

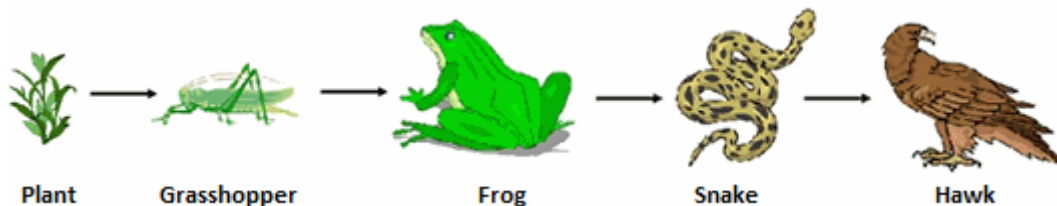
Organism Interactions

Organisms within an ecosystem interact with one another in many different ways. These interactions play an important role in the survival of the organisms and the function of the ecosystem.

Organisms can affect one another directly, through a shared resource, or through common enemies. Some interactions are harmful to the organisms involved, whereas others provide benefits for one or both of the organisms.

Energy Relationships

Food chains and food webs describe the feeding relationships between species and represent the flow of energy through an ecosystem. The Sun provides energy to **producers**, such as plants. Producers convert this energy into a form that can be eaten by **consumers**. Animals that eat producers are then consumed by animals at higher trophic levels. Eventually all organisms are broken back down into nutrients by **decomposers**.



The food chain above shows the flow of energy from a producer, a plant, to the consumers in the ecosystem. Decomposers may feed on organisms at any stage of the food chain. Decomposers recycle nutrients back into the ecosystem.

Symbiosis

Symbiosis is an interaction between individuals of different biological species. At least one of the organisms receives a benefit from the interaction. The other organism can either receive a benefit, be harmed, or not be affected in any way.

A symbiotic interaction involves a close relationship between the two organisms involved. There are three main kinds of symbiotic relationships: *commensalism*, *mutualism*, and *parasitism*.

Interaction	Species A	Species B
<u>Commensalism</u>	Receives benefit	Not affected
<u>Mutualism</u>	Receives benefit	Receives benefit
<u>Parasitism</u>	Receives benefit	Harmed

Mutualism



Bees receive nourishment from flowering plants, and plants are pollinated by the bees. Therefore, the relationship is *mutualism*.

Both organisms benefit in a mutualistic relationship.

Flowers and their pollinators are one of the most common examples of mutualism because many kinds of plants depend on insects, such as moths, bees, wasps, and beetles, to perform pollination in order to reproduce. Plants that rely on pollinators attract the pollinator by the shape, color, or smell of their flowers. As the pollinator feeds on the nectar or pollen from the flower, some of the pollen sticks to its legs and body. When the pollinator visits a second plant of the same species, the pollen from the first plant is transferred to the reproductive organs of the second plant, and pollination occurs. Both organisms receive a benefit from this interaction. The pollinator receives access to a food source and the plant is able to reproduce because of their relationship.

Commensalism



Cattle egrets follow behind large grazing herbivores and eat the insects that are stirred up. This is a form of *commensalism*.

One organism benefits and the other is neither helped nor harmed in a commensalistic relationship.

Often, the benefit that the organism receives is the ability to find food more easily or protection from other organisms.

For example, large grazing herbivores, such as cattle and horses, often stir up insects as they graze on grass in fields and pastures. Birds known as cattle egrets often follow behind the grazing herbivores and eat the insects that have been displaced. Since the cattle egret benefits by being able to find food easily and the grazing herbivores are not affected by the presence of the egrets, their interaction is an example of commensalism.

Parasitism



This mosquito receives nourishment, while the human is harmed. This is an example of *parasitism*.

Image is courtesy of the CDC.

One organism benefits and the other is harmed in a parasitic relationship.

The organism that receives a *benefit* is known as a **parasite**. The organism that is *harmed* by the relationship is known as the **host**. The host species is usually impaired slowly over a long period of time.

Parasites are usually smaller than the host species, but not always, and can live either inside the body of their host or externally. Common external parasites include fleas and mosquitoes which feed on the blood of their hosts. Internal parasites, such as tapeworms, live inside the body of their host and absorb nutrients from the host's body. In both cases, the parasite receives nutrients at the expense of the host and the host can no longer use these nutrients for its own life processes.

Predation

Predation is a type of interaction in which a predator hunts, kills, and eats its **prey**. Predators use the prey as a source of food. Predation is different from parasitism because the prey is killed immediately for consumption. During parasitism, the host is kept alive for a long period of time so that the parasite can continue to receive nutrients from the host. An example of predation is a wolf pack hunting, killing, and consuming a deer.



Lions kill and eat zebra. Lions are *predators*. Zebras are *prey*.

Competition

Since there are limited amounts of resources in an ecosystem, if one organism gets a particular resource, another does not. This leads to **competition** as two organisms try to access the same resources. Food, water, sunlight, and space are examples of resources that organisms compete for.

Plants and animals of the same species may compete for resources such as food, water, shelter, and space. Populations of different species will also compete with one other if their needs are the same as the needs of another population in that ecosystem.

For example, trees in a forest compete for sunlight. As one tree grows taller, the shorter trees are shaded by it, and they receive less sunlight. The shorter trees may die as a result.



The tall tree and the shorter trees in this picture are competing for sunlight.

Cooperation

Cooperation is a type of interaction in which organisms work together. Many species exhibit cooperative behavior, including horses, dolphins, lions, and ants. Animals that exhibit cooperative behavior often live, travel, and/or hunt in herds or groups. Living in these groups can provide protection for the animals and a higher success rate during hunts.

Groups of organisms that live together cooperatively are usually part of a **hierarchy of leadership**. Some members of the group have a higher status than other members of the group. Dominant members determine what the group will do and subordinate members follow their lead. This helps to eliminate aggression between group members and allows the group to work together for the benefit of all.

An example of an animal that lives in a cooperative group is the wolf. Wolves live in packs that usually include six or seven members. There are two leaders within the group, the alpha male and the alpha female, and these two pack members determine when the pack hunts, moves location, or stays in an area. The leaders of the pack are usually the pack members with the most experience in hunting and defending territory. The other pack members have roles within this pack to help the pack work effectively.

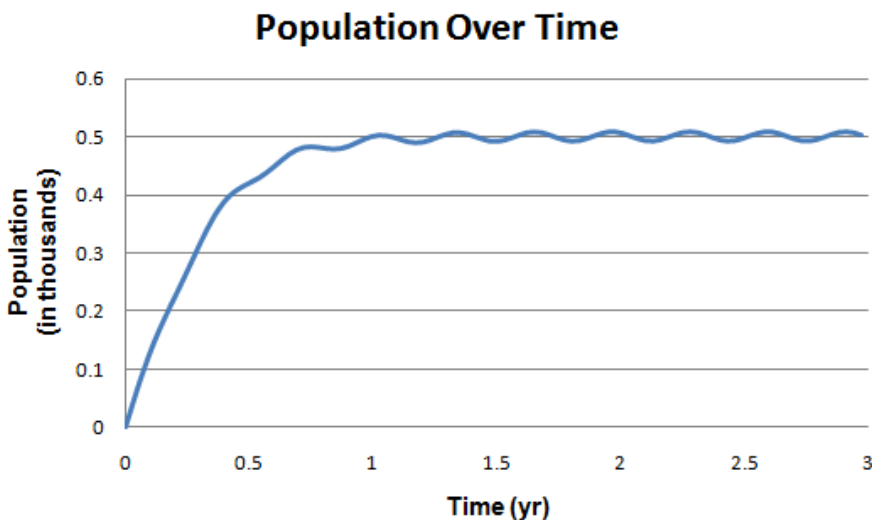
Carrying Capacity

*An ecosystem can only support a limited number of living things. This number is its **carrying capacity**.*

In any particular environment, the growth and survival of living things depends on the physical conditions and the materials available. For living things to grow and survive, they must have the correct:

- temperature range
- amount of minerals
- amount of soil
- amount of air
- amount of space
- amount of food or sunlight

Although populations of living things could grow to be unlimited in size, they may not have enough resources to do so. The **carrying capacity**, or the actual number of living things that an ecosystem can support, is limited by the available energy, water, air, space, food, and minerals. It is also limited by the ability of the ecosystems to recycle dead organisms through the activities of decomposers, such as bacteria and fungi.



Whenever the population of one kind of organism is greater than the carrying capacity, the population decreases. When the population is less than the carrying capacity, the population increases. This graph gives an "ideal" example of how the population of one kind of animal is related to the carrying capacity. In this case, the carrying capacity is **500 individuals**.

Population Growth Factors

There are a number of biotic and abiotic factors that affect the growth of a population.

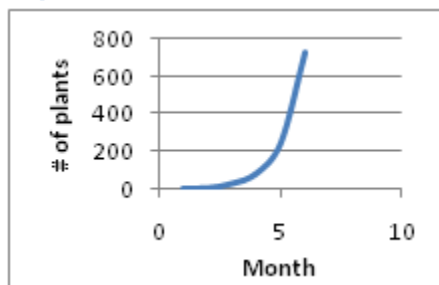
Populations

A population is a group of same-species organisms living in a particular location. The number of individuals within a given population is the **population size**.

Population density refers to the number of organisms in the population divided by a regular unit of area or volume. For instance, if there were ten fruit flies in a 10-milliliter test tube, the population would be 1 fly/mL (one fruit fly per milliliter).

Population Growth Patterns

Exponential Growth

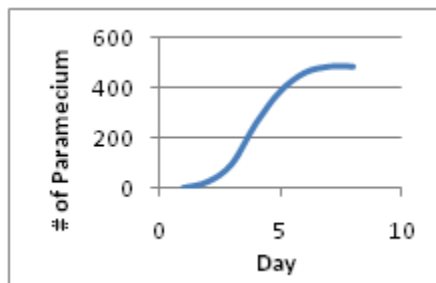


Exponential Growth

Exponential growth is often graphed as a ***J-shaped population growth curve***.

For a population to grow, it must have a non-hostile environment and sufficient food and space. When these needs are met, populations grow in an exponential pattern. That is, the population grows at a faster and faster rate.

Carrying Capacity



Stabilized Growth

When population growth is exponential at first, and then it levels off at the ecosystem's carrying capacity, the graph is represented as an ***S-shaped population growth curve***.

Populations growing exponentially tend to expand to the point that the available resources (food and space) cannot support additional organisms. The largest population that can be supported by the resources in an ecosystem is called the **carrying capacity**.

Population Growth Factors

As discussed earlier, populations with a proper environment and sufficient food and space tend to grow exponentially. This is a generalization that is made for simple systems. The generalization implies that the birth rate is higher than the death rate.

- **Birth rate** is defined as the ratio of births to the number of organisms in a population over a given time period.
- **Death rate** is defined as the ratio of deaths to the number of organisms in a population over a given time period.

In more complex systems, additional factors influence the population size. Individuals can immigrate into the ecosystem from neighboring ecosystems. Alternatively, individuals in the population can emigrate out of the ecosystem.

- **Immigration** is defined as the movement of individuals into a population or ecosystem.
- **Emigration** is defined as the movement of individuals out of a population or ecosystem.

One can imagine that in a simple system, such as a dish containing a population of *Paramecium*, the population members cannot emigrate out of the dish, and other *Paramecium* cannot immigrate into the dish on their own. Therefore, the only factors that influence the growth of the population are "birth" rate (*Paramecium* divide instead of giving birth) and death rate.

However, one can imagine that the population of the state of Michigan might be influenced by all of the population growth factors--birth rate, death rate, immigration, and emigration. Michigan's population will only grow if the birth rate and the immigration rate combined are greater than the combined death rate and the emigration rate.

Other Factors that Affect Populations

Other factors can affect organism populations. These factors include natural causes, such as tornadoes, hurricanes, and diseases, changes in climate, the introduction of non-native species, and human activity.

Typically, these factors cause a decline in the population sizes of native organisms.

Limiting Factors

Limiting factors are physical, biological or chemical factors that can affect the growth or diversity of organisms within an ecosystem. If there is a chemical spill that kills plant and animal life in an area, that ecosystem is dramatically impaired. Sometimes ecosystems can recover from limiting factors, and other times they cannot.