6.3 Climates and Biomes

Imagine that someone gave you an airplane ticket to travel to Africa to see Serengeti National Park in Tanzania. If you like adventures, you might say "Great! When do I leave?" Then you would want to pack your suitcase. But what would you take? What is the climate like in Africa?

Climate

Factors that affect climate

Climate is the type of weather patterns that a place has, on average, over a long period of time. If you wanted to know about the climate in a place you were about to visit, you might ask questions like "How hot and how cold does it usually get? Does it rain a lot? How often is the temperature below freezing?" Climate depends on many factors, including latitude, precipitation, elevation, topography, and distance from large bodies of water.

Characteristics of biomes

What is a biome?

Scientists divide the planet into climate regions. Each region is called a **biome**. Earth has six major biomes: deserts, grasslands, temperate deciduous forests, rainforests, taigas, and tundra's. These biomes generally differ in their latitude, weather and relative humidity, amount of sunlight, and topography. Each biome has a unique set of plants and animals that thrive in its climate.

Latitude, humidity, and biodiversity

Recall that *relative humidity* is a measure of how much water vapor an air mass contains relative to how much it can contain. From the poles to the equator, humidity, and the biodiversity of plants and animals increase. *Biodiversity* refers to the measure of the variety and number of organisms that live in an area.

Sunlight at the equator vs. high latitudes

Earth is hottest near the equator where the Sun is closest to being directly overhead year round. At the north and south poles, temperatures are much colder. This effect is related to the fact that light travels in straight parallel lines. To demonstrate what is happening, imagine shining a flashlight on a sheet of paper (Figure 6.19). The light makes a bright, small spot. By tilting the paper, you can make the light spot bigger and less intense.

Latitude and solar radiation

At the equator, sunlight is direct and intense. Earth's north and south poles are tilted away from or toward the Sun depending on the time of year. The locations of the poles relative to the Sun and Earth's spherical surface mean that sunlight reaching these areas is spread out and less intense (Figure 6.19). As a result, the average yearly temperature at the equator is 27 °C (80 °F), while at the North Pole it is –18 °C (0 °F). Generally, as latitude (or distance from the equator) increases, the amount of incoming solar radiation decreases.

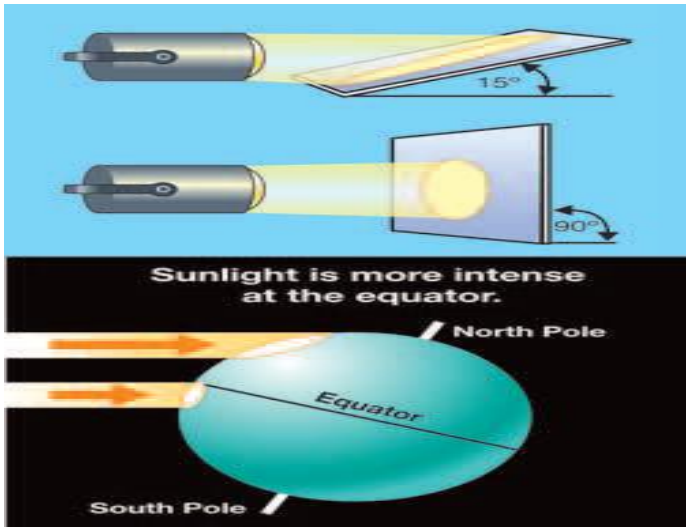


Figure 6.19: *A flashlight shining on a piece of paper represents solar radiation reaching Earth. If you tilt the paper, the spot of light spreads out and becomes less intense, like at the poles.*

Other factors besides latitude can affect climates

Temperatures in inland regions

Have you ever wondered why cities near the ocean don't get as hot in the summer or as cold in the winter as inland cities at the same latitude? Portland, Oregon and Minneapolis, Minnesota are two cities near the same latitude (Figure 6.20). Look at Table 6.1 below to see the average daily temperature ranges for these cities.

Table 6.1: Average daily temperature ranges for:

Portland	***Minneapolis.***
January 1–7 °C, (34–45 °F)	-16– -6 °C (3–21 °F)
July 14–27 °C (57–80 °F)	17–29 °C (63–84 °F)

Water helps regulate temperature

The differences in temperature between the two cities have to do with water. Because of its higher specific heat, water warms up and cools down slowly. In contrast, land warms up and cools down quickly because of its lower specific heat. Therefore, regions near water—like Portland—do not have extremely hot or cold weather.

Elevation Latitude is an important factor in defining a biome. However, elevation is also a factor. *Elevation* is the height or distance of an object or area from sea level. The range of biomes that exist on Earth from the equator to the poles also exists if one goes from the bottom of a mountain to the top of a mountain (Figure 6.21).

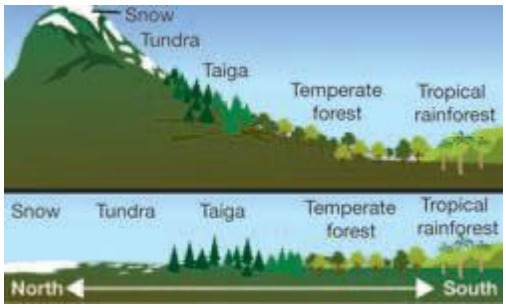
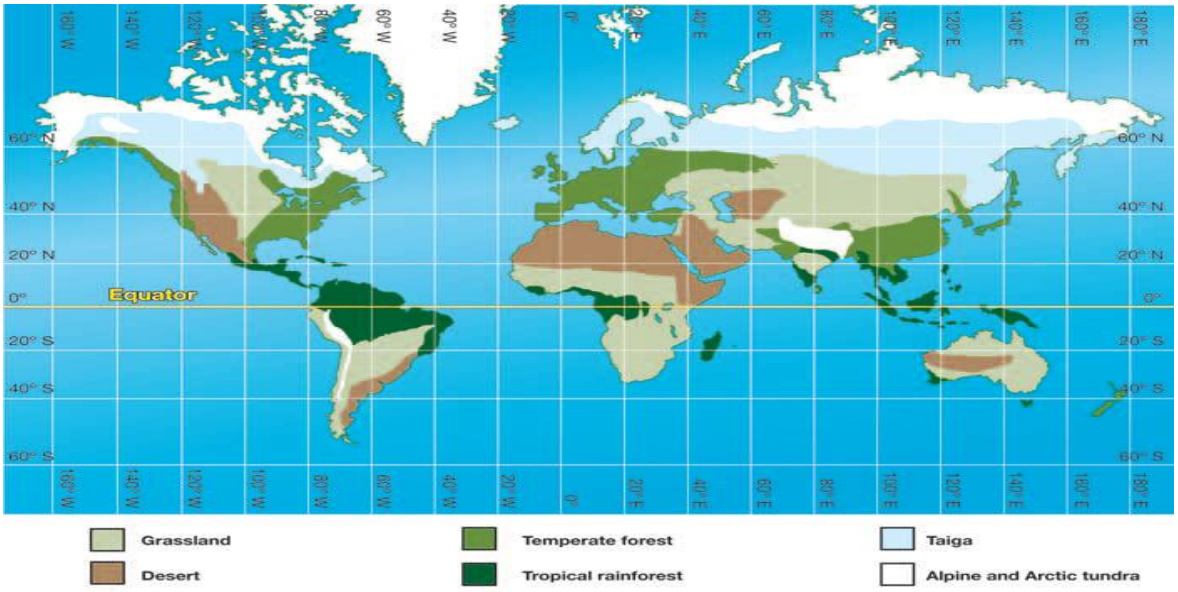


Figure 6.21: *Latitude versus elevation for the Northern Hemisphere*

Earth's biomes



Types of biomes

Deserts

A **desert** averages less than 35 centimeters of rainfall per year. Most deserts are found around the latitudes of 30° N and 30° S. Deserts have large variations in daily high and low temperatures.

Grasslands

Grasslands are on every continent except Antarctica. There are two types: tropical grasslands, known as *savannas*; and *temperate grasslands*. Savannas occur where there is not enough rainfall to create a rainforest. Temperate grasslands are in the mid-latitudes and receive most of their precipitation in the spring and summer.

Temperate Deciduous forests

Temperate deciduous forests are found in middle-latitude regions, where there are four distinct seasons. Average yearly rainfall is 75 to 150 centimeters, enough to support the growth of broad-leafed, deciduous trees like oak and maple. *Deciduous* means these trees lose their leaves the end of the growing season.

Rainforests

Tropical rainforests are near the equator—between the latitudes of 23.5° N and 23.5° S. They have an average rainfall of at least 200 centimeters per year. The temperature of these rainforests is nearly constant and in a narrow range—20 to 25 °C. Temperate rainforests, another kind of rainforest, are in the middle-latitude regions, and experience about 250 centimeters of rain per year.

Taiga

The **taiga** is the largest biome. The taiga can be found between the latitudes of 50° N and 70° N in North America, Europe, and Asia. The average temperature in the taiga is below freezing for at least six months of the year.

Tundras

The **tundra** is the coldest biome on Earth. The word *tundra* comes from a Finnish word for "treeless land." There are two types of tundra—Arctic tundra, found in a band around the Arctic Ocean, and alpine tundra, found high in mid-latitude mountains.

Plants and animals in biomes

Communities A biome is characterized by its plant and animal communities. The plants and animals in a community interact with each other and survive in a shared environment. The plants and animals in the environment have adaptations that allow them to obtain enough resources (such as food, water, or sunlight) to survive.

Adaptations Jackrabbits have an adaptation to keep cool in the hot desert— enormous ears with many blood vessels near the surface (Figure 6.22). Blood running through the vessels speeds up heat transfer from the jackrabbit's body to the air so the jackrabbit stays cooler.

Ecosystems Biomes are large geographic areas. Within a biome, there are many interrelated ecosystems. An *ecosystem* is made up of the plants and animals that live there, plus nonliving things like soil, air, water, sunlight, and nutrients. The living and nonliving parts of an ecosystem work together, and each organism plays an important ecological role.

How many roles? The number and types of organisms that an ecosystem can support depends on the resources available (food sources) and on environmental factors. Environmental factors include the amount of available sunlight, water, and the temperature. The roles within a biome ecosystem depend on the quantity and type of resources. Each ecosystem of a particular biome type has organisms that play similar roles. For example, both a rainforest in South America and a rainforest in Australia have predators, herbivores (plant eaters), and decomposers suited to surviving in the rainforest environment.

Figure 6.22: *The large ears of a jackrabbit help this desert animal to cool down.*

6.3 Section Review

1. What are three factors that affect climate?
2. Are climate and weather the same thing? If not, explain how these terms are different.
3. What happens to the intensity of solar radiation and Earth's average yearly temperature as you move from the equator to the South Pole or North Pole?
4. Find San Francisco, California and Topeka, Kansas on a map of the United States. How would the weather in the these two places compare? Explain your answer.
5. Refer to the Earth's biome map on page 136. What kind of biome occurs at 30° S and 150° E? Describe what this biome is like.
6. Alpine and Arctic tundra occur at a mid-latitude location near India (25° N 80° E). Why do you think this biome occurs here? (Hint: Find out what land form occurs at this location.)
7. A photograph of an Arctic hare is shown in Figure 6.23. This animal lives in cold environments.

a. What adaptations do you see that this animal has?

b. How does the appearance of this animal compare to the jackrabbit in Figure 6.22?

8. The main grass in a grassland in North America is prairie grass. The main grass in a South American grassland is pampas grass. Would you expect the ecological role of these grasses in these two locations to be the same or different? Explain your answer.

Figure 6.23: *An Arctic hare.*

climate - the long-term record of weather patterns and includes the temperature, precipitation, and wind for a region.
biome - a major climate region with particular plants and animals. Earth has six major biomes
desert - a climate region that averages less than 35 centimeters of rainfall per year.
grasslands - climate regions with too little rainfall to support a forest. Grasslands have grasses as the main vegetation.
temperate deciduous forests
- climate regions in the mid-latitudes that have four seasons.
tropical rainforests – climate regions found near the equator that have a lot of rainfall and high biodiversity.
taiga - the largest climate region, found in the higher latitudes; also known as a boreal or coniferous forest.
tundra - a climate region located in high latitudes; the coldest land biome.