15.3 Biomes

VOCABULARY

canopy
grassland
desert
deciduous
coniferous
taiga
tundra
chaparral

KEY CONCEPT **Biomes are land-based, global communities of organisms.**

MAIN IDEAS

- Earth has six major biomes.
- Polar ice caps and mountains are not considered biomes.

Connect to Your World

Have you ever seen a cactus in a tropical rain forest or a penguin in a desert? Individual plant and animal species have adaptations that let them thrive only in certain biomes. In this section, you will learn about the major biomes of the world and the characteristics of each.

MAIN IDEA

Earth has six major biomes.

CONNECT TO

LEVELS OF ORGANIZATION

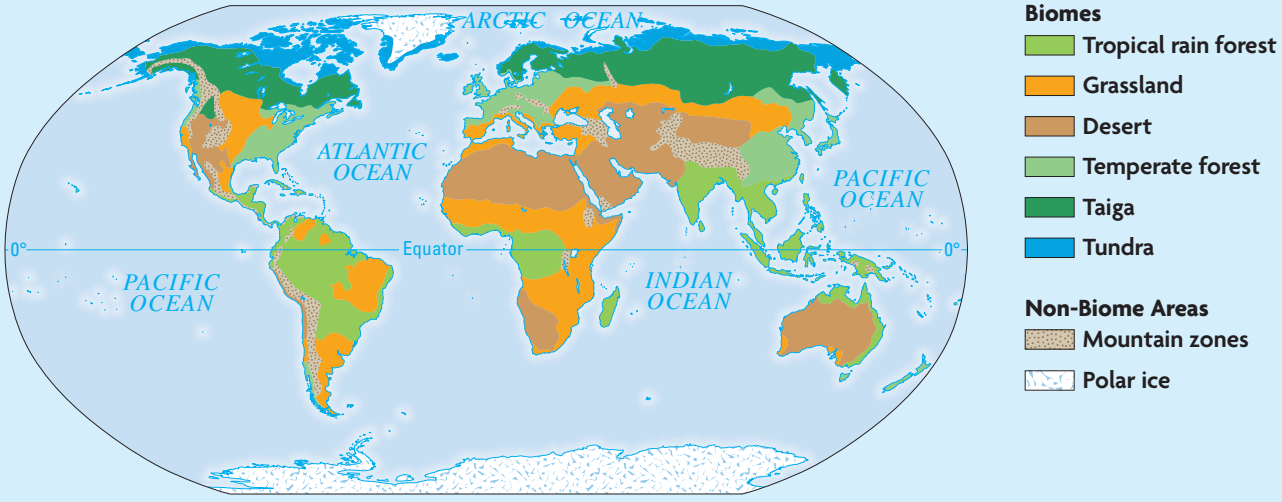
Recall from **Principles of Ecology** that a biome is a major community of organisms, usually characterized by the climate conditions and plant communities that live there.

The global distribution of biomes is shown in **FIGURE 3.1.** Characteristics of each biome are given in **FIGURE 3.2.** As you will see, these broad biome types can be divided into even more specific zones. For example, the grassland biome can be further separated into zones of temperate and tropical grassland.

A variety of different ecosystems are found within a biome. However, because a biome is characterized by a certain set of abiotic factors, ecosystems located across the globe in the same biome—the tropical rain forest of Brazil or Madagascar, for example—tend to have similar plant and animal species.

FIGURE 3.1 World Biomes

A biome is defined by its climate and by the plant communities that live there.



Identify **Which biomes are found in North America?**

FIGURE 3.2 Biomes

TROPICAL

Tropical rain forest

- Warm temperatures and abundant rainfall occur all year.
- Vegetation includes lush thick forests.
- Animals that live within the thick cover of the uppermost branches of rain forest trees use loud vocalizations to defend their territory and attract mates.


GRASSLAND

Tropical grassland

- Temperatures are warm throughout the year, with definite dry and rainy seasons.
- Vegetation includes tall grasses with scattered trees and shrubs.
- Hoofed animals, such as gazelles and other herbivores, dominate this biome.

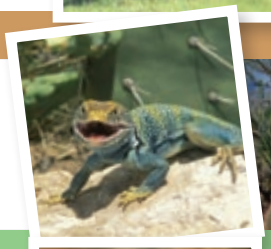

Temperate grassland

- This biome is dry and warm during the summer; most precipitation falls as snow during the winter.
- Vegetation includes short or tall grasses, depending on the amount of precipitation.
- Many animals live below ground to survive the dry and windy conditions in this biome.


DESERT

Desert

- This biome has a very dry climate.
- Plants, such as cacti, store water or have deep root systems.
- Many animals are nocturnal; they limit their activities during the day.




TEMPERATE

Temperate deciduous forest

- Temperatures are hot in the summer and cold in the winter; precipitation is spaced evenly over the year.
- Broadleaf forest dominates this biome, and deciduous trees lose their leaves in the winter.


Temperate rain forest

- This biome has one long wet season and a relatively dry summer.
- Evergreen conifers, which retain their leaves (needles) year-round, dominate this biome.
- While some species remain active in the winter, others migrate to warmer climates or hibernate.


TAIGA

Taiga

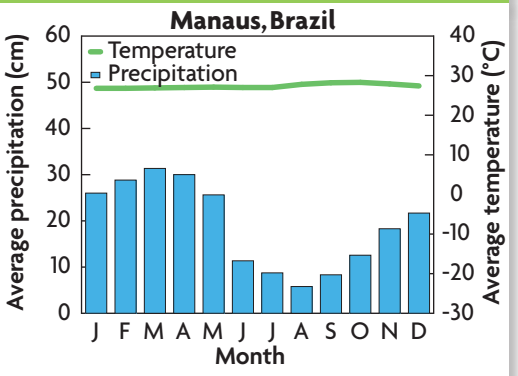
- This biome has long, cold winters and short, warm, humid summers.
- Coniferous trees dominate this biome.
- Mammals have heavy fur coats to withstand the cold winters.


TUNDRA

Tundra

- Subzero temperatures are the norm during the long winter, and there is little precipitation.
- The ground is permanently frozen; only mosses and other low-lying plants survive.
- Animal diversity is low.


TROPICAL RAIN FOREST



Source: World Meteorological Organization

Tropical Rain Forest Biome

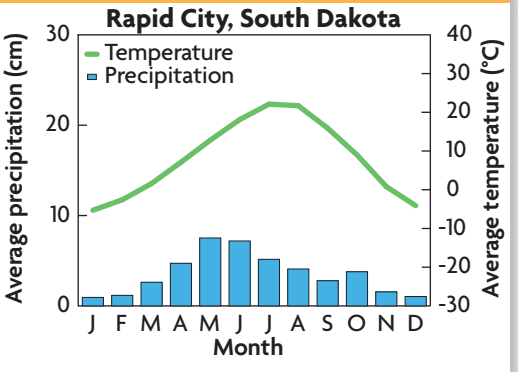
A tropical rain forest has warm temperatures and abundant precipitation throughout most, if not all, of the year. This climate typically produces lush, thick forests that can completely shade the forest floor. The limiting factor for plants that live on the forest floor is sunlight. In fact, as little as 1 percent of the sunlight that strikes the uppermost branches of the trees, called the **canopy,** may make it through to the ground. The soil is very thin and low in nutrients. Most organisms that live in this biome inhabit branches of the upper canopy. Some plants, called epiphytes, grow above the ground on the branches of trees. A few of these, such as some figs, sprout and develop on branches and then send down long lengths of roots that grow into the ground below.

Grassland Biomes

Grassland biomes occur in a variety of climates. A **grassland** is an area where the primary plant life is grass. Tropical grasslands are found in the tropical climate zones of South America, Africa, and Australia. Temperate grasslands are found in the temperate climate zones of South Africa, eastern Europe, and central North America.

Tropical grasslands, also called savannas, are covered with grass plants that may stand 1–2 meters (3–7 ft) in height. Some grasslands have scattered trees or shrubs, but the trees are never as thick and lush as in the tropical rain forests. The limiting factor in the savanna is rainfall. For five months or more each year, precipitation averages at most 10 centimeters (4 in.) a month; often there is much less. During the rainy season, however, water can replenish lakes, rivers, streams, and wetlands and form temporary ponds. This biome is home to plants and animals that have adapted to the extreme shifts in moisture.

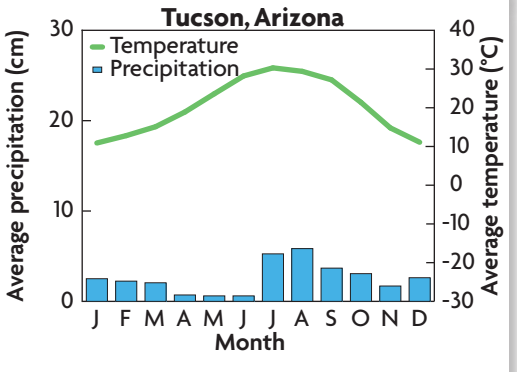
TEMPERATE GRASSLAND



Source: National Oceanic Atmospheric Administration

Temperate grasslands receive 50–90 centimeters (20–35 in.) of annual precipitation, most occurring as rain in the late spring and early summer. Summers may be warm or quite hot, depending on the latitude of the grassland. Under such arid conditions, fast-spreading fires are common. Some plants in temperate grasslands have adapted to fire by producing fire-resistant seeds that require the fire's heat to start germination.

DESERT



Source: National Oceanic Atmospheric Administration

Desert Biome

Desert biomes receive less than 25 centimeters (10 in.) of precipitation annually, and are always characterized by a very dry, or arid, climate. There are four different types of deserts: hot, semiarid, coastal, and cold.

In hot deserts, such as the Sonoran Desert in Arizona, the daily summer temperature may easily top 38°C (100°F). At night, however, the temperature can drop by 10 degrees Celsius or more. During the winter, the temperature may be as low as 0°C (32°F). The precipitation falls as rain in hot deserts.

Semiarid deserts, like hot deserts, have long and dry summers and low amounts of rain in the winter. In comparison with hot deserts, however, temperatures are cooler and rarely exceed 38°C. Coastal deserts are characterized by cool winters followed by relatively long, warm summers. Temperatures range from a maximum of 35°C (95°F) in the summer to –4°C (25°F) in the winter. In cold deserts, such as the Great Basin of the western United States, precipitation falls evenly throughout the year and often occurs as snow in the winter. Summer temperatures range between 10°C (50°F) at night to 24°C (75°F) during the day, and winter temperatures can drop below freezing.

Plants use a variety of strategies to survive a desert's heat and lack of moisture. The reduced surface area of a cactus's spines helps it to retain more water by avoiding moisture loss from transpiration. Many desert plants have the ability to conserve or store water over a long period of time. Some desert plants, such as mesquite, have extremely long root systems that absorb water by reaching down to the water table. Desert plants also have heat- and drought-resistant seeds.

Contrast **How do rainfall amounts differ in deserts and in tropical rain forests?**

Virtual INVESTIGATION
HMDScience.com
PREMIUM CONTENT
Ecosystems and Energy Pyramids

CONNECT TO
LOCAL ECOSYSTEMS
See **Appendix D** for information about local ecosystems and guidelines for analyzing an ecosystem.

Temperate Forest Biomes

A key feature of temperate biomes is their distinguishable seasons. The growing season occurs during the warmer temperatures from mid-spring to mid-fall and depends upon the availability of water.

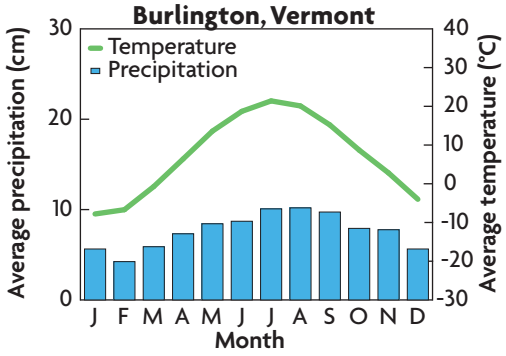
The **temperate deciduous forest** typically receives about 75–150 centimeters (30–59 in.) of precipitation spread over the entire year as rain or snow. This biome is characterized by hot summers and cold winters. **Deciduous** trees have adapted to winter temperatures by dropping their leaves and going dormant during the cold season. Trees, such as oaks, beeches, and maples, along with shrubs, lichens, and mosses, make up the main vegetation.

The **temperate rain forest** does not receive precipitation evenly spaced across the year. Instead, it has one long wet season and a relatively dry summer, during which fog and low-lying clouds provide the needed moisture. Precipitation in the temperate rain forest averages over 250 centimeters (98 in.) per year. Evergreen conifers, such as spruces, Douglas firs, and redwoods, dominate this biome. **Coniferous** trees retain their needles all year. Mosses, lichens, and ferns are plant species found on the forest floor.

Taiga Biome

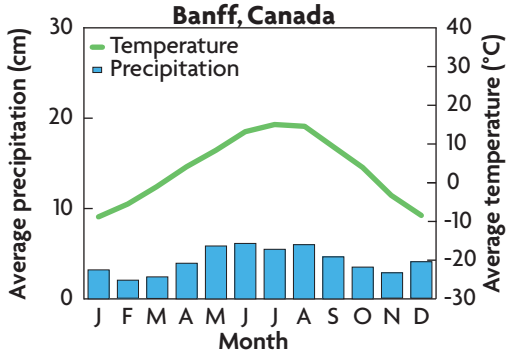
The **taiga** (TY-guh), also known as the boreal forest, is located in cooler climates. Winters are long and cold, often lasting six months or more. The average winter temperature is below freezing. Summers are short, typically with only two to three months of frost-free days. However, they may be quite humid and warm, sometimes reaching 21°C (70°F). Precipitation in the taiga is 30–85 centimeters (12–33 in.) per year, which is similar to that in the arid temperate grasslands. Coniferous forest is dominant in the taiga.

TEMPERATE FOREST

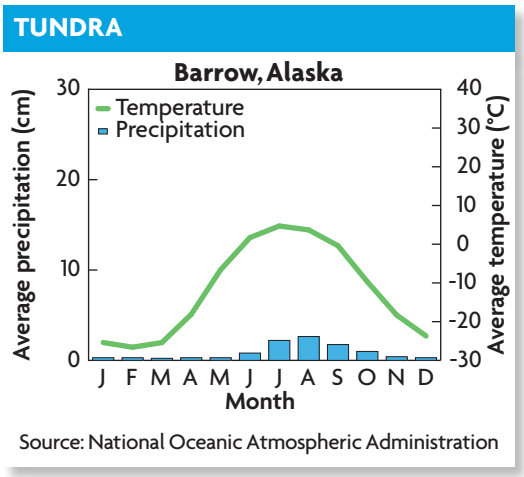


Source: National Oceanic Atmospheric Administration

TAIGA



Source: Environment Canada



Tundra Biome

Often described as bleak, the **tundra** is located beyond the taiga in far northern latitudes. Winter lasts as long as 10 months a year. The average winter temperature is below freezing. The ground below the surface is always frozen. This frozen ground is known as permafrost. Summers last just 6 to 10 weeks. Precipitation is meager, averaging less than 13 centimeters (5 in.) annually.

In addition to limited precipitation, permafrost captures and holds moisture, making very little available to plants. Therefore, the tundra is quite barren. Only mosses, other tiny, low-lying plants, and a few scattered shrubs are able to survive. Trees and most flowering plants do not grow here.

Minor Biomes

In addition to the six major biomes, there are also some other biomes that occur globally, but on a smaller scale. One example is chaparral, shown in **FIGURE 3.3.** **Chaparral** (SHAP-uh-RAL), also called Mediterranean shrubland, is characterized by its hot, dry summers and cool, moist winters. Over the year, temperatures in the chaparral range from 10°C (50°F) to 40°C (104°F). Annual precipitation ranges from 38–102 centimeters (15–40 in.), and occurs mostly during the winter as rain. The dominant plants in the chaparral are small-leaved evergreen shrubs. This biome is found in small areas across the globe, including the central and southern coast of California in the western United States, the coast of Chile in South America, the Mediterranean Sea coast in Europe, the southern and western coasts of Australia, and the southwestern tip of South Africa. Because of the fairly hot climate, the plants in this biome exhibit some of the same adaptations to heat as those found in the desert biome. Many plants have shallow root systems that let them take in as much water as possible when it rains. The leaves of shrubs have thick cuticles that help in water retention. Many plant species, such as sage and rosemary, give off a strong smell. These aromatic oils are also highly flammable, and promote fire. As in temperate grasslands, chaparral plants have adapted to the presence of fire, and some plants need fire in order for their seeds to germinate.

Connect **What biome includes the area where you live?**

FIGURE 3.3 In the United States, chaparral is found along the central and southern coasts of California. This biome is characterized by hot, dry summers and cool, moist winters.

MAIN IDEA

Polar ice caps and mountains are not considered biomes.

Polar ice caps are ice-covered areas that have no soil and do not have a specific plant community. In mountains, the climate and the animal and plant communities change depending on elevation. Because of these characteristics, polar caps and mountains are not categorized as biomes.

Polar ice caps occur around the poles at the top and bottom of Earth. In the Northern Hemisphere, the polar ice cap includes parts of Greenland and permanently frozen portions of the Arctic Ocean and surrounding islands. In the Southern Hemisphere, the polar ice cap includes the glacier-covered continent of Antarctica. At the ice caps, ice and snow cover the surface all year. Very few plants or fungi are able to survive the harsh conditions found in the polar regions. Some species found in Antarctica include mosses and lichens. Most animals in this region depend on the sea for their food. Animals such as polar bears, shown in **FIGURE 3.4**, have layers of fat that keep them warm in the cold polar conditions. Different animals are found in the northern and southern polar regions. For example, polar bears are found only in the north, while penguins are found only in the south.

Mountains are often rich with life. Different communities of species have adapted to the variety of ecosystems found at different mountain elevations. As you move up a mountain, the different communities that you see are similar to the biomes found in different latitudes across the globe. For example, you may begin a hike in a grassland at the base of the mountain, continue upward through a coniferous forest, and finally reach a desolate tundralike zone at the mountain's top. While the life zones found on mountains are similar across biomes, their species of plants and animals differ as a result of the different abiotic factors that shape each biome.

Summarize **Explain why neither polar ice caps nor mountains are considered biomes.**

FIGURE 3.4 A polar bear's thick layer of fat, or blubber, keeps it well insulated from the cold as it rests on an ice floe or swims in Arctic waters to catch food.

15.3 Formative Assessment

REVIEWING MAIN IDEAS

1. List and describe the six major biome types.
2. What are some characteristics of mountains and polar ice caps?

CRITICAL THINKING

3. **Predict** How might stopping fires change a temperate **grassland**?
4. **Infer** Polar bears have white fur but black skin underneath. Consider the climate in which the bears live. What might be the adaptive advantage of the bears' black skin?

CONNECT TO

ANIMAL BEHAVIOR

5. Male birds that migrate the earliest to their summer nesting sites can usually secure the best territories. What limiting factor keeps birds from arriving too early in the **taiga**?