129

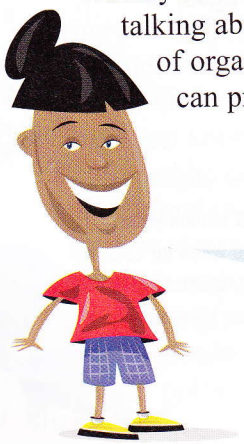
Ecosystems

An **ecosystem** is all the organisms that live in an area together with the nonliving factors of the environment. The study of how organisms interact with each other and with their physical environment is the focus of **ecology.**

130

Populations

When you talk about a certain *kind* of organism, you're really talking about a certain *species* of organism. A **species** is a group of organisms that can mate and produce offspring that in turn can produce more offspring.



The brown pelican is one kind of species. Humans are another.

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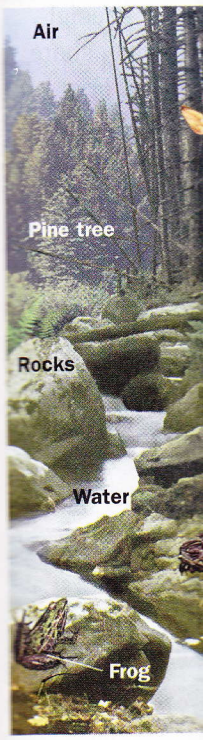
■ Non-living factors

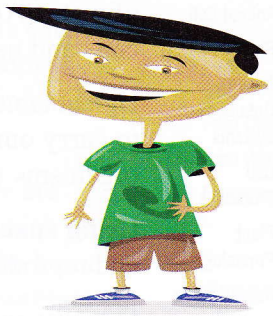


A pine forest ecos

All the organisms of the same species that live in the same place at the same time make up a **population.** The mice living in a small meadow are an example of a population. All the pine trees in a forest are a different population.

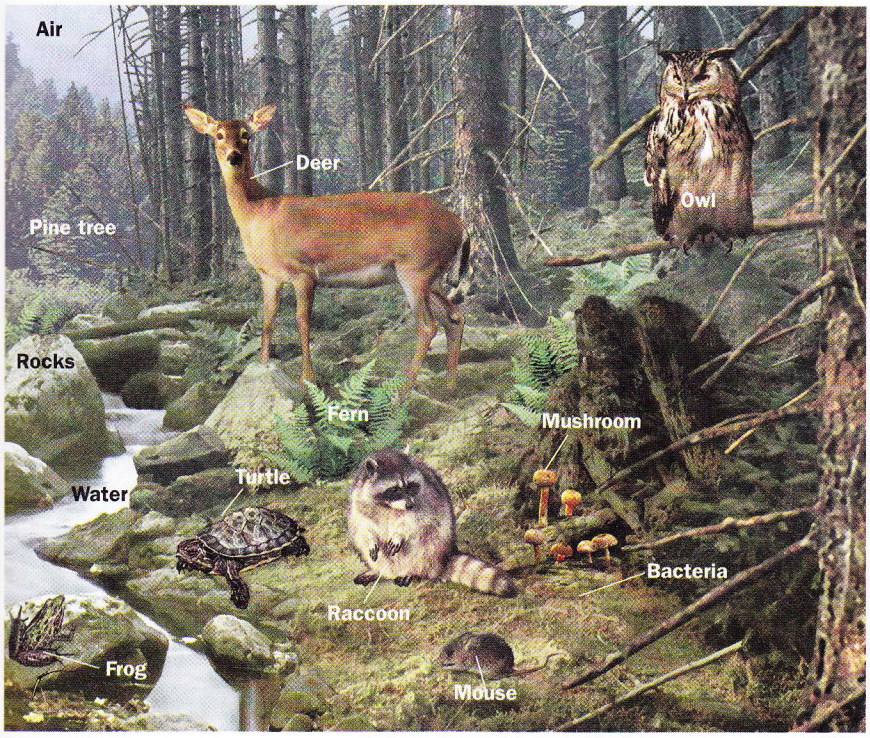
Populations do not live alone. They share the environment with other populations to form a **community.** The pine trees in a forest, for example, may form a community with populations of deer, mice, raccoons, bacteria, mushrooms, and ferns.

Ecosystems can be named for a dominant physical feature, such as a pond ecosystem, or a dominant plant population, such as a pine forest ecosystem.



Populations do not interact only with each other. They also interact with the nonliving factors of the environment. Pine trees, for example, need soil to grow. They also need air and water. Together, these living and nonliving factors form an ecosystem. An **ecosystem** includes all the populations that live in an area along with physical factors in the environment.

■ Non-living factors □ Living factors



A pine forest ecosystem

131

Factors That Affect Populations

For any population to thrive, there must be enough food, water, and living space. Such factors are called **limiting factors** because they limit how many organisms can live in an environment.

SEE ALSO

156 Protist Kingdom
157 Archae-bacteria and Eubacteria Kingdoms
077 Animal Cell
078 Plant Cell
082 Tissues, Organs, and Systems
079 Cell Processes
107 Plant Physiology
113 Reproduction

Listed below are some of the different kinds of limiting factors.

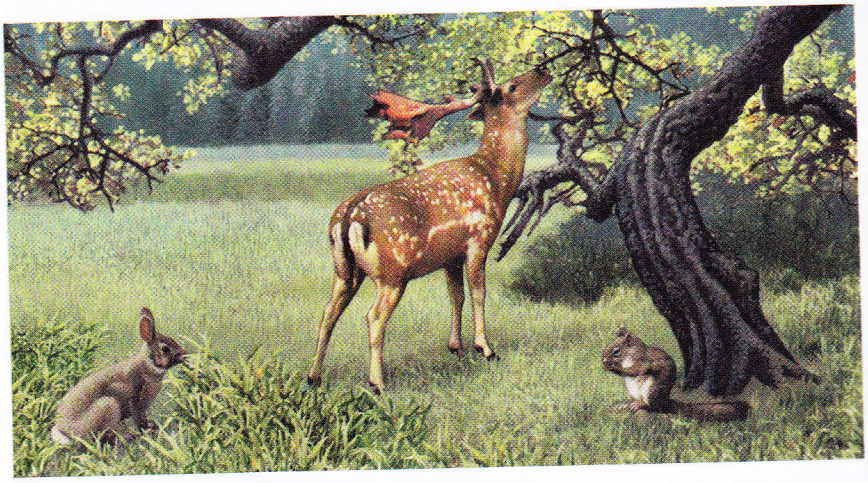
Food Plants (and a few other organisms) make their own food. All other organisms obtain food by eating plants or other organisms. Only so much food is available in an ecosystem.

Water The cells and tissues of animals and plants are made up mostly of water. All living things need water to move materials around in the cells and tissues of their bodies.

Light Plants and other organisms that make their own food need light to carry out photosynthesis. If light is limited, the growth of these organisms will also be limited.

Living space Organisms need enough room to live, obtain resources, and reproduce. The place where an organism lives is called its **habitat.**

One way organisms reduce competition for food and other resources is to occupy a specific niche within a habitat. A **niche** is the special role an organism plays within its habitat. Different species may share the same habitat, but no two can have exactly the same niche. For example, deer, rabbits, and squirrels may live in the same leafy forest, but because deer browse higher up on trees, rabbits graze on grasses, and squirrels eat acorns, each animal occupies a different niche.



Animals with same habitat, but different niches

Relationships

Different species one another. The main categories:

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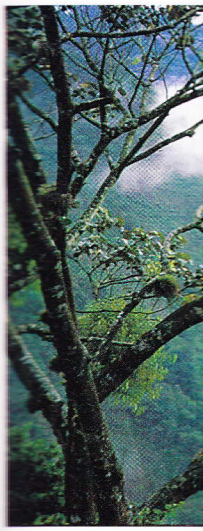
Predation is a ty captures and eats is the **prey.** The a relationships hel one population f

Symbiosis is a cl several types of species benefit. species benefits occurs when an or fluids of anot parasite benefits not killed.



Mistletoe is a para other plants.

Relationships Between Populations

Different species, or kinds, of organisms living together interact with one another. The relationships they form can be divided into three main categories:

Competition occurs whenever more than one individual or population tries to make use of the same limited resource. Because resources such as food, water, and space are limited, there is not enough for every organism. Only those organisms able to get the resources they need will survive.

SEE ALSO
130 Populations
127 Natural Selection

Predation is a type of feeding relationship in which one animal captures and eats another animal for food. The animal that is eaten is the **prey.** The animal eating the prey is the **predator.** Predator-prey relationships help keep an ecosystem in balance by preventing any one population from getting too large.

SEE ALSO
133 Feeding Relationships
134 Food Chains
135 Food Webs
129 Ecosystems

Symbiosis is a close relationship between two species. There are several types of symbiosis. **Mutualism** is a relationship in which both species benefit. **Commensalism** is a type of symbiosis in which one species benefits while the other seems to be unaffected. **Parasitism** occurs when an organism called a parasite feeds on the cells, tissues, or fluids of another organism called the **host.** In this relationship, the parasite benefits by getting food; the host is usually weakened, but not killed.

SEE ALSO
076 Cells
082 Tissues, Organs, and Systems

Mistletoe is a parasite that gets its nutrients from other plants.

Word Watch!

Symbiosis comes from the Greek *symbioun,* meaning "to live together."

133

Feeding Relationships

All organisms need energy to live. Organisms can be divided into three main groups—producers, consumers, and decomposers—based on how they get the energy they need to live.

SEE ALSO
159 Heterotrophs and Autotrophs
107 Plant Physiology

Plants, algae, and bacteria that make their own food are **producers.** Most producers make their food using the energy of the sun and raw materials from the environment.

Any organism that gets its food by eating other organisms is a **consumer.** Consumers are classified into groups based on what they eat.

SEE ALSO
153 Plant Kingdom
154 Animal Kingdom
155 Fungi Kingdom
156 Protist Kingdom
157 Archae-bacteria and Eubacteria Kingdoms
139 Nitrogen Cycle

- **Herbivores** are plant-eaters. They feed directly on producers. Animals that eat plants (such as rabbits) or those that eat plant products (such as squirrels eating acorns) are herbivores.
- **Carnivores** are meat-eaters. They get food by eating herbivores or other carnivores. Examples of carnivores include sharks, wolves, and eagles. **Scavengers,** on the other hand, eat the remains of organisms left behind by other animals. Examples of scavengers include hyenas and crabs.
- **Omnivores** are organisms that feed on both producers and other consumers. Raccoons, bears, people (except strict vegetarians), and skunks are omnivores.

Organisms that feed on the remains or wastes of other organisms are known as **decomposers.** Many bacteria and fungi are decomposers.

Producer Consumer Decomposer

Food Chain

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A food chain

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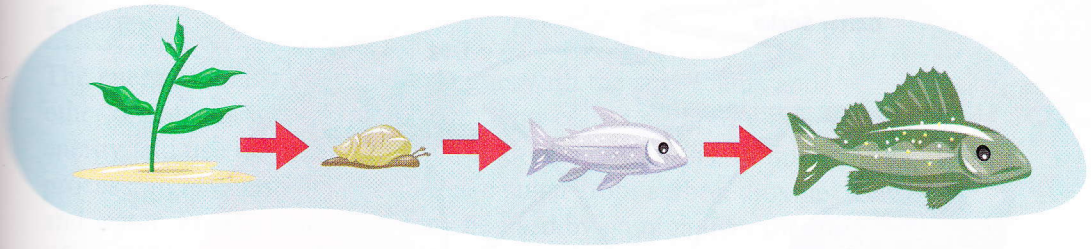
Food Chains

Organisms get the energy they need from food. A **food chain** traces the path of energy as it moves from one organism to the next in an ecosystem. In most ecosystems, energy begins with the sun, so producers (organisms that use the sun's energy to make food) always form the base, or starting point, of a food chain. Arrows show the direction of energy movement in a food chain.

SEE ALSO
300 Forms of Energy
137 Energy



A food chain

In the food chain above, the pondweed is the producer. As shown by the arrow, energy moves from the pondweed to the snail that eats it. The snail is the **primary consumer** in this food chain because it is the first to feed. Energy next moves from the snail to the minnow. As the second consumer in the food chain, the minnow is a **secondary consumer.** When the perch eats the minnow, it takes in energy. The perch is the **tertiary consumer** in this food chain—the third feeder. The final link in a food chain is filled by the bacteria and fungi that act as decomposers. These organisms feed on and break down the remains of the perch when it dies.

SEE ALSO
133 Feeding Relationships
139 Nitrogen Cycle

Science Alert!

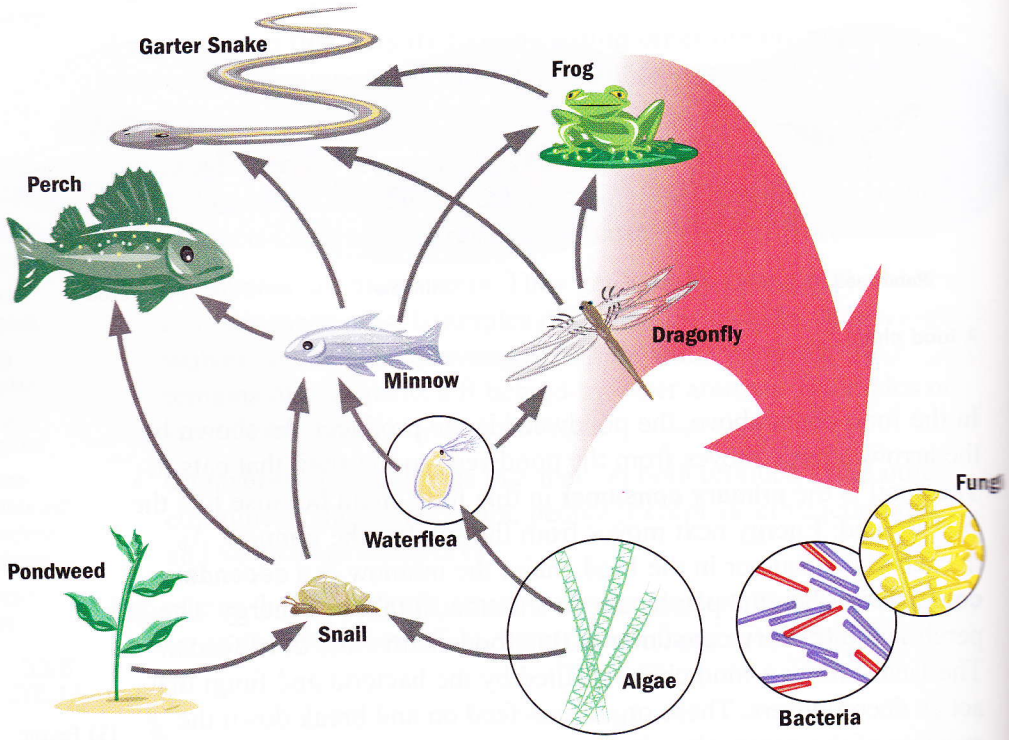
Decomposers are often left out of food chain diagrams. But remember that decomposers are always the final link in a food chain.

135

Food Webs

SEE ALSO
134 Food Chains
129 Ecosystems

A food chain shows only one energy path in an ecosystem. But most organisms are part of more than one food chain. Scientists often use a food web to show a more complete picture of the flow of energy in an ecosystem. A **food web** is a system of several overlapping food chains.



A food web

SEE ALSO
300 Forms of Energy
137 Energy
133 Feeding Relationships
139 Nitrogen Cycle

As with most ecosystems, the energy in a pond ecosystem starts with the sun. This energy is taken in by producers and converted to food energy. The energy in food then moves through different levels of consumers. The movement of energy ends with the many bacteria and fungi that live in the mud at the bottom of the pond. These decomposers feed on the wastes and remains of pond organisms. As they feed, they break down the organisms' tissues into valuable materials that are then returned to the ecosystem.

Energy and Matter in Ecosystems

136

Energy and matter are two factors present in every ecosystem. Most of the energy that enters an ecosystem comes from the sun. Some of this energy is converted into chemical energy that moves through the ecosystem by way of food chains. The matter in an ecosystem includes food, water, and air. This matter is constantly being changed in form and recycled through the environment.

SEE ALSO
250 Matter
300 Forms of Energy
134 Food Chains

Energy

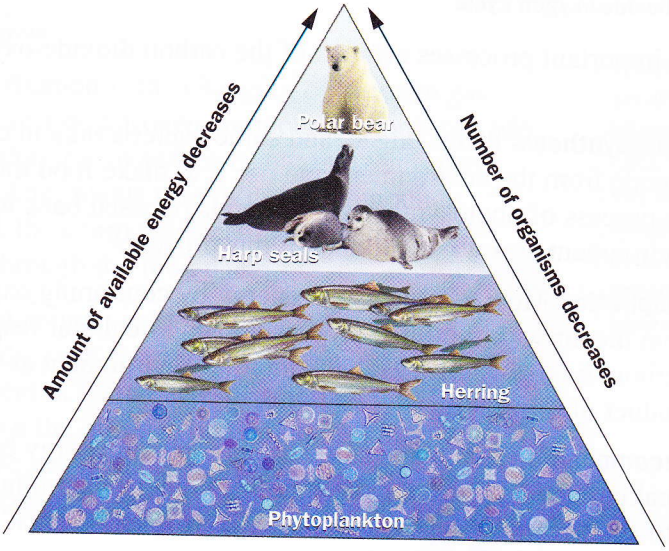
137

The energy in most ecosystems begins with the sun. Plants and other organisms with chlorophyll in their cells can capture this energy and use it to make food through photosynthesis. In this process, light energy is used to make sugar from carbon dioxide and water. Energy from food may be used by an organism for its life activities, or stored in its cells and tissues.

SEE ALSO
107 Plant Physiology
076 Cells
082 Tissues, Organs, and Systems

Energy stored in the cells and tissues of organisms is passed through the ecosystem by way of the food chain. Organisms at each level use the energy to carry out their life processes. As these processes are carried out, some energy is lost to the environment as heat. For this reason, only about 10 percent of the energy present at one feeding level is passed to the next feeding level. The decrease in available energy at each level of a food chain is shown in an **energy pyramid.**

SEE ALSO
134 Food Chains



Energy pyramid

138

Carbon Dioxide-Oxygen Cycle

SEE ALSO

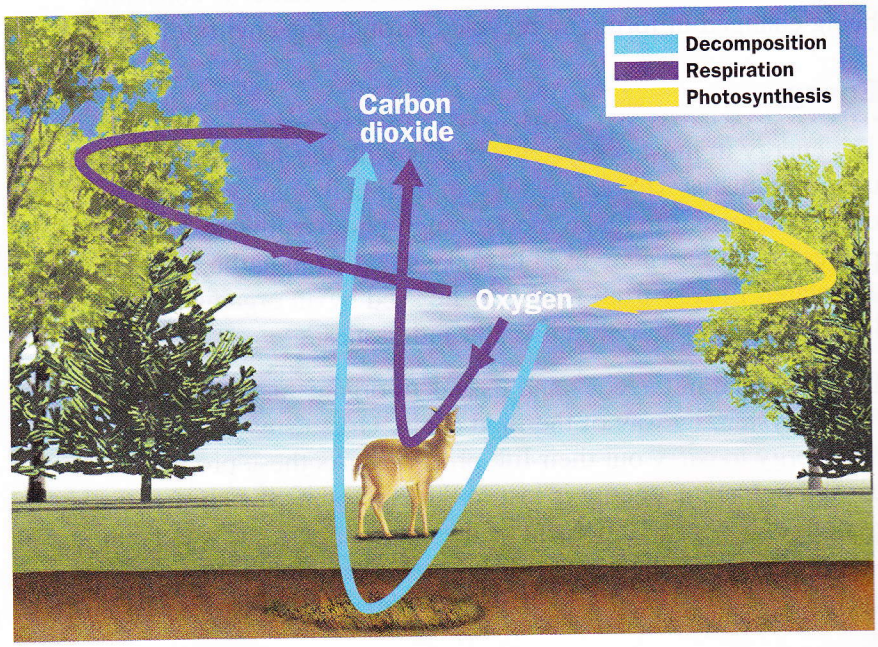
250 Matter

Matter moves in cycles through the environment, getting used over and over again. Carbon dioxide and oxygen are two important forms of matter that cycle through an ecosystem. The continual movement of carbon dioxide and oxygen between living things and the environment is known as the **carbon dioxide-oxygen cycle.**

SEE ALSO

079 Cell Processes

330 Renewable Material Resources



Carbon dioxide-oxygen cycle

Several important processes are part of the carbon dioxide-oxygen cycle.

SEE ALSO

107 Plant Physiology

105 Animal Physiology

133 Feeding Relationships

- **Photosynthesis** Plants, algae, and some bacteria take in carbon dioxide from the environment and use it to make food through the process of photosynthesis. Oxygen is released back to the environment as a waste product of this process.
- **Respiration** Most organisms get energy by combining oxygen from the air with food in a process known as cellular respiration. Carbon dioxide is released back into the environment as a waste product of respiration.
- **Decomposition** Fungi and some bacteria obtain energy by breaking down the wastes or remains of other living things into smaller molecules. Carbon dioxide is released back to the environment through this process.

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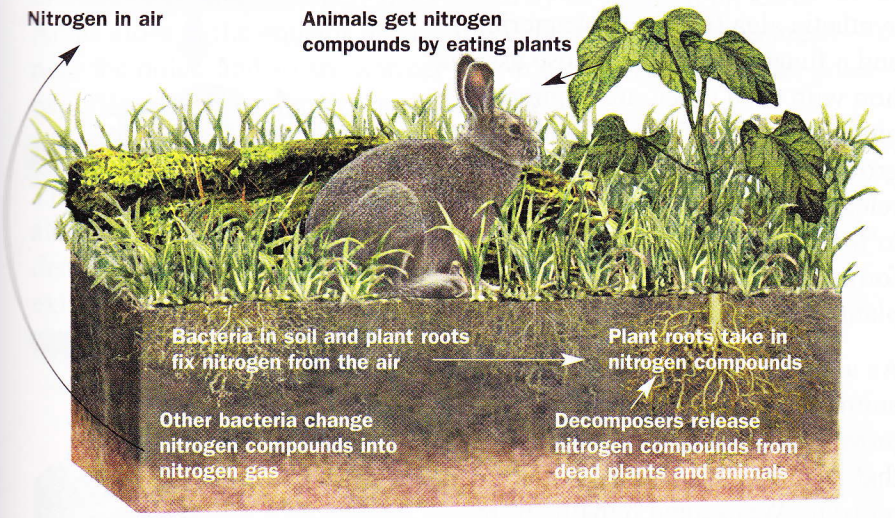
Nitrogen Cycle

Nitrogen is one of the elements needed to build the proteins that make up the structures of living things. Almost 78 percent of Earth's atmosphere is made up of nitrogen gas. But most organisms cannot use this nitrogen until it is combined with other elements to form nitrogen compounds. At the same time, nitrogen compounds found in the bodies of dead organisms must be broken down in order to return nitrogen gas back to the air where it can be used again. The constant movement of nitrogen between living things and the environment is represented by the **nitrogen cycle.**

SEE ALSO
079 Cell Processes
214 Composition of the Atmosphere
133 Feeding Relationships



Nitrogen cycle

Nitrogen fixation is the changing of nitrogen gas from the air into nitrogen compounds plants can use. Bacteria that live in soil carry out most nitrogen fixation. After plants take in these compounds from soil, the compounds can be passed to animals through the food chain.

Plants and animals return nitrogen compounds, such as ammonia, to the environment in their wastes. Bacteria break down the nitrogen compounds and release nitrogen gas back into the atmosphere.

Peas, clover, alfalfa, and soybeans are all legumes, plants that house nitrogen-fixing bacteria in their roots. The bacteria get the energy they need from the plant, and nitrogen compounds fixed by the bacteria fertilize the plant. Both organisms benefit from this relationship.

SEE ALSO
132 Relationships Between Populations

140

Ecological Succession

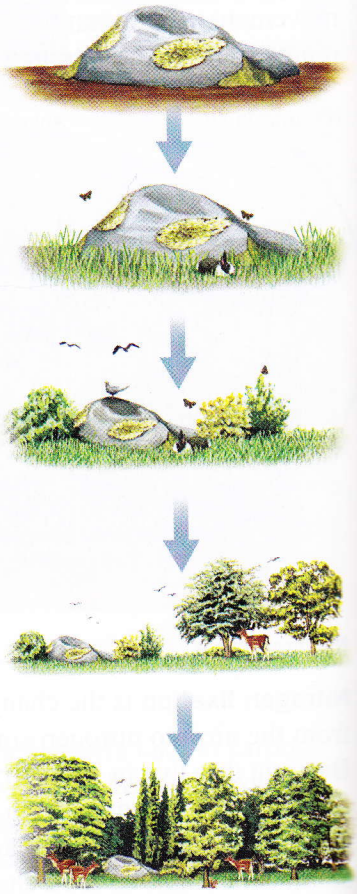
The set of organisms that occupy an area is constantly changing. The natural process by which one community of organisms slowly replaces another in a certain area is called **ecological succession.**

SEE ALSO
144 Deciduous Forests

Let's look at the development of one kind of ecological community, a deciduous forest:

SEE ALSO
079 Cell Processes
107 Plant Physiology

The first organisms to live in an area are called **pioneer species.** Mosses and **lichens,** organisms made up of a photosynthetic alga (or a cyanobacterium) and a fungus that live in close association with each other, are common pioneer species. They are both able to grow on bare rock. As they grow, they release acids that break down the rock to form soil. In time, enough soil is formed to support the growth of larger plants such as ferns or grasses.



An example of ecological succession

SEE ALSO
153 Plant Kingdom
154 Animal Kingdom

As a plant colony is established, small animals that feed on the plants will move into the area. Larger animals that feed on the small animals can also move in. Wastes and remains from these organisms decay, helping the soil to become richer and deeper. This deeper, richer soil can support the growth of larger plants, such as shrubs. As the shrubs replace the grasses, some populations of grass-eating animals leave the area in search of another food source. New animals that use the shrubs as food move in to take their place.

SEE ALSO
191 Soil

Soil continues becoming richer and deeper as new wastes and remains break down. In time, trees such as oaks and hickories take root and replace the shrubs. Still later, maples and beeches grow and mature. Eventually, the community reaches a stable point where very few new plants can **colonize,** or move into, the area. This type of community is known as a **climax community.**

Biomes

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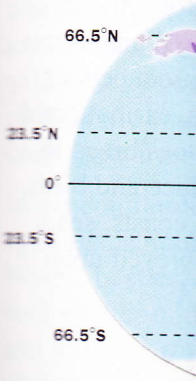

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