Chapter 3 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 3.1 **Communities** National Science Education Standards UCP.1, UCP.3, UCP.4; A.1, A.2; C.4, C.5; D.3; F.5; G.3 (2 sessions, 1 block)	1. **Explain** how limiting factors and ranges of tolerance affect distribution of organisms. 2. **Sequence** the stages of ecological succession.	**MiniLab 3-1:** Looking at Lichens, p. 69 **Problem-Solving Lab 3-1,** p. 70 **Investigate BioLab:** Succession in a Jar, p. 88
Section 3.2 **Biomes** National Science Education Standards UCP.1-3; A.1, A.2; C.4, C.5, C.6; F.3-5; G.1, G.3 (3 sessions, 1½ blocks)	3. **Compare and contrast** the photic and aphotic zones of marine biomes. 4. **Identify** the major limiting factors affecting distribution of terrestrial biomes. 5. **Distinguish** among biomes.	**Problem-Solving Lab 3-2,** p. 74 **MiniLab 3-2:** Looking at Marine Plankton, p. 75 **Focus On** Biomes, p. 78 **Inside Story:** A Tropical Rain Forest, p. 86 **Literature Connection:** *The Yellowstone National Park* by John Muir, p. 90

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at **http://www.carolina.com**

MATERIALS LIST

BioLab

p. 88 glass jar (3), pasteurized spring water, pond water with plant material, labels, microscope slides, coverslips, droppers, plastic wrap, cooked rice, plastic teaspoon, microscope

MiniLabs

p. 69 microscope, lichen samples
p. 75 microscope, microscope slide, coverslip, dropper, marine plankton culture

Alternative Lab

p. 80 cloth squares (3), large beaker, water, sand, clay, potting soil, balance, twist ties

Quick Demos

p. 68 cactus, broad-leafed houseplant
p. 82 paper towels, wax paper, water
p. 83 grass sod
p. 85 paper, scissors

Key to Teaching Strategies

- L1 Level 1 activities should be appropriate for students with learning difficulties.
- L2 Level 2 activities should be within the ability range of all students.
- L3 Level 3 activities are designed for above-average students.
- ELL ELL activities should be within the ability range of English Language Learners.
- COOP LEARN Cooperative Learning activities are designed for small group work.
- P These strategies represent student products that can be placed into a best-work portfolio.
- These strategies are useful in a block scheduling format.

Communities and Biomes

Teacher Classroom Resources

Section	Reproducible Masters	Transparencies
Section 3.1 **Communities**	Reinforcement and Study Guide, pp. 11-12 L2 Concept Mapping, p. 3 L3 ELL BioLab and MiniLab Worksheets, p. 13 L2 Laboratory Manual, pp. 15-22 L2 Content Mastery, pp. 13-14, 16 L1	Section Focus Transparency 6 L1 ELL Basic Concepts Transparency 3 L2 ELL Reteaching Skills Transparency 4 L1 ELL
Section 3.2 **Biomes**	Reinforcement and Study Guide, pp. 13-14 L2 Critical Thinking/Problem Solving, p. 3 L3 BioLab and MiniLab Worksheets, pp. 14-16 L2 Content Mastery, pp. 13, 15-16 L1 Inside Story Poster ELL	Section Focus Transparency 7 L1 ELL Reteaching Skills Transparency 5 L1 ELL

Assessment Resources

Chapter Assessment, pp. 13-18
MindJogger Videoquizzes
Performance Assessment in the Biology Classroom
Alternate Assessment in the Science Classroom
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 3 quiz

Additional Resources

Spanish Resources ELL
English/Spanish Audiocassettes ELL
Cooperative Learning in the Science Classroom COOP LEARN
Lesson Plans/Block Scheduling

NATIONAL GEOGRAPHIC Teacher's Corner

Products Available From Glencoe

To order the following products, call Glencoe at 1-800-334-7344:

CD-ROM
NGS PictureShow: Looking at Ecosystems

Transparency Set
NGS PicturePack: Looking at Ecosystems

Index to National Geographic Magazine

The following articles may be used for research relating to this chapter.

"Chesapeake Bay—Hanging in the Balance," by Tom Horton, June 1993.

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life

CD-ROM ELL
Exploration: *World Biomes*
Video: *Tundra*
Video: *Tiaga*
Video: *Desert*
Video: *Temperate Grassland*
Video: *Temperate Forest*
Video: *Tropical Rain Forest*

Videodisc Program
Tundra
Tiaga
Desert
Temperate Grassland
Temperate Forest
Tropical Rain Forest

The Infinite Voyage
Secrets From a Fozen World
The Living Clock

Chapter 3

Getting Started Demo

Have students examine the chapter opener photographs and describe specific differences and similarities between them. Ask them to share their ideas about why the land changed over time. Help them focus on local examples of succession by asking questions such as, "What would the school football field look like in 30 years if we left it alone?"

Theme Development

The theme of **systems and interactions** is illustrated as students learn about the changes involved in primary and secondary succession. Succession results from changes in interactions between biotic and abiotic factors. The system reaches relative stability when a climax community is formed. Biomes and their interactions are also discussed.

0:00 Out of Time?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Glencoe Technology

CD-ROM
Biology: The Dynamics of Life
Video: *How Organisms Interact*
Disc 1

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

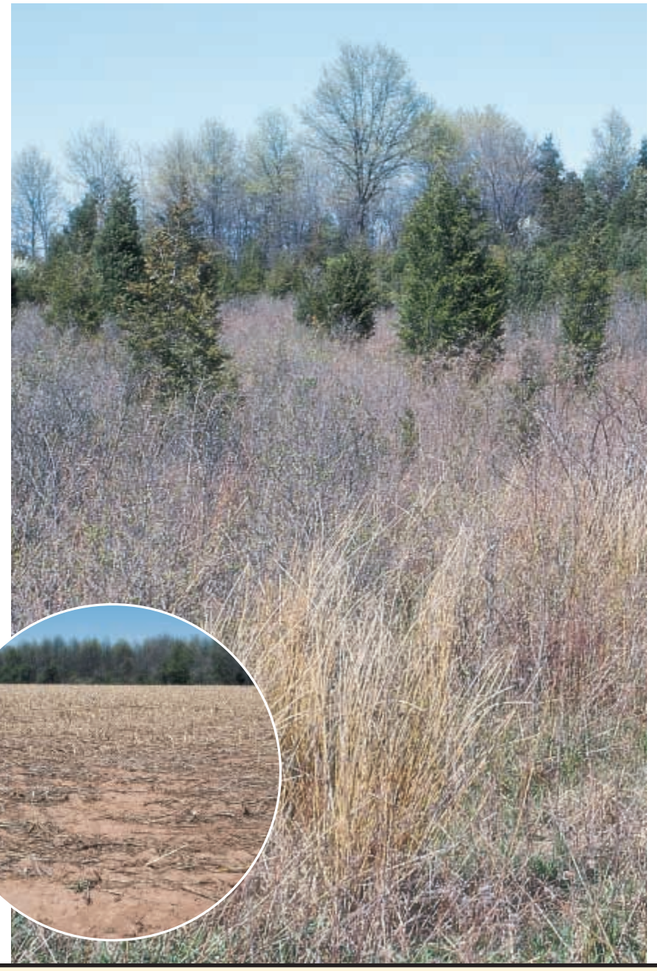
Life is found in communities made of different species. To understand life on Earth, it is important to understand the interactions and growth of communities.

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.

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Kinesthetic Project, p. 75; Enrichment, p. 81; Meeting Individual Needs, p. 83

Visual-Spatial Tech Prep, p. 70; Reteach, p. 71; Extension, p. 71; Biology Journal, p. 77; Enrichment, p. 77; Meeting Individual Needs, pp. 78, 86; Time Line, p. 81; Portfolio, p. 85

Linguistic Biology Journal, pp. 68, 79, 84; Meeting Individual Needs, p. 69; Enrichment, p. 84

Logical-Mathematical Portfolio, pp. 73, 77, 85

Naturalist Portfolio, p. 68; Quick Demo, p. 68; Biology Journal, p. 73; Meeting Individual Needs, p. 84; Concept Development, p. 85; Reteach, p. 87; Extension, p. 87

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.

Assessment Planner

Portfolio Assessment
MiniLab, TWE, p. 69
Assessment, TWE, p. 87
BioiLab, TWE, pp. 88-89
Portfolio, TWE, pp. 68, 73, 77, 85

Performance Assessment
MiniLab, SE, pp. 69, 75
Assessment, TWE, p. 73
MiniLab, TWE, p. 75
Alternative Lab, TWE, pp. 80-81
BioLab, SE, pp. 88-89

Knowledge Assessment
Assessment, TWE, pp. 68, 71
Section Assessment, SE, pp. 71, 87
Problem-Solving Lab, TWE, p. 74
Alternative Lab, TWE, pp. 80-81
Chapter Assessment, SE, pp. 91-93

Skill Assessment
Problem-Solving Lab, TWE, p. 70

Prepare

Key Concepts

The concept of limiting factors, the biotic and abiotic factors that restrict life activities, is introduced. The orderly successions in ecosystems are discussed.

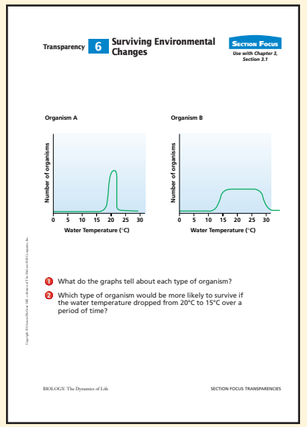
Planning

- Gather lichen, microscopes, and other materials for MiniLab 3-1.
- Purchase or borrow a cactus and broad-leafed houseplant for the Quick Demo.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 6** on the overhead projector and have the students answer the accompanying questions. L1 ELL



Resource Manager

Section Focus Transparency 6 and Master L1 ELL
Concept Mapping 3, p. 3 L3 ELL

2 Teach

Quick Demo

Naturalist Hold up a small cactus and a broad-leafed houseplant. Ask: What are similarities and differences between the two plants? What are the natural habitats for each one? What would happen if we planted each plant in the other's habitat? L1

Visual Learning

Direct students' attention to Figure 3.1. Have students infer the climate of the North Pole region. *cold temperatures, with ice and snow rather than rain* Ask them to describe adaptations of the polar bear that allow it to survive in this climate. *thick fur, much body fat, large paws for walking on snow and ice*

INVESTIGATE BioLab

The BioLab at the end of the chapter can be used at this point in the lesson.

Assessment

Knowledge Have groups of students quiz one another on the topic of limiting factors. Students can take turns making up questions. L2 COOP LEARN

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Latitude and Isolation

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 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.

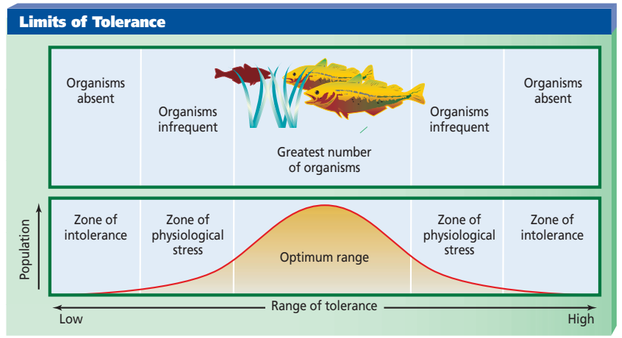


Figure 3.3
The limits of an organism's tolerance are reached when the organism receives too much or too little of some environmental factor. Organisms become fewer as conditions move toward either extreme of the range of tolerance.

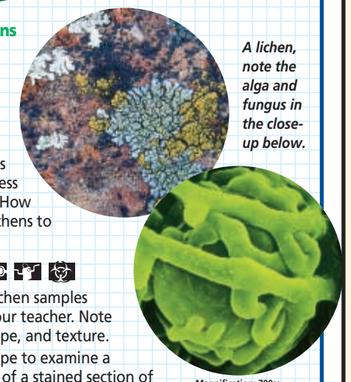
Primary succession

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.

Biology Journal

Life as a Cactus

Linguistic Tell students to imagine they are cacti growing in the desert of the southwestern United States. Ask them to describe what their range of tolerance might be to water availability, humidity, and day and nighttime temperatures. L2

Portfolio

Setting Limits

Naturalist Ask students to think of environments in which they feel comfortable. Have them prepare a list of their personal limits for temperature, humidity, shade, and bright light. Have students compare their lists and discuss why they are similar. L2 P

Meeting Individual Needs

English Language Learners

Linguistic Have students use a dictionary to explain why the term *pioneer organism* is well suited to the role such organisms perform. *Pioneers are the first to colonize or settle an area. In succession, pioneer organisms are the first to inhabit a region.* L1 ELL

Resource Manager

BioLab and MiniLab Worksheets, p. 13 L2
Laboratory Manual, pp. 15-22 L2
Basic Concepts Transparency 3 and Master L2 ELL

MiniLab 3-1

Purpose
Students will observe the gross and microscopic appearance of a lichen.

Process Skills
observe, apply concepts, define operationally, draw a conclusion

Safety Precautions
Remind students to wear goggles and aprons and to wash their hands after handling lichens.

Teaching Strategies
- Prepared slides and whole lichens are available from biological supply houses. If available, gather whole lichens locally.
- Teasing apart small sections of a whole lichen for microscopic observation is an alternative.
- Review symbiosis with students prior to starting this lab.

Expected Results
Students will be able to observe the algae and the fungi in a lichen.

Analysis
1. Color may be dull green, red, orange, or yellow; shape may be crusty or flat. Fungus portion may be long, clear strands; alga portion, small green cells
2. The fungus receives food from the alga, and the alga receives moisture from the fungus.
3. Rocks offer harsh living conditions. The algae and fungi in lichens overcome this by making their own food and retaining moisture.

Assessment

Portfolio Have students design an experiment to determine if each component of a lichen could survive without the other. Use the Performance Task Assessment List for Designing an Experiment in **PASC,** p. 23. L2

Problem-Solving Lab 3-1

Purpose

Students will use a graphic representation to determine differences and similarities between primary and secondary succession.

Process Skills

think critically, apply concepts, compare and contrast, draw a conclusion, interpret scientific illustrations

Teaching Strategies

- If necessary, review the meanings of *primary* and *secondary* before students do this activity.
- Have students work in small groups to complete this activity.

Thinking Critically

1. B; primary succession takes longer to reach stability.
2. A; secondary succession takes less time to reach stability than primary succession.
3. C; climax communities are stable and exist prior to a disturbance. D; pioneer organisms are not stable.
4. a sudden, disruptive event, such as a fire

Assessment

Skill Have students draw a graph with proper time units along the *x*-axis to depict the expected appearance of a vacant lot as it undergoes succession. Use the Performance Task Assessment List for Graph from Data in **PASC,** p. 39. L2

Resource Manager

Content Mastery, p. 14 L1
Reinforcement and Study Guide, pp. 11-12 L2
Reteaching Skills Transparency 4 and Master L1 ELL

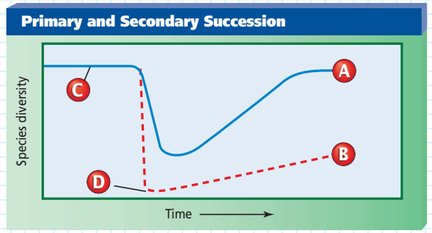
Problem-Solving Lab 3-1

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.



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 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.

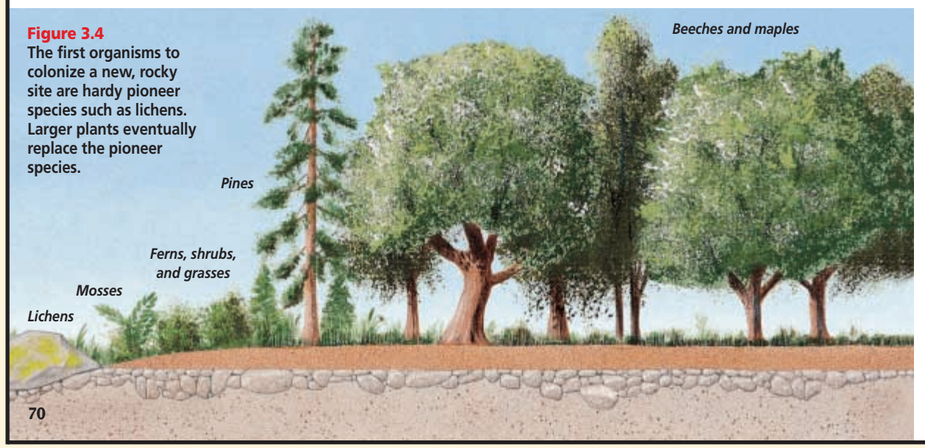


Figure 3.4
The first organisms to colonize a new, rocky site are hardy pioneer species such as lichens. Larger plants eventually replace the pioneer species.

Section Assessment

Understanding Main Ideas

1. Give an example of a limiting factor for a pine tree.
2. Some species of fishes can survive in both fresh- and salt water. What does this say about their range of tolerance?
3. Give an example of secondary succession. Include plants and animals in your example.
4. Give an abiotic factor, and explain how it could be a limiting factor for a coyote population.

Thinking Critically

5. Explain how the growth of one population can bring about the disappearance of another population during succession.

Skill Review

6. **Making and Using Graphs** Using the following data, graph the limits of tolerance for temperature for carp. The first number in each pair is temperature in degrees Celsius; the second number is the number of carp surviving at that temperature: 0, 0; 10, 5; 20, 25; 30, 34; 40, 27; 50, 2; 60, 0. For more help, refer to *Organizing Information* in the **Skill Handbook.**

TechPrep

Highway Succession

Visual-Spatial Many transportation departments are letting grassy areas near highways revert to their natural condition. Have students contact the local highway department and find such areas. They should then make a photo journal showing the different areas and the dates of the last mow. L3

Section Assessment

1. Answers will vary, but pine trees require water, deep soil rich in nutrients, and proper temperatures.
2. These fish have either a wide range of tolerance or during their life history their range of tolerance shifts.
3. Examples should describe the return of life to a damaged ecosystem. Examples should include both plants and animals returning to the area.
4. Examples may include absence of water or extreme temperatures that limit the places where coyotes can survive.
5. One species can crowd, block the sun, eat the available food, or absorb the nutrients and water needed by the other species.
6. Check student graphs for logic and accuracy.

3 Assess

Check for Understanding

Have students explain how the terms in the following pairs are related. L1

a. limiting factors—range of tolerance
b. primary succession—secondary succession
c. pioneer community—climax community

Reteach

Visual-Spatial Have students prepare a chart showing similarities and differences between primary and secondary succession. L2

Extension

Visual-Spatial Have students use library references to prepare a flow chart showing the sequence of changes that occur during succession of a pond into a hardwood forest. L2

Assessment

Knowledge Ask students to recall the opening discussion regarding what a football field lot might look like if it were not used for 30 years. Ask them to rethink the changes they described and state whether they would predict the same changes now. Ask them to name this process of change. *succession* L2

4 Close

Discussion

Have students explain how human activities may disrupt or contribute to succession. Then have them list examples of natural events that bring about or hasten succession. L2

Prepare

Key Concepts

Students are introduced to world biomes—both aquatic and terrestrial. Limiting factors such as annual rainfall, temperature range, and sunlight availability are discussed in terms of how they result in the establishment of life zones throughout the world.

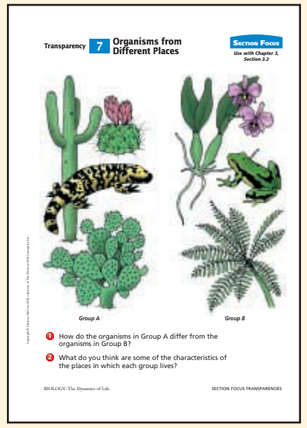
Planning

- Gather grass sod for the Quick Demo.
- Gather pond water and sediment, jars, and other materials for the BioLab.
- Purchase or gather cloth squares, sand, clay, and potting soil for the Alternative Lab.
- Purchase plankton and gather other materials for Mini-Lab 3-2.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 7** on the overhead projector and have the students answer the accompanying questions. L1 ELL



SECTION PREVIEW

Objectives

Compare and contrast the photic and aphotic zones of marine biomes.

Identify the major limiting factors affecting distribution of terrestrial biomes.

Distinguish among biomes.

Vocabulary

biome
photic zone
aphotic zone
estuary
intertidal zone
plankton
tundra
permafrost
taiga
desert
grassland
temperate forest
tropical rain forest

Section 3.2

3.2 Biomes

Climate, a combination of temperature, sunlight, prevailing winds, and precipitation, is an important factor in determining which climax community will develop at any spot on Earth. Soil type is also important. Many regions of the world share similar soil and climate characteristics and, as a result, also share similar types of climax communities. Although the species of organisms living in each desert ecosystem may vary, all are adapted for life in an environment with dry weather and poor soil.

Cardon cactus (above) and kangaroo rat (inset)

Aquatic Biomes: Life in the Water

Ecosystems that have similar kinds of climax communities can be grouped into a broader category of organization called a biome. A **biome** is a large group of ecosystems that share the same type of climax community. Biomes located on land are called terrestrial biomes; those located in oceans, lakes, streams, ponds, or other bodies of water are called aquatic biomes.

As a human who lives on land, you may tend to think of Earth as a primarily terrestrial planet. But one look at a globe, a world map, or a photograph of Earth taken from space tells you there is an aquatic world, too; approximately 75 percent of Earth's surface is covered with water. Most of that water is salty. Oceans, seas, and even some inland lakes contain salt water. Freshwater is confined to rivers, streams, ponds, and most lakes. Saltwater and freshwater environments have similarities, but they also have important differences. As a result, aquatic biomes are separated into marine biomes and freshwater biomes.

Marine biomes

If you've watched TV programs about ocean life, you may have gotten the impression that the oceans are mostly full of great white sharks, whales, and other large animals. However, different parts of the ocean differ in physical factors and in the organisms found there. The oceans contain the largest amount of biomass, or living material, of any biome on Earth, but most of this biomass is made up of extremely small, often microscopic, organisms that humans usually don't see.

One of the ways ecologists study marine biomes is to separate them into shallow, sunlit zones and deeper, unlighted zones. The portion of the marine biome that is shallow enough for sunlight to penetrate is called the **photic zone.** Shallow marine environments exist along the coastlines of all landmasses on Earth. These coastal ecosystems include rocky shores, sandy beaches, and mudflats, and all are part of the photic zone. Deeper water that never receives sunlight makes up the **aphotic zone.** The aphotic zone includes the deepest, least explored areas of the ocean.

A mixing of waters

If you were to follow the course of any river, you would eventually reach a sea or ocean. Wherever rivers join oceans, freshwater mixes with salt water. In many such places, an estuary is formed. An **estuary** (ES chuh wer ee) is a coastal body of water, partially surrounded by land, in which freshwater and saltwater mix. It may extend many miles inland. The salinity in an estuary ranges between that of seawater and that of freshwater, and depends on how much freshwater the river brings into the estuary. Salinity in the estuary also changes with the tide. Because of these changes in salinity, a wide range of organisms can live in estuaries. Estuaries may contain salt marsh ecosystems, which are dominated by salt-tolerant grasses, as illustrated in ***Figure 3.6.*** These plants often grow so thick that their stems and roots form a tangled mat that traps food material and provides additional habitat for small organisms. These small organisms attract a wide range of predators, including cranes and other birds. The decay of dead organisms proceeds quickly, recycling nutrients through the food web.

Figure 3.6
Because estuaries provide an abundant supply of food and shelter, many fishes, clams, and other commercially important organisms live there while young. Many of them venture out of the estuary and into the ocean once they reach adulthood.

WORD Origin

photic
From the Greek word *phos*, meaning "light." The marine photic zone receives light from the sun.

aphotic
From the Greek words *a*, meaning "without," and *phos*, meaning "light." The aphotic zone doesn't receive light.

2 Teach

Visual Learning

Ask students to explain which organisms in Figure 3.6 are likely to benefit most from the availability of light and nutrients in estuary waters. *Producers are most likely to benefit because they require light and nutrients for growth and development.*

Assessment

Performance Assessment in the Biology Classroom, p. 57, *Investigating Salinity and Marine Algae*. Have students carry out this activity to determine the effect of salinity on marine algae. L2

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *World Biomes* Disc 1

VIDEODISC
The Secret of Life
Ocean Zones

Resource Manager

Critical Thinking/Problem Solving 3, p. 3 L3

Resource Manager

Section Focus Transparency 7 and Master L1 ELL

Portfolio

Graphing Earth's Surface

Logical-Mathematical Ask students to prepare a circle graph that depicts the composition of Earth's surface. Provide these data for their graphs: salt water 73.5%, freshwater 1.5%, land 25.0 %. L2 P

BIOLOGY JOURNAL

Comparing Estuaries and Oceans

Naturalist Have students compare estuaries and oceans. As part of this comparison, ask students to focus on both biotic and abiotic factors associated with each ecosystem. L3

Problem-Solving Lab 3-2

Purpose

Students will read a graph and analyze the extent and limitations of the information in it.

Process Skills

analyze information, draw a conclusion, hypothesize, interpret data, make and use graphs, predict, think critically

Teaching Strategies

- To do this activity with the entire class, ask for their input on each question.
- This activity is suitable for cooperative group analysis.
- Explain to students that the final analysis of results is least important.
- Review the concept of tide pools if necessary.

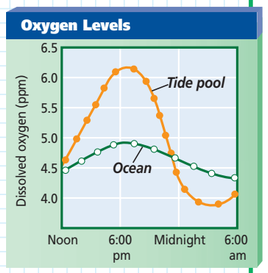
Thinking Critically

1. Answers may include that oxygen levels were measured in ppm, the experiment was conducted for 18 hours, the dependent variable (oxygen levels) is plotted on the *y*-axis, and the independent variable (time of day) is plotted on the *x*-axis.
2. Answers may include that both tide pool and ocean were sampled, samples were taken about every two hours for ocean oxygen, samples were taken almost every hour for tide pool oxygen, and 17 samples were taken for tide pool analysis, while 10 samples were taken for ocean analysis.
3. Answers may include how the samples were tested for oxygen, where the experiment was conducted, when during the year the experiment was conducted, when the tide pool was cut off from the ocean, and from what depth the ocean samples were taken.

Problem-Solving Lab 3-2 Analyzing Information

What information can be learned from studying a graph?

Tide pools are depressions along rocky coasts that are covered by ocean waters during high tide. However, when oceans retreat during low tide, these tide pools are stranded and become temporarily cut off from ocean waters.



Analysis

The graph shows results from tests of water samples taken in a tide pool and in the surrounding ocean. A scientist measured oxygen levels in ppm (parts per million). Both the ocean and tide pool have the same producer present, a green algae called Cladophora.

Thinking Critically

1. What can you tell about how the experiment was done using only the *x*- and *y*-axis information?
2. What can you tell about how the experiment was done from studying the graph?
3. What can't you tell about the experiment from the data provided?
4. What specific information was learned as a result of the experiment?

The effects of the tides

Twice a day, the gravitational pull of the sun and moon causes the rise and fall of ocean tides. The portion of the shoreline that lies between the high and low tide lines is called the **intertidal zone.** The size of this zone depends upon the slope of the land and the height of the tide. Intertidal ecosystems have high levels of sunlight, nutrients, and oxygen, but productivity may be limited by waves crashing against the shore. Intertidal zones differ in rockiness and wave action. ***Figure 3.7*** shows examples of different types of intertidal zones. If the shore is rocky, waves constantly threaten to wash organisms into deeper water. Snails, sea stars, and other intertidal animals of the rocky shore have body parts that act as suction cups for holding onto the wave-beaten rocks. Other animals, such as mussels and barnacles, secrete a strong glue that helps them remain anchored. If the shore is sandy, wave action keeps the bottom in constant motion. Most of the clams, worms, snails, crabs, and other organisms that live along sandy shores survive by burrowing into the sand.

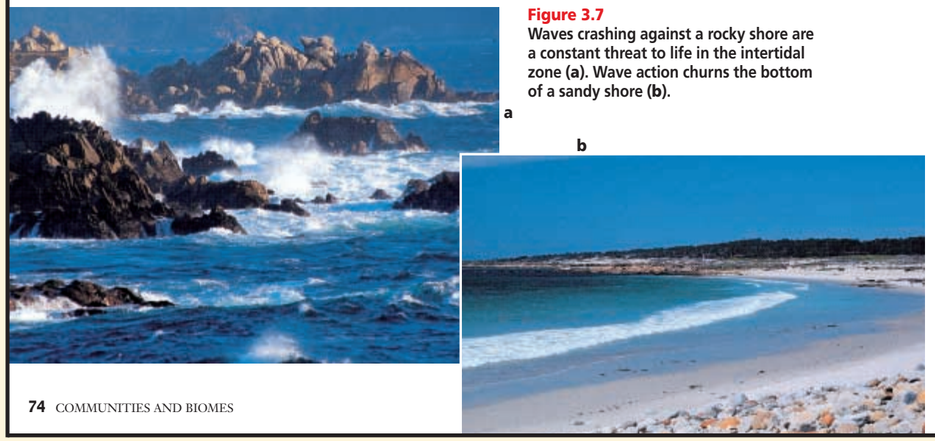


Figure 3.7
Waves crashing against a rocky shore are a constant threat to life in the intertidal zone (a). Wave action churns the bottom of a sandy shore (b).

4. The amount of dissolved oxygen in the tide pool rose sharply during the early afternoon and then fell sharply. The amount in the ocean rose and fell only slightly during the same periods.

Assessment

Knowledge Ask students to explain the scientists' findings. Have them correlate increases or decreases in oxygen levels with the fact that there is a photosynthetic organism present. Use the Performance Task Assessment List for Analyzing the Data in **PASC,** p. 27. L3

Tide pools, pools of water left when the water recedes at low tide, can landlock the organisms that live in the intertidal zone until the next high tide. These areas vary greatly in nutrient and oxygen levels from the nearby ocean. Compare and contrast oxygen content between tide pools and the ocean in the *Problem-Solving Lab.*

In the light

As you move away from the intertidal zone and into deeper water, the ocean bottom is less and less affected by waves or tides. Many organisms live in this shallow-water region that surrounds most continents and islands. Nutrients washed from the land by rainfall contribute to the abundant life and high productivity of this region of the photic zone.

The photic zone of the marine biome also includes the vast expanse of open ocean that covers most of Earth's surface. Most of the organisms that live in the marine biome are plankton. **Plankton,** shown in ***Figure 3.8,*** are small organisms that live in the waters of the photic zone. Examine plankton more closely in the *MiniLab* shown here. Plankton include autotrophs, such as diatoms, and heterotrophs, such as juvenile stages of many marine animals.

In the dark

Imagine a darkness blacker than night and pressure so intense it exerts hundreds of pounds of weight on every square centimeter of your body's surface. Does this sound like a hospitable place to live? Almost 90 percent of the ocean is more than a kilometer deep. In some places, it may extend kilometers below the sunlit surface. Even though the animals living there are very far below the photic zone where plankton abound, many of them still depend on plankton for food, either directly or indirectly by eating organisms that feed directly on plankton. Fishes living in the deep areas of the ocean are adapted to a life of darkness and a scarcity of food. What adaptations might help these organisms survive in this environment?

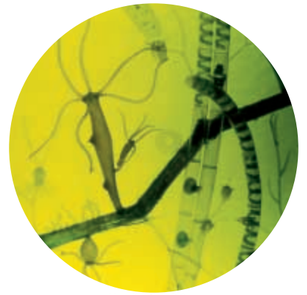
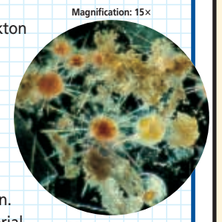


Figure 3.8
Plankton forms the base of all aquatic food chains, but not all organisms that eat plankton are small. Baleen whales and whale sharks, some of the largest organisms that have ever lived, consume vast amounts of plankton.

MiniLab 3-2 Comparing and Contrasting

Looking at Marine Plankton Plankton is the term used to define the microscopic life forms present in an aquatic environment. Plankton consists mainly of protists and animal larvae.



Marine plankton

Procedure

1. Use a medicine dropper to obtain a small sample of marine plankton.
2. Prepare a wet mount of the material. **CAUTION:** ***Handle microscope slides and coverslips carefully.***
3. Observe under low-power magnification of the microscope.
4. Look for a variety of organisms and diagram several different types.

Analysis

1. Describe the appearance of specific planktonic organisms. Draw what you see.
2. Are both autotrophs and heterotrophs present? How can you distinguish them?
3. Why are plankton important in food chains?

PROJECT

Measuring Oxygen

Kinesthetic Purchase kits from a biological supply house that measure the dissolved oxygen in water. Have students use these kits to test water samples from different local bodies of water. Ask students to record the source of each sample. L2 ELL

Resource Manager

BioLab and MiniLab Worksheets, p. 14 L2

MiniLab 3-2

Purpose

Students will study the diverse nature of ocean plankton.

Process Skills

observe and infer, classify, compare and contrast

Safety Precautions

Have students wash their hands after the MiniLab.

Teaching Strategies

- Marine plankton samples are available from biological supply houses. Freeze-dried plankton can be purchased at pet shops.
- Because of the preservative used, many producer organisms may have lost their green color in the plankton samples.
- You may wish to collect your own plankton samples. Pond plankton would be suitable. Small clusters of plants or algae from a pond system will provide good examples of both producer and consumer organisms.

Expected Results

Students will observe a variety of young or larval stages of consumer organisms in plankton.

Analysis

1. Plankton consists of many small shrimplike, wormlike, or insectlike organisms.
2. Answers may vary. Producers are green, but consumers are not.
3. Small fish eat plankton, and larger fish eat the small fish. Plankton are the basis of many marine food chains.

Assessment

Performance Have students use references to identify some of the organisms observed in the plankton samples. Use the Performance Task Assessment List for Making Observations and Inferences in **PASC,** p. 17. L2

Tying to Previous Knowledge

Have students diagram a food chain that illustrates the relationships among photic zone organisms. Ask them to identify each organism in their food chain as a producer, first-order consumer, second-order consumer, or third-order consumer. L1

Discussion Question

Elicit from students why organisms that live on lake bottoms are often scavengers. *Dead organisms that drift to the bottom of the lake provide an ample food source for these organisms. Also, plant life is scarce in this part of a lake, so organisms that feed on living plants cannot survive here.*

GLENCOE TECHNOLOGY

VIDEODISC

The Infinite Voyage
Secrets from a Frozen World, The Southern Ocean—A Rich Marine Ecosystem (Ch. 1)
5 min. 30 sec.

The Infinite Voyage
The Living Clock, Circadian Rhythm and the Biological Clock (Ch. 4), 5 min.

Figure 3.9
The shallow waters in which these plants grow are highly productive and include fishes, algae, protists, insect larvae, tadpoles, and crayfishes. As you move from the margins of a lake or pond toward the center, you find concentric bands of different species of plants.

Freshwater biomes

Have you ever gone swimming or boating in a lake or pond? If so, you may have noticed different kinds of plants, such as cattails and sedges, growing around the shoreline and even into the water, as shown in ***Figure 3.9***. The shallow water in which these plants grow serves as home for tadpoles, aquatic insects, turtles that bask on fallen tree trunks, and worms and crayfishes that burrow into the muddy bottom. Insect larvae, whirligig beetles, dragonflies, and fishes such as minnows, bluegill, and carp also live here.

If you have ever jumped into a deep lake on a warm summer day, you probably got a cold surprise the instant you entered the water. Although the summer sun heats the lake's surface, the water a few feet below the surface remains cold because cold water is denser than warm water. If you were to dive all the way to the bottom of the lake, you would discover more layers of increasingly cold water as you descended. These temperature variations within a lake are an abiotic factor that limits the kinds of organisms that can survive in deep lakes.

Another abiotic factor that limits life in deep lakes is light. Not enough sunlight penetrates to the bottom to support photosynthesis, so few aquatic plants or algae grow. As a result, population density is lower in deeper waters. Decay takes place at the bottom of a lake. As dead organisms drift to the bottom, bacteria break them down and recycle the nutrients they contain.

Terrestrial Biomes

Imagine that you are setting off on an expedition beginning at the north pole and traveling south to the equator, as ***Figure 3.10*** shows. What kinds of environmental changes do you notice? The weather gets warmer, of course. You also see a gradual change in the kinds of plants that cover the ground. At the snow- and ice-covered polar cap, temperatures are always freezing and no plants exist. A little farther south, where temperatures sometimes rise above freezing but the soil never thaws, you might see soggy ground with just a few small cushions of low-growing lichens and plants.

As you continue on your journey, temperatures rise a little and you enter forests of coniferous trees. Farther south are grasslands and deserts, with higher summertime temperatures and little rain, and deciduous forests, with more rain and lower temperatures than the grasslands and deserts. Finally, as you approach the equator, you may find yourself surrounded by the lush growth of a tropical forest, where it rains almost every day.

As you move south from the north pole, you find yourself traveling through one biome after another. The graph in ***Figure 3.11*** shows how two abiotic factors—temperature and precipitation—influence the kind of climax community that develops in a particular part of the world. Small differences in temperature or precipitation can create many different climax communities, ecosystems, and biomes. Look at the distribution of the six most common terrestrial biomes in *Focus On Biomes*.

Figure 3.11
If you know the average annual temperature and rate of precipitation of a particular area, you should be able to determine the climax community that will develop.

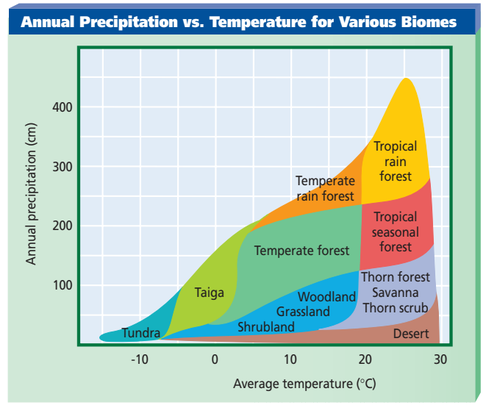
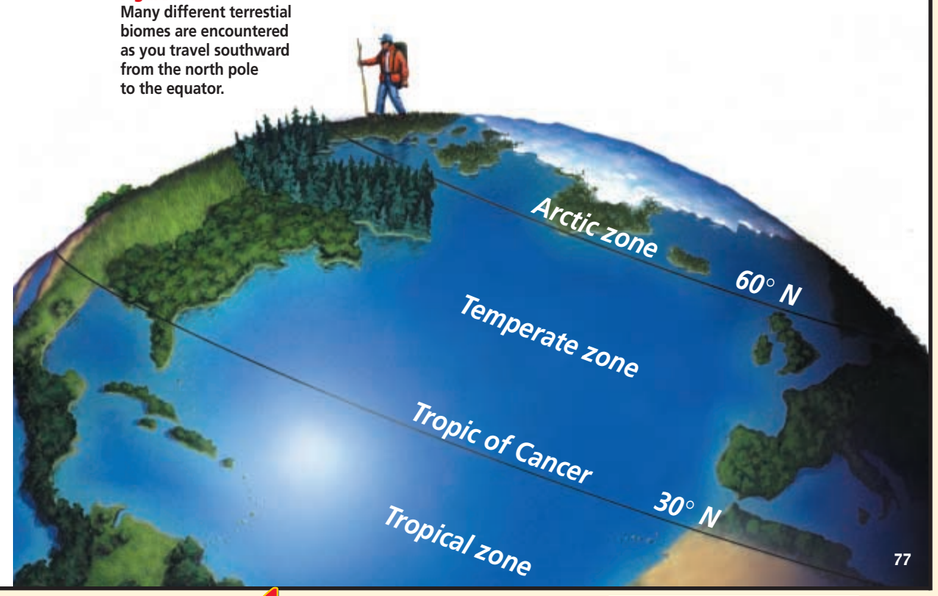


Figure 3.10
Many different terrestial biomes are encountered as you travel southward from the north pole to the equator.



Visual Learning

Predict which climax community would result from an area that has an annual precipitation of 150 cm and an average temperature of 15°C. *a temperate forest*

Discussion

You may wish to discuss with students what effect increased altitude has on temperature. Ask them to use this information to explain why mountaintops in tropical areas may be covered by snow.

Enrichment

Visual-Spatial Have interested students research the rain shadow effect that produces desert conditions in some areas. Ask students to prepare a diagram for their portfolios that explains this process. L3 P

Resource Manager

Reteaching Skills Transparency 5 and Master
L1 ELL

Cultural Diversity

Saving the World's Biomes

The treaties negotiated at the Earth Summit held in Rio de Janeiro in 1992 represented a major step in protecting the world's biomes. A global warming treaty included firm guidelines to reduce gas emissions that contribute to the greenhouse effect. A biodiversity treaty called for protection of the millions of species that inhabit Earth, half of which live in rain forest regions. Many developing nations resent having to suppress their economies to protect the environment when many environmental problems were created by industrialized nations. Initiate a debate on this subject and discuss the importance of international cooperation in the effort to preserve Earth and its resources.

Portfolio

Recognizing Biome Characteristics

Logical-Mathematical Have students research the average annual temperature and precipitation for the area in which they live. Have them determine if the values correlate with those given in the text for the biome in their area. Have students explain any discrepancies. L2 P

Biology Journal

Mapping Biomes

Visual-Spatial Group students with different ability levels. Ask them to prepare a concept map showing the six terrestrial biomes. The biomes should be correlated with their general location on the globe, starting with the North Pole and moving south toward the equator. L1 L2

Focus On

Biomes

Purpose

Students will associate terrestrial biomes with their geographic locations.

Background

The major biomes of the world are shown on this map. Latitude influences biomes because generally the closer to the equator, the warmer the area. Precipitation is also a major influence on the formation of biomes.

Teaching Strategies

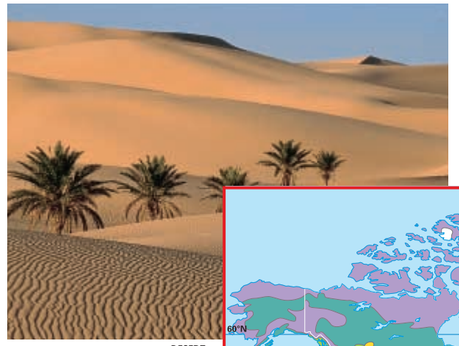
- Ask students to name organisms that live in the different biomes.
- Remove a globe from its stand. Have one student gently toss it to another student. Have them look at their right thumbs and record which biomes they are touching. Repeat 10 times. Most of the time, the thumbs will be on the ocean, helping students realize that oceans cover the greatest area.
- Show a video or slides for each biome.
- Discuss how air currents carrying moisture drop this moisture as precipitation as they approach a mountain. Therefore, one side of a mountain range has a lot of precipitation, and the other side is a desert.

GLENCOE TECHNOLOGY

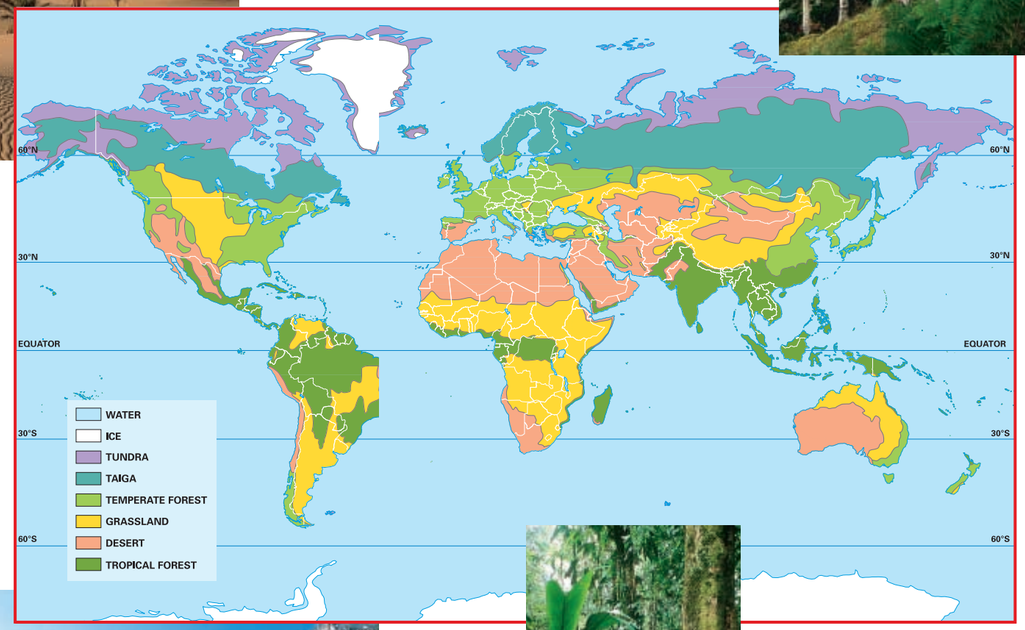
CD-ROM
Biology: The Dynamics of Life
Video: *Tundra*
Disc 1

FOCUS ON Biomes

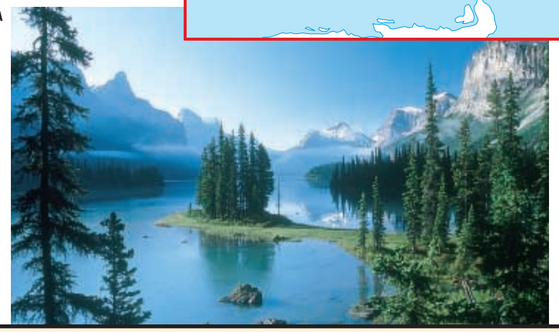
A biome is a large group of ecosystems that share the same type of mature climax community undergoing little or no succession. When you think of a biome, you may imagine lions on an African grassland or monkeys in the rain forest. But ecologists look at climax communities of plants rather than animals. Because plants don't migrate, they are a better indicator of the long-term characteristics of a biome.


DESERT


SALTWATER




GRASSLAND


TAIGA

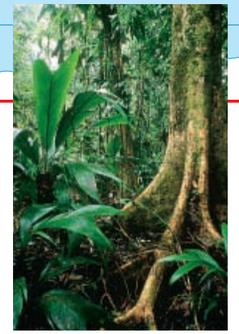

TEMPERATE FOREST

BIOMES

Earth's surface is marvelously diverse. Millions of species find a home here. But their distribution is not random. As the world map shows, Earth's biomes exhibit a definite pattern.

In general, three factors—latitude, altitude, precipitation—determine which biome dominates a terrestrial location. A rainy, low-lying area near the Equator will have a tropical rain forest as climax vegetation. A few kilometers away on a mountainside, ecologists may find plants typical of a biome thousands of kilometers to the north or south.

Look at the world map. Notice that Earth is more than two-thirds water. This water is mostly oceans, which make up the saltwater biome. Freshwater from precipitation makes up the other major water biome on land.


TROPICAL RAIN FOREST


TUNDRA

EXPANDING Your View

1. **THINKING CRITICALLY** Which biome do you think would recover most slowly from destruction arising from natural events or human causes? Explain.
2. **COMPARING AND CONTRASTING** Think about the general pattern of biome types that exists from the equator to the poles. Do you think you would find a similar pattern if you climbed from the foot of a very high mountain to its peak? Explain.

MEETING INDIVIDUAL NEEDS

English Language Learners/ Learning Disabled

Visual-Spatial Use a globe to review the locations of Earth's equator, the tropics of Cancer and Capricorn, and the Arctic and Antarctic Circles. Review the orientation of latitude lines on the globe and correlate these with those on a map. L1 ELL

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Tundra (Ch. 7)
Disc 1, Side 1, 23 sec.

BIOLOGY JOURNAL

Biome Distribution

Linguistic Ask students to describe in their journals how terrestrial and marine biomes are distributed over the globe in relation to the equator. That is, what general percentages of land and water appear above and below the equator? L3

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Taiga (Ch. 8)
Disc 1, Side 1, 40 sec.

NATIONAL GEOGRAPHIC

Visual Learning

- Have students identify the biome that makes up most of the area directly above the equator. *desert*
- Have students use the map to name the three biomes that occupy the greatest area on Earth. *taiga, temperate forest, and grassland* Then ask them to identify the biome that occupies the smallest percentage of Earth's surface. *tropical rain forest*
- Point out that the biomes that make up the United States, in order from largest to smallest, are grassland, temperate forest, and desert.

Answers to Expanding Your View

1. A tropical rain forest. Because this biome contains the greatest species diversity, habitat destruction can result in extinction of large numbers of species.
2. Yes. Temperature decreases with an increase in altitude, just as it decreases with an increase in latitude.

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Video: *Taiga*
Disc 1

Tying to Previous Knowledge

Have students name examples of survival adaptations used by organisms living in the tundra. *Responses may include color camouflage, migration, heavy fur coats, hibernation, and flat leaves on plants to reduce water loss from wind.* L1

Revealing Misconceptions

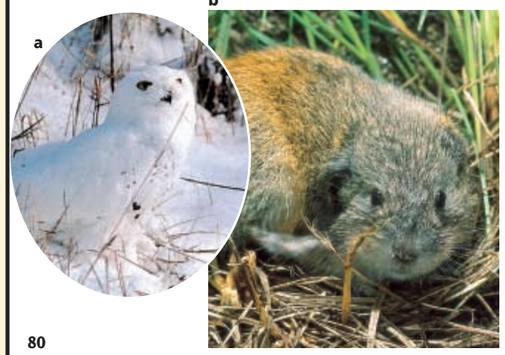
A popular belief is that lemmings, small mammals common in the tundra, periodically march into the ocean in mass suicides to reduce their large population. Actually, lemmings are migratory. After severely depleting an area of food, they move in large numbers to other areas. Sometimes, the animals stumble into the ocean during these mass migrations. However, this event is not a programmed effort to reduce their population.

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Biome Distribution

Figure 3.12
Grasses, grasslike sedges, small annuals, and reindeer moss, a type of lichen on which reindeer feed, are the most numerous producers of the tundra. The short growing season may last fewer than 60 days.

Figure 3.13
Snowy owls (a) are lemming (b) predators. Lemmings are the most numerous mammals living in tundra communities. Populations of these small, furry animals rise to exceedingly high numbers. As the lemming population increases, so does the population of snowy owls.



Life on the tundra

As you begin traveling south from the north pole, you reach the first of two biomes that circle the pole. This first area is the **tundra** (TUN druh), a treeless land with long summer days and short periods of winter sunlight.

Because temperatures in the tundra never rise above freezing for long, only the topmost layer of soil thaws during the summer. Underneath this topsoil is a layer of permanently frozen ground called **permafrost.** Some areas of permafrost have remained frozen for so long that the frozen bodies of animals that have been extinct for thousands of years, such as the elephantlike mammoth, are sometimes found there.

In most areas of the tundra, the topsoil is so thin it can support only shallow-rooted grasses and other small plants. The soil is also lacking in nutrients. The process of decay is so slow due to the cold temperatures that nutrients are not recycled quickly.

Summer days on the tundra may be long, but the growing season is short. Because all food chains depend on the producers of the community, the short growing season is a limiting factor for life in this biome. For example, typical flowering tundra plants, ***Figure 3.12,*** are grasses, dwarf shrubs, and cushion plants. These organisms live a long time and are resistant to drought and cold.

Mosquitoes and other biting insects are some of the most common tundra animals, at least during the short summer. The tundra is also home to a variety of small animals, including ratlike lemmings, weasels, arctic foxes, snowshoe hares, snowy owls, and hawks. Musk oxen, caribou, and reindeer are among the few large animals that inhabit this biome during the summer months. ***Figure 3.13*** shows two common tundra animals.

Life on the taiga

Just south of the tundra lies another biome that circles the north pole. The **taiga** (TI guh), also called the northern coniferous forest, is a land of larch, fir, hemlock, and spruce trees, as shown in ***Figure 3.14.***

How can you tell when you leave the tundra and enter the taiga? The line between any two biomes is indistinct, and patches of one blend almost imperceptibly into the other. For example, if the soil in the taiga is waterlogged, a peat swamp habitat develops that looks much like tundra. Taiga communities are usually somewhat warmer and wetter than tundra, but the prevailing climatic conditions are still harsh, with long, severe winters and short, mild summers.

In the taiga, which stretches across much of Canada, Northern Europe, and Asia, permafrost is usually absent. The topsoil, which develops from decaying coniferous needles, is acidic and poor in minerals. When fire or logging disrupt the taiga community, the first trees to recolonize the land may be birch, aspen, or other deciduous species because the new soil conditions are within their ranges of tolerance. The abundance of trees in the taiga provides more food and shelter for animals than the tundra. More large species of animals are found in the taiga as compared with the tundra. ***Figure 3.15*** shows some animals of the taiga.

Figure 3.14
The dominant climax plants of the taiga in North America are primarily fir and spruce trees.

Figure 3.15
The taiga stretches across most of Canada, Northern Europe, and Asia.

A The lynx is a predator that depends on the snowshoe hare as its primary source of food.

B During the winter, the snowshoe hare grows a thick, white winter coat that includes extra hair on its feet for warmth.

C Caribou are large, herbivorous mammals of the taiga, where they may be found during most of the year.

Enrichment

Kinesthetic Have students test the pH of a variety of soil samples. Instruct them on the use of and significance of the test. Have them familiarize themselves with pH paper by testing samples of vinegar (an acid) and wet hand soap (a base). Make sure that soil samples are moist and include a sample collected from under a coniferous tree. L2 ELL

Brainstorming

Ask students to supply common names for coniferous trees. *pines, firs, spruces, evergreens* Ask students to compare and contrast conifers and deciduous trees in appearance, adaptations, and where they grow.

Time Line

Visual-Spatial Have students prepare a time line that shows the progression of plant types in the taiga after a fire or logging has occurred. Have students indicate if the succession is primary or secondary. *Succession will progress as follows: grasses and other small plants ⇒ shrubs ⇒ birch, aspen, fir, or spruce trees. The succession is secondary.* L2

Alternative Lab

Water-Holding Capacity of Soils

Purpose

Students are introduced to an abiotic factor that affects plant life in different biomes.

Safety Precautions

Remind students to wash their hands after the lab.

Materials

3 cloth squares (30 cm per side), large beaker, water, sand, clay, potting soil, balance, twist ties

Procedure

Give students the following directions.

1. Wrap a sample of sand into a cloth square. Fold the ends to form a bag and secure it with a twist tie.
2. Determine and record the mass of the sand bag.
3. Place the sand bag into a large beaker filled with water and allow it to soak for 5 minutes.
4. Remove the bag and allow it to drain for 1 minute. Determine and record the mass of the sand bag. Calculate the gain in mass of the wet sand.
5. Calculate and record the water-holding capacity (WHC) of sand using this formula:
   WHC = mass gain x 100/dry mass
6. Repeat steps 1-5 using the clay and then the potting soil.

Analysis

1. How might water-holding capacity be important to plants? *Plant growth may be restricted in certain soil types.*
2. Which soil samples held the highest and the lowest percentage of water? *Highest was potting soil; lowest was sand.*
3. How do your data support the fact that cacti had to evolve a water storage system to survive in a desert? *Sand does not hold much water for plant use.*

Assessment

Knowledge Ask students how they would improve on the procedure for this experiment. Why would they make this change? *Students may suggest deducting the mass of wet and dry cloth from soil mass data. They may also suggest using the same amount of the three soil types.* Use the Performance Task Assessment List for Assessing a Whole Experiment and Planning the Next Experiment in **PASC**, p. 33. L2

Quick Demo

Tell students that the waxy material that coats creosote leaves is called cutin. Compare the action of cutin to a sheet of wax paper by doing the following. Moisten two paper towels and flatten them on a table. Cover one towel with wax paper on both sides. Note the time needed for the uncovered towel and the covered towel to dry out. Ask students to interpret the analogy and the results. L2

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Desert (Ch. 9)
Disc 1, Side 1, 29 sec.

CD-ROM
Biology: The Dynamics of Life
Video: *Desert*
Disc 1

Figure 3.16
Creosote bushes cover many square kilometers of desert in the southwestern United States. These plants have yellow flowers and small leaves coated with a waxy resin that helps reduce water loss.

Life in the desert

The driest biome is the desert biome. A **desert** is an arid region with sparse to almost nonexistent plant life. Deserts usually get less than 25 cm of precipitation annually. One desert, the Atacama Desert in Chile, is the world's driest place. This desert receives an annual rainfall of zero.

Vegetation in deserts varies greatly, depending on precipitation levels. Areas that receive more rainfall produce a shrub community that may include drought-resistant trees such as mesquite. Less rainfall supports scattered plant life and produces an environment with large areas of bare ground. The driest deserts are drifting sand dunes with virtually no life at all. Plants have developed various adaptations for living in arid areas, as shown in ***Figure 3.16.*** Many desert plants are annuals that germinate from seed and grow to maturity quickly after sporadic rainfall. Cacti have leaves reduced to spines, photosynthetic stems, and thick waxy coatings that reduce water loss. The leaves of some desert plants curl up, or even drop off altogether, to reduce water loss during extremely dry spells. Desert plants sometimes have spines, thorns, or poisons that act to discourage herbivores.

Most desert mammals are small herbivores that remain under cover during the heat of the day, emerging at night to forage on plants. The kangaroo rat is a desert herbivore that does not have to drink water. These rodents obtain all the water they need to live from the water content in their food. Coyotes, hawks, owls, and roadrunners are carnivores that feed on the snakes, lizards, and small mammals of the desert. Scorpions are an example of a desert carnivore that uses venom to capture prey. Two of the many reptiles that make the desert their home are shown in ***Figure 3.17.***

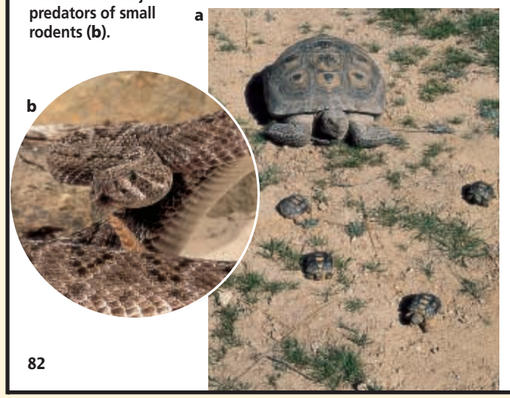


Figure 3.17
Lizards, tortoises, and snakes are numerous in desert communities. Desert tortoises feed on insects and plants (a). Venomous snakes such as the diamondback rattlesnake are major predators of small rodents (b).

Life in the grassland

If an area receives between 25 and 75 cm of precipitation annually, a grassland usually forms. **Grasslands** are large communities covered with grasses and similar small plants. Grasslands, such as the ones shown in ***Figure 3.18,*** occur principally in climates that experience a dry season, where insufficient water exists to support forests. Called prairies in Australia, Canada, and the United States, these communities are called steppes in Russia, savannas in Africa, and pampas in Argentina. A grassland in the United States can be found in Yellowstone National Park. Find out how Yellowstone became our first national park in the *Literature Connection* at the end of this chapter.

Grasslands contain fewer than ten to 15 trees per hectare, though larger numbers of trees are found near streams and other water sources. This biome occupies more area than any other terrestrial biome, and it has a higher biological diversity than deserts, often with more than 100 species per acre.

The soils of grasslands have considerable humus content because many grasses die off each winter, leaving decay byproducts to build up in the soil. Grass roots survive through the winter, enlarging every year to form a continuous underground mat called sod.

Because they are ideal for growing cereal grains such as oats, rye, and wheat, which are different species of grasses, grasslands have become known as the breadbaskets of the world. Many other plant species live in this environment, including drought-resistant and late-summer-flowering species of wildflowers, such as blazing stars and sunflowers.

Most grasslands are populated by large herds of grazing animals, such as bison, a species of mammal native to the American prairies, shown in ***Figure 3.18.*** Millions of bison, commonly known as buffalo, once ranged over the American prairie, where they were preyed upon by wolves, coyotes, and humans. Other important prairie animals include prairie dogs, which are seed-eating rodents that build underground "towns" known to stretch across mile after mile of grassland, and the foxes and ferrets that prey on them. Many species of insects, birds, and reptiles, also make their homes in grasslands.

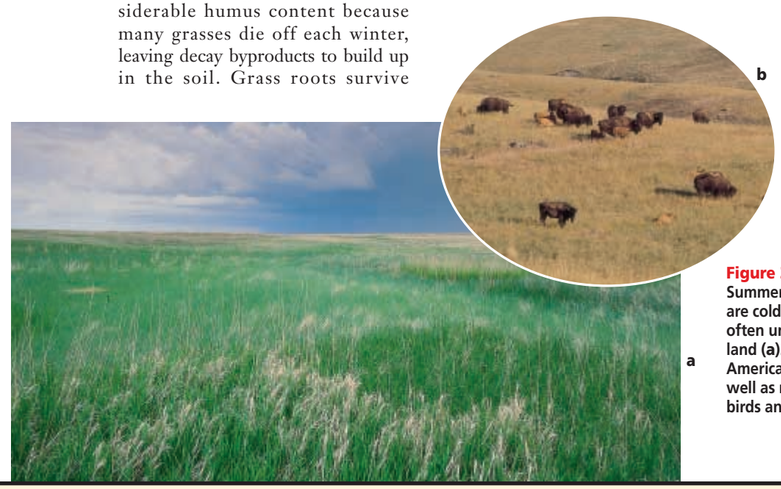


Figure 3.18
Summers are hot, winters are cold, and rainfall is often uncertain in a grassland (a). The prairies of America support bison as well as many species of birds and insects (b).

Quick Demo

Hold up a square of grass sod taken from a lawn. Explain that the roots hold the soil together and survive harsh winters to sprout new grass in spring.

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Temperate Grassland (Ch. 10)
Disc 1, Side 1, 28 sec.

CD-ROM
Biology: The Dynamics of Life
Video: *Temperate Grassland*
Disc 1

Internet Address Book

internet CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

MEETING INDIVIDUAL NEEDS

Visually Impaired

Kinesthetic Bring samples of sandy, clay, and loam soils to class. Allow visually impaired students to feel the texture of the soils. Have them work with peers to rank the samples in terms of decayed material present. Ask them to explain how such material contributes to the fertility of each soil. L1

Enrichment

Linguistic This section presents the six most commonly known biomes. However, there are many more biomes, such as temperate rain forests, tropical seasonal forests, alpine areas, and wetlands. Have students research biomes, choose one that is not presented in this section, and write a report on it. L3

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Temperate Forest (Ch. 11)
Disc 1, Side 1, 34 sec.

The Infinite Voyage
To the Edge of the Earth, The Tropical Rainforest (Ch. 5)
8 min.

CD-ROM
Biology: The Dynamics of Life
Video: *Temperate Forest*
Disc 1

Figure 3.19
There are many types of temperate forests, each described by the two or three dominant species of trees. Typical trees of the temperate forest include birch, hickory, oak, beech, and maple.

Life in the temperate forest

When precipitation ranges from about 70 to 150 cm annually in the temperate zone, temperate deciduous forests develop. **Temperate forests** are dominated by broad-leaved hardwood trees that lose their foliage annually, ***Figure 3.19***.

When European settlers first arrived on the east coast of North America, they cleared away vast tracts of temperate forest for farmland. The thin soil of the mountainous regions was soon depleted by crops, and farmers abandoned their land. Since then, secondary succession has restored much of the original forest.

The soil of temperate forests usually consists of a top layer that is rich in humus and a deeper layer of clay. If mineral nutrients released by the decay of the humus are not immediately absorbed by the roots of the living trees, they may be washed into the clay and lost from the food web for many years.

The animals that live in the temperate deciduous forest, as shown in ***Figure 3.20***, include familiar squirrels, mice, rabbits, deer, and bears. Many birds, such as bluejays, live in the forest all year long, whereas others, such as the great crested flycatcher, migrate south to tropical regions during the winter.

Figure 3.20
Black bears and deer have always been residents of temperate forests in the United States. Other abundant animals in temperate forests are squirrels and salamanders.

Life in tropical rain forests

Tropical rain forests, such as the one shown in ***Figure 3.21***, are home to more species of organisms than any other place on Earth. For example, one small national park in Costa Rica has more species of butterflies than all of North America. One tree in a South American rain forest was found to contain more species of ants than exist in all of the British Isles. The huge number of species in tropical rain forests has made their protection from human destruction an important mission of many people.

As their name implies, **tropical rain forests** have warm temperatures, wet weather, and lush plant growth. These forests are warm because they are near the equator. The average temperature is about 25°C. They are moist because wind patterns drop a lot of precipitation on them. Rain forests receive at least 200 cm of rain annually; some rain forests receive 600 cm.

Why do tropical rain forests contain so many species? The following hypotheses have been proposed by ecologists:

1. Due to their location near the equator, tropical rain forests were not covered with ice during the last ice age. Thus, the communities of species had more time to evolve.
2. Unlike the temperate forests—where deciduous trees drop their leaves in autumn—the warm weather near the equator gives tropical rain forest plants year-round growing conditions. This creates a greater food supply in tropical rain forests, which can support larger numbers of organisms.
3. Tropical rain forests provide a multitude of possible habitats for diverse organisms.

One reason for the large number of niches is the vertical layering of the tropical rain forest. Just as a library has shelves to hold more books, a tropical rain forest has layers that allow more species to exist. How are these layers arranged? Find out by reading the *Inside Story*. From bottom to top, these layers are the ground, understory, and canopy layers. The layers often blend together, but their differences allow many organisms to find a niche.

Most of the nutrients in a tropical rain forest are tied up in the living material. There are very few nutrients held in the soil. The hot humid climate enables ants, termites, fungi, and other decomposers to break down dead plants and animals rapidly. Plants must quickly absorb these

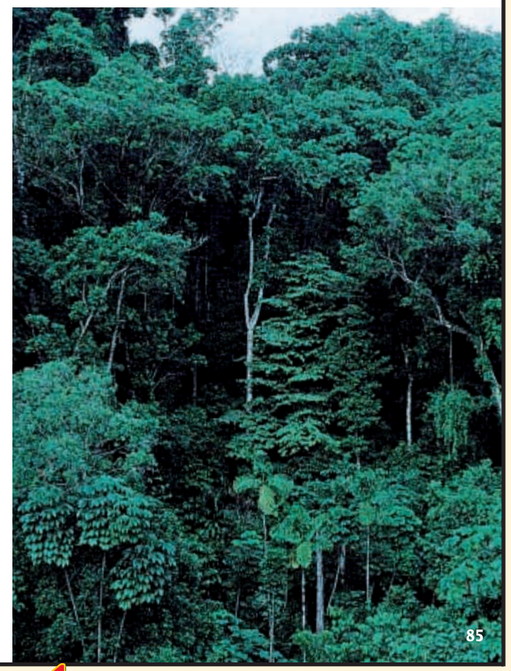


Figure 3.21
Warm temperatures, high humidity, and abundant rainfall allow the lush growth and great species diversity found in the tropical rain forest.

Quick Demo

A tropical rain forest may receive as much as 400 inches (10 m) of rain in one year. Make this more visual by cutting a 40-inch (1-m) strip of paper to represent 400 inches. Then cut another strip reflecting the average rainfall in your area. For example, the average in North Fork, North Carolina, is 58 inches (1.5 m) per year. Ask students why rain forest soil is poor. *Heavy rain washes away nutrients.*

Concept Development

Naturalist Bring samples from evergreen and deciduous trees to class. Have students describe the similarities and differences between these two types. Then have them relate the following terms to evergreen or deciduous trees: *hardwood*, *coniferous*, *broad-leaved*, *needlelike leaves*. L2

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Video: *Tropical Rain Forest*
Disc 1

VIDEODISC
Biology: The Dynamics of Life
Tropical Rain Forest (Ch. 12)
Disc 1, Side 1
39 sec.

Meeting Individual Needs

Learning Disabled

Naturalist Take students to an area with organisms from a major biome. Have them make a class list of all the animals they see. L1

Biology Journal

Building Vocabulary

Linguistic Review the meaning of *limiting factors*. Then have students describe limiting factors that make the grassland and temperate forest biomes different. Have students prepare a concept map of these ideas. They should include the location of these biomes in North America as part of their concept maps. L2

Portfolio

Locating Tropical Rain Forests

Visual-Spatial Provide students with an outline map of North, South, and Central America. Ask them to color in regions that have tropical rain forests. L1 ELL P

Measuring Coverage

Logical-Mathematical Have students devise a method for determining the approximate percentage of land covered by tropical rain forests in the Western Hemisphere. L3 P

INSIDE STORY

Purpose
Students study the layers of rain forests and how they act to increase biodiversity.

Teaching Strategies
- Have students create their own mural of the rain forest layers. L1 ELL
- Have students make a table that for each layer shows the abiotic factors and organisms in that layer.

Visual Learning
- Have students describe how conditions above the canopy differ from those below it. L2
- Refer students to Figure 3.18. Have them explain why rain forests support greater biodiversity than grasslands.

Critical Thinking
Life in the canopy is exposed to the sun, wind, and temperature extremes. Below the canopy, there are fewer sun, wind, and temperature extremes. Organisms with different niches live in different layers.

3 Assess

Check for Understanding
Have students explain the following word relationships. L1 ELL
a. photic zone—aphotic zone
b. intertidal zone—estuary
c. river—estuary—ocean
d. food chain—plankton
e. biome—limiting factor

INSIDE STORY

A Tropical Rain Forest

The layers of a tropical rain forest provide niches for thousands of species. Ecologists generally consider rain forests to have three layers. The illustration shows organisms in a Central American tropical rain forest.

Critical Thinking ***How are the niches in the canopy different from those in the understory?***

1 Canopy The canopy layer, 25-45 meters high, is a living roof. The tree tops are exposed to rain, sunlight, and strong winds. A few giant trees called emergents poke through the canopy. Monkeys frequently pass through. Birds, such as the beautiful scarlet macaw, live on the fruits and nuts of the trees.

2 Understory In the understory, the air is still, humid, and dark. Vines and trees grow from the soil to the canopy. Leaf cutter ants harvest leaves and bring them to the ground. Plants include ferns, broad-leaved shrubs, and dwarf palms. Insects are common in the understory. The limbs of the trees are coated with a thick layer of mosses and other epiphytes. Birds and bats prey upon the insects. Tree frogs are common understory amphibians. Reptiles include chameleons and snakes.

3 Ground The ground layer is a moist forest floor. Leaves and other organic materials decay quickly. Roots spread throughout the top 18 inches of soil, competing for nutrients. Mammals living on the ground include rodents and cats, such as the jaguar. Ants, termites, earthworms, bacteria, and fungi live in the soil and decompose organic materials.

Figure 3.22
Tropical rain forests are rich ecosystems. Sloths (a) and other mammals, as well as a multitude of bird species such as this black-headed cacique (c), live in the rain forest canopy. Insects, such as this Hercules beetle (b), are numerous in the understory.

nutrients before they are leached out of the soil by the rain. Rain forest trees have roots and mycorrhizae near the surface that enable them to absorb the nutrients. The shallow tree roots form a thick mat on the surface of the soil. Roots that support tall trees are sometimes greatly enlarged or may form buttresses, which resemble the fins of a rocket.

Tropical rain forest habitats, such as those of the species shown in ***Figure 3.22***, are being destroyed by human activities. Rain forests are cut for their hardwoods, such as mahogany. Farmers clear the rain forest land to grow crops. After a few years, the crops deplete the soil of nutrients, and the farmers must then move on and clear a different rain forest area. Rain forests are also cleared to produce grasslands for cattle.

Fortunately, people are realizing the importance of tropical rain forests and efforts are aimed at protecting these species-rich environments. In some areas, logging is now prohibited. But in areas where people need to use the land, they are being taught how to preserve the land they currently have cleared through crop rotation and fertilization.

Section Assessment

Understanding Main Ideas
1. Explain why the photic and aphotic zones of marine biomes are interdependent.
2. What is the most important abiotic factor that limits distribution of the tundra biome?
3. Describe some common plants and animals from a tropical rain forest and a grassland biome.
4. Describe three changes you would observe as you travel south from a taiga into a temperate forest.

Thinking Critically
5. Shaneka and her family were planning a trip to a foreign country. In reading before the trip, Shaneka found that the winter was cold, the summer was hot, and most of the land was planted in fields of wheat. Infer which biome Shaneka's family would visit. Explain your answer.

Skill Review
6. **Making and Using Tables** Make a table to show the climate, plant types, plant adaptations, animal types, and animal adaptations for the terrestrial biomes. For more help, refer to *Organizing Information* in the **Skill Handbook.**

Reteach
Naturalist Ask students to pick a biome and describe its location, climatic characteristics, typical animals and plants, and special or unusual traits. L2

Extension
Naturalist Have students explain the relationship among the following: greenhouse effect, rain forest destruction, and the carbon cycle. L2

Assessment
Portfolio Have students describe how the destruction of a biome such as the ocean would affect them directly. Have them suggest one or two ways that they personally can make a difference in the saving of a specific biome. L2 P

4 Close

Activity
Advise students that they are to lead a group of tourists to a biome of their choice. Have them: (a) pick a specific biome as a destination; (b) suggest clothing the tourists should pack; (c) explain what the tourists should be prepared to see and experience. L1

Resource Manager
Content Mastery, pp. 13, 15-16 L1
Reinforcement and Study Guide, pp. 13-14 L2

MEETING INDIVIDUAL NEEDS

Gifted
Visual-Spatial Have students prepare an illustrated chart that describes the major features of the three zones of the tropical rain forest: the canopy, understory, and forest floor. Have students include typical plant and animal life as well as the limiting factors that produce the zonation effect. L3

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Rain Forest, *Forest Floor*
Unit 2, Side 1, 8 min. 13 sec.
Forest Floor (in its entirety)
Forest Canopy Unit 3, Side 1, (in its entirety)

Section Assessment

1. The photic zone provides food for the scavengers and decomposers in the aphotic zone. The decomposers of the aphotic zone return nutrients to water that can be used by plants in the photic zone.
2. temperature
3. tropical rain forest: trees, vines, ferns, insects, monkeys; grasslands: grass, wildflowers, bison, prairie dogs, foxes
4. It gets warmer, forests turn from coniferous to deciduous, soil becomes less acidic, summers are longer, and winters are less harsh.
5. Grasslands; most of the grassland biome has been replaced with grass-like crop plants such as wheat. The conditions of this biome support the cultivation of commercial crops.
6. Students' tables should resemble the following example. Taiga biome: long, harsh winters and short, cool summers; coniferous trees with needlelike leaves that resist drought; snowshoe hares grow white fur in winter and dark fur in summer; moose have heavy fur for warmth.

INVESTIGATE BioLab

Succession in a Jar

Succession is usually described as changes seen in ecosystems following forests destroyed by fire or in farmlands left to lie fallow. Succession, however, can also be observed in a micro ecosystem, such as in a jar of pond water. The type and number of organisms will change over time. The advantage of studying this type of succession is that it will take only weeks, not years.

Preparation

Problem

Can you observe succession in a pond water ecosystem?

Objectives

In this BioLab, you will:

- **Observe** changes in three pond water environments.
- **Count** the number of each type of organism seen.
- **Determine** if the changes observed illustrate succession.

Materials

glass jars, 3
pasteurized spring water
pond water containing plant material
labels
glass slides and cover glasses
droppers
plastic wrap
cooked white rice
teaspoon, plastic
microscope

Safety Precautions

Always wear goggles in the lab.

Skill Handbook

Use the **Skill Handbook** if you need additional help with this lab.

Procedure

1. Examine the pond water sample provided by your teacher.
2. Fill three glass jars with equal amounts of pasteurized (sterilized) spring water.
3. Label them A, B, and C. Add your name and today's date to each label.
4. Add the following to each of your three jars:
   Jar A: Nothing else
   Jar B: 3 grains of cooked white rice
   Jar C: 3 grains of cooked white rice, one teaspoon of pond sediment, and a small amount of any plant material present in the pond water.
5. Record the turbidity of each jar in the data table below. Turbidity means cloudiness and can best be judged by comparing jar A to B to C. Score turbidity on a scale of 1 to 10, with 1 meaning very clear water and 10 meaning very cloudy water.
6. Gently swirl the contents of each jar.
7. Using a different clean dropper for each jar, remove a sample and prepare a wet mount of the liquid from each jar. Label each glass slide A, B, or C to avoid any mix-up. **CAUTION:** ***Handle glass slides, coverslips, and glassware carefully.***
8. Observe each slide under low power. Look for autotrophic and heterotrophic organisms. Identify these organisms by name, describe their appearance, or make a sketch of what they look like.
9. Report the number of each type of organism as viewed in a low-power field of view (the circle of light seen when looking through the microscope under low power is your field of view).
10. Complete the data table for your first observations.
11. Cover each jar with either a lid or plastic wrap and place them in a lighted area.
12. Observe the jars every three days for several weeks, repeating steps 5-11 each time an observation is made. Use your data table to record your observations.

Data Table

Date	Jar	Turbidity	Name, description, or diagram of organism seen	Autotroph or heterotroph?	Number seen per low-power field
	A				
	B				
	C				
	A				
	B				

Analyze and Conclude

1. **Applying Concepts** Which of the three jars was a control? Explain why.
2. **Observing and Inferring** What might have been the role of the cooked rice?
3. **Recognizing Cause and Effect** Turbidity was a means of indirectly measuring the amount of bacterial growth in the jars. Why was there little, if any, turbidity in jar A?
4. **Analyzing Information** Describe the changes over time in the number and type of heterotrophs. Could these changes be described as succession? Explain.
5. **Observing and Inferring** Were you able to observe a climax ecosystem during this experiment? Explain your answer.

Going Further

Experimenting Design and carry out an experiment that tests the effect of temperature on the rate at which succession occurs in pond water.

internet CONNECTION To find out more about succession, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

INVESTIGATE BioLab

Time Allotment

First day—one class period. Every third day for the next three to four weeks—15 minutes.

Process Skills

apply concepts, classify, experiment, compare and contrast, draw a conclusion, interpret data, observe and infer, predict

Safety Precautions

Have students wash their hands well each time they examine the jars.

Preparation

Alternative Materials

- Jar C may be "seeded" with protist cultures from a biological supply house.
- Beakers or culture dishes may be used in place of glass jars.
- Cooked wheat or pea seeds may be used in place of rice. Do not use instant rice.
- Boiled and cooled tap water may be used in place of pasteurized water (available from supply houses).
- Plastic culture tubes, from supply houses, will enable students to grow the organisms in a microenvironment.

Procedure

Teaching Strategies

- A good reference for identifying organisms is *Guide to Microlife*, available through Connecticut Valley Biological.
- Students may work in groups of four.
- Examine the jars once a week if time is short.
- Continue the experiment for at least three weeks.
- You may wish to present overhead diagrams of the most common organisms to help students identify them.
- You may ask students to make and display large labeled diagrams of their organisms to help classmates identify similar organisms.
- Hold each jar against newspaper print. Inability to read the print through the jar indicates turbidity.
- Have students add new pasteurized water to replace any lost through evaporation.

Troubleshooting

- If students have trouble counting organisms, drops of *Protoslo* (available from supply houses) may be used in preparing wet mounts. This chemical slows the organisms down.

Data and Observations

- Jar A should remain clear, showing no turbidity or life forms. Jar B may show turbidity caused by bacteria but should show no auto- or heterotrophs.
- Jar C will show increasing and then decreasing turbidity. Autotrophic organisms will appear and increase in number. Heterotrophs will increase and decrease as follows: steady decrease in bacteria; sharp rise and then decline in *Colpidium* within first 20 days; sharp rise and then decline in *Euplotes* from days 40-60; slow and steady rise in *Paramecium* from days 10-50.

INVESTIGATE BioLab

Analyze and Conclude

1. A; only pasteurized water was added.
2. food for heterotrophs
3. It had no living organisms.
4. See Data and Observations. Yes; any change in population is a key element of succession.
5. Answers will depend on how long the experiment continues.

Assessment

Portfolio Have students pick three organisms (preferably some auto- and heterotrophs) and graph the changes in their population during the experiment. Use the Performance Task Assessment List for Graph from Data in **PASC**, p. 39. L2

Going Further

Have students determine the effect on succession when the jars are placed in the dark rather than in light.

Resource Manager

BioLab and MiniLab Worksheets, p. 15 L2

Literature Connection

Purpose

Students learn how a writer can influence public opinion and government policy towards the conservation of natural resources.

Teaching Strategies

- Ask students what they can do to protect the environment. *Responses may include recycling, using public transportation, and eating organically grown foods.*
- Have students debate whether public use of national parks should be restricted in order to protect the land from damage caused by overuse.

Connection to Biology

Authors might include Rachel Carson, Ralph Waldo Emerson, Henry David Thoreau, Charles Darwin, E.O. Wilson, Annie Dillard.

Literature Connection

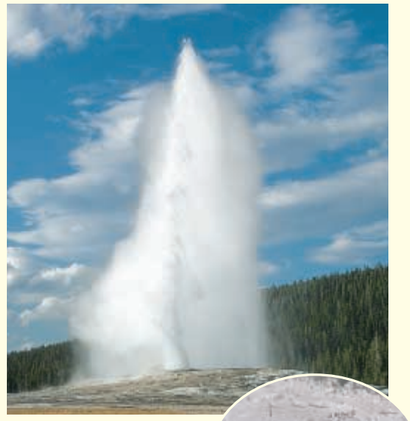
The Yellowstone National Park by John Muir

The first, and largest, national park in the world was commissioned by an act of the United States Congress in 1872 as Yellowstone National Park. Because of the writing and influence of a man named John Muir, Congress also created the National Parks System, which includes Yellowstone, to preserve the lands that we still enjoy today. In recognition of his contributions, Muir is often called "The Father of our National Park System."

Although it includes waterfalls, a high-elevation lake with one hundred and ten miles of shoreline, and one of the world's largest volcanic explosion craters, Yellowstone National Park is probably most famous for its hot springs and geysers. In fact, more boiling caldrons and spouting plumes of hot water and mud are found in Yellowstone than in all of the rest of the world. In his book, *The Yellowstone National Park*, Muir provides his readers with the following description of the boiling basins and geysers:

> *Many of these pots and caldrons have been boiling thousands of years. Pots of sulphurous mush, stringy and lumpy, and pots of broth as black as ink, are tossed and stirred with constant care, and thin transparent essences, too pure and fine to be called water, are kept simmering gently in beautiful sinter cups and bowls that grow ever more beautiful the longer they are used.*

Muir's Dream As a young man Muir had a vision of a "wildlands set aside by the government." The purpose of these lands would be simply to preserve the scenery and to educate people about the natural wonders of the land. As an adult, he was an avid explorer and prolific writer whose goals were to educate the public about the value of nature and the destructive effects man had on the natural environment. Muir felt that the beauty of nature was as essential to the well-being of man as was food.



"Old Faithful" geyser (above) and boiling mud pots (inset)

Over his lifetime, Muir wrote ten books and three hundred articles popularizing the idea of wilderness conservation. His writings so affected the attitude of the public, and even presidents of the United States, towards preservation of our natural resources that Muir has been called the United States' most famous and influential naturalist and conservationist.

Connection to Biology

What other authors have written material that influenced public opinion about the value of nature and preserving our natural environment?

interNET CONNECTION To find out more about Yellowstone National Park, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Internet Address Book

interNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

Chapter 3 Assessment

Summary

Section 3.1 Communities

Main Ideas

- Communities, populations, and individual organisms occur in areas where biotic or abiotic factors fall within their range of tolerance. Abiotic or biotic factors that define whether or not an organism can survive are limiting factors.
- The sequential development of living communities from bare rock is an example of primary succession. Secondary succession occurs when communities are disrupted. Left undisturbed, both primary succession and secondary succession will eventually result in a climax community.

Vocabulary

climax community (p. 70)
limiting factor (p. 68)
primary succession (p. 69)
secondary succession (p. 71)
succession (p. 69)

Section 3.2 Biomes

Main Ideas

- Biomes are large areas that have characteristic climax communities. Aquatic biomes may be marine or freshwater. Estuaries occur at the boundaries of marine and freshwater biomes. Approximately three-quarters of Earth's surface is covered by aquatic biomes, and the vast majority of these are marine communities.
- Terrestrial biomes include tundra, taiga, desert, grassland, deciduous forest, and tropical rain forest. Two climatic factors, temperature and precipitation, are the major limiting factors for the formation of terrestrial biomes.

Vocabulary

aphotic zone (p. 73)
biome (p. 72)
desert (p. 82)
estuary (p. 73)
grassland (p. 83)
intertidal zone (p. 74)
permafrost (p. 80)
photic zone (p. 73)
plankton (p. 75)
taiga (p. 81)
temperate forest (p. 84)
tropical rain forest (p. 85)
tundra (p. 80)

Understanding Main Ideas

1. The removal of which of the following organisms would have the biggest impact on a marine ecosystem?
   a. fishes **c.** shrimp
   b. whales **d.** plankton
2. An undersea volcano erupts creating a new island off the coast of South Carolina. Life slowly starts appearing on the island. What would probably be the first species to grow and survive?
   a. maple trees **c.** lichens
   b. finches **d.** grasses
3. The changes in communities that take place on a new island would best be described as _____.
   a. primary succession **c.** tertiary succession
   b. secondary succession **d.** none of the above
4. Which of the following is true?
   a. Temperate forests have more rainfall than tropical rain forests.
   b. Tropical rain forests have more species of trees than temperate forests.
   c. Temperate forests are closer to the equator than tropical rain forests.
   d. Tropical rain forests are younger than temperate forests.

GLENCOE TECHNOLOGY

VIDEOTAPE
MindJogger Videoquizzes
Chapter 3: *Communities and Biomes*
Have students work in groups as they play the videoquiz game to review key chapter concepts.

Resource Manager

Chapter Assessment, pp. 13-18
MindJogger Videoquizzes
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 3 quiz

Chapter 3 Assessment

Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site.
www.glencoe.com/sec/science

THE PRINCETON REVIEW

All Chapter Assessment questions and answers have been validated for accuracy and suitability by The Princeton Review.

Understanding Main Ideas

1. d
2. c
3. a
4. b

5. c
6. b
7. c
8. b
9. b
10. b
11. permafrost
12. pioneer
13. estuaries, grasses
14. grassland, prairies, savannas
15. canopy
16. tundra, lemmings
17. climax
18. tropical rain forest
19. taiga
20. desert

Chapter 3 Assessment

5. The photograph shows a forest in the United States. The annual rainfall is 300 cm and the average temperature is 15°C. What type of forest is shown in the photograph?
a. tropical rain forest
b. coniferous forest
c. temperate rain forest
d. temperate forest

6. A lack of food prevents further growth in a deer population. This is an example of a _____.
a. range of tolerance **c.** photic zone
b. limiting factor **d.** biome

7. Most species of ocean fishes spend their entire life in salty water. However, some fishes, such as the flounder and salmon, travel up freshwater rivers to reproduce. Which statement is most likely true about the salmon and flounder?
a. They aren't affected by physiological stress.
b. They have no zones of intolerance.
c. They have wider optimum ranges.
d. They are pioneer species.

8. A deep sea fisherman catches an ocean fish. This fish, like others of the same species, has no developed eyes. Its habitat is most likely the _____.
a. intertidal zone **c.** photic zone
b. aphotic zone **d.** zone of intolerance

THE PRINCETON REVIEW — TEST-TAKING TIP

Beat the Clock and Then Go Back
As you take a practice test, pace yourself to finish a few minutes early so you can go back and check over your work. You'll usually find a mistake or two. Don't worry. It is better to make corrections than to hand in a test with wrong answers.

9. Locations of biomes are usually determined by _____.
a. temperature and altitude
b. temperature and precipitation
c. altitude and precipitation
d. soil type and temperature

10. The kangaroo rat conserves its water and obtains all its water from the food it eats. In what ecosystem is the kangaroo rat most likely to live?
a. tropical rain forest **c.** taiga
b. desert **d.** savanna

11. The layer of frozen soil found in the tundra is called the _____.

12. A species that first occupies and lives in an area is called a _____ species.

13. Aquatic areas with a mix of salt water and freshwater are called _____. They contain salt marsh ecosystems where the dominant plant life is _____.

14. Cereal grains grow best in the biome called the _____. These areas are called _____ in the United States and _____ in Africa.

15. An ecologist climbs the tallest tree in a patch of rain forest. She is probably at the _____ layer.

16. Between the north pole and the taiga lies the _____. In this area there are more _____, a furry, ratlike animal, than any other mammals.

17. Beech trees and maple trees dominate a forest that has stayed the same for 100 years. The ecological term for this stable community is a _____ community.

18. The terrestrial biome with lush plant growth but poor soil is the _____.

19. The biome shown here is most likely _____.

Chapter 3 Assessment

20. A diamondback rattlesnake rattles his rattle and you back into a cactus. You are most likely stuck in a _____ biome.

Applying Main Ideas

21. How may agriculture lead to soil erosion in a grassland biome?

22. How might annual fires affect the succession of a temperate deciduous forest?

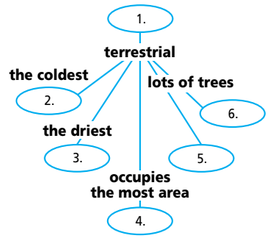
23. Compare the biodiversity of the temperate forest biome with that of a tropical rain forest biome.

Thinking Critically

24. **Forming a Hypothesis** What would be the characteristics of a successful pioneer species in a secondary succession?

25. **Recognizing Cause and Effect** Some plant seeds need fire to germinate. Describe the niche of these organisms in secondary succession.

26. **Concept Mapping** Complete the concept map by using the following vocabulary terms: biomes, desert, grassland, temperate forest, tropical rain forest, tundra.



CD-ROM
For additional review, use the assessment options for this chapter found on the ***Biology: The Dynamics of Life Interactive CD-ROM*** and on the Glencoe Science Web Site.
www.glencoe.com/sec/science

Assessing Knowledge & Skills

The table below shows rates of decomposition for terrestrial ecosystems.

Table 3.1 Rates of Decomposition

Ecosystem	Rate
Tundra	– –
Taiga	–
Desert	–
Temperate Forest	+
Tropical Rain Forest	+++
Grassland	++

Interpreting Data Study the table and answer the following questions.

1. Which ecosystem has the slowest rate of decomposition?
a. tundra
b. taiga
c. tropical rain forest
d. desert

2. Where would a twig decay fastest?
a. tundra
b. taiga
c. tropical rain forest
d. grassland

3. **Sequencing** Put the ecosystems in a list from fastest to slowest rates of decomposition.

4. **Hypothesizing** Suggest two possible reasons why there are differences in rates of decomposition between the biomes.

5. **Predicting** What rating do you think the following aquatic ecosystems would have? Why?
a. estuaries
b. interdidal zone
c. aphotic zone
d. pond

Chapter 3 Assessment

Applying Main Ideas

21. After crops are harvested, the bare soil may be subject to erosion by wind and water.
22. Annual fires would prevent the growth of the climax species of deciduous trees.
23. Biodiversity is much higher in a tropical forest biome than in a temperate forest biome.

Thinking Critically

24. Pioneers are fast-growing plants that produce many seeds. They are sun-tolerant and hardy.
25. They are among the first to germinate and grow after a fire, making them a pioneer species.
26. 1. biomes; 2. tundra; 3. desert; 4. grassland; 5. and 6. tropical rain forest and temperate forest

Assessing Knowledge & Skills

1. a
2. c
3. (1) tropical rain forest, (2) grassland, (3) temperate forest, (4) desert and (4) taiga, (5) tundra
4. The different rates could be caused by different temperatures, amounts of moisture, and biomasses of decomposers.
5. Answers may vary, but students should support their responses with logical reasons.