SECTION 3

READING WARM-UP

Terms to Learn

carrying capacity	mutualism
prey	commensalism
predator	parasitism
symbiosis	coevolution

What You'll Do

- Distinguish between the two types of competition.
- Give examples of predators and prey.
- Distinguish between mutualism, commensalism, and parasitism.
- Define *coevolution*, and give an example.

Types of Interactions

Look at the seaweed forest shown in **Figure 10** below. Notice that some types of organisms are more numerous than others. In natural communities, populations of different organisms vary greatly. The interactions between these populations affect the size of each population.

Figure 10 *This seaweed forest is home to a large number of interacting species.*

Interactions with the Environment

Most living things produce more offspring than will survive. A female frog, for example, might lay hundreds of eggs in a small pond. In a few months, the population of frogs in that pond will be about the same as it was the year before. Why won't the pond become overrun with frogs? An organism, such as a frog, interacts with biotic or abiotic factors in its environment that can control the size of its population.

Limiting Factors. Populations cannot grow indefinitely because the environment contains only so much food, water, living space, and other needed resources. When one or more of those resources becomes scarce, it is said to be a *limiting factor.* For example, food becomes a limiting factor when a population becomes too large for the amount of food available. Any single resource can be a limiting factor to population size.

Carrying Capacity The largest population that a given environment can support over a long period of time is known as the environment's **carrying capacity.** When a population grows larger than its carrying capacity, limiting factors in the environment cause the population to get smaller. For example, after a very rainy growing season in an environment, plants may produce a large crop of leaves and seeds. This may cause a herbivore population to grow large because of the unlimited food supply. If the next year has less rainfall than usual, there won't be enough food to support the large herbivore population. In this way, a population may temporarily exceed the carrying capacity. But a limiting factor will cause the population to die back. The population will return to a size that the environment can support over a long period of time.

Self-Check

1. Explain how water can limit the growth of a population.
2. Describe how the carrying capacity for deer in a forest ecosystem might be affected by weather.

(See page 168 to check your answers.)

Interactions Among Organisms

Populations contain interacting individuals of a single species, such as a group of rabbits feeding in the same area. Communities contain interacting populations of several species, such as a coral reef community with many species trying to find living space. Ecologists have described four main ways that species and individuals affect each other: competition, predators and prey, certain symbiotic relationships, and coevolution.

Competition

When two or more individuals or populations try to use the same limited resource, such as food, water, shelter, space, or sunlight, it is called *competition*. Because resources are in limited supply in the environment, their use by one individual or population decreases the amount available to other organisms.

Competition can occur among individuals *within* a population. The elks in Yellowstone National Park are herbivores that compete with each other for the same food plants in the park. This is a big problem for this species in winter. Competition can also occur *between* populations of different species. The different species of trees in **Figure 11** are competing with each other for sunlight and space.

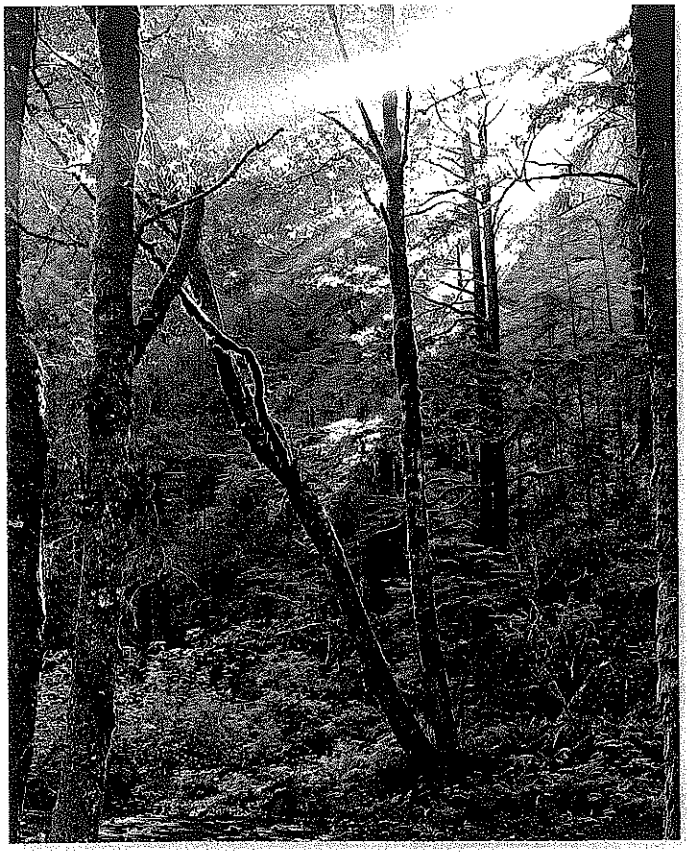


Figure 11 *Some of the trees in this forest grow tall in order to reach sunlight, reducing the amount of sunlight available to shorter trees nearby.*

Predators and Prey

Many interactions among species occur because one organism eats another. The organism that is eaten is called the **prey.** The organism that eats the prey is called the **predator.** When a bird eats a worm, the worm is the prey and the bird is the predator.

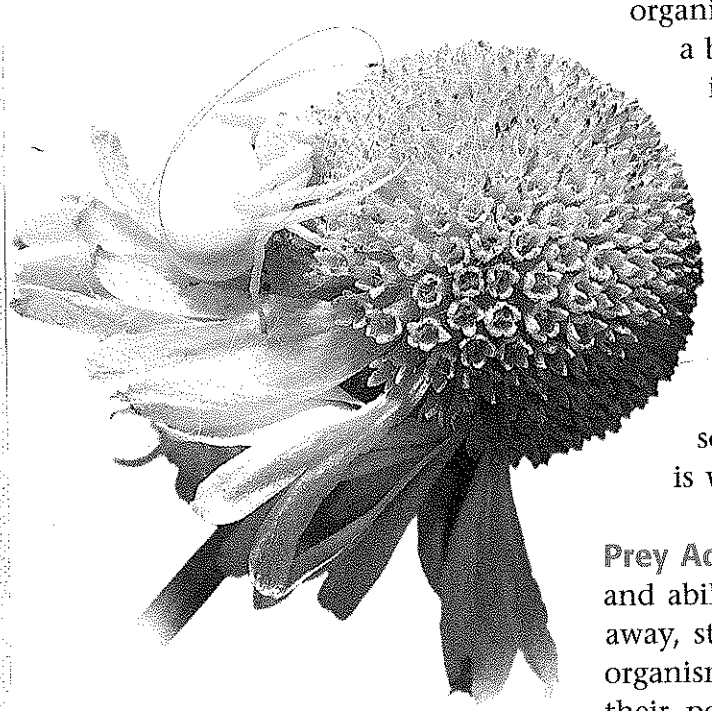


Figure 12 *The goldenrod spider is difficult for its insect prey to see. Can you see it?*

Predator Adaptations In order to survive, predators must be able to catch their prey. Predators have a wide variety of methods and abilities for doing this. The cheetah, for example, is able to run at great speed to catch its prey. Other predators, such as the goldenrod spider, shown in **Figure 12,** ambush their prey. The goldenrod spider blends in so well with the goldenrod flower that all it has to do is wait for its next insect meal to arrive.

Prey Adaptations Prey organisms have their own methods and abilities to keep from being eaten. Prey are able to run away, stay in groups, or camouflage themselves. Some prey organisms are poisonous to predators. They may advertise their poison with bright colors to warn predators to stay away. The fire salamander, shown in **Figure 13,** sprays a poison that burns. Predators quickly learn to recognize its warning coloration.

Many animals run away from predators. Prairie dogs run to their underground burrows when a predator approaches. Many small fishes, such as anchovies, swim in groups called schools. Antelopes and buffaloes stay in herds. All the eyes, ears, and noses of the individuals in the group are watching, listening, and smelling for predators. This behavior increases the likelihood of spotting a potential predator.

Some prey species hide from predators by using camouflage. Certain insects resemble leaves so closely that you would never guess they are animals.

Figure 13 *Experienced predators know better than to eat the fire salamander! This colorful animal will make an unlucky predator very sick.*

Symbiosis

Some species have very close interactions with other species. **Symbiosis** is a close, long-term association between two or more species. The individuals in a symbiotic relationship can benefit from, be unaffected by, or be harmed by the relationship. Often, one species lives in or on the other species. The thousands of symbiotic relationships that occur in nature are often classified into three groups: mutualism, commensalism, and parasitism.

Mutualism A symbiotic relationship in which both organisms benefit is called **mutualism.** For example, you and a species of bacteria that lives in your intestines benefit each other! The bacteria get a plentiful food supply from you, and in return you get vitamins that the bacteria produce.

Another example of mutualism occurs between coral and algae. The living corals near the surface of the water provide a home for the algae. The algae produce food through photosynthesis that is used by the corals. When a coral dies, its skeleton serves as a foundation for other corals. Over a long period of time, these skeletons build up large, rocklike formations that lie just beneath the surface of warm, sunny seas, as shown in **Figure 14.**

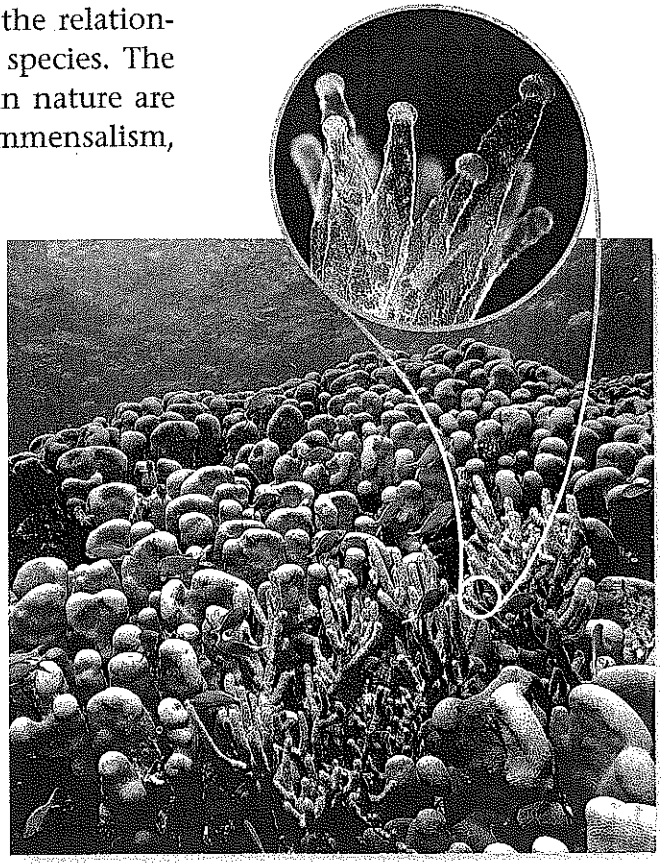


Figure 14 *In the smaller photo above, you can see the gold-colored algae inside the coral.*

Commensalism A symbiotic relationship in which one organism benefits and the other is unaffected is called **commensalism.** One example of commensalism is the relationship between sharks and remoras. **Figure 15** shows a shark with a remora attached to its body. Remoras "hitch a ride" and feed on scraps of food left by sharks. The remoras benefit from this relationship, while sharks are unaffected.

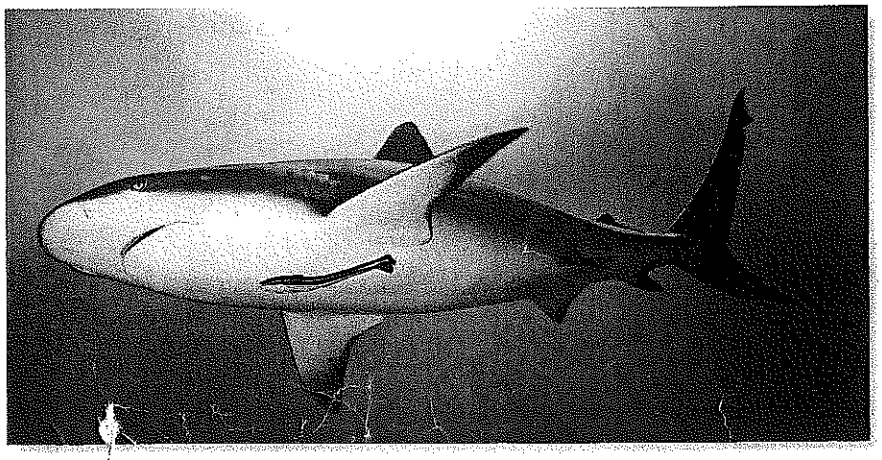


Figure 15 *The remora attached to the shark benefits from the relationship. The shark is neither benefited nor harmed.*

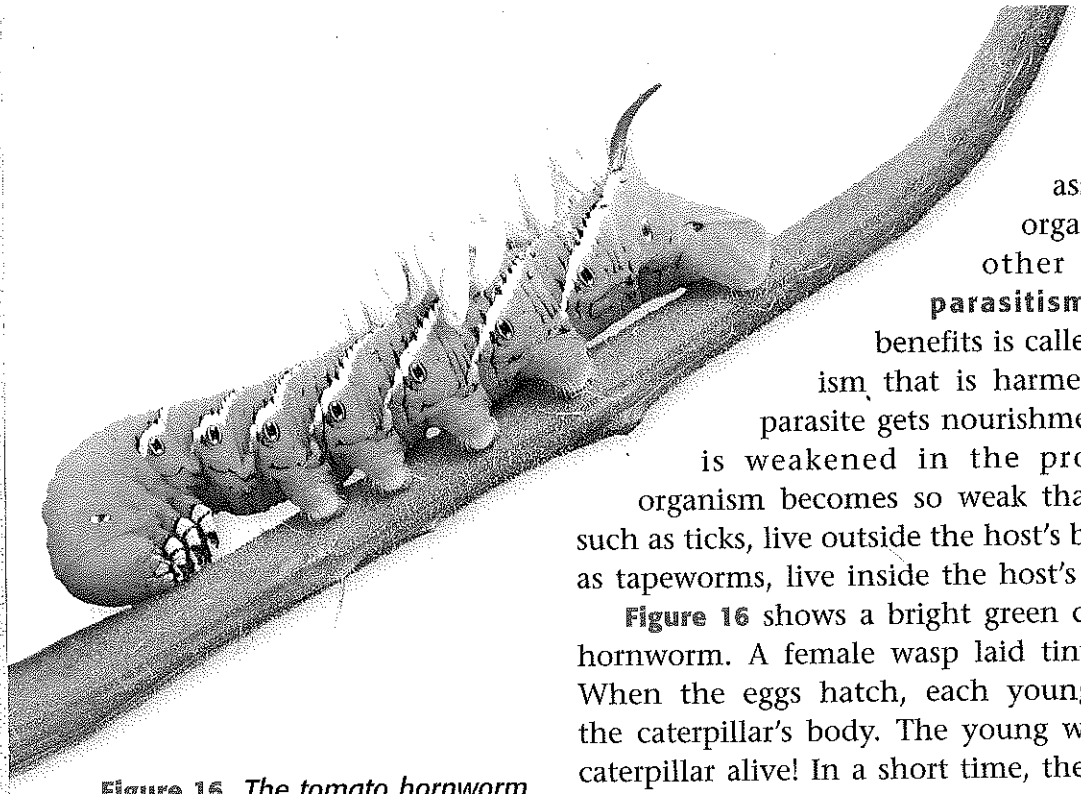


Figure 16 *The tomato hornworm is being parasitized by young wasps. Do you see their cocoons?*

Parasitism A symbiotic association in which one organism benefits while the other is harmed is called **parasitism.** The organism that benefits is called the *parasite.* The organism that is harmed is called the *host.* The parasite gets nourishment from its host, which is weakened in the process. Sometimes a host organism becomes so weak that it dies. Some parasites, such as ticks, live outside the host's body. Other parasites, such as tapeworms, live inside the host's body.

Figure 16 shows a bright green caterpillar called a tomato hornworm. A female wasp laid tiny eggs on the caterpillar. When the eggs hatch, each young wasp will burrow into the caterpillar's body. The young wasps will actually eat the caterpillar alive! In a short time, the caterpillar will be almost completely consumed and will die. When that occurs, the mature wasps will fly away.

In this example of parasitism, the host dies. Most parasites, however, do not kill their hosts. Can you think of reasons why?

Coevolution

Symbiotic relationships and other interactions among organisms in an ecosystem may cause coevolution. **Coevolution** is a long-term change that takes place in two species because of their close interactions with one another.

Coevolution sometimes occurs between herbivores and the plants on which they feed. For example, the ants shown in **Figure 17** have coevolved with a tropical tree called the acacia. The ants protect the tree on which they live by attacking any other herbivore that approaches the tree. The plant has coevolved special structures on its stems that produce food for the ants. The ants live in other structures also made by the tree.

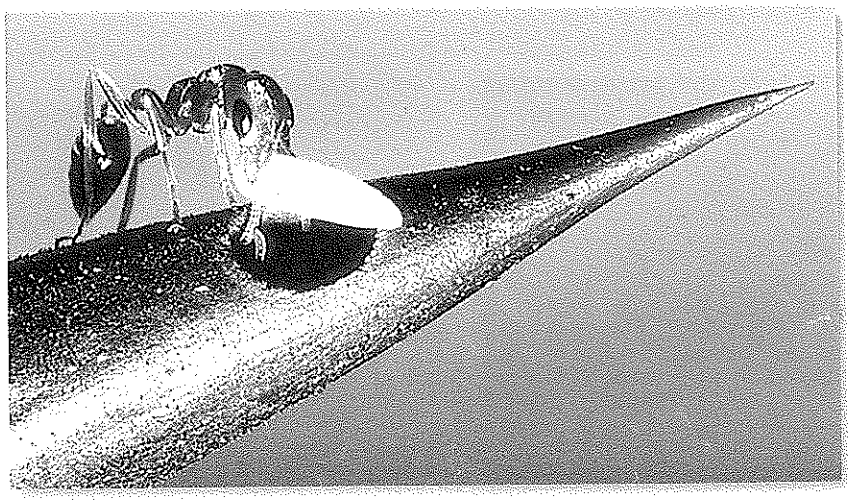
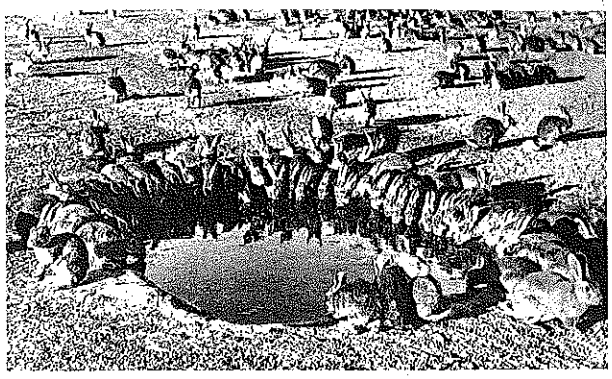


Figure 17 *Ants collect food made by the acacia tree and store the food in their shelter, also made by the tree.*

APPLY

Coevolution in Australia

In 1859, settlers released 12 rabbits in Australia. There were no predators or parasites to control the rabbit population, and there was plenty of food. The rabbit population increased so fast that the country was soon overrun by rabbits. To control the rabbit population, the Australian government introduced a virus that makes rabbits sick. The first time the virus was used, more than 99 percent of the rabbits died. The survivors reproduced, and the rabbit population grew large again. The second time the virus was used, about 90 percent of the rabbits died. Once again, the rabbit population increased. The third time the virus was used, only about 50 percent of the rabbits died. Suggest what changes might have occurred in the rabbits and the virus.



Coevolution and Flowers Some of the most amazing examples of coevolution are between flowers and their pollinators. (An organism that carries pollen from flower to flower is called a *pollinator.)* When the pollinator travels to the next flower to feed, some of the pollen is left behind on the female part of the flower and more pollen is picked up. Because of pollination, reproduction can take place in the plant. Organisms such as bees, bats, and hummingbirds are attracted to a flower because of its colors, odors, and nectar.

During the course of evolution, hummingbird-pollinated flowers, for example, developed nectar with just the right amount of sugar for their pollinators. The hummingbird's long, thin tongue and beak coevolved to fit into the flowers so that they could reach the nectar. As the hummingbird, like the one shown in **Figure 18,** feeds on the nectar, its head and body become smeared with pollen.

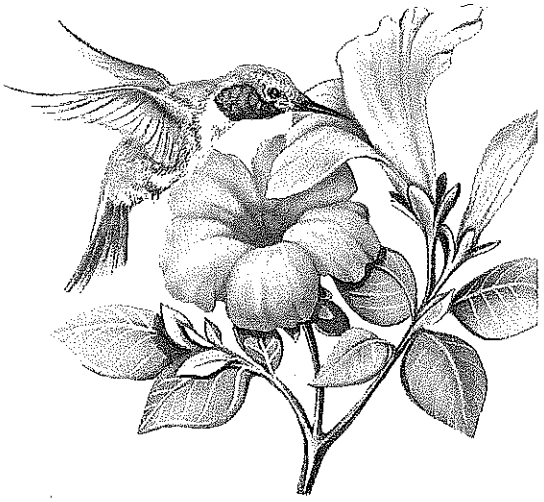


Figure 18 *The bird is attracted to the flower's nectar and picks up the flower's pollen as it feeds.*

SECTION REVIEW

1. Briefly describe one example of a predator-prey relationship. Identify the predator and the prey.
2. Name and define the three kinds of symbiosis.
3. **Analyzing Relationships** Explain the probable relationship between the giant *Rafflesia* flower, which smells like rotting meat, and the carrion flies that buzz around it. HINT: *carrion* means "rotting flesh."

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