

# Organism Interactions in Ecosystems

## Reflect



Have you ever grown a plant or taken care of a pet? If so, you know they have certain needs, such as water or warmth. Plants need sunlight to grow. Animals need food and shelter. Plants and animals in an **ecosystem**, as single organisms and as a **population**, depend on both **biotic** and **abiotic** factors to survive and multiply. If an organism's needs are not met in an ecosystem, they might not survive. If a population's needs are not met, a species may become threatened. Different organisms have different needs. What are the basic requirements for all life?

**ecosystem** – all the biotic and abiotic factors in an area, and the interactions among them




**population** – all the members of one species living in a particular area at a particular time

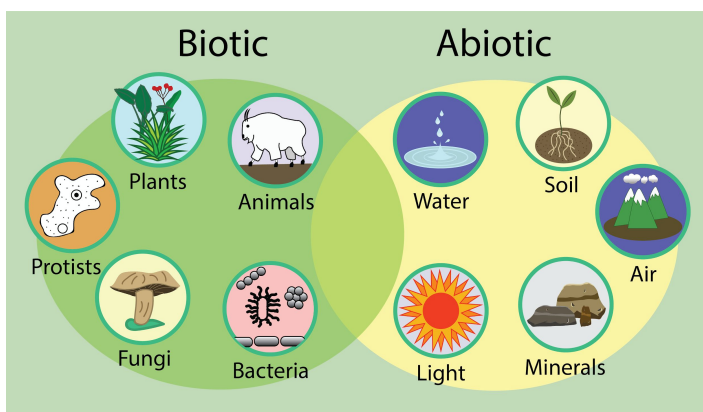
**biotic** – all living or once-living things in an ecosystem

**abiotic** – nonliving things in an ecosystem

### Ecosystem organisms have needs.

Earth is diverse and includes many different ecosystems, both large and small. Organisms in any ecosystem must have their basic needs met. Scientists have identified three main ecosystems.

Aquatic Marine	Aquatic Freshwater	Terrestrial
Saltwater habitats such as oceans, seas, coral reefs, and salt marshes	Freshwater habitats such as ponds, lakes, streams, rivers, and swamps	Land habitats such as forests, grasslands, and deserts
		



Populations respond to factors in the biotic and abiotic environment that limit their size and growth. Examples of *limiting factors* include space, nutrients, predators, water, sunlight, and pathogens. The limiting factor for a species in a specific habitat is the resource that is most difficult to obtain. Water would be the limiting factor for many plant species in the desert. Limiting factors limit the population of each species living in an ecosystem.

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## A Closer Look at Limiting Factors

**Light:** Plants need light to help them make food through the process of photosynthesis. Some plants need more light than others. They will grow poorly if there is not enough light. Other plants grow well in the shade and may not do as well with too much light. Animals also need light to help balance their wake-and-sleep cycles. Light from the Sun allows animals to see during the day. This helps them search for their food sources. Sunlight also provides energy in the form of heat to keep cold-blooded organisms such as reptiles warm.



**Water:** Water is essential for life on Earth. All organisms need water to survive. Like light, the required amount varies among different organisms. For example, organisms in dry ecosystems do not need as much water as organisms in wet ecosystems. A cactus can survive with very little water, but a cypress tree will die if it does not have large amounts of water.



**Shelter:** Organisms need shelter to protect them from harsh weather conditions. Some organisms also need protection from other organisms. For example, mice often seek shelter by burrowing in the ground. They do this to stay warm and to hide from *predators*. Many birds build nests high in the trees to provide a safe shelter for themselves and for their eggs.



**Temperature:** All organisms have a certain temperature range in which they can survive. Some organisms, such as polar bears, require cold climates. Other animals, such as crocodiles, require warm climates. Some extreme organisms, such as *archaea*, can survive in temperatures up to 93°C (200°F)! Some organisms can survive in a broad range of temperatures, but others are limited to a narrow range.



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**Soil composition:** Soil directly affects the types of organisms that live in an ecosystem. Certain plants require certain types of soil and will only grow in ecosystems that contain that soil. Compare a forest ecosystem to a desert ecosystem. The soil in a forest is moist and fertile. Therefore, an abundant variety of plants can live in the forest and support an abundant variety of animal species. On the other hand, the soil in a desert is dry and sandy. Only a small variety of plant species can survive in this type of soil. This limits the number of animal species as well.

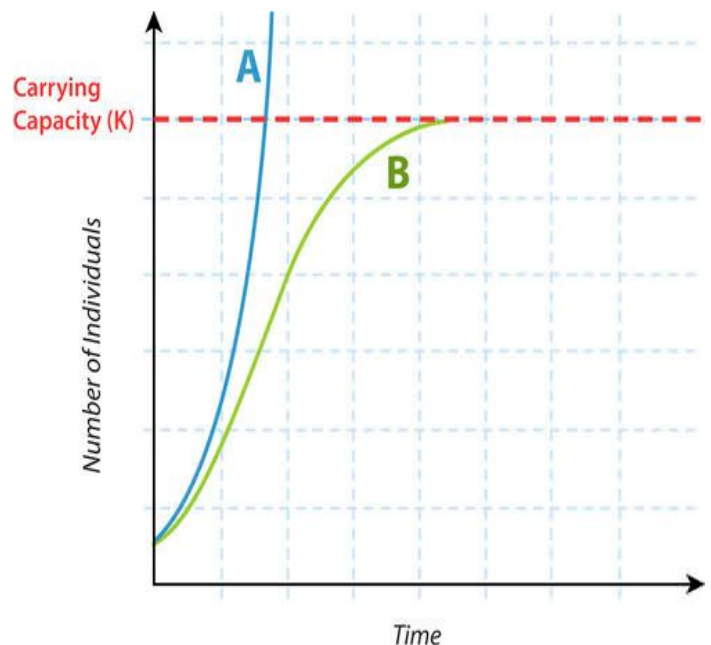


## What Do You Think?

The *carrying capacity* ( $K$ ) is the maximum population size that can be supported by an ecosystem. Limiting factors, such as low food supply and lack of space, determine the carrying capacity. When organisms encounter limiting factors, they show limited growth (curve B). When competition for resources causes the growth rate to slow down, the population levels off. The red straight upper line on a growth curve is the carrying capacity. Carrying capacity is the number of organisms of a particular species or population that can survive with the amount of resources available in a particular ecosystem at a particular time.

Limiting factors determine the carrying capacity of a population. If no limiting factors exist, the population grows exponentially (curve A): as the population size increases, the growth rate also increases. What do you think is the shape of the growth curve for a scenario in which cities extend into rural countrysides?

The Effect of Limiting Factors on Carrying Capacity



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In addition to abiotic (nonliving) factors, there are biotic factors that affect an organism's survival and an ecosystem's overall populations. Biotic factors are the living factors in an environment and may include food sources and other populations.

**predator** – an animal that hunts and eats other animals

Predator–prey interactions are an important biotic factor for both **predator** and prey populations. For example, if there are more prey available, predator numbers can increase because there is more available food. As predator numbers increase, prey numbers will decrease because more of them are eaten. As prey numbers decrease, predator numbers also decrease because there is less food available. As you might have guessed, when predator numbers decrease, prey numbers increase because fewer of them are being eaten. Predator and prey numbers often follow these cyclic patterns over time.



Predators and prey are biotic factors that affect populations.

Another important biotic factor is related to organisms that compete for resources. *Competition* occurs when more than one individual or population tries to use the same limited resource. If a lot of organisms compete for the same resources, it is difficult for each individual to obtain what it needs. Only the organisms that can get the needed resources will survive. For example, if too many plants compete for sunlight in an ecosystem, only the plants that get enough sunlight will survive. You'll learn more about competition later in the lesson.

## What Do You Think?

Take a look at the photographs below. Describe some of the abiotic and biotic factors that each organism needs. How are these factors similar among the organisms? How are they different?



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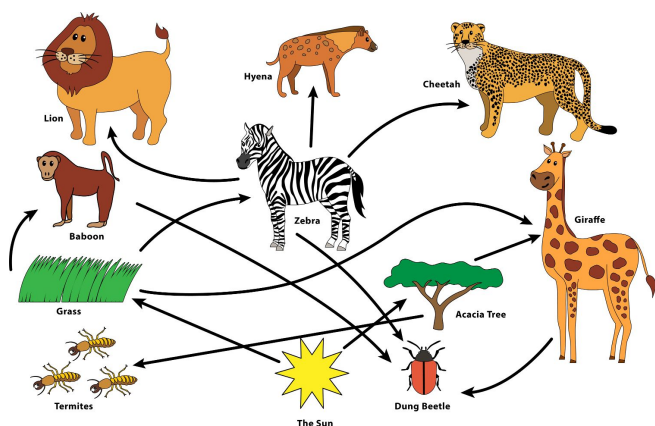
### Everyday Life: Choosing Plants for a Garden

When planting a garden, it is important to consider where you live. You should choose plants that do well in your environment. A good way to start is by using the USDA Plant Hardiness Zone maps. These maps are created by the US Department of Agriculture and can be found on the internet. The maps use average temperature ranges to help people determine which zones they live in. Certain plants thrive in certain zones. You can go online to explore these maps.



**irrigation** – artificial method of adding water to an ecosystem, often used by farmers to grow crops

It is also important to consider how much water is available during the year. Water can be from rain or from **irrigation**. If you live in an area that does not receive a lot of rainfall each year, choose plants that are adapted for drier environments. More local considerations include how much sun the garden area will receive, the soil quality, and whether wild animals will eat the plants. If you live in an area with a lot of deer, it's best to avoid plants that deer are likely to eat.



**food web** – a series of overlapping food chains that show the path of energy among organisms in an ecosystem

### Two Species: Same Niche

The interactions among organisms in an ecosystem are complex. Many organisms depend on one another to survive, as is shown in **food webs**. If one part of a food web is disturbed, all the other organisms are affected. For example, if the plants in a food web are destroyed, the animals that eat the plants will not survive. Like a chain reaction, all other animals that depend on the plant-eating animals will also find it difficult to survive.

As you have learned, competition also affects the individuals and populations in an ecosystem. One way that species reduce competition is by occupying a specific *niche*. An organism's

niche is its role in an ecosystem. Deer, rabbits, and chipmunks often live in the same ecosystem. They all feed on plants. However, each species occupies a different niche. Deer feed on leaves higher up on trees, rabbits eat low-lying grasses, and chipmunks eat acorns and other plant products.

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Sometimes two species in the same ecosystem occupy the same niche. Let's take a look at a specific example. Giraffes are *browsers* and live in an area called the African savanna. They eat leaves from shrubs and trees rather than grasses. Giraffes tend to eat the leaves at the top of the trees. Giraffes also tend to eat during the cooler times of the day and are prey to lions. These characteristics are all part of the giraffes' niche.



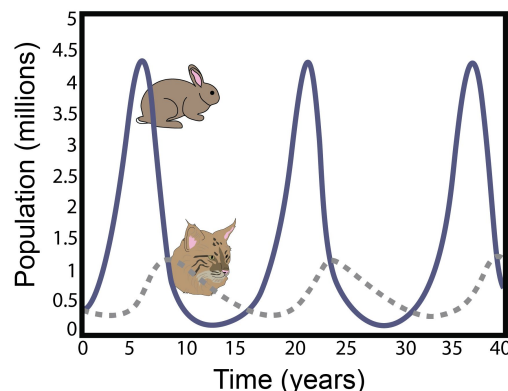
Giraffes are not the only browsers on the African savanna. Zebras share a similar niche. Overlapping niches lead to increased competition. In this case, the zebras and giraffes compete for the same food source. However, although their niches overlap, there are some differences. Giraffes eat the leaves at the top of the trees, while the zebras eat the lower leaves and grasses. This decreases the level of competition for food. Competition between two different species is called *interspecific competition*. *Intraspecific competition* is competition within the same species. All the giraffes are competing for the same food source. Separating resources can help minimize competition. For example, males tip their heads upward when feeding, while females tip their heads downward. This allows male and female giraffes to divide resources so that they are not competing. Many animals also divide resources by claiming territories. Animals defend their territories from any other animals that threaten the resources within their claimed territory.

## Look Out!

Competition does not always lead to winners and losers. In some cases, one population in an ecosystem outcompetes another. The second population may become extinct. In many cases, both populations will survive. Either way, both populations will have decreased numbers, because there will be fewer resources available.

## What Do You Think?




Take a look at the graph to the right. It shows the change in population size of two populations living in the same environment: rabbits and lynx. Lynx are a species of wildcat. Carefully analyze how the increase and decrease in population size of one affect the other. Does this graph show that these populations are competing for the same resources or that they are in a predator-prey relationship? Explain your reasoning.



# Organism Interactions in Ecosystems

## Try Now

Study each image in the left column of the chart. For each image, identify the resource that is being used by the organism or organisms. Then, determine whether the resource is abiotic or biotic. Finally, read each scenario in the final column of the chart. Predict how and why the scenario will affect parts of the ecosystem by filling in the blanks. Write all your answers in the spaces provided.

	Resource	Abiotic or Biotic?	Scenario
			<p>The population size of panda bears increases dramatically.</p> <p>The _____ population will decrease because _____.</p>
			<p>A large number of prairie dogs move into the ecosystem.</p> <p>Competition for _____ will increase because _____.</p>
			<p>The ecosystem experiences a drought, and all the water bodies dry up.</p> <p>The lion population will _____ because _____.</p>