Ecosystems

Ecologists organize ecosystems into four major levels. These levels are: **population, community, ecosystem, and biosphere**.

Population

A **population** is a group of individuals of the same species living in the same area at the same time. An example of a population of organisms is a grove of orange trees.

Populations can be defined at different levels of size. For example, a local population could occupy a very small habitat, such as a puddle. A population could also include every member of a species of monkey that occupies a large island. There is generally a boundary between populations of the same species, such as an ocean or an area of land that the animals do not freely cross.

All of the orange trees in this grove belong to the same population.

Community

A **community** is all of the populations that live and interact in the same area. A community includes all of the plant and animal species that live in the same area. An example of a community is all of the plants and animals inside of a forest. All of these organisms interact and depend on one another for survival. A community makes up an ecosystem's **biotic**, or living, factors.

At the community level, interactions between organisms can be observed. For example, predator/prey and consumer/producer interactions occur at this level. Competition and cooperation between different species are also part of community ecology.

All of the plants and animals in this forest belong to the same community.

Ecosystem

An **ecosystem** is made up of the **biotic**, or living, community and its **abiotic**, or nonliving, environment. Abiotic factors include rocks, air, dirt, sunlight and water.

An example of an ecosystem would include all of the living and nonliving factors that are inside a pond. The water in the pond, the algae and plants that grow in the water, the animals and bacteria that live in the water, the dirt and rocks on the bottom of the pond, and the sunlight that hits the water would all be considered a part of this ecosystem.

Ecosystems can vary greatly in size and conditions. The abiotic factors that make up an ecosystem determine what kinds of plants and animals can live there. For example, a desert ecosystem that is very hot and does not receive much water can only support certain kinds of organisms, such as cacti and lizards.

All of the living and nonliving factors of this coral reef are part of the coral reef ecosystem.

Biosphere

The **biosphere** includes any part of the Earth where organisms live. It extends from the crust of the Earth to the atmosphere. All of the ecosystems on the Earth are included within the biosphere.

The biosphere is the broadest level of ecological study. It includes interactions between different ecosystems that can only be studied by viewing the entire Earth as one large system. The lithosphere, hydrosphere, and atmosphere are all part of the biosphere.

All of the ecosystems on Earth are part of the biosphere.

Some ecosystems are more stable than others. Stable ecosystems are able to maintain their balance because they have a great deal of **biodiversity**.

Biodiversity

The **biodiversity** of an ecosystem is the variation, or differences, among living organisms within that ecosystem. This includes genetic variation within a species as well as the variety of different species within an ecosystem. The biodiversity of an ecosystem increases with the number of different species of organisms that live in that ecosystem.

Biodiversity is not evenly distributed on Earth. Some ecosystems are more diverse than others. Usually, the more diverse that an ecosystem is, the more stable it is. Biodiversity on land is generally highest at the equator and decreases as you move toward the poles.

Rainforests have a high level of biodiversity. A large number of different and unique species live in rainforests.

Disturbances, such as disease and fire, can cause ecosystems to become unstable. When an ecosystem is disturbed, individual organisms, as well as entire species, can die out.

Ecosystems can better handle disturbances whenever there is a high amount of biodiversity within that ecosystem. The more varied the organisms within an ecosystem, the more likely it is that some of them could use their specialized and unique adaptations to survive major changes or disturbances in the ecosystem.

Ecological **succession** can occur when the conditions of an ecosystem are greatly changed by a disturbance and the ecosystem does not have enough biodiversity to remain stable.

Ecological **succession** is the process by which an ecosystem undergoes a series of changes as communities of organisms change their environment and new communities of organisms move in to the ecosystem. This process is usually gradual because it can take a long time for communities to become established in an ecosystem.

In some cases, the species structure of an ecosystem is changed rapidly by a disturbance, such as a forest fire. If the ecosystem becomes unstable, primary or secondary succession can result. If succession begins in a new, unoccupied habitat where there is no soil present, it is called **primary succession**. Primary succession can occur after severe landslides or volcanic eruptions. If there is a disturbance in an area but soil is still present after the disturbance, this change in species structure is known as **secondary succession**.

Primary succession, or the development of an ecosystem in an area where life did not exist before, occurs in the following stages:

- Succession begins when the first organisms, usually lichens or mosses, colonize a bare rock. Acids from the lichens and mosses weather the rock. Eroded sediments combine with bacteria and dead lichens and mosses to form a thin layer of soil.
- As soil forms, more and more plants are able to grow in the area. Grasses usually grow in this thin layer of soil first, followed by shrubs and, eventually, trees. This attracts insects and other animal species. Over time, the soil layer thickens and the biodiversity of the community increases.
- After many years, a stable ecosystem develops. Often, this is a forest ecosystem. Depending on the ecosystem's abiotic factors, however, a stable ecosystem may be a mature desert community, a coral reef, or any other kind of ecosystem on Earth. The final stage of ecological succession is called the **climax** community and the species in this community are in relative **equilibrium**.

The **climate** of a region determines what types of organisms are able to live there.

Climates that are very cold are inhabited by plants and animals that have adaptations suited to the extreme temperatures. The same is true for climates that are extremely hot and dry.

Tropical Rainforest - The climate of a tropical rainforest is hot and wet. Heavy rainfall (around 150 cm per year) and year-round warm temperatures make it very humid. This climate is found near the equator. A tropical rainforest is very dense with lots of large trees that block out sunlight. Very little sunlight reaches the rainforest floor.

Rainforests are very hot and wet.

Desert - The climate of deserts is very hot and dry. The amount of precipitation in these areas is less than the amount of water that could potentially evaporate. Deserts get less than 25 centimeters of rain every year. Desert plants and animals are adapted to store water and withstand year-round hot temperatures.

Deserts are very hot and dry.

Grassland - Grasslands receive enough rainfall to support grasses, but not enough to support the growth of large trees. Drought and wildfire are common. Temperatures in grasslands are warm in the summer and cold in the winter.

Drought and wildfire are common in grasslands.

Deciduous Forest - The climate of a deciduous forest is temperate with four distinct seasons (spring, summer, fall, and winter). Deciduous forests have warm summers and cold winters. They have moderate precipitation throughout the year. During winter months, however, the precipitation is usually frozen and unavailable to the organisms that live there. Trees in a deciduous forest usually lose their leaves during the winter and have thick bark to conserve water and protect them from the cold.

Deciduous forests have four distinct seasons.

Coniferous Forest - Coniferous forests are located in northern latitudes. The climate in coniferous forests is very cold and dry. Coniferous forests have cold, snowy winters and warm summers. The main types of vegetation located in coniferous forests are conifers, such as pine trees. These trees are evergreens that have needles that stay on them all year long and produce cones. Arctic foxes, wolves, and snowy owls are a few examples of the animals that live in coniferous forests.

Coniferous forests are very cold and the plants that grow there are evergreens.

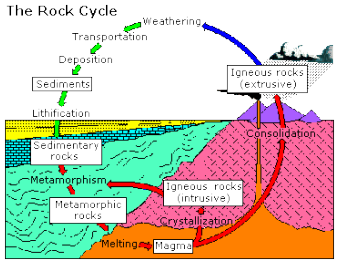
Tundra - The tundra has very low temperatures and very little precipitation. Winters in the tundra are long and extremely cold; summers are short, mild, and cool.

The tundra is very cold and dry.

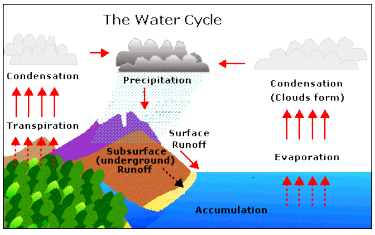
Earth's Cycles

The Earth's materials have many natural cycles. Some examples are below.

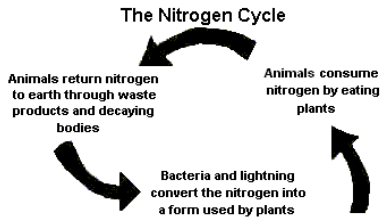
Rock Cycle | Water Cycle | Nitrogen Cycle | Carbon Cycle



The earth is an ever evolving and changing system fueled by energy from the sun and the radioactive decay of material in the interior of the earth. The constant cycle of change in the earth's crust is called the rock cycle where by rocks are created, changed and reformed.

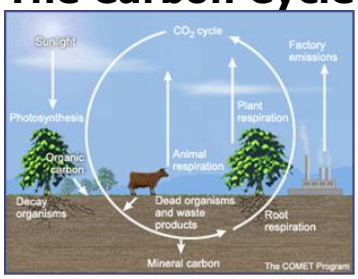


The Water Cycle is the journey water takes as it circulates from the land to the sky and back again. The sun's heat provides energy to evaporate water from the Earth's surface (oceans, lakes, etc.). The water vapor eventually condenses, forming tiny droplets in clouds. When the clouds meet cool air over land, precipitation (rain, sleet, or snow) is triggered, and water returns to the land (or sea). The water flows downhill as runoff (above ground or underground), eventually returning to the seas as slightly salty water. And then the cycle starts over.



The **nitrogen cycle** is the cycle of consumption and regeneration of nitrogen within our environment.

The Carbon Cycle



The **Carbon Cycle** is a complex cycle where carbon rotates through the earth's atmosphere, oceans, land, and living things.

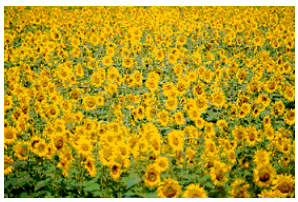
The same carbon in your body today has been used in countless other areas of the earth since time began. The wood burned just a few decades ago could have produced carbon dioxide which through photosynthesis became part of a plant. When you eat that plant, the same carbon from the wood which was burnt can become part of you. Unfortunately, the extent of the carbon cycle's importance is rarely stressed enough. Without the proper functioning of the carbon cycle, every aspect of life could be changed dramatically.

Content Blast from Study Island

Energy Flow Through an Ecosystem

The organization of communities is based on the use of energy from the Sun within a given **ecosystem**. Organisms within a community are dependent on the survival of the other organisms because **energy is passed from one organism to another**. The Sun's energy cycles through ecosystems. Producers absorb the Sun's energy and pass this to consumers, which eat producers. Finally, decomposers break down consumers and allow the energy to go back into the nutrient pool.

Producer - Producers are organisms that use the Sun's energy to **make their own food**. Green plants are producers. They make their own food using energy from the Sun in a process called photosynthesis. Other producers include algae and some kinds of bacteria and protists.



Green plants, such as sunflowers, are producers that use energy from the Sun to make food. All of the other organisms in an ecosystem depend on producers for energy.

Consumer - Consumers are organisms that **gain energy by eating producers and/or other consumers**. Primary consumers are organisms that feed off of producers. **Herbivores** are primary consumers. For example, a deer that eats grass is a primary consumer. Secondary consumers are organisms that eat primary consumers. **Carnivores** are secondary consumers. A wolf that kills and eats a deer is a secondary consumer. Next come tertiary consumers, then quaternary consumers, and so forth until the top carnivore is reached.

Consumers eat other organisms. Deer are primary consumers because they eat grass, which is a producer. Wolves are secondary consumers because they eat primary consumers like deer.

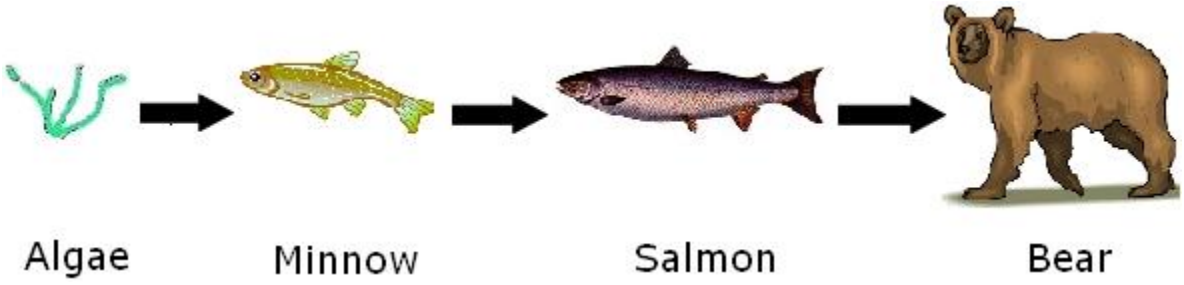
Decomposer - Decomposers are organisms that **consume dead plants and animals** and **release nutrients** from those dead organisms into the soil, water, and atmosphere. The role that decomposers play in an ecosystem is crucial. Decomposers are important for the water, carbon, nitrogen, and oxygen cycles. The nutrients that decomposers release into the soil are also used by producers to make food. Fungi, such as mushrooms, are examples of decomposers. Some kinds of bacteria are also decomposers.

Decomposers, such as mushrooms, are vital to ecosystems because they decompose dead organisms and recycle nutrients back into ecosystems.

The energy flow through an ecosystem can be shown in many ways:

A **food chain** describes the eating relationships and energy flow between species within an ecosystem.

The **ultimate source of energy for all ecosystems is the Sun**. Producers receive energy from the Sun and make food. Producers are the beginning of a **food chain** because all of the other organisms in the food chain depend on the food energy that is made by producers. The next organisms in the food chain are primary consumers, which eat producers. Next come secondary consumers, then tertiary consumers, and so forth until the top carnivore is reached. All organisms in the food chain are decomposed by decomposers.



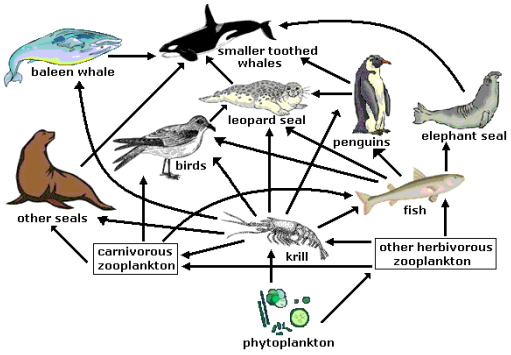
The food chain above shows the flow of energy from a producer, algae, to the consumers in the ecosystem. Minnows are primary consumers, salmon are secondary consumers, and bears are tertiary consumers.

The **arrows in a food chain** or a food web **represent the direction of energy flow**. The arrow points from the organism that is being consumed to the organism that is receiving energy. For example, in the food chain above, the arrow points from the algae to the minnow. This means that the minnow is consuming the algae and receiving energy.

A **food web** is a group of interconnected food chains. Organisms in a food web can belong to multiple trophic levels.

A food web shows multiple interrelated food chains. Organisms within a food web can belong to more than one **trophic level**, or feeding level. For example, in the food web below, krill are both primary and secondary consumers. Krill are primary consumers because they eat phytoplankton, which are producers. Krill are also secondary consumers because they eat carnivorous zooplankton, which are primary consumers.

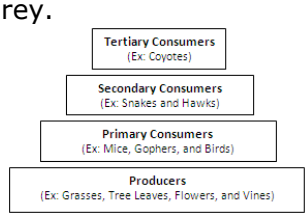
A trophic level describes the feeding level that an organism belongs to. Producer, decomposer, primary consumer, secondary consumer, and tertiary consumer are all trophic levels that can be used to describe an organism's place in an ecosystem.



An Antarctic food web is shown in the picture above. Organisms in food webs can belong to more than one feeding level.

An **energy pyramid** is a diagram in which each trophic level is represented by a block. The blocks are stacked one on top of another, with the lowest trophic level on the bottom. Each trophic level in an energy pyramid has less energy available to it than the level below.

Producers make up the bottom layer of an **energy pyramid**. Most of the stored energy in an ecosystem is in plants and other producers. The reason for this is because most of the energy in an energy pyramid is used or lost as heat energy as it moves up the pyramid. In fact, only about ten percent of the energy produced at each level is available to the one above it. This is the reason that consumers in an ecosystem cannot outnumber producers and predators cannot outnumber prey.



The size of each block of the energy pyramid is determined by the amount of energy stored in the organisms at that trophic level. An average of only 10% of the energy from the previous level moves to the next level. The rest is used up or lost as heat energy.

The number of organisms in each level of the energy pyramid is directly related to an ecosystem's **carrying capacity**, or the population size of a certain species that an environment can sustain.

In any ecosystem, the basic resources that organisms need for survival are always in limited supply. Examples include food, water, sunlight, oxygen, and shelter.

As a growing population reaches the limits of the available resources in an environment, its size levels off to "match" the amount of resources available. In doing so, the population has reached its carrying capacity.

When the populations of an ecosystem reach **equilibrium**, or balance, the population sizes remain relatively unchanged. Changes in the climate, pollution, destruction of habitat, and so on can disrupt an ecosystem's equilibrium, causing the populations of some species to rapidly shrink while the populations of other species may rapidly swell.

Ecological succession is the process by which an ecosystem undergoes a series of changes as communities of organisms modify the environment and give rise to newer communities of organisms. Since it can take a long time for communities to become established in an ecosystem, the process of ecological succession is typically a gradual one.

When a disturbed or uninhabited ecosystem begins to take on new communities of organisms, the population growth of these new communities tends to be irregular at first. Over time, though, population sizes usually stabilize as the living and non-living components of the ecosystem come into equilibrium with one another.

An ecosystem is said to have great **species diversity** when it has a large and varied population of organisms. Generally, having greater diversity of species enhances the stability of an ecosystem because there are more types of organisms, each with special adaptations. The more varied the organisms, the more likely it is that some could use their specialized adaptations to survive major changes to the ecosystem.

Producers

An organism that makes its own food is known as a **producer**. Most producers use light energy from the Sun to make their own food.

Consumers cannot make their own food, so they depend on the food made by producers. In this way, the Sun is the ultimate energy source for almost all living things.

Plants, algae, and even certain types of bacteria are examples of producers.

Consumers

Consumers are organisms that cannot produce their own food and must feed upon other organisms.

Consumers get their energy by feeding upon producers or other consumers. Without producers, consumers would starve.

Snakes, wolves, eagles, ants, and humans are examples of consumers.

Decomposers

A **decomposer** is an organism that obtains nutrients by breaking down the remains of dead organisms.

Decomposers are very important in ecosystems. By breaking down matter from dead organisms, they serve to "clean" the environment and replenish the food web with basic nutrients that plants can use to produce food. Some decomposers, like bacteria, are microscopic. Others, like earthworms and fungi, are visible to the human eye.

Mushrooms are fungi which feed on decaying plant materials,
such as fallen trees or leaves.

Human Environmental Impact

POLLUTION

What do you think of when you hear the word ***pollution***? Trash? Car exhaust? These are both common forms of pollution produced by people, but there are many other types of pollution being added to the environment every day. **Pollution** is any harmful substance in our air, water, or soil.

The activities of humans often lead to pollution. Humans have always produced pollution, such as solid waste (garbage), but when the Industrial Revolution began in the 1800s, humans started producing a lot of chemical waste from technology. One example is the air pollution produced by factory machines.

TECHNOLOGY

The use of knowledge, tools, and materials to solve problems and accomplish tasks is **technology**. But the word "technology" can also be used to describe the tools, machines, or computers that are used to accomplish tasks.

CONSERVATION & RECYCLING

Lately, scientists have found out that humans have changed the environment in negative ways. One of these changes is global warming.

Learning about global warming has made it clear that each person needs to think about how his or her actions affect the environment. One important way to act in an environmentally safe manner is to practice conservation.

Conservation is the careful use and preservation of Earth's natural resources. Anyone who tries to cut down on the amount of material they consume, reuse materials, and recycle the materials they cannot reuse is practicing conservation.

Recycling is the process of making new products from products that have been used before.

There are some materials that are easier to recycle than others. Glass bottles, plastic milk jugs, and newspaper are easy to recycle because each is made of mostly one kind of material.

Styrofoam and some other kinds of plastic are not recycled. These materials and other items, such as light bulbs, are difficult to recycle. Some have recycling processes that are expensive. Others have processes that use a lot of energy or produce large amounts of waste.