

Climates of the World

Terms to Learn

biome evergreens
 tropical zone polar zone
 temperate zone microclimate
 deciduous

What You'll Do

- ◆ Locate and describe the three major climate zones.
- ◆ Describe the different biomes found in each climate zone.

Have you ever wondered why the types of plants and animals in one part of the world are different from those found in another part? One reason involves climate. Plants and animals that have adapted to one climate may not be able to live in another climate. For instance, frogs do not live in Antarctica.

The three major climate zones of Earth—tropical, temperate, and polar—are illustrated in **Figure 9**. Each zone has a temperature range that relates to its latitude. However, in each of these zones there are several types of climates due to differences in the geography and the amount of precipitation. Because of the various climates in each zone, there are different biomes. A **biome** is a large region characterized by a specific type of climate and the plants and animals that live there.

Figure 10 shows the distribution of the Earth's land biomes. In this section we will review each of the three major climate zones and the biomes that are found in each zone.

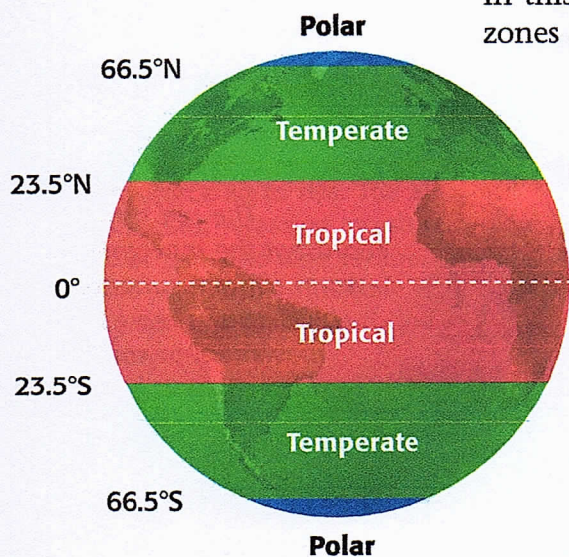
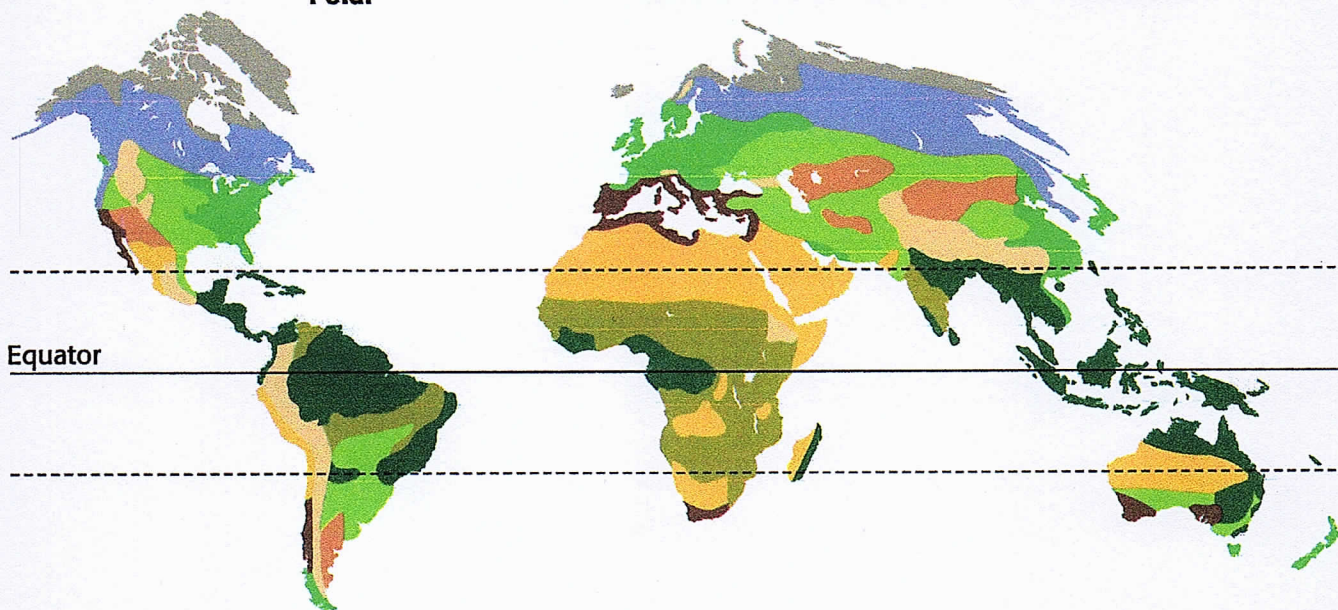


Figure 9 Climate Zones of the Earth

Figure 10 The Earth's Land Biomes

Tundra	Tropical savanna
Taiga	Temperate desert
Temperate forest	Tropical desert
Tropical rain forest	Chaparral
Temperate grassland	Mountains



The Tropical Zone

The **tropical zone**, or the *Tropics*, is the warm zone located around the equator, as shown in **Figure 11**. This zone extends from the tropic of Cancer to the tropic of Capricorn. As you have learned, latitudes in this zone receive the most solar radiation. Temperatures are therefore usually hot, except at high elevations. Within the tropical zone there are three types of biomes—tropical rain forest, tropical desert, and tropical savanna. **Figure 12** shows the distribution of these biomes.

Figure 11 The Earth's Tropical Zone

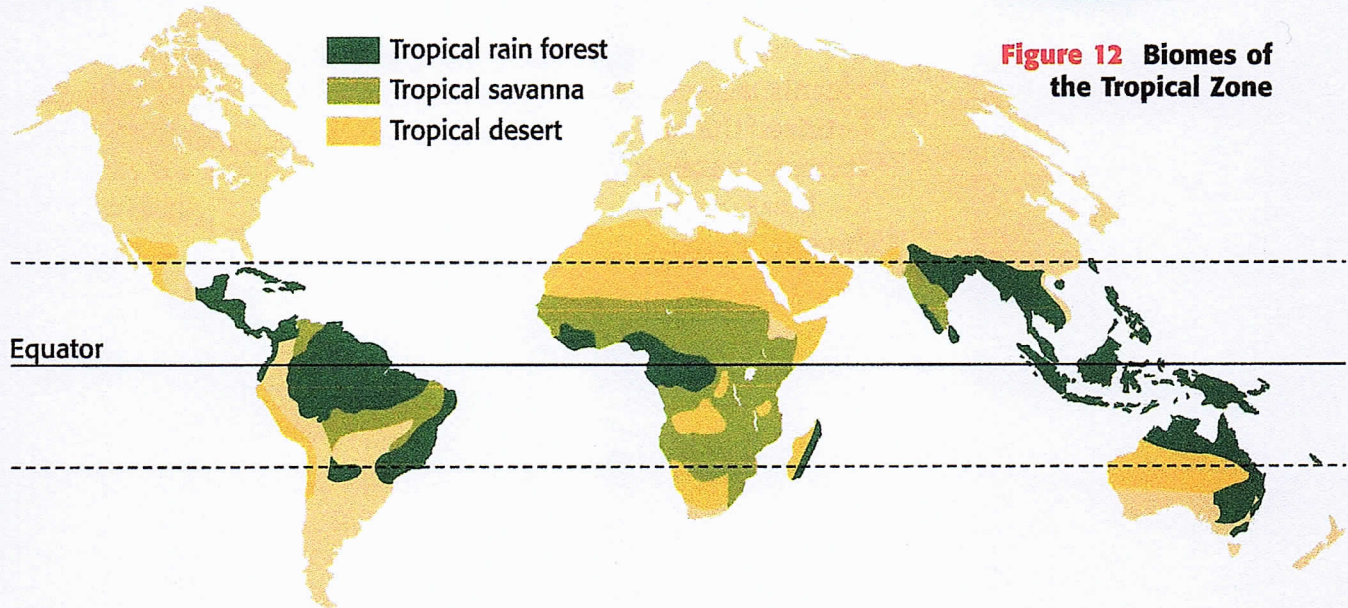
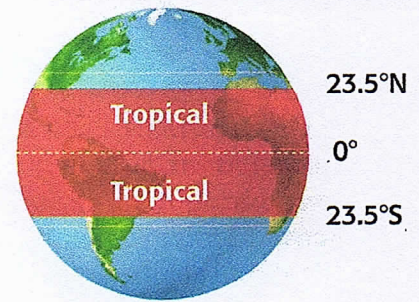


Figure 12 Biomes of the Tropical Zone

Tropical Rain Forest Tropical rain forests are always warm and wet. Because they are located near the equator, they receive strong sunlight year-round, causing little difference between seasons.

Tropical rain forests contain the greatest number of plant and animal species of any biome. But in spite of the lush vegetation, shown in **Figure 13**, the soil in rain forests is poor. The rapid decay of plants and animals returns nutrients to the soil, but these nutrients are quickly absorbed and used by the plants. The nutrients that are not immediately used by the plants are washed away by the heavy rains, leaving soil that is thin and nutrient poor.



Figure 13 In tropical rain forests, many of the trees form aboveground roots that provide extra support for the trees in the thin soil.

Avg. Temperature Range: 25°C–28°C
(77°F–82°F)

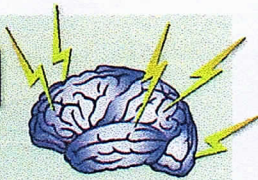
Avg. Yearly Precipitation: 200 cm or more

Soil Characteristics: thin and nutrient poor

Vegetation: mahogany, ebony, rosewood, and balsa trees; vines, ferns, and bamboo

Animals: monkeys, lemurs, parrots, snakes, tree frogs, bats, pigs, small antelopes, tigers, jaguars, and leopards

BRAIN FOOD



Most desert rodents, such as the kangaroo rat, hide in burrows during the day and are active at night, when the temperatures are cooler.

Tropical Deserts A desert is an area that receives less than 25 cm of rainfall per year. Because of this low yearly rainfall, deserts are the driest places on Earth. Desert plants, shown in **Figure 14**, are adapted to survive in a place with little water.

Deserts can be divided into hot deserts and cold deserts. The majority of hot deserts, such as the Sahara, in Africa, are tropical deserts. Hot deserts are caused by cool sinking air masses. Daily temperatures in tropical deserts vary from very hot daytime temperatures (50°C) to cool nighttime temperatures (20°C). Winters in hot deserts are usually mild. Because of the dryness, the soil is poor in organic matter, which fertilizes the soil. The dryness makes it hard to break down dead organic matter.

Avg. Temperature Range:
16°C–50°C (61°F–120°F)

Avg. Yearly Precipitation:
0–25 cm

Soil Characteristics: poor in organic matter

Vegetation: succulents (cactus and euphorbia), shrubs, thorny trees

Animals: kangaroo rats, lizards, scorpions, snakes, birds, bats, toads



Biology

CONNECTION

Some desert animals, such as the spadefoot toad, survive the scorching summer heat by burying themselves in the ground and sleeping through the dry season.

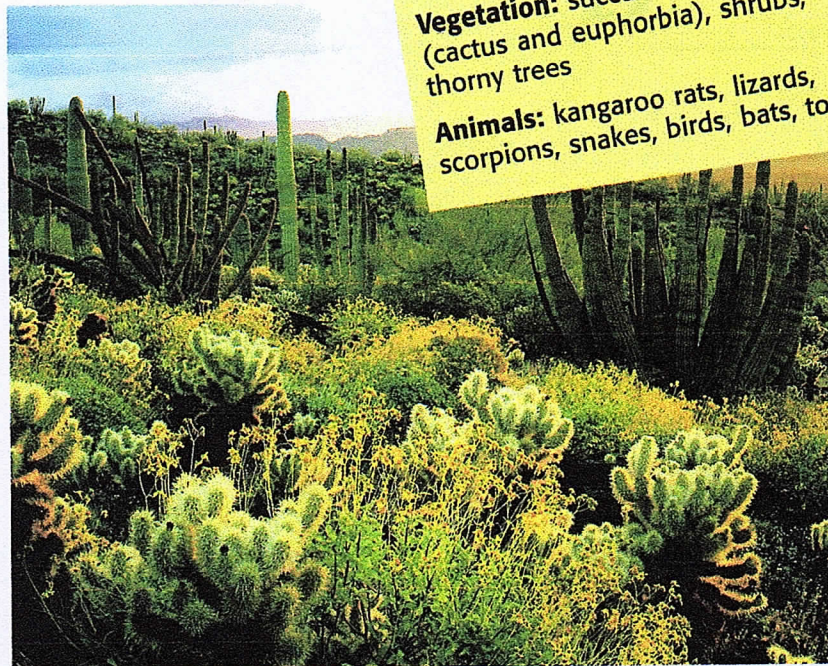


Figure 14 Plants called succulents have adapted to dry conditions by developing fleshy stems and leaves to store water and a waxy coating to prevent water loss. A cactus is a type of succulent.



Self-Check

If desert soil is so nutrient rich, why are deserts not suitable for agriculture? (See page 136 to check your answer.)

Tropical Savannas Tropical savannas, sometimes referred to as grasslands, are dominated by tall grasses, with trees scattered here and there. **Figure 15** is a photo of an African savanna. The climate is usually very warm, with a dry season that lasts four to eight months followed by short periods of rain. Savanna soils are generally nutrient poor, but grass fires, which are common during the dry season, leave the soils nutrient enriched.

Many plants have adapted to fire and use it to reproduce. Grasses sprout from their roots after the upper part of the plant is burned. The seeds of some plant species require fire in order to grow. For example, some species need fire to break open the seed's outer skin. Only after this skin is broken can the seed grow. Other species drop their seeds at the end of fire season. The heat from the fire triggers the plants to drop their seeds into the newly enriched soil.

Avg. Temperature Range:
27°C–32°C (80°F–90°F)

Avg. Yearly Precipitation: 100 cm

Soil Characteristics: generally nutrient poor

Vegetation: tall grasses (3–5 m), trees, thorny shrubs

Animals: gazelles, rhinoceroses, giraffes, lions, hyenas, ostriches, crocodiles, elephants

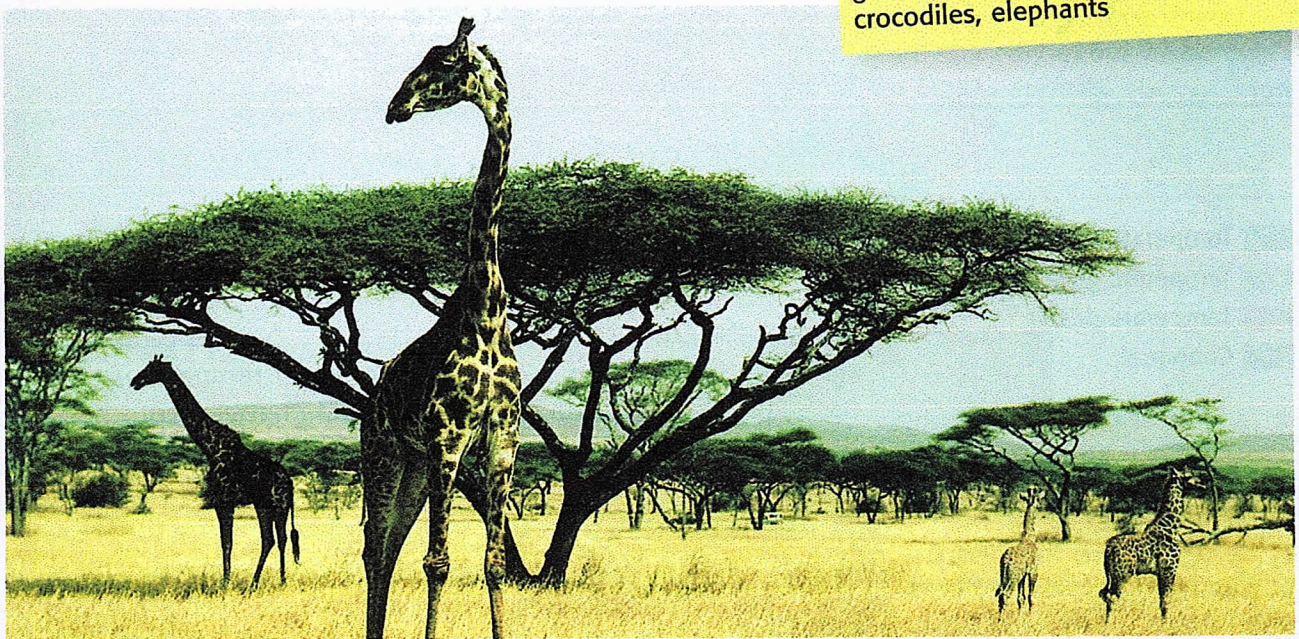


Figure 15 The grass of a tropical savanna is 3–5 m tall, much taller than that of a temperate grassland.

SECTION REVIEW

1. What are the soil characteristics of a tropical rain forest?
2. In what way has savanna vegetation adapted to fire?
3. **Summarizing Data** How do each of the tropical biomes differ?

internetconnect

sciLINKS_™
NSTA

TOPIC: Climates of the World
GO TO: www.scilinks.org
sciLINKS NUMBER: HSTE410



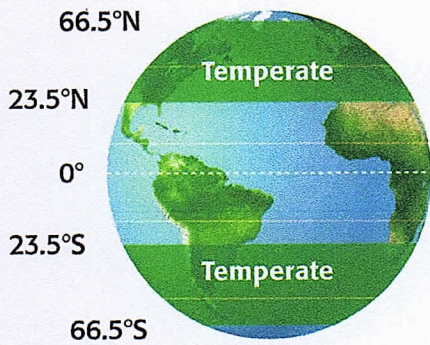


Figure 16 The Earth's Temperate Zones

The Temperate Zone

The **temperate zone**, as shown in **Figure 16**, is the climate zone between the Tropics and the polar zone. Temperatures in the temperate zone tend to be moderate. The continental United States is in the temperate zone, which includes the following four biomes: temperate forest, temperate grassland, chaparral, and temperate desert. **Figure 17** shows the distribution of the biomes found in the temperate zone.

Figure 17 Biomes of the Temperate Zone

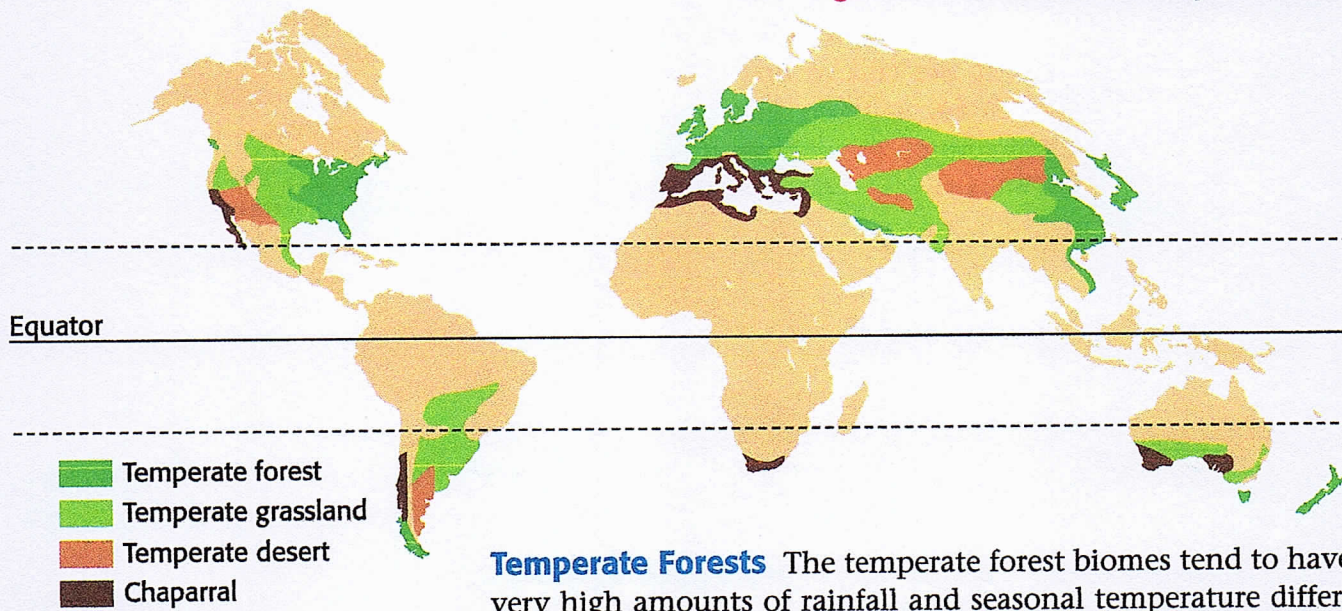


Figure 18 Deciduous trees have leaves that change color and drop when temperatures become cold.



Avg. Temperature Range: 0°C–28°C
(32°F–82°F)

Avg. Yearly Precipitation:
76–250 cm

Soil Characteristics: very fertile,
organically rich

Vegetation: deciduous and evergreen
trees, shrubs, herbs

Animals: deer, bears, boars, badgers,
squirrels, wolves, wild cats, red foxes,
owls, and many other birds

Temperate Forests The temperate forest biomes tend to have very high amounts of rainfall and seasonal temperature differences. Because of these distinct seasonal changes, summers are usually warm and winters are usually cold. The largest temperate forests are deciduous, such as the one shown in **Figure 18**. **Deciduous** trees are trees that lose their leaves when the weather becomes cold. These trees tend to be broad-leaved. The soils in deciduous forests are usually quite fertile because of the high organic content contributed by decaying leaves that drop every winter.

Another type of temperate forest is the evergreen forest. **Evergreens** are trees that keep their leaves year-round. Evergreens can be either broad-leaved trees or needle-leaved trees, such as pine trees. Mixed forests of broad-leaved and needle-leaved trees can be found in humid climates, such as Florida, where winter temperatures rarely fall below freezing.

Temperate Grasslands Temperate grasslands, such as those shown in **Figure 19**, occur in regions that receive too little rainfall for trees to grow. This biome has warm summers and cold winters. The temperate grasslands are known by many local names—the *prairies* of North America, the *steppes* of Eurasia, the *veldt* of Africa, and the *pampas* of South America. Grasses are the most common type of vegetation found in this biome. Because grasslands have the most fertile soils of all biomes, much of the temperate grassland has been plowed to make room for croplands.



Avg. Temperature Range:
-6°C–26°C (21°F–78°F)

Avg. Yearly Precipitation:
38–76 cm

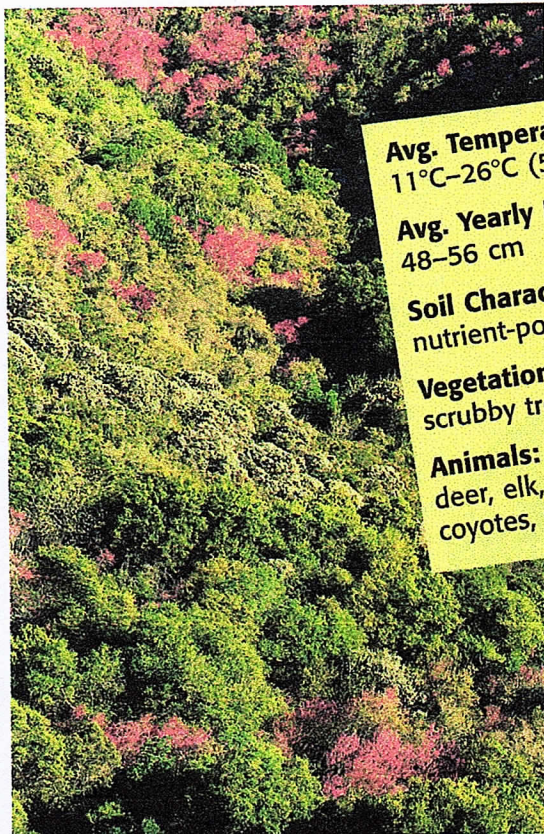
Soil Characteristics: most fertile soils of all biomes

Vegetation: grasses

Animals: large grazing animals, including the bison of North America, the kangaroo of Australia, and the antelope of Africa

Figure 19 The world's grasslands once covered about 42 percent of Earth's total land surface. Today they occupy only about 12 percent of the Earth's surface.

Chaparrals Chaparral regions, as shown in **Figure 20**, have cool, wet winters and hot, dry summers. The vegetation is mainly evergreen shrubs, which are short, woody plants with thick, waxy leaves. The waxy leaves are adaptations that help prevent water loss in dry conditions. These shrubs grow in rocky, nutrient-poor soil. Like tropical-savanna vegetation, chaparral vegetation has adapted to fire. In fact, some plants, such as chamise, can grow back from their roots after a fire.



Avg. Temperature Range:
11°C–26°C (51°F–78°F)

Avg. Yearly Precipitation:
48–56 cm

Soil Characteristics: rocky, nutrient-poor soils

Vegetation: evergreen shrubs, scrubby trees, herbs

Animals: ground squirrels, deer, elk, mountain lions, coyotes, wolves

Figure 20 Some plant species found in chaparral produce substances that help them catch on fire. These species require fire to reproduce.

Avg. Temperature Range:
1°C–50°C (34°F–120°F)

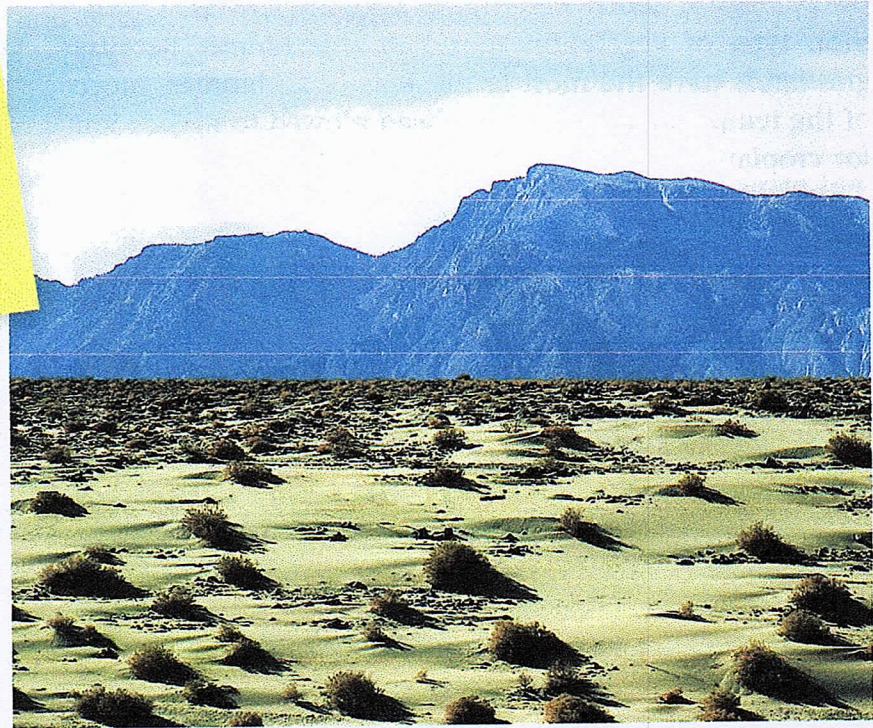
Avg. Yearly Precipitation:
0–25 cm

Soil Characteristics: poor in
organic matter

Vegetation: succulents (cactus),
shrubs, thorny trees

Animals: kangaroo rats, lizards,
scorpions, snakes, birds, bats,
toads

Figure 21 *The Great Basin Desert is in the rain shadow of the Sierra Nevada.*



The temperatures sometimes drop below freezing. This large change in temperature between day and night is caused by low humidity and cloudless skies. These conditions allow for a large amount of energy to reach, and thus heat, the Earth's surface during the day. However, these same characteristics allow the energy to escape at night, causing temperatures to drop. You probably rarely think of snow and deserts together, but temperate deserts often receive light snow during the winter.

Temperate deserts are dry because they are generally located inland, far away from a moisture source, or are located on the rain-shadow side of a mountain range.

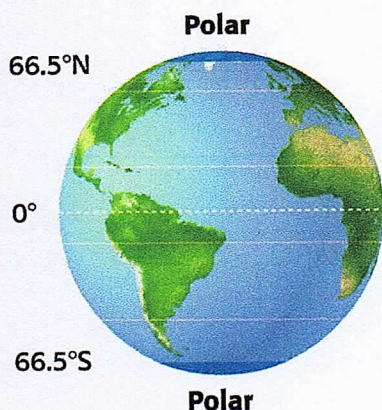
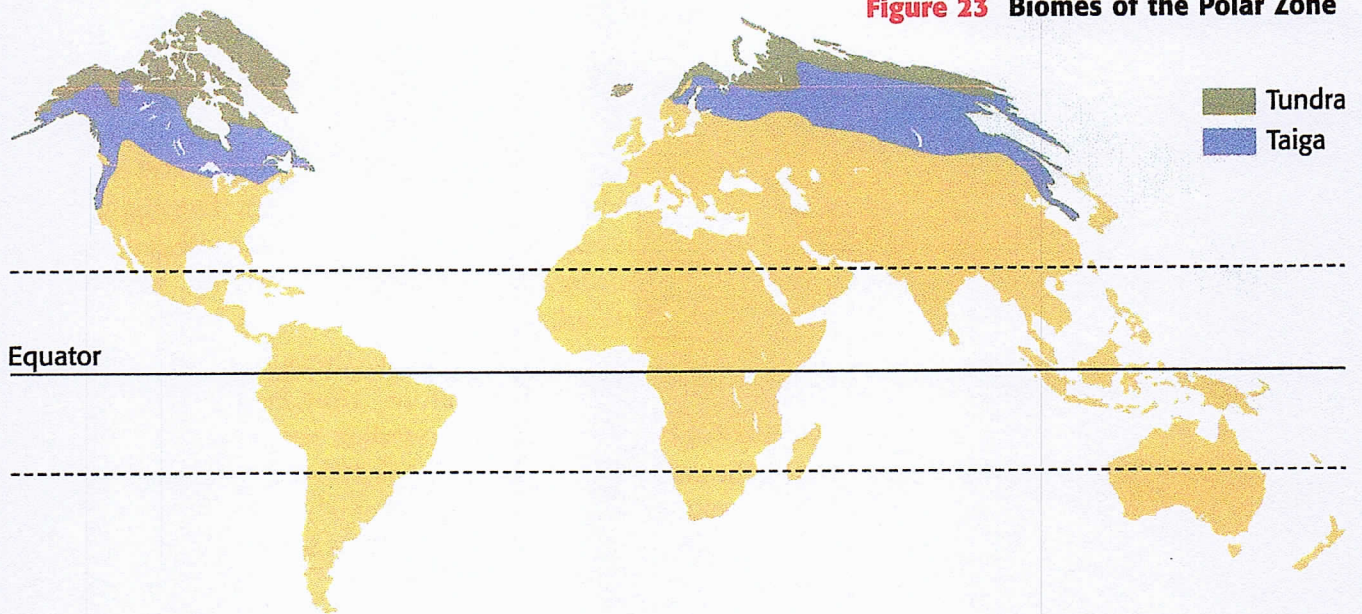


Figure 22 *The Earth's Polar Zones*

The Polar Zone

The **polar zone** includes the northernmost and southernmost climate zones, as shown in **Figure 22**. Polar climates have the coldest average temperatures. The temperatures in the winter stay below freezing, and the temperatures during the summer months remain chilly. **Figure 23**, on the next page, shows the distribution of the biomes found in the polar zone.

Figure 23 Biomes of the Polar Zone



Tundra Next to deserts, the tundra, as shown in **Figure 24**, is the driest place on Earth. This biome has long, cold winters with almost 24 hours of night and short, cool summers with almost 24 hours of daylight. In the summer, only the top meter of soil thaws. Underneath the thawed soil lies a permanently frozen layer of soil, called *permafrost*. This frozen layer prevents the water in the thawed soil from draining. Because of the poor drainage, the upper soil layer is muddy and is therefore an excellent breeding ground for insects, such as mosquitoes. Many birds migrate to the tundra during the summer to feed on the insects.



Figure 24 In the tundra, mosses and lichens cover rocks. Dwarf trees grow close to the ground to protect themselves from strong winds and to absorb energy from the Earth's sunlit surface.

Environment CONNECTION

Subfreezing climates contain almost no decomposing bacteria. The well-preserved body of John Torrington, a member of an expedition that explored the Northwest Passage in Canada in the 1840s, was uncovered in 1984, appearing much as it did when he died, more than 140 years earlier.

Avg. Temperature Range:
-27°C-5°C (-17°F-41°F)

Avg. Yearly Precipitation:
0-25 cm

Soil Characteristics: frozen

Vegetation: mosses, lichens, sedges, and dwarf trees

Animals: rabbits, lemmings, reindeer, caribou, musk oxen, wolves, foxes, birds, and polar bears



Avg. Temperature Range:
 -10°C – 15°C (14°F – 59°F)

Avg. Yearly Precipitation:
 40–61 cm

Soil Characteristics: acidic soil

Vegetation: mosses, lichens, conifers

Animals: birds, rabbits, moose, elk, wolves, lynxes, and bears

Figure 25 The taiga is the major source of wood for paper.

Taiga (Northern Coniferous Forest)

Just south of the tundra lies the taiga biome. The taiga, as shown in **Figure 25**, has long, cold winters and short, warm summers. Like the tundra, the soil during the winter is frozen. The majority of the trees are evergreen needle-leaved trees called *conifers*, such as pine, spruce, and fir trees. The needles and bendable branches allow these trees to shed heavy snow before they can be damaged. Conifer needles contain acidic substances. When the needles die and fall to the soil, they make the soil acidic. Most plants cannot grow in acidic soil, and therefore the forest floor is bare except for some mosses and lichens.

Microclimates

You have learned the types of biomes that are found in each climate zone. But the climate and the biome of a particular place can also be influenced by local conditions. **Microclimates** are small regions with unique climatic characteristics. For example, elevation can affect an area's climate and therefore its biome. Tundra and taiga biomes exist in the Tropics on high mountains. How is this possible? Remember that as the elevation increases, the atmosphere loses its ability to absorb and hold thermal energy. This results in lower temperatures.

Cities are also microclimates. In a city, temperatures can be 1°C to 2°C warmer than the surrounding rural areas. This is because buildings and pavement made of dark materials absorb solar radiation instead of reflecting it. There is also less vegetation to take in the sun's rays. This absorption of the sun's rays by buildings and pavement heats the surrounding air and causes temperatures to rise.

Physics CONNECTION

Roof temperatures can get so hot that you can fry an egg on them! In a study of roofs on a sunny day when the air temperature was 13°C , scientists recorded roof temperatures ranging from 18°C to 61°C depending on color and material of the roof.



To find out more about microclimates, turn to page 109 of the LabBook.

SECTION REVIEW

1. Describe how tropical deserts and temperate deserts differ.
2. List and describe the three major climate zones.
3. **Inferring Conclusions** Rank each biome according to how suitable it would be for growing crops. Explain your reasoning.