Chapter 3

Communities and Biomes

What You'll Learn

- You will identify factors that limit the existence of species to certain areas.
- You will describe how and why different communities form.
- You will compare and contrast biomes of planet Earth.

Why It's Important

Life is found in communities made of different species. To understand life on Earth, it is important to understand the interactions and growth of communities.

Getting Started

Identify a Community

Observe your classroom. *What organisms live there? How do they interact?*

interNET CONNECTION To find out more about communities and biomes, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**

This forest is a community of life. The inset photo shows the same area 50 years ago. Plants and animals return to an area in stages. Because communities depend on the climate and other abiotic factors, different regions of the world have different biomes.

Section

3.1 Communities

SECTION PREVIEW

Objectives

Explain how limiting factors and ranges of tolerance affect distribution of organisms.

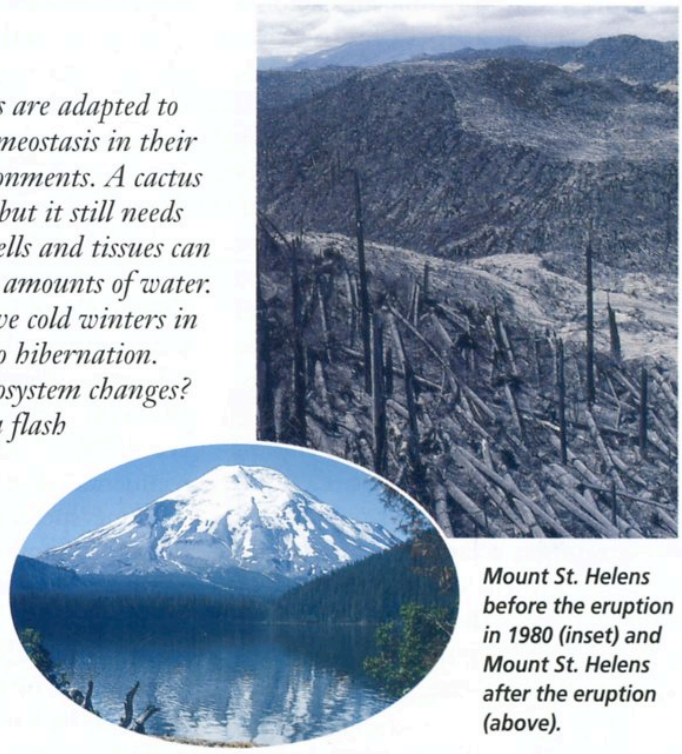
Sequence the stages of ecological succession.

Vocabulary

limiting factor
succession
primary succession
climax community
secondary succession

Most organisms are adapted to maintain homeostasis in their native environments. A cactus can live in the desert, but it still needs water to survive. Its cells and tissues can absorb and store large amounts of water. Chipmunks can survive cold winters in the forest by going into hibernation.

But what if the ecosystem changes? What happens when a flash flood sends torrents of water through the desert? What happens when a forest fire destroys hundreds of acres of trees?



Mount St. Helens before the eruption in 1980 (inset) and Mount St. Helens after the eruption (above).

Living in the Community

Look closely at a green lawn. At first glance, you might think there is only one species of plant, a grass. However, with closer examination you will find other organisms, such as insects, worms, weeds, and other species of grasses. Recall that communities are interacting populations of different species. How do species interact in your lawn?

Have you ever wondered why plants, animals, and other organisms live where they do? Why do lichens grow on bare rock but not on rich soil? Why do polar bears, such as shown in ***Figure 3.1***, live only in cold, snowy polar regions? How do catfish manage to live in waters that are too warm for trout to survive? Abiotic and biotic factors interact and result in conditions that are suitable for life for some organisms and unsuitable for other organisms.

Figure 3.1
Polar bears live near the north pole. Their white fur makes them hard to distinguish from the surrounding ice and snow, enabling them to stalk the seals and walruses that serve as their primary food.

Limiting factors

Environmental factors that affect an organism's ability to survive in its environment, such as food availability, predators, and temperature, are **limiting factors.** A limiting factor is any biotic or abiotic factor that restricts the existence, numbers, reproduction, or distribution of organisms. The timberline in ***Figure 3.2*** illustrates how limiting factors affect the plant life of an ecosystem. At high elevations, temperatures are too low, winds too strong, and the soil too thin to support the growth of large trees. Vegetation is limited to small, shallow-rooted plants, mosses, ferns, and lichens.

Factors that limit one population in a community may also have an indirect effect on another population. For example, a lack of water could limit the growth of grass in a grassland, reducing the number of seeds produced. The population of mice dependent on those seeds for food will also be reduced. What about hawks that feed on mice? Their numbers may be reduced, too, as a result of a decrease in their food supply.

Figure 3.2
The timberline is the upper limit of tree growth on this mountainside.

Ranges of tolerance

Farmers will tell you that corn plants need two to three months of sunny weather and a steady supply of water to produce a good yield. Corn grown in the shade or during a long dry period may survive, but probably won't produce much of a crop. The ability of an organism to withstand fluctuations in biotic and abiotic environmental factors is known as tolerance. ***Figure 3.3*** illustrates how the size of a population varies according to its tolerance for environmental change.

Some species can tolerate conditions that another species cannot. For example, catfish can live in warm water with low amounts of dissolved oxygen, which other fish species, such as bass or trout, could not tolerate. The bass or trout would have to swim to cooler water with more dissolved oxygen to avoid exceeding their range of tolerance.

Succession: Changes over Time

If grass were no longer cut on a lawn, what would it look like in one year, five years, and 20 years? Ecologists can accurately predict the changes that take place. The grass gets taller; weeds start to grow. The area resembles a meadow. Later, bushes grow, trees appear and different animals enter the area to live. The bushes and trees change the environment; less light reaches the ground. The grass slowly disappears. Thirty years later, the area is a forest. Ecologists refer to the orderly, natural changes and species replacements

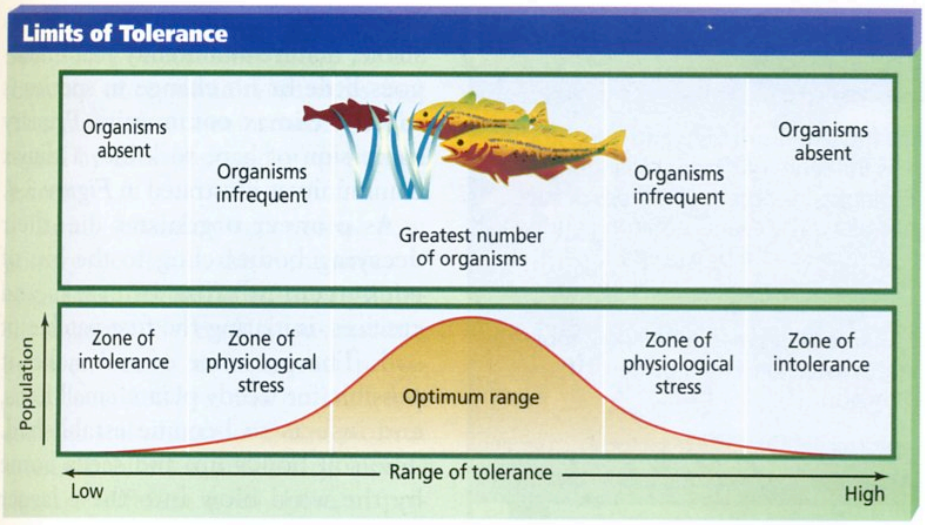


Figure 3.3
The limits of an organism's tolerance are reached when the organism receives too much or too little of some environmental factor. Organisms become fewer as conditions move toward either extreme of the range of tolerance.

that take place in the communities of an ecosystem as **succession** (suk SESH un).

Succession occurs in stages; different species at different stages create conditions that are suitable for some organisms and unsuitable for others. Succession is often difficult to observe. It can take decades, or even centuries, for one type of community to completely succeed another. Observe the effects of succession in the *BioLab* at the end of this chapter.

Primary succession

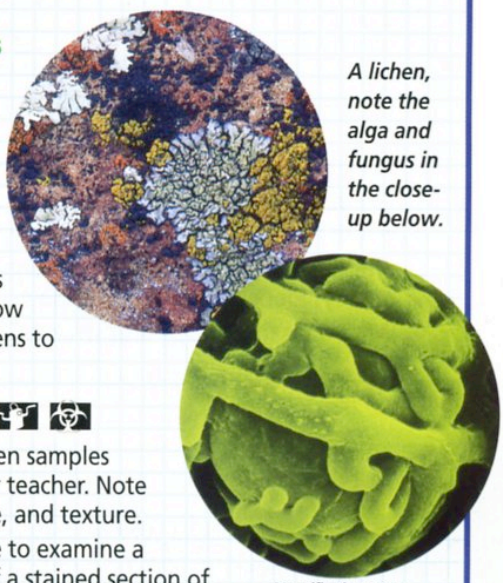
Lava flowing from the mouth of a volcano is so hot it destroys everything in its path, but when it cools it forms new land. An avalanche exposes rock and creates ledges and gullies even as it buries the areas below. The colonization of new sites like these by communities of organisms is called **primary succession.** The first species in an area are called pioneer species. An example of a pioneer species is a lichen. Examine lichens more closely in the *MiniLab* on this page.

After some time, primary succession slows down, and, after many changes in species composition, the

MiniLab 3-1 Observing

Looking at Lichens

Lichens have the reputation for being a pioneer species when it comes to succession. They often inhabit rocky areas and start the process of soil formation. How is it possible for lichens to grow on a rock?



A lichen, note the alga and fungus in the close-up below.

Magnification: 700×

Procedure

1. Examine the lichen samples provided by your teacher. Note their color, shape, and texture.
2. Use a microscope to examine a prepared slide of a stained section of a lichen. Use low-power magnification and then change to high power as needed.
3. Observe the dark bodies that are cells containing chloroplasts. Notice that lichens are composed of an alga and a fungus. Diagram what you see.

Analysis

1. Describe the general appearance of a whole lichen and of the lichen under a microscope.
2. How does a lichen illustrate mutualism?
3. Explain how mutualism explains why lichens are able to survive on rocks.

Problem-Solving Lab 3-1

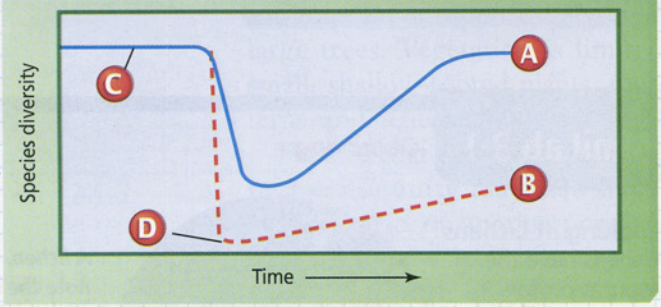
Interpreting Scientific Illustrations

How do you distinguish between primary and secondary succession? Succession is the series of gradual changes that occur in an ecosystem. Ecologists recognize two types of succession—primary and secondary. The events occurring during these two processes can be represented by a graph.

Analysis

Examine the graph. The two lines marked A and B represent primary and secondary succession. Note, however, that neither line is identified for you.

Primary and Secondary Succession



Thinking Critically

1. Which line best represents primary succession? Explain.
2. Which line best represents secondary succession? Explain.
3. Which label, C or D, might best represent a climax community? Pioneer organisms? Explain.
4. What does the sudden drop of line C represent?

community becomes fairly stable. A stable, mature community that undergoes little or no change in species is called a **climax community.** Primary succession of bare rock into a climax community is illustrated in ***Figure 3.4.***

As pioneer organisms die, their decaying bodies cling to the bits of rock accumulating in cracks and crevices, initiating the first patches of soil. The presence of soil makes it possible for weedy plants, small ferns, and insects to become established. The soil builds up, and seeds borne by the wind blow into these larger patches of soil and begin to grow.

Over time, as the community of organisms changes and develops, additional habitats emerge, new species move in, and old species disappear. Eventually, the area becomes a forest of vines, trees, and shrubs inhabited by birds and other forest-dwelling animals.

Secondary succession

What happens when a natural disaster such as a forest fire or hurricane destroys a community? What happens when farmers abandon a field or when a building is demolished in a

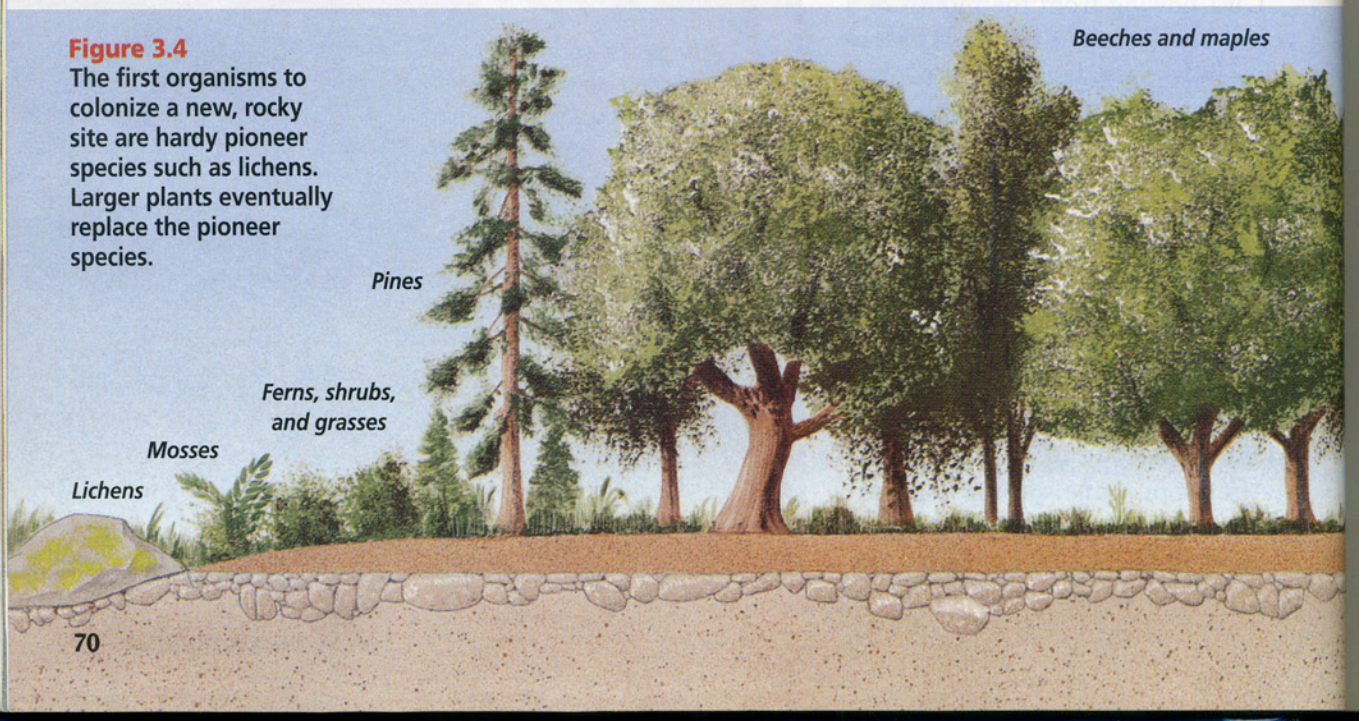


Figure 3.4
The first organisms to colonize a new, rocky site are hardy pioneer species such as lichens. Larger plants eventually replace the pioneer species.

city and nothing is built on the site? **Secondary succession** refers to the sequence of community changes that takes place after a community is disrupted by natural disasters or human actions.

During secondary succession, as in primary succession, the community of organisms inhabiting an area gradually changes. Secondary succession, however, occurs in areas that previously contained life, and on land that contains soil. Therefore, the pioneer species involved in secondary succession are different from those in primary succession, but the same climax community will be reached in areas with a similar climate. Because soil already exists, secondary succession usually takes less time than primary succession to reach a climax community. Learn more about the differences between primary and secondary succession in the *Problem-Solving Lab.*

In 1988, a forest fire burned out of control in Yellowstone National Park. Thousands of acres of trees, shrubs, and grasses were burned. As you can see in ***Figure 3.5***, the fire has given biologists an excellent opportunity to study secondary succession in a community. They have been able to observe and compare secondary succession in areas that suffered damage of different levels of severity. Annual wildflowers were the first plants to grow back. Previously, the shade of the trees inhibited wildflower growth. Within three years, perennial wildflowers, grasses, ferns, and pine seedlings began to replace the annuals. Once the pine seedlings grow above the shade cast by the grasses and perennials, the trees will grow more quickly, and eventually a mature forest of lodge pole pines, the same community that was destroyed, will once again develop.

Figure 3.5
After Yellowstone National Park's forest fire of 1988, the pioneer species were wildflowers.