Reflect

Have you ever grown a plant or taken care of a pet? If so, you know they have certain needs that must be met. Plants and animals need to have enough water. Plants need sunlight to grow. Pets need food and shelter. If the needs of an organism are not met, the organism may not survive. Different organisms have different needs, but all organisms have basic requirements for life. What are these basic requirements?

Abiotic and Biotic Factors

Earth is diverse and includes many different **ecosystems,** both large and small. Scientists have identified three main ecosystems: marine, freshwater, and terrestrial. Marine ecosystems include saltwater environments such as oceans, coral reefs, and salt marshes. Freshwater ecosystems include lakes, streams, and rivers. A terrestrial ecosystem is any ecosystem on land. Forests, grasslands, and deserts are examples of terrestrial ecosystems.

ecosystem: interacting populations of organisms with biotic and abiotic factors

The organisms in all ecosystems have specific needs that must be met. For example, there must be enough food and water in an ecosystem for a **population** to survive. These needs are called *limiting factors* because they limit the number of organisms that can live in an environment if not enough of each factor are available.

population: all the members of the same group of organisms living in a particular area at a particular time

Some limiting factors are nonliving and are called *abiotic factors*.

Let's take a closer look at some of the abiotic factors that determine which organisms can live in an ecosystem.

- **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 source. Sunlight also provides energy in the form of heat to keep organisms warm.
- **Water:** Water is essential for life on Earth. All organisms need water to survive, but, 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. Think about cactus plants that grow in the desert. They have special structures to help them survive with little water. Kangaroo rats never need to drink water. Kangaroo rats have **adaptations** that allow them to survive in extremely dry environments. They can get the water they need from their food.

photosynthesis: the process by which plants use energy from sunlight to produce food

Kangaroo rats are adapted to survive in dry ecosystems.

adaptations: structures or behaviors in organisms that help them survive in their environment

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- **Shelter:** Organisms need *shelter* that will 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 to stay warm and to hide from **predators**. Many birds build nests to provide shelter for their eggs.

predator: an animal that hunts and eats other animals

- **Temperature:** All organisms can only survive within a certain temperature range. Some organisms require cold climates, while others require warm climates. Some simple, bacteria-like organisms called *archaea* can survive in extreme temperatures of up to 93° C (200° F)! Some organisms can survive in a broad range of temperatures, while others are limited to a narrow range of temperatures.
- **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. It supports a variety of plant life. Therefore, a variety of animals can live in the forest and feed on the plants. Animals that feed on the plant-eaters are also supported. On the other hand, the soil in a desert is dry and sandy. Only a small variety of plants can grow in this type of soil. As a result, fewer organisms can live in the desert.

Forest soil can support a wide variety of plants.

Desert soil limits the types of plants that can live in the dry conditions.

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

Reflect

prey: an animal that is hunted or eaten by 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 since there is more available food. However, as predator numbers increase, prey numbers will tend to decrease because more of them are eaten. Then as prey numbers decrease, predator numbers decrease because there is less available food. 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.

Predator 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 the resources they need. 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 needed by each organism. How are these factors similar among the organisms? How are they different?

What Do You Think?

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 United States Department of Agriculture and can typically be found on the Internet. The maps use average temperature ranges to help people figure out the zone in which they live. Certain plants will thrive in certain zones. You can go online to explore more about these maps.

It is also important to consider how much water is available during the year, either as rain or as **irrigation**. For example, 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 are likely to get in and eat the plants. If you live in an area with a lot of deer, it's best to avoid plants that deer are more likely to eat.

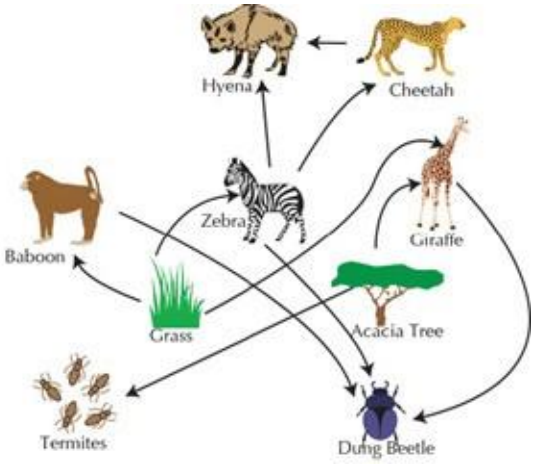
irrigation: an artificial method of adding water to an ecosystem, often used by farmers to grow crops

Two Species: Same Niche

The interactions among organisms in an ecosystem are complex. Many organisms depend on one another in order to survive, as is shown in **food webs** like the one below. If one part of a food web is disturbed, all of 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.

food web: a series of overlapping food chains which show the path of energy among organisms in an ecosystem

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.) For example, 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 acorr and other plant products.



What Do You Think?

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.

browser: an animal that feeds mainly on leaves, flowers, and twigs

Giraffes also tend to eat during the cooler times of the day and are prey to lions. These characteristics are all part of the giraffe's niche.

Giraffes are not the only browsers on the African Savanna. Zebras have a similar niche; they are also browsers on the African Savanna. Overlapping niches lead to increased competition. In this case the zebras and giraffes compete for the same food source. However, no two species can successfully function in exactly the same niche in the same environment. Although their niches overlap, there are some differences. For example, 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*.

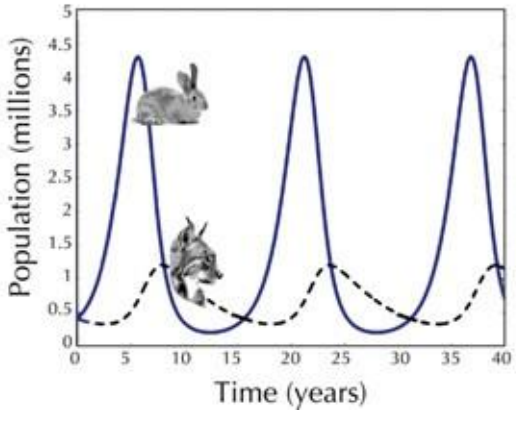
Intraspecific competition is competition within the same species. All the giraffes are competing for the same food source. Separating resources can help minimize competition. For example, males tip their heads upward when feeding, while females tip their heads downward. This allows male and female giraffes to divide resources so they are not competing as strongly. Many animals also divide resources by claiming territories. Animals defend their territories from any other animals that threaten the resources within the territory they claim.

Look Out!

Competition does not always lead to winners and losers. In some cases, one population in an ecosystem out-competes another, and the second population may become extinct. In many cases, however, both populations will survive. Either way, both populations will have decreased numbers because there are 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 wild cats. Carefully analyze how the increase and decrease in population size of one affects 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.



What Do You Think?

Habitat Resources and Competition

Both intraspecific and interspecific competition increase as **population density** increases. This is because, as more individuals compete for resources, there are fewer resources available for any given individual or population.

population density: a measure of the population size in a given area

Competition occurs more often in areas that have fewer resources. Areas with limited resources, such as deserts, tend to have fewer organisms and smaller populations than areas with more resources such as rain forests.

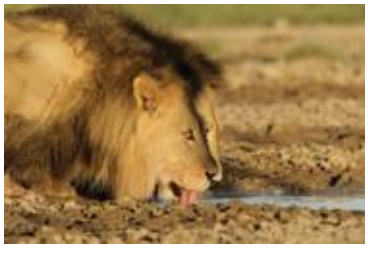
In addition to affecting organisms, competition also affects an ecosystem as a whole. If a lot of organisms compete for the same resources, these resources are more likely to be depleted. This depletion of resources increases competition and leads to a decrease in the number of organisms. When there are fewer organisms in an ecosystem, resources are replenishable. An increase in resources allows for an increase in the number of organisms. This cycle sets up a balance point called the *carrying capacity*, which is the maximum number of organisms that can be maintained by an ecosystem. The carrying capacity depends on the availability of resources in the area. This can be illustrated by comparing forest ecosystems with desert ecosystems.

Comparison of Forest and Desert Ecosystems

Forest	Desert
moist, fertile soil, abundant plant life, moderate to high water availability, high carrying capacity	dry, sandy soil, limited plant life, low water availability, low carrying capacity

Try Now

What do you know?
Study each image in the left column of the chart. For each image, identify the resource that is being used by the organism(s). 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 of your answers in the spaces provided.

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

Connecting With Your Child

Interdependence in a Terrarium

To help your child learn about the interdependence of organisms, set up a terrarium. Begin by listing all of the abiotic and biotic factors you will use. Examples include soil, a living space (such as a glass tank), plants, air, water, sunlight, and possibly earthworms. Have your child classify each factor as abiotic or biotic. Then, have them write a summary of how the living things in the terrarium will use and depend on the nonliving things. For example, earthworms use soil for shelter and eat bacteria and other tiny organisms in the soil. If necessary, use the Internet or other resources to research an organism's particular needs.

After discussing the components, gather the materials and set up the terrarium. Remind your child that the living things in the terrarium are not in their natural environment, so you will need to provide the living things with all of their required resources such as water, light, and moderate temperatures. It is important to treat living things with care. Have your child observe and take care of the terrarium each day for several weeks. If the terrarium is going to be broken down at the end of the study, plants, earthworms, and even soil can typically be placed in a garden or wooded area outside. Please be sure the season is appropriate for the living things that are placed outside.

If setting up a terrarium is not possible, conduct the activity using computer generated graphics or sketches. Your child should label all parts of the terrarium.

Here are some questions to discuss with your child:

- How is a terrarium similar to a natural ecosystem? How is it different?
- What resource(s) did you have to replenish in the terrarium? Were the resources biotic or abiotic? What would happen if you had not replaced those resources?
- Assuming you had earthworms in the terrarium, what would happen if you added a lot more of them? What if you added a different species that uses the same resources as the earthworms?