

4-3 Land Biomes

Guide for Reading

Key Concept

- What are the unique characteristics of the world's major land biomes?

Vocabulary

- biome • microclimate
- canopy • understory
- deciduous • coniferous
- humus • taiga
- permafrost

Reading Strategy:

Using Visuals Before you read, preview **Figure 4-11**. Write down the names of the different biomes. As you read, examine the photographs and list the main characteristics of each biome.

Our planet is home to an amazing diversity of organisms that live in many different ecosystems—from frozen, treeless expanses near the North Pole to steaming tropical forests with trees that tower higher than the Statue of Liberty. Sometimes, it is useful to classify the bewildering variety of ecosystems into a manageable number of categories. To do this, ecologists may use the concept of biomes. A **biome** is a particular physical environment that contains a characteristic assemblage of plants and animals.

For example, the temperate grassland biome occupies large areas of flat or rolling land in regions with dry, temperate climates on several continents. This biome generally receives too little rainfall for forests to grow, but does support grasses and wildflowers and large herds of herbivores.

Climate and Microclimate

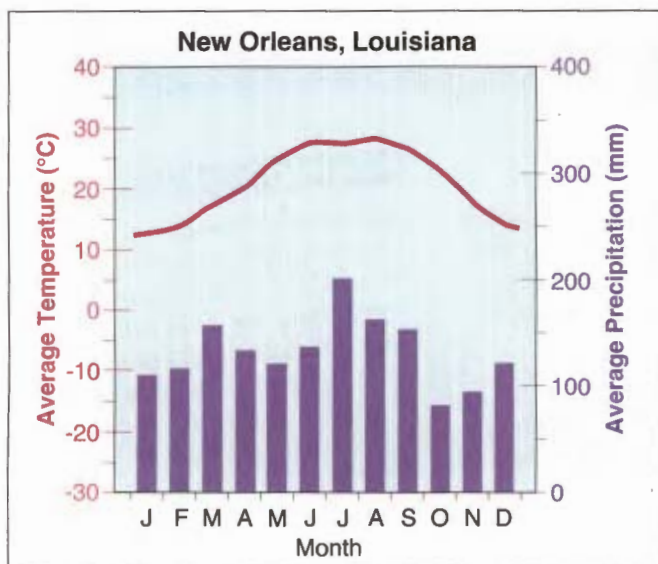
Climate is especially important in determining the characteristics of a biome. The two main factors that determine a region's climate—temperature and precipitation—can be summarized on a graph called a climate diagram. Study the general climate diagram in **Figure 4-10**, because you will encounter similar diagrams on the next few pages.

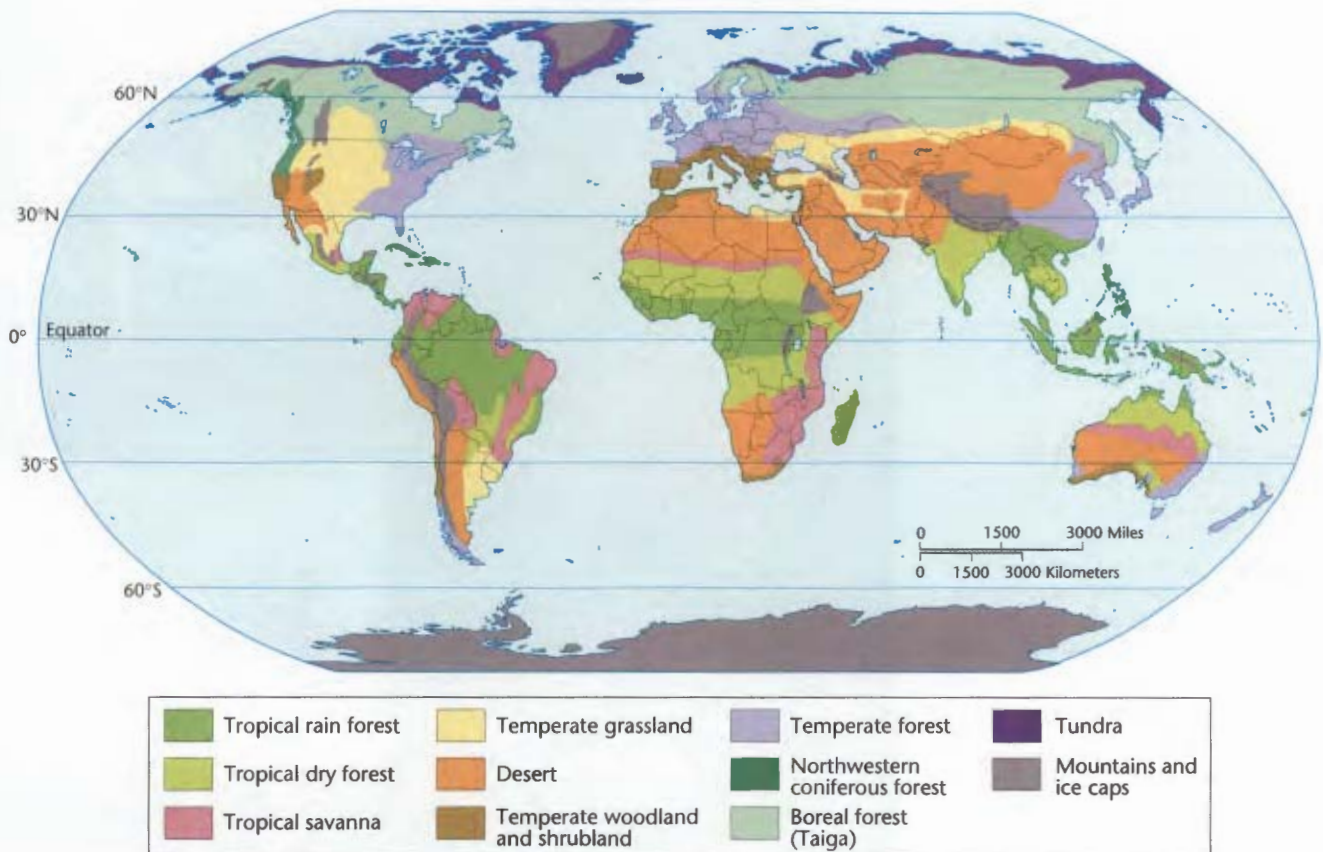
Climate conditions can vary over much smaller distances than you might imagine. Mountains, forests, oceans, lakes, and other natural features can influence the climate in a small area within a biome. The climate within a small area that differs significantly from the climate around it is called a **microclimate**. In California, for example, certain streets within the city of

San Francisco are often blanketed with thick fog, yet the sun shines just a few blocks away. Parts of California's northern coast are covered with lush redwood forests, while areas a short distance inland are desertlike, spotted with cacti and other drought-resistant plants. Even a small park, if it is usually sunnier or windier than nearby areas, can have its own microclimate.

CHECKPOINT What is a microclimate?

◀ **Figure 4-10** Climate diagrams show the average temperature and precipitation at a given location during each month of the year. In this graph, and the others to follow, temperature is plotted as a red line. Precipitation is shown as vertical bars. **Interpreting Graphics** What is the approximate average temperature and precipitation in New Orleans during the month of July?





The Major Biomes

Ecologists recognize at least ten different biomes. 🌍 **The world's major land biomes include tropical rain forest, tropical dry forest, tropical savanna, desert, temperate grassland, temperate woodland and shrubland, temperate forest, northwestern coniferous forest, boreal forest, and tundra. Each of these biomes is defined by a unique set of abiotic factors—particularly climate—and has a characteristic ecological community.** The map in **Figure 4-11** shows the natural geographic distribution of these major biomes. Be aware, however, that this is just one of many different systems that are used to classify biomes. The map does not take into account changes made by human activity, which you will read about in a later chapter.

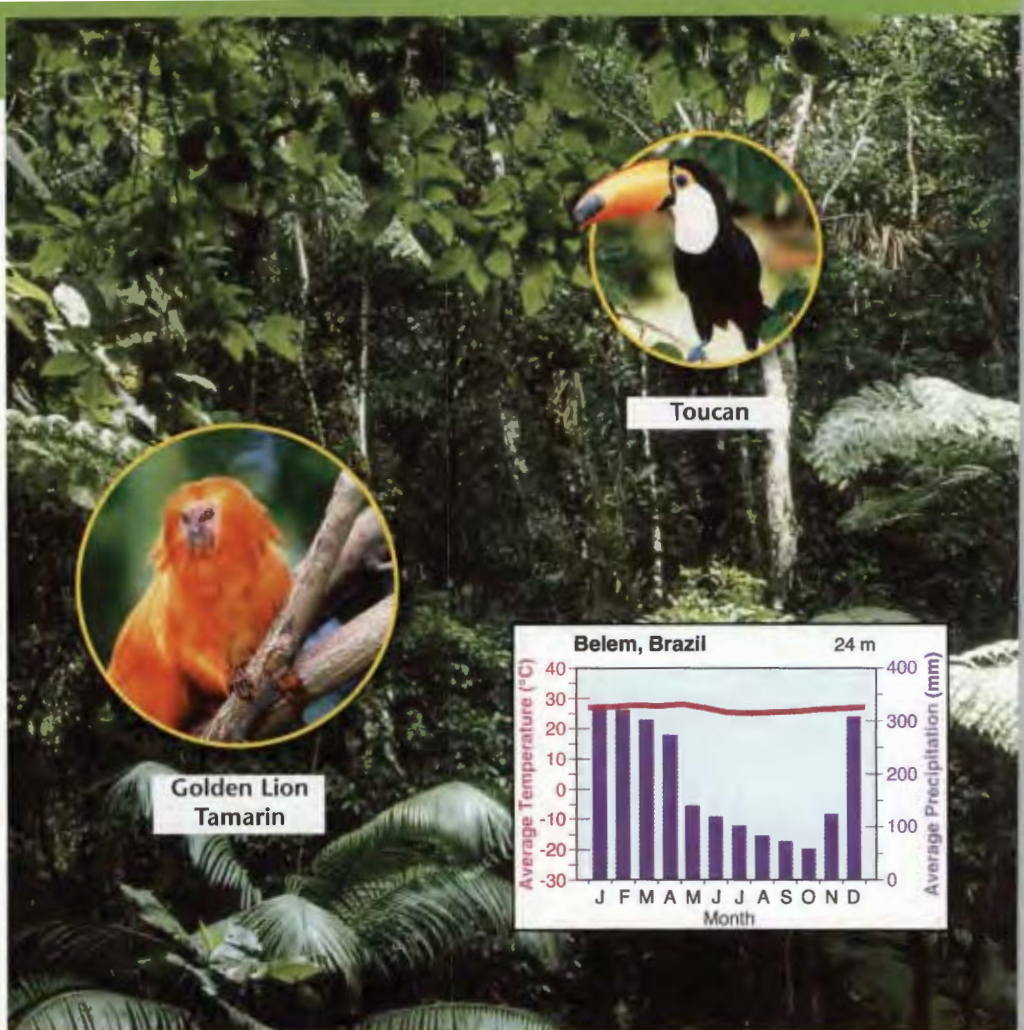
The boundaries between the biomes may appear to be sharp on the map. On the ground, however, there are often transitional areas between biomes. In these transitional areas, one biome's plants and animals gradually become less frequent, while the organisms characteristic of the adjacent biome become more frequent. In addition, the community structure of a particular biome will differ slightly, depending on location and elevation above sea level. For this survey, you will study an example of each major biome from a specific location and elevation. You will begin in the tropics and finish at the poles.

▲ **Figure 4-11** This map shows the locations of the world's major land biomes. Other parts of Earth's surface are classified as mountains or ice caps. 🌍 **Each biome has a characteristic climate and community of organisms.** These characteristics are shown in the pages that follow.

Tropical Rain Forest

Tropical rain forests are home to more species than all other land biomes combined. The leafy tops of tall trees—extending up to 70 meters above the forest floor—form a dense covering called a **canopy**. In the shade below the canopy, a second layer of shorter trees and vines forms an **understory**. Organic matter that falls to the forest floor quickly decomposes and the nutrients are recycled.

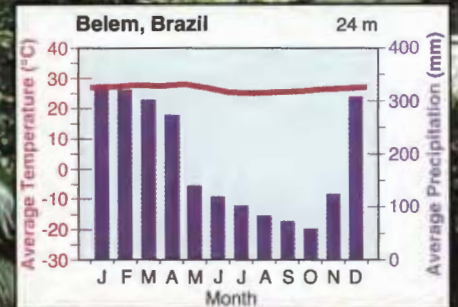
- ▶ **Abiotic factors:** hot and wet year-round; thin, nutrient-poor soils
- ▶ **Dominant plants:** broad-leaved evergreen trees; ferns; large woody vines and climbing plants; orchids and bromeliads
- ▶ **Dominant wildlife:** herbivores such as sloths, tapirs, and capybaras; predators such as jaguars; anteaters; monkeys; birds such as toucans, parrots, and parakeets; insects such as butterflies, ants, and beetles; piranhas and other freshwater fishes; reptiles such as caymans, boa constrictors, and anacondas
- ▶ **Geographic distribution:** parts of South and Central America, Southeast Asia, parts of Africa, southern India, and northeastern Australia



Toucan



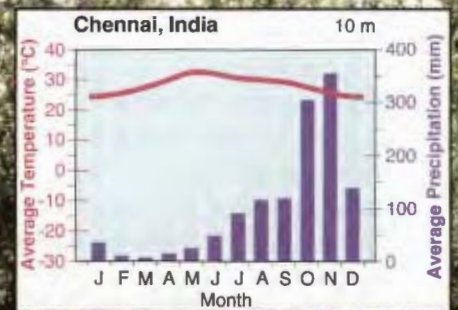
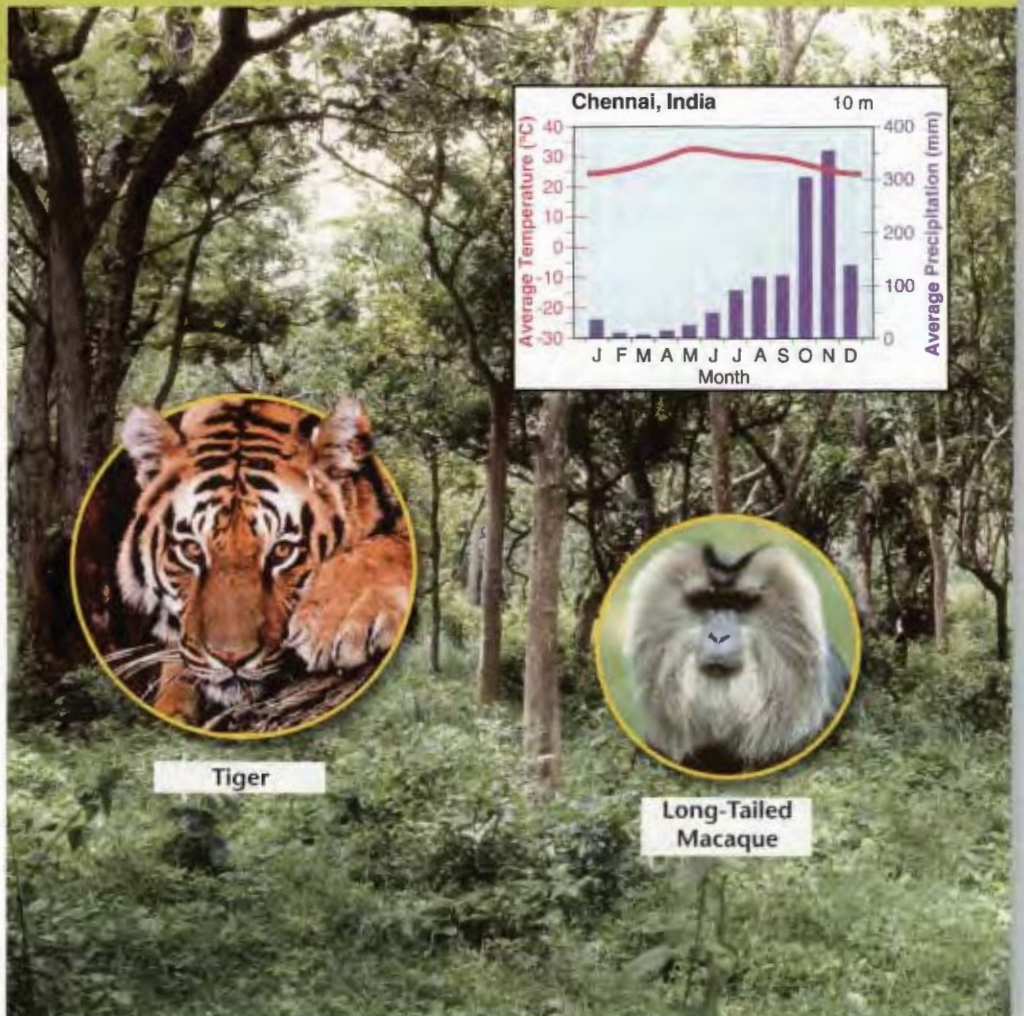
Golden Lion Tamarin



Tropical Dry Forest

Tropical dry forests grow in places where rainfall is highly seasonal rather than year-round. During the dry season, nearly all the trees drop their leaves to conserve water. A tree that sheds its leaves during a particular season each year is called **deciduous**.

- ▶ **Abiotic factors:** generally warm year-round; alternating wet and dry seasons; rich soils subject to erosion
- ▶ **Dominant plants:** tall, deciduous trees that form a dense canopy during the wet season; drought-tolerant orchids and bromeliads; aloes and other succulents
- ▶ **Dominant wildlife:** tigers; monkeys; herbivores such as elephants, Indian rhinoceros, hog deer; birds such as great pied hornbill, pied harrier, and spot-billed pelican; insects such as termites; reptiles such as snakes and monitor lizards
- ▶ **Geographic distribution:** parts of Africa, South and Central America, Mexico, India, Australia, and tropical islands



Tiger



Long-Tailed Macaque

Tropical Savanna

Receiving more seasonal rainfall than deserts but less than tropical dry forests, tropical savannas, or grasslands, are characterized by a cover of grasses. Savannas are spotted with isolated trees and small groves of trees and shrubs. Compact soils, fairly frequent fires, and the action of large animals such as rhinoceros prevent some savanna areas from turning into dry forest.

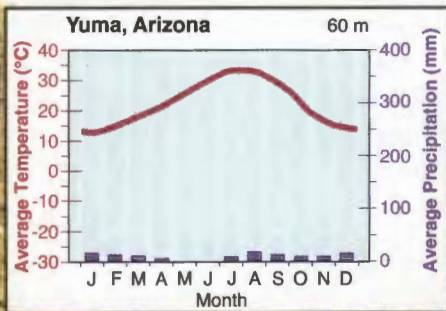
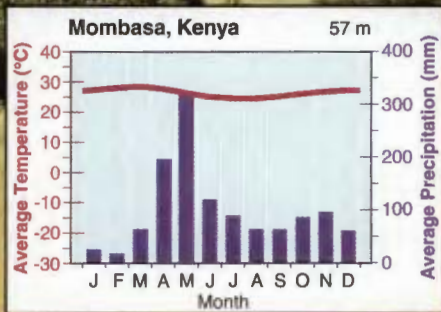
- ◀ **Abiotic factors:** warm temperatures; seasonal rainfall; compact soil; frequent fires set by lightning
- ◀ **Dominant plants:** tall, perennial grasses; sometimes drought-tolerant and fire-resistant trees or shrubs
- ◀ **Dominant wildlife:** predators such as lions, leopards, cheetahs, hyenas, and jackals; aardvarks; herbivores such as elephants, giraffes, antelopes, and zebras; baboons; birds such as eagles, ostriches, weaver birds, and storks; insects such as termites
- ◀ **Geographic distribution:** large parts of eastern Africa, southern Brazil, northern Australia



Nubian Vulture



White Rhinoceros



Desert Hairy Scorpion



Golden Eagle

Desert

All deserts are dry—in fact, a desert biome is defined as having annual precipitation of less than 25 centimeters. Beyond that, deserts vary greatly, depending on elevation and latitude. Many undergo extreme temperature changes during the course of a day, alternating between hot and cold. The organisms in this biome can tolerate the extreme conditions.

- ◀ **Abiotic factors:** low precipitation; variable temperatures; soils rich in minerals but poor in organic material
- ◀ **Dominant plants:** cacti and other succulents; creosote bush and other plants with short growth cycles
- ◀ **Dominant wildlife:** predators such as mountain lions, gray foxes, and bobcats; herbivores such as mule deer, pronghorn antelope, desert bighorn sheep, and kangaroo rats; bats; birds such as owls, hawks, and roadrunners; insects such as ants, beetles, butterflies, flies, and wasps; reptiles such as tortoises, rattlesnakes, and lizards
- ◀ **Geographic distribution:** Africa, Asia, the Middle East, United States, Mexico, South America, and Australia

Temperate Grassland

Characterized by a rich mix of grasses and underlaid by some of the world's most fertile soils, temperate grasslands—such as plains and prairies—once covered vast areas of the midwestern United States. Since the development of the steel plow, however, most have been converted to agricultural fields. Periodic fires and heavy grazing by large herbivores maintain the characteristic plant community.

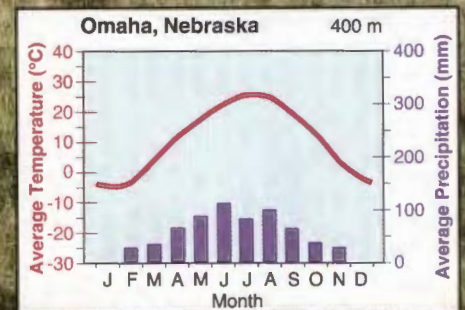
- ▶ **Abiotic factors:** warm to hot summers; cold winters; moderate, seasonal precipitation; fertile soils; occasional fires
- ▶ **Dominant plants:** lush, perennial grasses and herbs; most are resistant to drought, fire, and cold
- ▶ **Dominant wildlife:** predators such as coyotes and badgers—historically included wolves and grizzly bears; herbivores such as mule deer, pronghorn antelope, rabbits, prairie dogs, and introduced cattle—historically included bison; birds such as hawks, owls, bobwhite, prairie chicken, mountain plover; reptiles such as snakes; insects such as ants and grasshoppers
- ▶ **Geographic distribution:** central Asia, North America, Australia, central Europe, and upland plateaus of South America



**Black-Tailed
Prairie Dog**



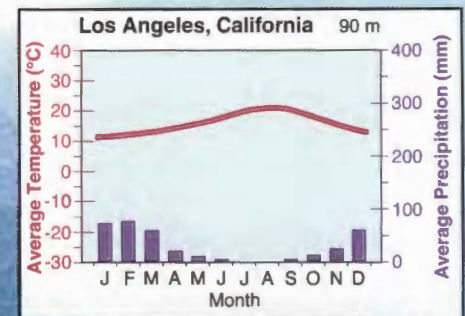
**Prairie
Chicken**



Temperate Woodland and Shrubland

This biome is characterized by a semiarid climate and a mix of shrub communities and open woodlands. In the open woodlands, large areas of grasses and wildflowers such as poppies are interspersed with oak trees. Communities that are dominated by shrubs are also known as chaparral. The growth of dense, low plants that contain flammable oils makes fires a constant threat.

- ▶ **Abiotic factors:** hot, dry summers; cool, moist winters; thin, nutrient-poor soils; periodic fires
- ▶ **Dominant plants:** woody evergreen shrubs with small, leathery leaves; fragrant, oily herbs that grow during winter and die in summer
- ▶ **Dominant wildlife:** predators such as coyotes, foxes, bobcats, and mountain lions; herbivores such as blacktailed deer, rabbits, squirrels, and mice; birds such as hawks, California quail, western scrub jay, warblers and other songbirds; reptiles such as lizards and snakes; butterflies; spiders
- ▶ **Geographic distribution:** western coasts of North and South America, areas around the Mediterranean Sea, South Africa, and Australia



Coyote



**California
Slender Salamander**

Temperate Forest

Temperate forests contain a mixture of deciduous and coniferous (koh-NIF-ur-us) trees. **Coniferous** trees, or conifers, produce seed-bearing cones and most have leaves shaped like needles. These forests have cold winters that halt plant growth for several months. In autumn, the deciduous trees shed their leaves. In the spring, small plants burst out of the ground and flower. Soils of temperate forests are often rich in **humus** (HYOO-mus), a material formed from decaying leaves and other organic matter that makes soil fertile.

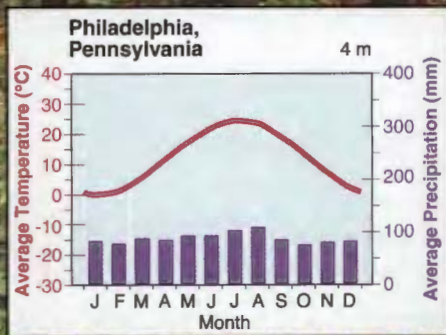
- ◀ **Abiotic factors:** cold to moderate winters; warm summers; year-round precipitation; fertile soils
- ◀ **Dominant plants:** broadleaf deciduous trees; some conifers; flowering shrubs; herbs; a ground layer of mosses and ferns
- ◀ **Dominant wildlife:** Deer; black bears; bobcats; nut and acorn feeders, such as squirrels; omnivores such as raccoons and skunks; numerous songbirds; turkeys
- ◀ **Geographic distribution:** eastern United States; southeastern Canada; most of Europe; and parts of Japan, China, and Australia



Tiger Beetle



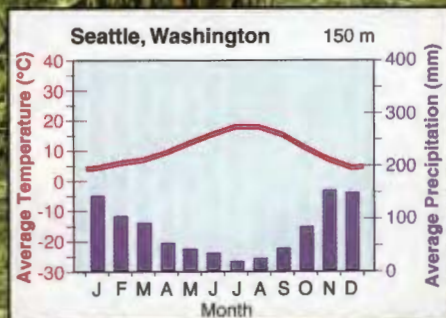
Whitetail Deer



Northwestern Coniferous Forest

Mild, moist air from the Pacific Ocean provides abundant rainfall to this biome. The forest is made up of a variety of conifers, ranging from giant redwoods along the coast of northern California to spruce, fir, and hemlock farther north. Moss often covers tree trunks and the forest floor. Flowering trees and shrubs such as dogwood and rhododendron are also abundant. Because of its lush vegetation, the northwestern coniferous forest is sometimes called a "temperate rain forest."

- ◀ **Abiotic factors:** mild temperatures; abundant precipitation during fall, winter, and spring; relatively cool, dry summer; rocky, acidic soils
- ◀ **Dominant plants:** Douglas fir, Sitka spruce, western hemlock, redwood
- ◀ **Dominant wildlife:** bears; large herbivores such as elk and deer; beavers; predators such as owls, bobcats, and members of the weasel family
- ◀ **Geographic distribution:** Pacific coast of northwestern United States and Canada, from northern California to Alaska



Flying Squirrel

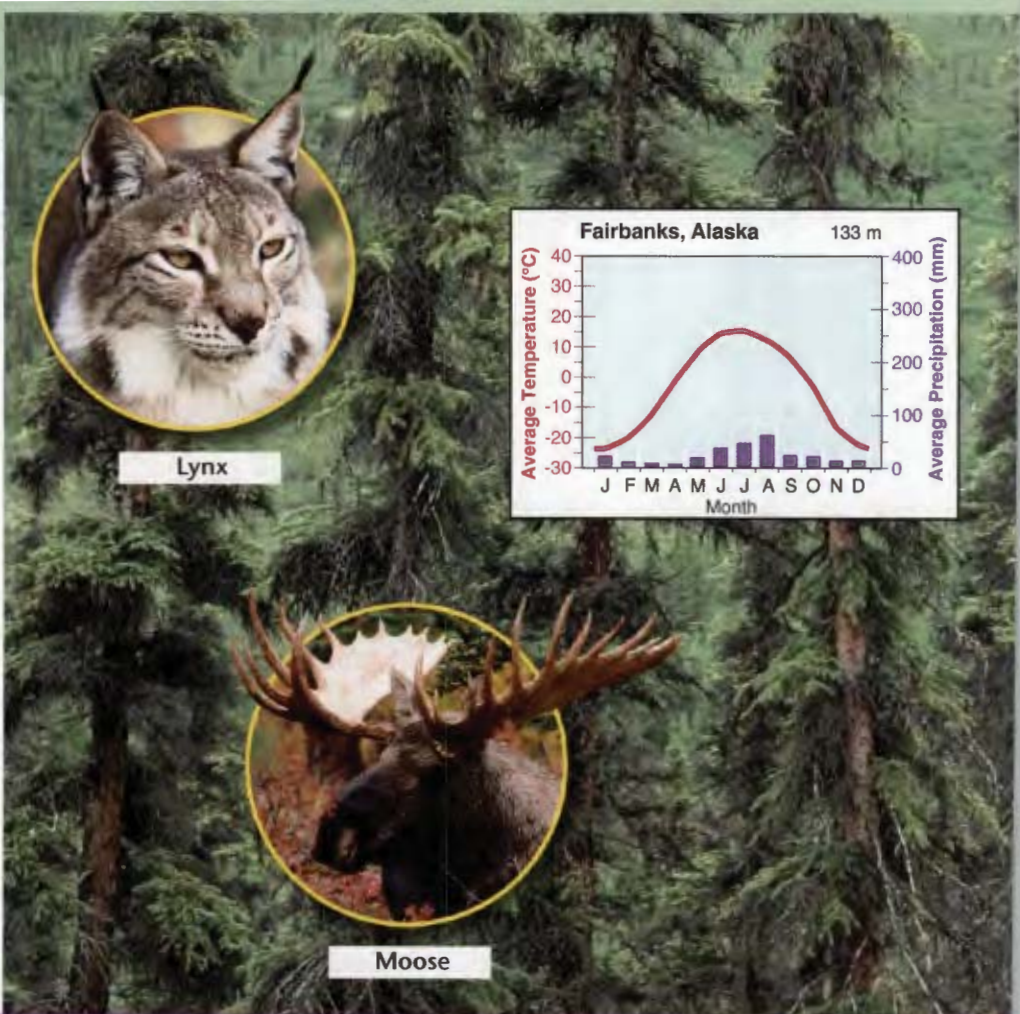


Black Bear

Boreal Forest

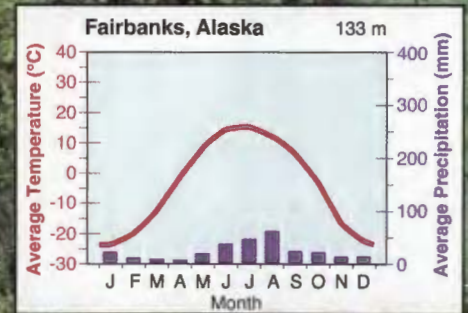
Along the northern edge of the temperate zone are dense evergreen forests of coniferous trees. These biomes are called boreal forests, or **taiga** (TY-guh). Winters are bitterly cold, but summers are mild and long enough to allow the ground to thaw. The word *boreal* comes from the Greek word for “north,” reflecting the fact that boreal forests occur mostly in the Northern Hemisphere.

- ▶ **Abiotic factors:** long, cold winters; short, mild summers; moderate precipitation; high humidity; acidic, nutrient-poor soils
- ▶ **Dominant plants:** needleleaf coniferous trees such as spruce and fir; some broadleaf deciduous trees; small, berry-bearing shrubs
- ▶ **Dominant wildlife:** predators like lynx and timberwolves and members of the weasel family; small herbivorous mammals; moose and other large herbivores; beavers; songbirds and migratory birds
- ▶ **Geographic distribution:** North America, Asia, and northern Europe



Lynx

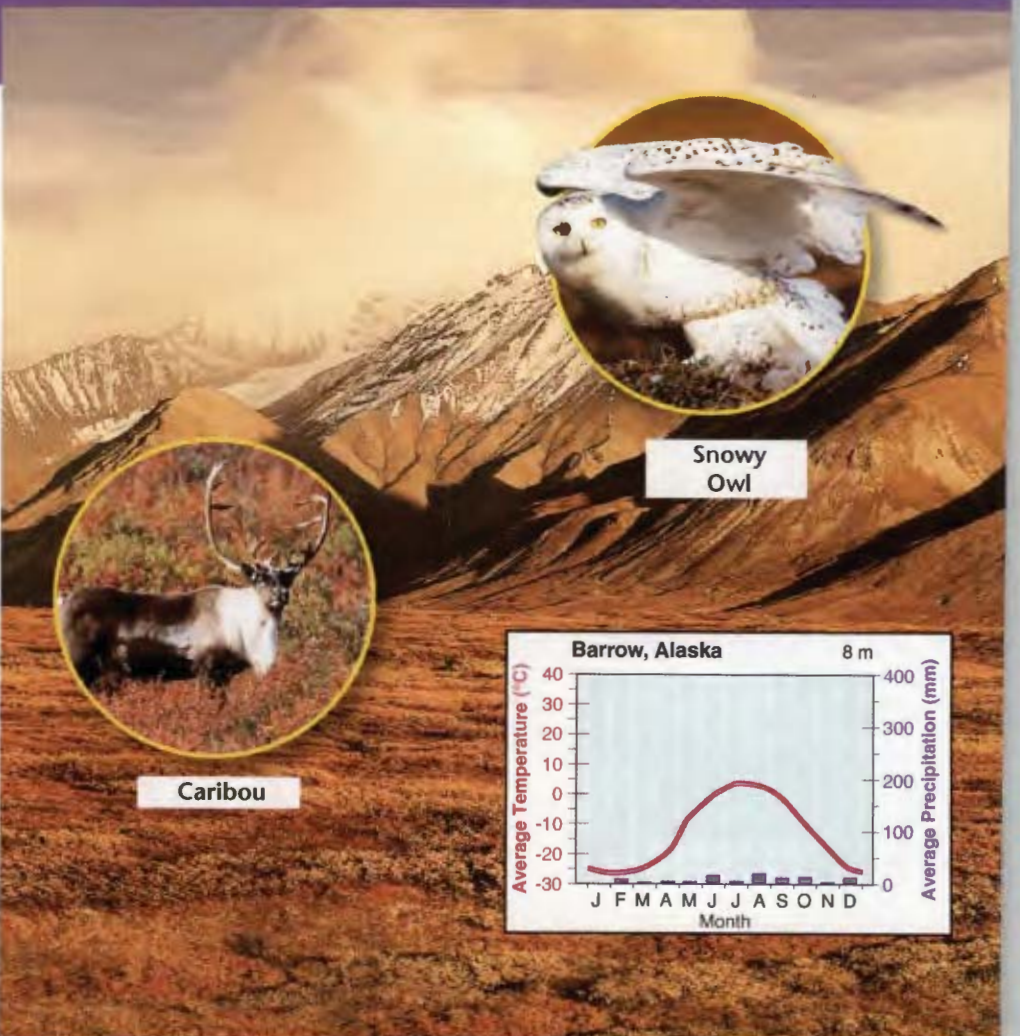
Moose



Tundra

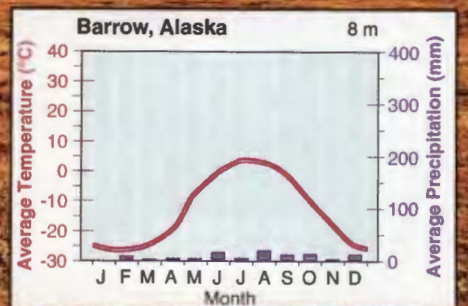
The tundra is characterized by **permafrost**, a layer of permanently frozen subsoil. During the short, cool summer, the ground thaws to a depth of a few centimeters and becomes soggy and wet. In winter, the topsoil freezes again. This cycle of thawing and freezing, which rips and crushes plant roots, is one reason that tundra plants are small and stunted. Cold temperatures, high winds, the short growing season, and humus-poor soils also limit plant height.

- ▶ **Abiotic factors:** strong winds; low precipitation; short and soggy summers; long, cold, and dark winters; poorly developed soils; permafrost
- ▶ **Dominant plants:** ground-hugging plants such as mosses, lichens, sedges, and short grasses
- ▶ **Dominant wildlife:** a few resident birds and mammals that can withstand the harsh conditions; migratory waterfowl, shore birds, musk ox, Arctic foxes, and caribou; lemmings and other small rodents
- ▶ **Geographic distribution:** northern North America, Asia, and Europe



Caribou

Snowy Owl



Other Land Areas

Some areas of land on Earth do not fall neatly into the major biome categories described on the previous pages. These areas include mountain ranges and polar ice caps.

Mountain Ranges Mountain ranges can be found on all continents. On mountains like the one in **Figure 4-12**, the abiotic and biotic conditions vary with elevation. As you move up from base to summit, temperatures become colder and precipitation increases. Therefore, the types of plants and animals also change. If you were to climb the Rocky Mountains in Colorado, for example, you would begin in a grassland. Then, you would pass through an open woodland of pines. Next, you would hike through a forest of spruce and other conifers. Near the summit, you would reach open areas of wildflowers and stunted vegetation resembling tundra. In the Canadian Rockies, ice fields occur at the peaks of some ranges.

Polar Ice Caps The icy polar regions that border the tundra are cold year-round. Outside of the ice and snow, plants and algae are few but do include mosses and lichens. In the north polar region, the Arctic Ocean is covered with sea ice, and a thick ice cap covers most of Greenland. Polar bears, seals, insects, and mites are the dominant animals. In the south polar region, the continent of Antarctica is covered by a layer of ice that is nearly 5 kilometers thick in some places. There, the dominant wildlife includes penguins and marine mammals.



▲ **Figure 4-12** Washington's Mount Rainier towers above the tree line. **Applying Concepts** Based on what you have seen in the previous pages, which biome lies at the base of this mountain?

4-3 Section Assessment

1. **Key Concept** List the major land biomes and give one characteristic feature of each.
2. How are biomes classified?
3. What are the two types of tropical forest? How do they differ?
4. How might the presence of a mountain range affect the types of plants and animals found in an area?

5. **Critical Thinking Inferring** What characteristics would you expect tundra animals to have?

iTEXT **Assessment** Use iText to review the important concepts in Section 4-3.

ALTERNATIVE ASSESSMENT

Creating Artwork
Choose one of the land biomes discussed in this section. Then, depict the biome in a piece of artwork. Include the biome's characteristic plant and animal life in your art.