Chapter 10

Diversity of Life 1

10.7 Plants

Photos of Earth from space show large green patches stretching across wide areas of the continents. Much of Earth's land surface is green because it is covered with plants. **Plants** are terrestrial, multicellular, autotrophic eukaryotes that obtain energy through photosynthesis. Plants are green because they contain chlorophyll, a pigment used in photosynthesis.

Plants have a variety of adaptations for living in terrestrial environments. Roots anchor them to the ground and absorb water and nutrients from the soil. Shoots, the stems and leaves of a plant, conduct photosynthesis. The leaves of plants have a large surface area for catching sunlight, which powers photosynthesis. Carbon dioxide, which is also needed for photosynthesis, diffuses from the air into leaves through small pores called *stomata* (Figure 10.11).

FIGURE 10.11

Stomata are tiny pores in plant leaves that allow carbon dioxide to enter. You can see several stomata in this magnified image of a rose plant leaf.

Most plants also have a *vascular system*, a sort of plant "circulatory system" that distributes water and other resources. The plant vascular system consists of two types of tissue: xylem and phloem. The *xylem* is made up of dead, tube-shaped cells through which water and nutrients move up from the roots. The *phloem* consists of living cells that pass the sugars produced during photosynthesis down from the leaves. The liquid that flows in a plant's vascular system is known as *sap*. One sap you may be familiar with is maple syrup, which is made by boiling down liquid collected from the vascular systems of maple trees.

Plant reproduction occurs through an *alternation of generations*, in which the life cycle alternates between a haploid stage called a *gametophyte* and a diploid stage called a *sporophyte*. You may remember that haploid cells contain a single set of chromosomes, whereas diploid cells contain two sets of chromosomes. The details of this life cycle vary among the three major groups of plants—mosses, ferns, and seed plants. A diagram of the alternation of generations in plants is shown in Figure 10.12.

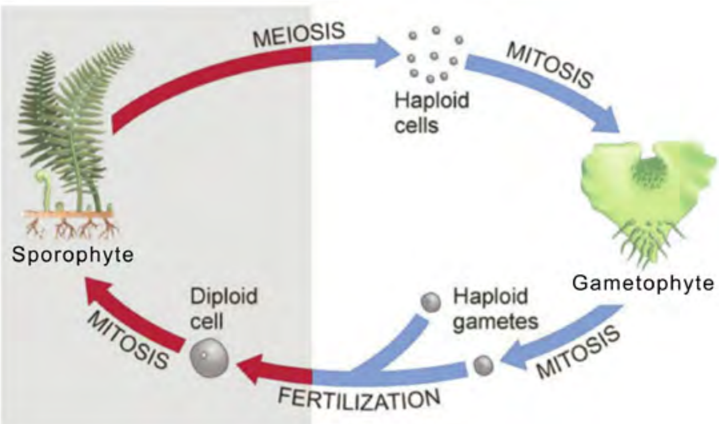


FIGURE 10.12

The plant life cycle is characterized by the "alternation of generations." Plants alternate between a haploid gametophyte (shown on the right) and a diploid sporophyte (shown on the left). Different groups of plants differ in whether the gametophye or sporophyte dominates the life cycle.

Mosses

Mosses are small plants with simple leaves and no vascular system. They often grow in dense clumps in bogs, forests, and other moist, shady habitats (Figure 10.13). Mosses are restricted to moist habitats for several reasons. First, because mosses do not have a vascular system, every part of a moss plant must obtain water directly from the environment through diffusion. Second, male and female moss plants are usually separate, and during reproduction, sperm must swim from the male plant through a film of water in the environment to fertilize eggs in the female plant.

Mosses are unique among plants in that the gametophyte is much larger than the sporophyte. When you see a moss in the forest, you are looking at a haploid gametophyte.

FIGURE 10.13

Mosses growing in the forest understory in Great Smoky Mountains National Park, Tennessee.

Ferns

Ferns are seedless plants with distinctive feathery leaves. They are often found in the forest understory, where they thrive in the shade of large trees (Figure 10.14). Unlike mosses, ferns have a vascular system for transporting water and nutrients.

However, ferns are similar to mosses in that their sperm swim through the environment to fertilize eggs. Because of this, ferns can also live only in moist habitats. In ferns, the diploid sporophyte is much larger than the haploid gametophyte—when you see a fern in the forest, you are looking at a diploid sporophyte.

FIGURE 10.14
Ferns grow in Muir Woods National Monument in California.

Seed Plants

Seed plants are the largest group of plants by far. Two key features of seed plant reproduction have made these plants successful in a wide variety of land habitats: pollen and seeds. **Pollen** consists of many tiny grains, each of which is a male gametophyte wrapped in a protective coating. The male gametophyte produces the sperm used in reproduction.

Pollen can be transported to female gametophytes, which produce eggs, by wind or (as we will see) by animals. Because the sperm of seed plants do not have to swim through the environment to fertilize eggs, seed plants are not restricted to moist environments.

Seed plants also make seeds. The fertilized eggs of seed plants grow into small embryos that are encased in a tough outer coating along with a food supply—this entire structure is a **seed**. Seeds can survive in a dormant state until environmental conditions are appropriate for growth. This is why many seeds do not sprout until you plant them in soil and water them. All the seed plants you see are diploid sporophytes.

FIGURE 10.15
Conifers are seed plants with reproductive structures called cones. (a) This is a cone and seeds from a Sequoia redwood. (b) This is a pine branch showing male and female cones.

The two largest groups of seed plants are conifers and flowering plants. *Conifers* include plants such as redwoods, pines, cedars, and firs. Conifers have waxy, needlelike leaves and reproductive structures called *cones* (Figure 10.15). Male cones release pollen, and then wind carries the pollen to female cones. Note that most conifers have both male and female cones. Because wind blows pollen all over the place, conifers make large amounts of pollen—this makes it more likely that some of the pollen will reach female cones. Fertilization occurs in the female cones, which eventually drop the mature seeds.

Flowering plants are the largest and most successful group of seed plants. Flowering plants have two important features absent in conifers: flowers and fruit. A **flower** functions in reproduction. Flowers may contain the male structures that produce pollen, the female structures that produce eggs, or both (Figure 10.16). The *stamen* is the male reproductive structure. It consists of a stalk capped with an *anther* where pollen develops. The *carpel* is the female reproductive structure. It includes an *ovary* where eggs develop and a stalk capped by the *stigma*, a sticky structure that traps pollen. As in conifers, a single flowering plant usually has both male and female reproductive structures, whether in separate flowers or the same flowers. However, there are a small number of plants that only have male reproductive structures, or only female reproductive structures.

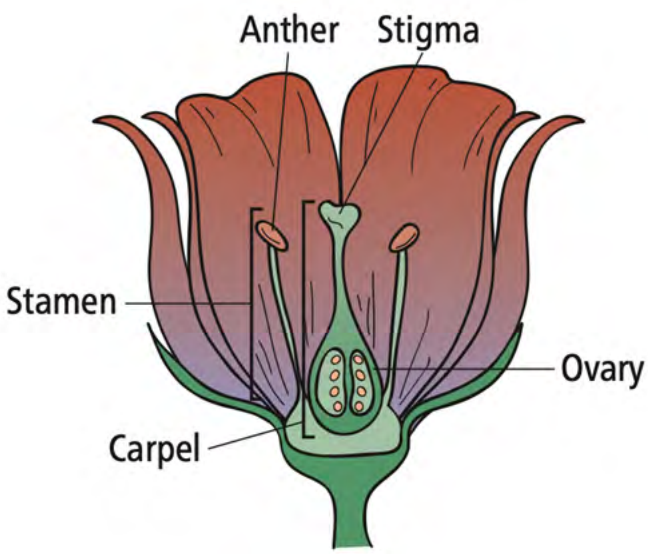


FIGURE 10.16

Flowers contain the reproductive structures of flowering plants.

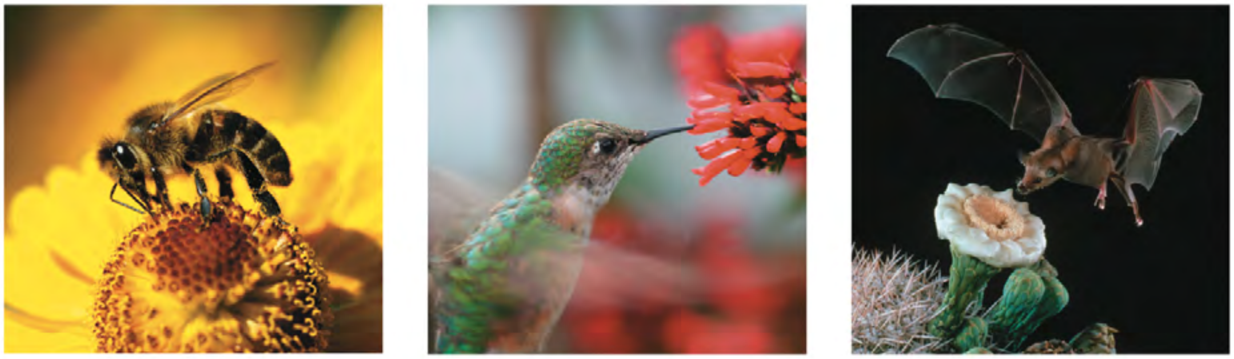
In many flowering plants, insects or other animals transport pollen from one flower to another. The petals, scent, and nectar of many flowers have evolved to attract specific animal pollinators. In fact, flowers and their pollinators can be so perfectly suited to each other that you can often look at one and predict features of the other. For example, after Charles Darwin studied a night-blooming orchid in Madagascar, he predicted that there should exist a nocturnal moth with a tongue 30 centimeters long.

Forty years later, that moth was finally discovered! Not all flowers smell sweet, however. Flowers of the "dead horse arum lily" smell like rotting meat. Who are their pollinators? Flies that lay their eggs in rotting meat. Figure 10.17 shows more examples of flowers and their animal pollinators.

Flowering plants surround their seeds with a structure called a **fruit**. A fruit is an adaptation for spreading seeds. When an animal eats a fruit, the seeds pass through its digestive system and eventually come out far from the parent plant. Tasty fruits evolved in certain plants because animals were more likely to eat them. But not all fruits have evolved to be eaten. The burrs that catch on your socks during a hike are also fruits. These fruits hitch a ride until you pull them off and drop them on the ground—again, far from the parent plant.

Seed plants are very important to human societies. Humans use many different trees for wood, and much of our food comes from the roots, stems, leaves, and fruits of flowering plants.

Also, did you know that the most massive living organism on Earth is a seed plant? In Utah, there is a quaking aspen that has more than 47,000 separate tree trunks covering over 100 acres. The aspen is nicknamed "Pando"—Latin for "I spread." Although Pando looks like a forest of separate trees, its trunks are all connected to a single enormous root system—and they all have the same DNA. Pando may be 80,000 years old or more.



(a) (b) (c)

FIGURE 10.17

Many flowering plants are pollinated by insects or other animals. (a) Flowers pollinated by bees are often blue or yellow, the colors bees see best. Bee-pollinated flowers may also give off a pleasant scent and provide suitable landing spots for the beeds. (b) Flowers pollinated by hummingbirds are often red. Hummingbirds have a poor sense of smell, and the flowers they pollinate are usually odorless. Hummingbirds hover while feeding, so hummingbird-pollinated flowers may be trumpet shaped. (c) Flowers pollinated by bats, which are active at night, tend to be white, a color that is easy to see at night. Bat-pollinated flowers also have strong odors and grow at the tops of plants for easy access.

READING CHECK

Fruits are adaptations that help flowering plants spread their seeds. Why is it adaptive for a plant to spread its seeds?

CHECK YOUR ANSWERS

If plants are able to spread their seeds to a variety of environments, their offspring have a better chance of encountering environments that are well suited to their survival and reproduction.

You can learn more about plants, including the different groups of plants, here:

https://basicbiology.net/plants