

Know Your Limits

What environmental factors influence population size?

A tropical rain forest can support large populations of trees. A desert, however, will probably support few or no trees. Each environment has different amounts of the resources that living things need, such as food, water, and space.

Resource Availability

The amount of resources in an area influences the size of a population. If important resources are lost from the environment, a population may shrink. The population may grow if the amount of resources in the environment is increased. But if the population continues to grow, the individuals would eventually run out of resources. The **carrying capacity** is the maximum number of individuals of one species that the environment can support. For example, the carrying capacity, or the number of owls that a forest can support, depends on how many mice are available to eat and how many trees are available for the owls to live in.

Deforestation causes a sudden change in resource availability.



Visualize It!

8 Identify Make a list of each population in the image that would be affected by drought.

Animals use plants as food and shelter. Plants depend on sunlight and water as resources.



Changes in the Environment

The carrying capacity can change when the environment changes. For example, after a rainy season, plants may produce a large crop of leaves and seeds. This large amount of food may allow an herbivore population to grow. But what if important resources are destroyed? A population crash occurs when the carrying capacity of the environment suddenly drops. Natural disasters, such as forest fires, and harsh weather, such as droughts, can cause population crashes. The carrying capacity can also be reduced when new competitors enter an area and outcompete existing populations for resources. This would cause existing populations to become smaller or crash.

Active Reading 9 Describe What are two ways in which the environment can influence population size?

Drought slowly reduces the amount of water available as a resource to different populations.



Think Outside the Book

10 Apply With a classmate, discuss how the immigration of new herbivores might affect the carrying capacity of the local zebra population.



Maximum Capacity

What factors can limit population size?

A part of the environment that keeps a population's size at a level below its full potential is called a **limiting factor**. Limiting factors can be living or nonliving things in an environment.

Abiotic Factors

The nonliving parts of an environment are called *abiotic factors*. Abiotic factors include water, nutrients, soil, sunlight, temperature, and living space. Organisms need these resources to survive. For example, plants use sunlight, water, and carbon dioxide to make food. If there are few rocks in a desert, lizard populations that use rocks for shelter will not become very large.

Biotic Factors

Relationships among organisms affect each one's growth and survival. A *biotic factor* is an interaction between living things. For example, zebras interact with many organisms. Zebras eat grass, and they compete with antelope for this food. Lions prey on zebras. Each of these interactions is a biotic factor that affects the population of zebras.

Inquiry

11 Apply Think about how people limit the populations of pests such as insects and mice. List one abiotic factor and one biotic factor that humans use to limit these pest populations.

Abiotic _____
Biotic _____

Visualize It!

12 Identify Label each of the following factors that limits plant population growth as abiotic or biotic.



Why It Matters

A Fungus Among Us!

In many parts of the world, frog populations are shrinking. We now know that many of these frogs have died because of a fungal infection.

Meet the fungus

Chytrid fungi [ky-trid FUNN-yi] live in water. They are important decomposers. One of them, called Bd, infects frogs.

Stop the Spread

Bd is found in wet mud. If you go hiking in muddy places, washing and drying your boots can help stop Bd from spreading.

Deadly Disease

Frogs take in oxygen and water through their skin. Bd interferes with this process. The fungus also affects an infected frog's nervous system.



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Extend

13 Describe How does Bd fungus harm frogs?

14 Recommend Imagine that an endangered frog lives near an area where Bd was just found. How could you help protect that frog species?

Inquiry

15 Apply Design an experiment to test whether using soap or using bleach is the better way to clean boots to prevent Bd contamination. What are the independent and dependent variables? Remember to include a control in designing your experiment.

Teamwork

Animals compete for access to water.

What interactions between organisms can influence population size?

As living things try to gather the resources they need, they often interact with each other. Sometimes interactions help one individual and harm another. At other times, all of the organisms benefit by working together.

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**. Competition can happen among individuals within a population. The elk in a forest compete with each other for the same food plants. This competition increases in winter when many plants die. Competition also happens among populations. For example, different species of trees in a forest compete with each other for sunlight and space.

16 Predict The image above shows individuals from two populations competing for access to water.

What would happen to the size of the lion population if elephants usually won this competition?

What would happen to each population if lions usually won this competition?

Visualize It!

Active Reading 17 Identify

As you read, underline how cooperation can influence population dynamics.

Cooperation

Cooperation occurs when individuals work together. Some animals, such as killer whales, hunt in groups. Emperor penguins in Antarctica stay close together to stay warm. Some populations have a structured social order that determines how the individuals work with each other. For example, ants live in colonies in which the members have different jobs. Some ants find food, others defend the colony, and others take care of the young. Cooperation helps individuals get resources, which can make populations grow.

18 Compare Make an analogy between an ant colony and a sports team. How does each group work together to achieve a goal?

These ants cooperate to protect aphids that produce a substance that ants eat.



Living Together

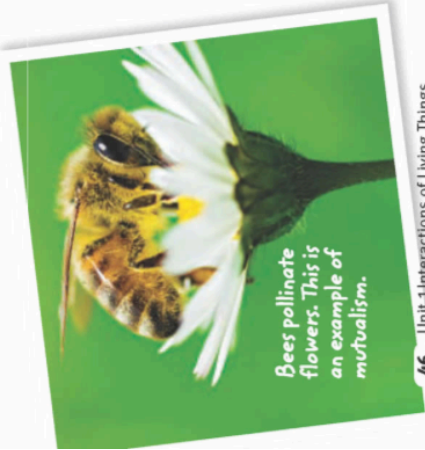
What are the types of symbiotic relationships?

A close long-term relationship between different species in a community is called **symbiosis** (sim•bee•OH•sis). In symbiosis, the organisms in the relationship can benefit from, be unaffected by, or be harmed by the relationship. Often, one organism lives in or on the other organism. Symbiotic relationships are classified as mutualism, commensalism, or parasitism.

Active Reading 9 Identify As you read, underline examples of symbiotic relationships.

Mutualism

A symbiotic relationship in which both organisms benefit is called **mutualism**. For example, when the bee in the photo drinks nectar from a flower, it gets pollen on its hind legs. When the bee visits another flower, it transfers pollen from the first flower to the second flower. In this interaction, the bee is fed and the second flower is pollinated for reproduction. So, both organisms benefit from the relationship. In this example, the mutualism benefits the bee and the two parent plants that are reproducing.



Bees pollinate flowers. This is an example of mutualism.



Think Outside the Book Inquiry

12 Predict Observe and take notes about how the organisms in your area interact with one another. Imagine what would happen if one of these organisms disappeared. Write down three effects that you can think of.



Parasitism

A symbiotic relationship in which one organism benefits and another is harmed is called **parasitism** (PAR•uh•sih•tiz•uhm). The organism that benefits is the **parasite**. The organism that is harmed is the **host**. The parasite gets food from its host, which weakens the host. Some parasites, such as ticks, live on the host's surface and feed on its blood. These parasites can cause diseases such as Lyme disease. Other parasites, such as tapeworms, live within the host's body. They can weaken their host so much that the host dies.

11 Summarize Using the key, complete the table to show how organisms are affected by symbiotic relationships.

Symbiosis	Species 1	Species 2
Mutualism	+	+
Parasitism	+	0

Key + organism benefits
0 organism not affected
- organism harmed

Commensalism

A symbiotic relationship in which one organism benefits while the other is unaffected is called **commensalism**. For example, orchids and other plants that often live in the branches of trees gain better access to sunlight without affecting the trees. In addition, the tree trunk shown here provides a living space for lichens, which do not affect the tree in any way. Some examples of commensalism involve protection. For example, certain shrimp live among the spines of the fire urchin. The fire urchin's spines are poisonous but not to the shrimp. By living among the urchin's spines, the shrimp are protected from predators. In this relationship, the shrimp benefits and the fire urchin is unaffected.



Lichens can live on tree bark.

10 Compare How does commensalism differ from mutualism?



Let the Games Begin!

Why does competition occur in communities?

In a team game, two groups compete against each other with the same goal in mind—to win the game. In a biological community, organisms compete for resources. **Competition** occurs when organisms fight for the same limited resource. Organisms compete for resources such as food, water, sunlight, shelter, and mates. If an organism doesn't get all the resources it needs, it could die.

Sometimes competition happens among individuals of the same species. For example, different groups of lions compete with each other for living space. Males within these groups also compete with each other for mates.

Competition can also happen among individuals of different species. Lions mainly eat large animals, such as zebras. They compete for zebras with leopards and cheetahs. When zebras are scarce, competition increases among animals that eat zebras. As a result, lions may steal food or compete with other predators for smaller animals.

14 Predict In the table below, fill in the missing cause and effect of two examples of competition in a community.

Cause	Effect
A population of lions grows too large to share their current territory.	
Several male hyenas compete to mate with the females present in their area.	



13 Identify Underline each example of competition.



Many organisms rely on the same water source.

Think Outside the Book

15 Apply With a classmate, discuss how competition might affect the organisms in this photo.



Why It Matters

Strange Relationships

Glow worms? Blind salamanders? Even creepy crawlers in this extreme cave community interact in ways that help them meet their needs. How do these interactions differ from ones in your own community?

Guano Buffet

Cave swiftlets venture out of the cave daily to feed. The food they eat is recycled as bird dung, or guano, which piles up beneath the nests. The guano feeds many cave dwellers, such as insects. As a result, these insects never have to leave the cave!



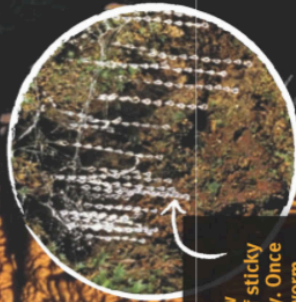
A Blind Hunter

Caves are very dark and, over generations, these salamanders have lost the use of their eyes for seeing. Instead of looking for food, they track prey by following water movements.



Sticky Traps

Bioluminescent glow worms make lines of sticky beads to attract prey. Once a prey is stuck, the worm pulls in the line to feast.



Extend

16 Identify Name the type of relationship illustrated in two of the examples shown above.

17 Research Name some organisms in your community and the interactions they have.

Inquiry

18 Create Illustrate two of the interactions you just described by doing one of the following:

- make a poster
- write a song
- write a play
- draw a graphic novel