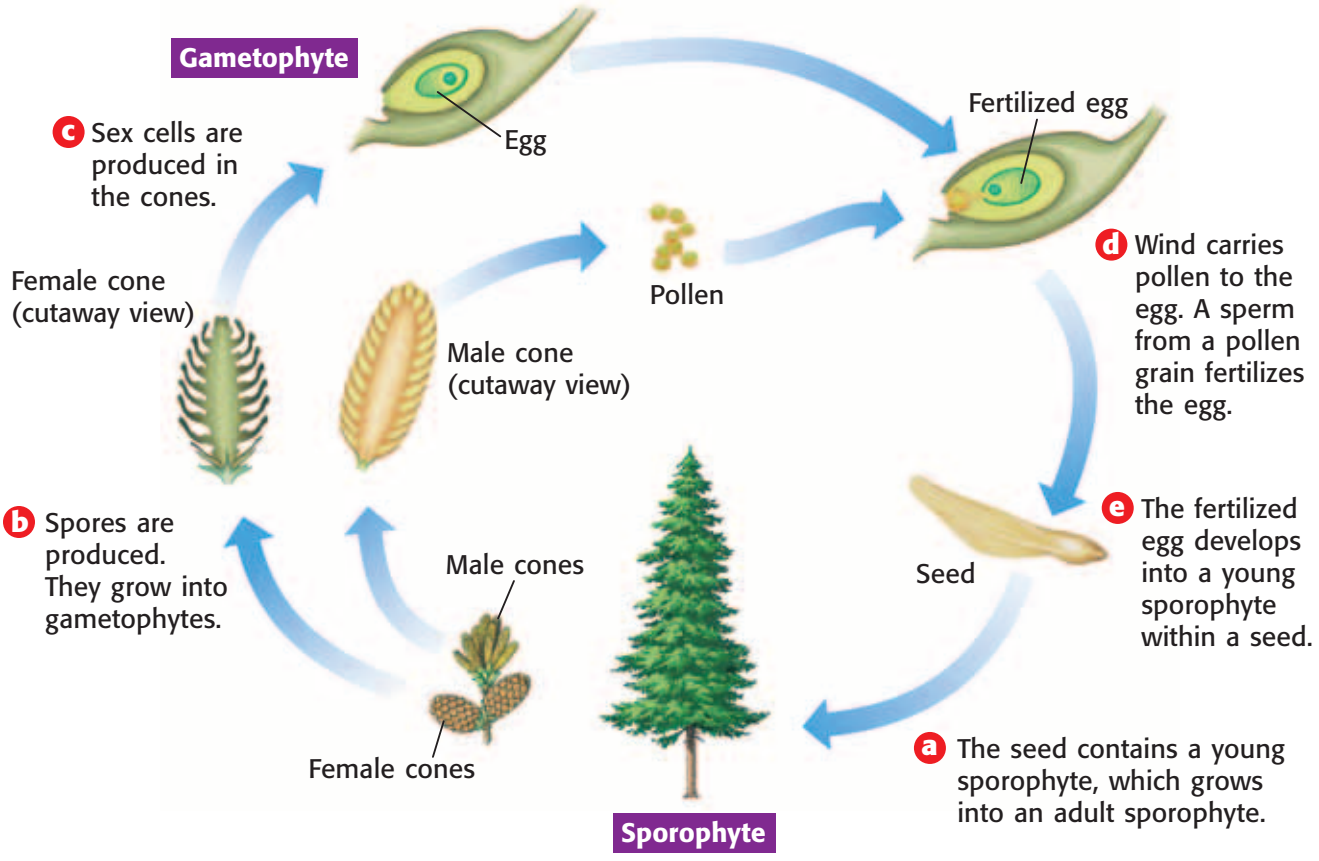
Conifers The conifers, such as this ponderosa pine, are the largest group of gymnosperms. There are about 630 species of conifers. Most conifers are evergreens that keep their needle-shaped leaves all year. Conifer seeds develop in cones.

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.

Figure 4 The Life Cycle of a Pine Tree



Life Cycle of Gymnosperms

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 from each kind of cone develop into tiny gametophytes.

The male gametophytes of gymnosperms are found in pollen. Pollen grains 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 to the female is called **pollination.** Pollination occurs during sexual reproduction.

pollination (PAWL uh NAY shuhn) the transfer of pollen from the male reproductive structures to the female structures of seed plants

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.**

Standards Check **Describe the life cycle of gymnosperms.** 7.2.a

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 about 300,000 species of angiosperms. Angiosperms can be found in almost every land ecosystem.

Reproduction in Angiosperms

Flowers are the reproductive structures of angiosperms. Some angiosperms depend on the wind for pollination. But others have flowers that attract animals. As **Figure 5** shows, when animals visit different flowers, the animals may carry pollen from flower to flower.

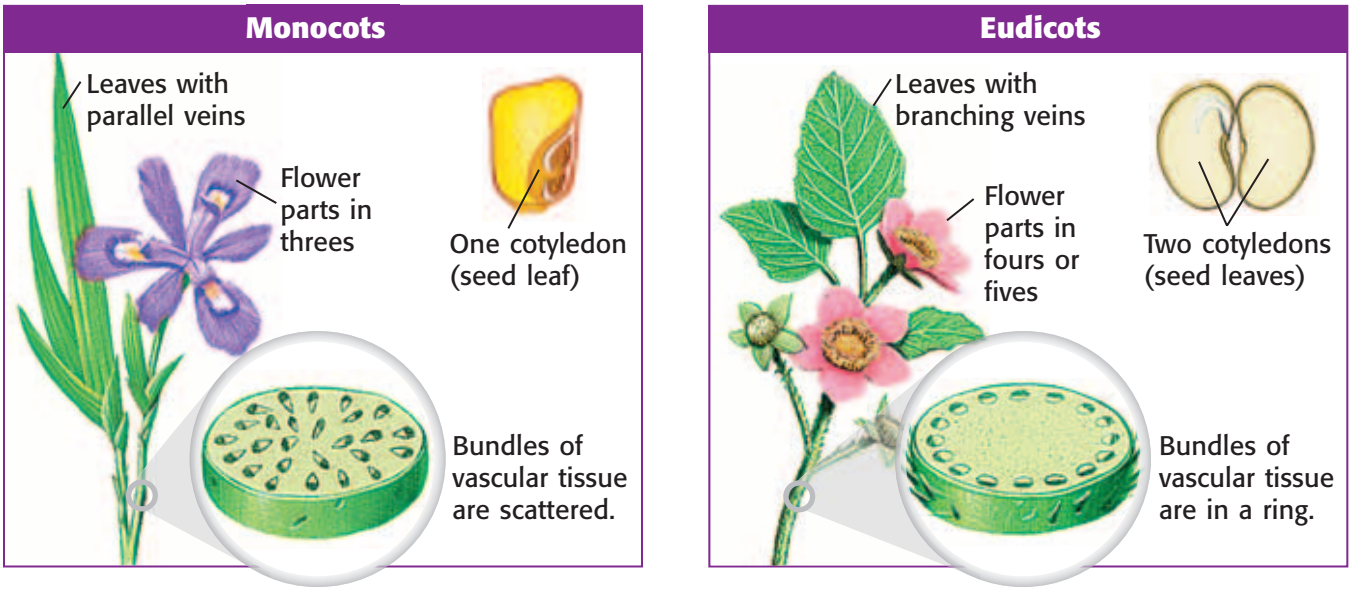
Fruits surround seeds. Some fruits and seeds have structures that help the wind carry them short or long distances. Other fruits attract animals that eat the fruits. The animals discard the seeds away from the plant. Some fruits, such as burrs, are carried from place to place by sticking to the fur of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

Standards Check **Why do angiosperms have flowers and fruits?** 7.5.f

Two Kinds of Angiosperms

Most angiosperms are divided into two classes—monocots and eudicots. 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. Eudicot seeds have two cotyledons. Eudicots include roses, cactuses, sunflowers, peanuts, and peas. Other differences between monocots and eudicots are shown in **Figure 6.**

Figure 6 **Two Classes of Angiosperms**



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. Flowering plants are also a food source for the insects that pollinate them.

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.

SECTION Review

7.2.a, 7.5.f

Summary

- Seeds nourish the young sporophyte of seed plants. Seed plant gametophytes rely on the sporophyte. Also, they do not need water for fertilization.
- Sexual reproduction occurs in gymnosperms when sperm from the male cone fertilizes the eggs of the female cone. The embryo develops within the female cone, which then releases seeds.
- Flowers are the reproductive structures of angiosperms. Wind and animals help angiosperms reproduce.
- Many organisms rely on seed plants for food. Humans have many uses for seed plants.

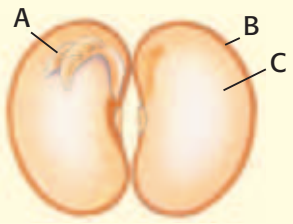
Understanding Concepts

1. **Describing** What are two advantages of seed plants?
2. **Comparing** How are the gametophytes of seed plants different from the gametophytes of seedless plants?
3. **Identifying** Describe the structure of seeds.
4. **Identifying** When does fertilization occur during the gymnosperm life cycle?
5. **Comparing** How are angiosperms and gymnosperms similar to one another?

Critical Thinking

6. **Making Inferences** How do angiosperms use flowers and fruits to reproduce?
7. **Applying Concepts** An angiosperm lives in a dense rain forest and close to the ground. It receives little wind. Several herbivores (animals that eat plants) live in this area of the rain forest. What are some ways the plant can ensure its seeds are carried throughout the forest?

INTERPRETING GRAPHICS Use the image below to answer the next question.



8. **Identifying Relationships** In the seed above, describe how part A relies on parts B and C for its survival.

Math Skills

9. **Making Calculations** About 330,000 species of plants have been discovered. Approximately 300,000 of those species are angiosperms. What percentage of plants are NOT angiosperms?

Internet Resources

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

Topic: Plants with Seeds; Plants of California

SciLinks code: HY71168; HY7C03