

2.2

KEY CONCEPT

Organisms can interact in different ways.

BEFORE, you learned

- Different populations live together in a habitat
- Different species fill different niches in a habitat
- There are patterns in the ways organisms interact with each other and their environment

NOW, you will learn

- About different types of interactions in an ecosystem
- How some species benefit from interactions
- How some species are harmed by interactions

VOCABULARY

- predator p. 55
prey p. 55
competition p. 55
cooperation p. 57
symbiosis p. 58
mutualism p. 58
commensalism p. 59
parasitism p. 59

THINK ABOUT

What are some of the ways people interact?

People in a community interact with each other in many ways. An interaction is the way a person behaves toward or responds to another person. This photograph shows groups of people at a soccer game. There are players from two teams and fans who are watching the game. How would you describe the interactions between the people in this photograph?



Organisms interact in different ways.

The photograph above shows how members of a human community both compete and cooperate. Different members of the populations of a biological community also compete and cooperate. They not only share a habitat, but they also share the resources in that habitat. How different organisms interact depends on their relationship to each other.

A robin in a meadow picks at the soil, pulls out an earthworm, and swallows it. This is one obvious way organisms in an ecosystem interact—one eats, and the other gets eaten. Organisms also compete. The robin may have to compete with a chickadee to get the earthworm. And organisms can cooperate. Ants work together to build a nest, collect food, and defend their colony.



CHECK YOUR READING

Name three ways organisms may interact with each other in an ecosystem.

Predator and Prey

Many interactions between organisms in an ecosystem involve food. A food chain shows the feeding relationships between different species. There are producers and consumers. Another way to look at a food chain is through the interactions of predators and prey. The **predator** is an animal that eats another. The **prey** is an animal that is eaten by a predator. In a food chain, an organism can be both predator and prey. A meadowlark that feeds on a grasshopper is, in turn, eaten by a prairie falcon.

Predators can affect how members of their prey populations are distributed. Herring move together in a school and wildebeests travel in herds to protect themselves. It is the sick or older members of the population that will most likely be eaten by predators. Species of prey may also have adaptations that relate to the behavior of predators. This is true of cicadas and their long reproductive cycles.

Prey populations, in turn, affect the location and number of predator populations. For example some birds are predators feeding on insects. One factor that may affect movement of birds from one location to another is the availability of insects.

REMINDER

A *producer* is an organism that makes its own food; a *consumer* is an organism that eats another organism for food.

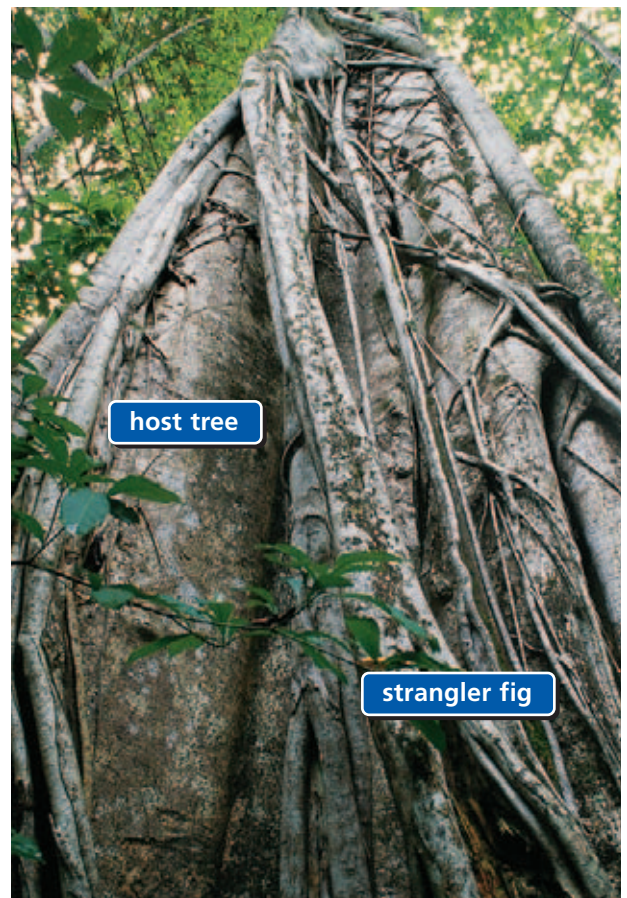
Competition

In a team game, two teams compete against each other with the same goal in mind—to win the game. In a biological community, competition is for resources, not wins. **Competition** is the struggle between individuals or different populations for a limited resource.

In an ecosystem, competition may occur within the same species. Individual plants compete with each other for light, space, and nutrients. For example, creosote bushes compete with other creosote bushes for the same water supply. The toxins produced by the roots of one creosote bush prevent other creosote bushes from growing.

Competition also occurs between members of different species. In the tropical rain forests of Indonesia, vines called strangler figs compete with trees for water, light, and nutrients. The vine attaches itself to a host tree. As it grows, the vine surrounds and eventually kills the tree by blocking out sunlight and using up available water and nutrients.

INFER Do you think a strangler fig could survive on its own?



Competition

Competition between species

Two different species, hyenas and vultures, compete for the remains of a dead animal.



Competition within species

Two male deer lock horns as they battle over territory.



Competition occurs between species and within species. For example, vultures and hyenas will compete over the food left in the remains of a dead animal. Wolves will compete with one another over territory. A wolf will mark its territory by urinating on trees and so warn off other wolves. Animals also compete over territory by fighting, using threatening sounds, and putting on aggressive displays.

Competition within species often occurs during the mating season. Male birds use mating songs and displays of feathers to compete for the attention of females. Male hippopotamuses fight to attract female hippopotamuses. Male crickets chirp to attract female crickets.



What sorts of resources do plants and animals compete for?

READING TIP

Compare and contrast the meanings of *competition* and *coexistence*.

Competition does not occur between all populations that share the same resources. Many populations can coexist in a habitat—different species can live together without causing harm to one another. Many different populations of plants coexist in a forest. Maple trees, beech trees, and birch trees can live side by side and still have enough water, nutrients, and sunlight to meet their needs.

INVESTIGATE Species Interactions

How do predator-prey populations interact?

Use these rules for predator-prey interaction for each round. If a predator card touches three or more prey cards, remove the prey cards touched. If the predator card does not touch at least three prey cards, remove the predator card and leave the prey cards. Predator cards are large, prey cards are small.

PROCEDURE

- 1 Use masking tape to mark a boundary on a table top.
- 2 Scatter five prey cards into the area. Take a predator card and toss it, trying to get it to land on the prey.
- 3 According to the rules above, remove the predators and prey that have “died.” Record the number of predators and prey that have “survived.” This represents one generation.
- 4 Double the populations of predators and prey—they have “reproduced.”
- 5 Scatter the prey cards into the area and then toss the predator cards as before. Repeat steps 3 and 4 for a total of 15 rounds (generations).

WHAT DO YOU THINK?

- How does the size of the prey population affect the predator population?
- How might the size of a habitat affect the interaction of predators and prey?

CHALLENGE Use graph paper and colored pencils to make a graph of your results. Or use a spreadsheet program if one is available to you.

SKILL FOCUS
Analyzing data

MATERIALS

- 20 10 × 10 cm cardboard squares—predators
- 200 3 × 3 cm paper squares—prey
- masking tape
- for Challenge:*
- graph paper
- 2 colored pencils

TIME
30 minutes



Cooperation

Not all interactions in an ecosystem involve competition. **Cooperation** is an interaction in which organisms work in a way that benefits them all. Some predators cooperate when they hunt. Although individual lions may hunt on their own, they also hunt in packs to kill large prey.

Killer whales also cooperate when they hunt. The whales swim in packs called pods. The pod swims in circles around a school of fish, forcing the fish close together so they are easier to catch. Pod members may also take turns chasing a seal until it gets tired and is easily killed. The pod may even work together to attack larger species of whales.

Ants, bees, and termites are social insects. Members of a colony belong to different groups, called castes, and have different responsibilities. Some groups gather food while others defend the colony. Other animals, like apes and monkeys, live in family groups. Members of the family cooperate to care for their young.



Cooperation
Driver ants work together to bring food to their nest.

The survival of one species might depend on another species.

OUTLINE

Add a sentence about *symbiosis* to your outline and define the three types of symbiosis in the supporting details.

You have learned that many different organisms live together in a habitat. The fact that organisms live together forces them to interact in different ways. For example, an organism preys upon another for food. Or perhaps there is competition among organisms over resources such as food, water, and territory.

The actions of different organisms can be so closely related that the survival of one species depends on the action or presence of another. In such a relationship, at least one of the species is getting a resource that it needs to survive. Benefits of the relationship may include food, reproductive help, or protection.

The relationship between individuals of two different species who live together in a close relationship is called **symbiosis** (SIHM-bee-OH-sih). This word means “living together.” A symbiotic relationship may affect the partners in different ways.

- Both species benefit from the relationship.
- One species benefits while the other is not affected.
- One species benefits while the other is harmed.

Here are some examples for each of the three types of symbiosis.

Mutualism The interaction between the hummingbird and the flower benefits both.

Both Species Benefit

Stroll through a garden on a sunny day and notice the bees buzzing from flower to flower. Look closely at a single bee and you may see yellow pollen grains sticking to its hairy body. The relationship between the flower and the bee is an example of **mutualism** (MYOO-choo-uh-LIHZ-uhm)—an interaction between two species that benefits both. The bees get food in the form of nectar, and the flowers get pollen from other flowers, which they need to make seeds.



Many plants rely on mutualism to reproduce. The pollen needed to make seeds must be spread from flower to flower. The birds and insects that feed on the nectar in these flowers transfer pollen from one flower to the next. The seeds produced are then moved to new ground by animals that eat the seeds or the fruits that hold the seeds. This form of mutualism doesn't benefit the individual flower but instead ensures the survival of the species.

In some cases, mutualism is necessary for the survival of the organisms themselves. For example, termites are able to live off a food that most animals cannot digest: wood. The termites, in fact, can't digest wood either. However, they have living in their guts tiny single-celled organisms, protozoans, that can break the wood down into digestible components. The protozoans get a safe place to live, and the termites can take advantage of a plentiful food source.



Explore symbiotic relationships.



CHECK YOUR READING

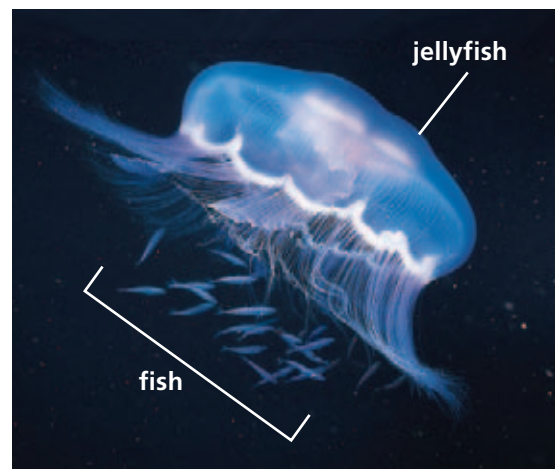
Describe how a bee and a flower benefit from a symbiotic relationship.

One Species Benefits

Commensalism (kuh-MEHN-suh-LIHZ-uhm) is a relationship between two species in which one species benefits while the other is not affected. Orchids and mosses are plants that can have a commensal relationship with trees. The plants grow on the trunks or branches of trees. They get the light they need as well as nutrients that run down along the tree. As long as these plants do not grow too heavy, the tree is not affected.

Commensal relationships are very common in ocean ecosystems. Small fish called remoras use a type of built-in suction cup to stick to a shark's skin and hitch a ride. When the shark makes a kill, the remora eats the scraps. The shark makes no attempt to attack the remora. The remora benefits greatly from this commensal relationship; the shark is barely affected.

Not all commensal relationships involve food. Some fish protect themselves by swimming among the stinging tentacles of a moon jellyfish. The fish benefit from the relationship because the tentacles keep them safe from predators. The jellyfish is not helped or hurt by the presence of the fish. As in this example, it is common in commensal relationships for the species that benefits to be smaller than the species it partners with.



Commensalism The interaction between the jellyfish and the fish benefits the fish only.

One Species Is Harmed

There is one symbiotic relationship in which a small partner can harm a much larger host. **Parasitism** (PAR-uh-suh-TIHZ-uhm) is a relationship between two species in which one species benefits while the species it depends on, its host, is harmed. Parasites are often tiny organisms that feed off, and weaken, their hosts. Ticks, lice, and mites are external parasites that live on or attach to their host's skin. Other parasites, like tapeworms and ringworms, are internal parasites that live inside their hosts.

Symbiotic Relationships

Mutualism

Both species benefit from the relationship.

Commensalism

One species benefits while the other is not affected.

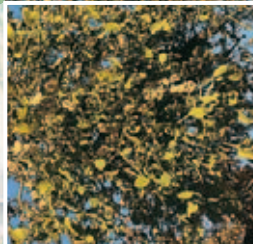
Parasitism

One species benefits while the other is harmed.



Commensalism

Lichens benefit from living on a tree, but the tree is not harmed.



Parasitism

Mistletoe is a plant that takes nourishment from a tree, causing damage to the tree.



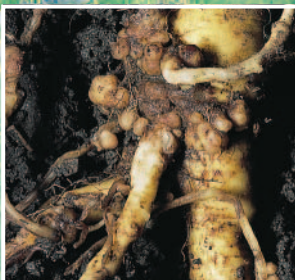
Mutualism

Aphids are insects that provide ants with a sweet liquid. Ants live alongside the aphids, protecting them from predators.



Parasitism

Ticks are animals that attach to their hosts, feeding on the host's blood.



Mutualism

Nitrogen-fixing bacteria get their nourishment from the roots of certain plants, providing the plants with nitrogen in return.



Commensalism

Mice do well living near humans, living off the food scraps humans leave behind.



The relationship between cowbirds and warblers is an unusual type of association called nest or brood parasitism. Female cowbirds never build their own nests or rear their own young. Instead, they lay their eggs in warbler nests. Although nest parasitism does not harm the host warbler, it does harm the warbler species because either warblers eggs do not hatch, or the chicks do not survive. The warbler species is often harmed because cowbirds push most warbler eggs from the nest in order to make room for their own eggs. Once the cowbird chicks hatch, their larger size helps them to outcompete the smaller warbler chicks for food, so that the host's chicks starve.



Parasitism The larger cowbird chick is cared for by a warbler at the expense of the smaller warbler chick.

CHECK YOUR READING How is parasitism different from commensalism?

Interactions in an ecosystem are complex.

Different types of symbiosis occur throughout an ecosystem and often overlap. They may occur in the same locations, and the same species might be involved in more than one symbiotic relationship. The illustration on page 60 shows different symbiotic relationships that may occur in a backyard.

Symbiosis is just one of many interactions that take place in an ecosystem. The yard may have a garden, with individual tomato plants competing for water and nutrients; it may have ants cooperating to maintain a successful colony. An ecosystem is more than just a collection of biotic and abiotic factors. Interactions within an ecosystem help explain how resources are shared and used up and how energy flows through the system.

2.2 Review

KEY CONCEPTS

1. Name two ways in which members of the same species interact.
2. In what ways do members of different species interact?
3. Give an example of each type of symbiotic relationship: mutualism, commensalism, and parasitism.

CRITICAL THINKING

4. **Apply** Think of a biological community near you, and give an example of how one population has affected another.
5. **Compare and Contrast** Explain how symbiotic relationships are similar to and different from predator-prey interactions.

CHALLENGE

6. **Synthesize** Mutualism is more common in tropical ecosystems such as rain forests and coral reefs than in other ecosystems. Why do you think this is so?