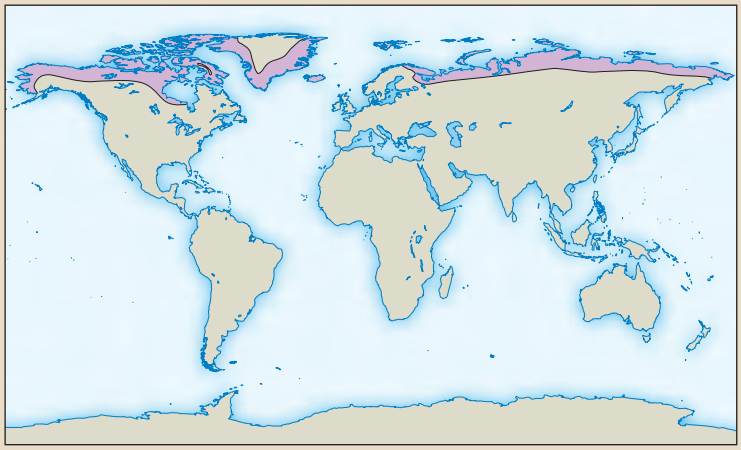
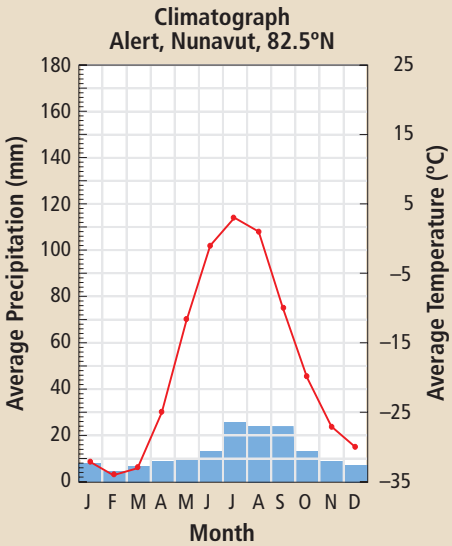
Tundra

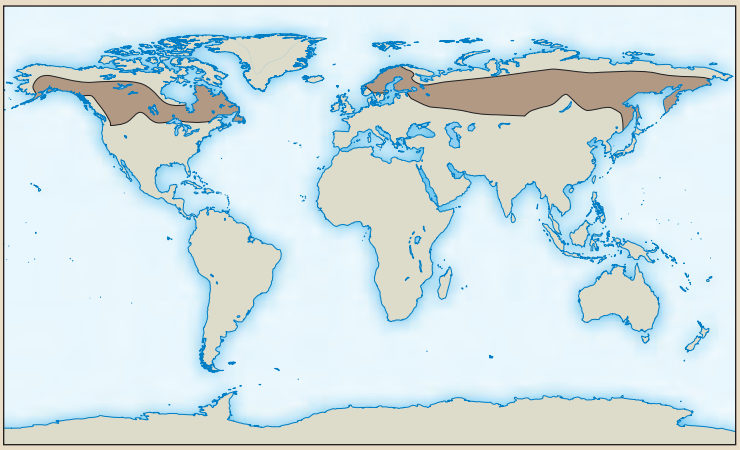


Caribou



Location: The tundra biome is in the upper northern hemisphere, just below the ice-covered polar seas, at 60° to 70° north latitude.
Climate: Precipitation is less than 25 cm annually. Annual summer average temperatures range from 3°C to 12°C. Winter temperatures range from −20°C to −30°C.
Physical features: The tundra biome always has a layer of permanently frozen soil called permafrost. Its flat terrain (the physical features of its land area) results in poor drainage. In summer, a thin layer of topsoil thaws, creating many pools and marshes. The tundra is cold and dark much of the year but has 24 hours of daylight each day during its brief summer.
Plant adaptations: No trees grow here since the growing season is too short. Roots cannot penetrate permafrost. Many plants grow close to the ground, where they absorb the warmth that has been trapped by the dark soil and are sheltered from the fierce winds. Short grasses, lichens, and mosses survive here. Some flowering plants, such as the arctic crocus, have fuzzy coverings on their stems, leaves, and buds that provide protection from the wind. Shrubs flower quickly during the long, sunlit summer days. The Labrador tea bush keeps its old leaves rather than dropping them, which conserves nutrients and helps protect the plant from cold, wind, and drying out.
Animal adaptations: Arctic foxes and hares have compact bodies and shorter legs and ears, which reduce heat loss. Many tundra animals grow more slowly and reproduce less frequently than animals in temperate biomes, therefore requiring less energy. The Greenland sulfur butterfly has a long life cycle, taking up to 14 years to become an adult. Caribou migrate to food sources in winter. In winter, the white feathers of the snowy owl prevent its prey from seeing it against the snow. Many birds migrate here in summer to eat insects that reproduce in great numbers in the marshy conditions.

Boreal Forest



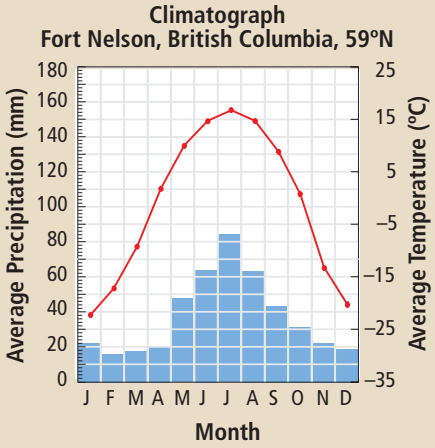
Location: Boreal forests are found in the northern hemisphere between 45° and 65° north latitude across Canada (shown above) and between 55° and 65° north latitude in Russia, Finland, and Scandinavia.

Climate: Precipitation is 30 cm to 85 cm annually, much of it falling as snow. Temperatures are below freezing half of the year and often drop to −40°C.

Physical features: There is a short summer growing season of an average of 50 days. The terrain is often rough. Many marshes, shallow lakes, and wetlands hold vast amounts of water. The soil is also very wet.

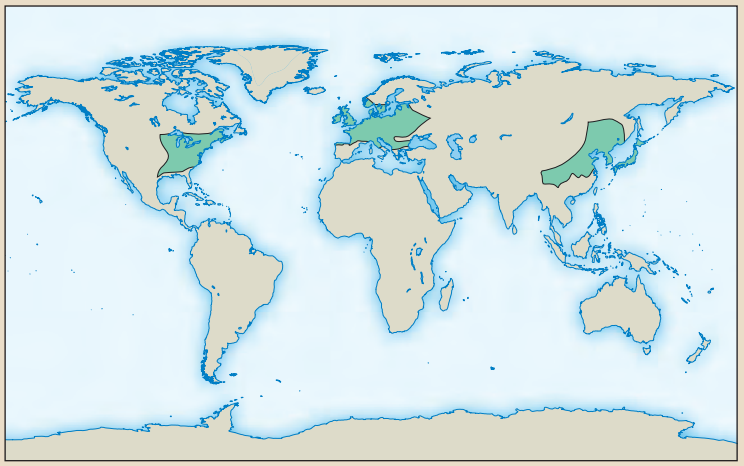
Plant adaptations: Trees are mainly coniferous (cone-bearing), such as black spruce and white spruce, with small, pointed, waxy needles that resist water loss and allow snow to slide off easily. In a balsam fir–white spruce forest, little light reaches the forest floor, so there are few understorey plants.

Animal adaptations: Insect-eating birds such as warblers migrate south in the fall. Seed eaters such as the finch stay year-round. Small mammals such as chipmunks and shrews burrow in winter to stay warm. Mammals such as moose have thick insulating coats and tend to be large. Large bodies enable moose to retain their body heat. The fur of snowshoe hares changes from summer brown to winter white, which camouflages them from predators. Insects multiply rapidly and in large quantities in the summer. Reptiles and amphibians are rare since they are not adapted to survive low temperatures.

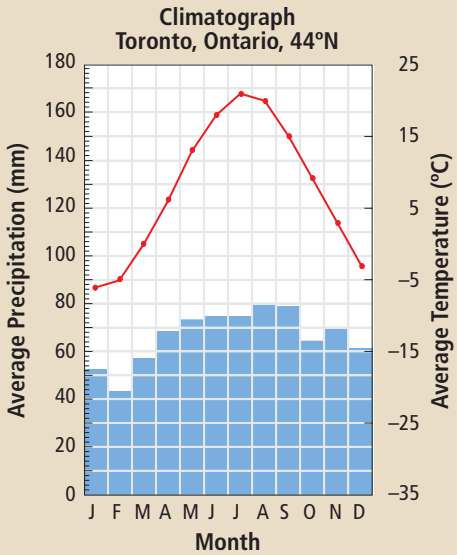


Snowshoe hare

Temperate Deciduous Forest



Canada goose



Location: These forests are found mainly in eastern Canada (shown above), the eastern United States, eastern Asia, and western Europe. Southern Australia and New Zealand also have areas of deciduous forest. They occur above 23.5° north latitude and between 23.5° and 38° south latitude.

Climate: The annual rainfall is about 75 cm to 180 cm, with precipitation equally distributed throughout the year. Temperatures range from −30°C in winter to 30°C in summer.

Physical features: Seasonal changes between summer and winter are very large. Temperature changes during a day can also be large. This biome has four distinct seasons and a long, warm growing season. The soil is enriched by fallen leaves that break down and provide nutrients.

Plant adaptations: Plants grow in four to five layers, with tall maple, oak, and birch trees in the canopy layer. Light penetrates the layers, resulting in an understorey that has great biodiversity. Shorter trees occupy the second layer, with shrubs in the third layer, berries in the fourth layer, and ferns, herbs, and mosses on the forest floor. Deciduous trees shed their large, broad leaves in winter, which prevents water loss and reduces breakage of limbs with heavy snow. Thick bark limits moisture loss from the trees.

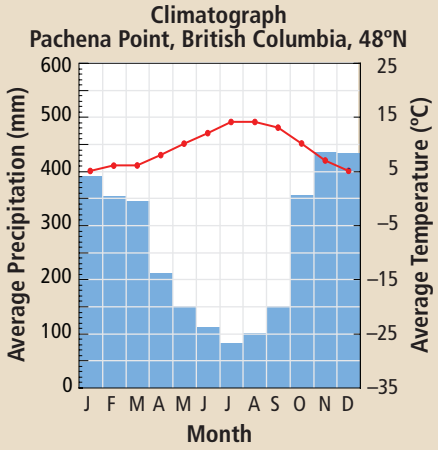
Animal adaptations: The many layers in the forest provide many habitats for squirrels, rabbits, skunks, cougars, deer, wolves, bears, and amphibians. Squirrels, chipmunks, and blue jays store nuts and seeds in tree hollows. Some mammals hibernate. Many birds migrate to warmer areas in winter.

Temperate Rainforest

Location: Temperate rainforests run from about 38° to 56° south latitude along the coast of Chile in South America and from 38° to 61° north latitude along the northwest coast of North America, including coastal British Columbia (shown above). New Zealand and part of southern Australia also have temperate rainforests.

Climate: Rainfall exceeds 200 cm a year with average temperatures ranging from 5°C to 25°C. Coastal fog supplies additional moisture.

Physical features: Temperate rainforests occur in narrow strips along coastlines that are backed by mountains, where the ocean winds drop large amounts of moisture on the windward side of the mountains.

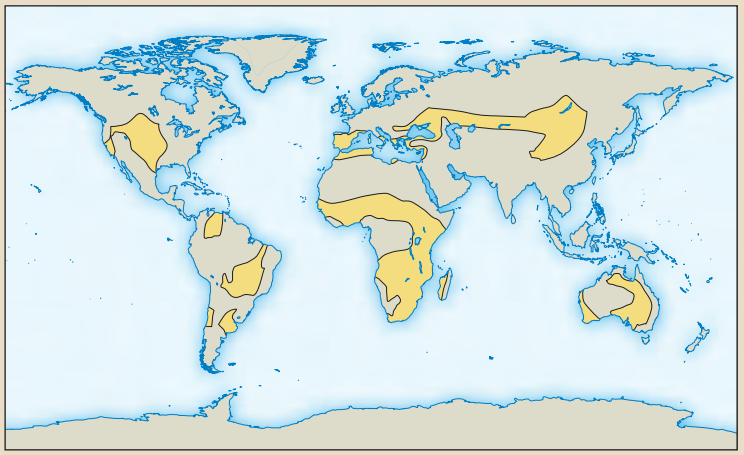


Plant adaptations: Trees can grow very tall because of high precipitation and include large evergreens such as the Sitka spruce (up to 48 m tall) and the Douglas fir (up to 60 m tall). Mosses are draped on trees, and lichens cling on tree trunks, where they receive more light than on the forest floor. Ferns, mosses, and fungi that survive in the shade blanket the forest floor.

Animal adaptations: Most animals live on or near the forest floor, where they are protected from the wind and rain. Many birds and small mammals, such as chipmunks, eat seeds that fall on the forest floor. Many insects live in the tree bark and decomposing plant matter. Birds with long beaks and amphibians with sticky tongues eat these insects.

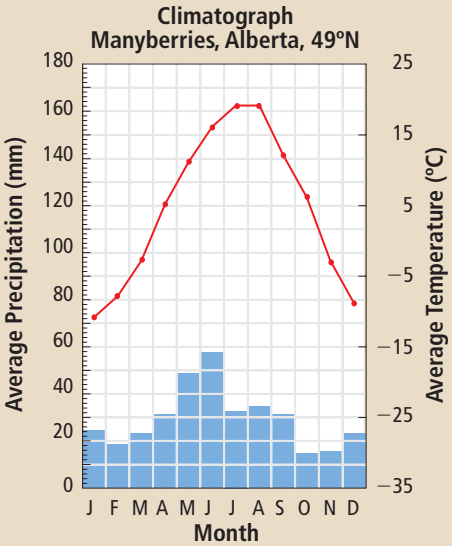
Long-toed salamander

Grassland (Temperate and Tropical)



Location: The grassland found in Canada is referred to as the temperate grassland or prairies (shown above). They are also called prairies in other locations in North America and steppes in Russia. Temperate grasslands are found above 23.5° north latitude and below 23.5° south latitude. Tropical grasslands or savannas are found from 5° to 20° north and south of the equator in Africa, South America, and northern Australia.

Climate: In temperate grasslands, the precipitation is 25 cm to 100 cm annually, with hot summers of 30°C and cold winters below −10°C. In tropical grasslands, precipitation is 50 to 130 cm annually, with daily temperatures ranging from 20°C to 30°C.



Physical features: In both temperate and tropical grasslands, the land is mainly flat. The soil is very rich and fertile in the temperate grassland created by the growth and decay of deep grass roots. The tropical grassland is less rich because nutrients are removed by occasional heavy rain. In both grasslands, strong winds may cause soil erosion. Precipitation usually occurs in late spring or early summer and is followed by an extended dry period. Grass fires are common in hot tropical grasslands but occur less frequently in temperate grasslands.

Plant adaptations: In both temperate and tropical grasslands, trees are scarce because of limited rainfall. Fire and grazing animals also kill seedlings. In temperate grasslands, grasses such as blue grama and buffalo grass are well adapted for drought as their roots are deep and form dense mats that collect water when it is available. Because of their well-developed root systems, plants can regrow after a fire. Flexible stalks enable these grasses to bend without breaking in the wind.

Grassland (Temperate and Tropical)

Many wind- and insect-pollinated wildflowers, such as asters, goldenrod, and clover, grow between the grasses. In tropical grasslands, grasses also have deep roots. Some trees, such as acacia, have thorns that deter animals from eating them. Some grasses have sharp edges or are too bitter for grazing.

Animal adaptations: Many large grazing mammals are present in large numbers because there is plentiful grass. Animals such as antelope are found in both biomes and have flat teeth that grind plant materials. In tropical grasslands, herds of antelope, giraffes, and zebras are found with predators such as lions, cheetahs, and leopards. In temperate grasslands, large mammals include antelope, wild horses, kangaroos, and predators such as wolves and coyotes. Animals such as mice, rabbits, gophers, and snakes are common to both grassland types. These animals burrow to escape fire, predators, and extreme weather.

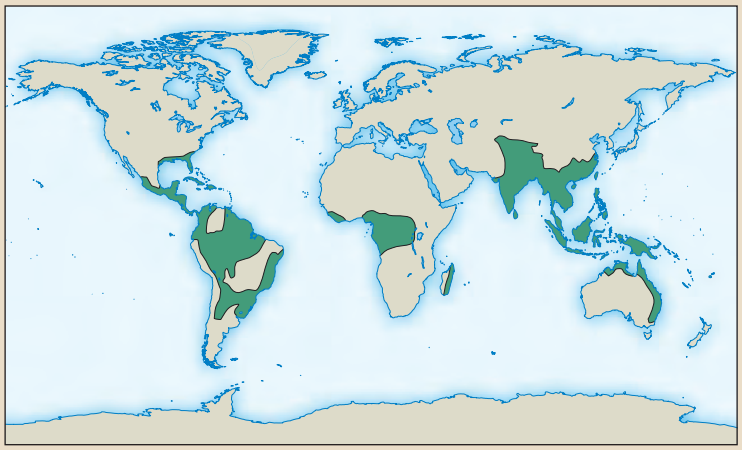
Pronghorn antelope (temperate grassland)

Zebra (tropical grassland)

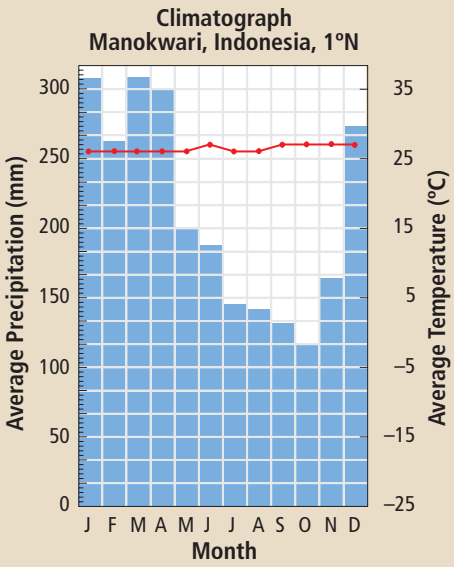
Reading Check

1. List three characteristics of the tundra biome.
2. List two characteristics of the boreal forest biome.
3. Describe the plant life of a temperate rainforest.
4. Identify the two types of grassland.
5. Explain why grassland plants can survive drought and prairie fires.

Tropical Rainforest



Toucan



Location: Tropical rainforests are located in a band 4800 km wide around the equator, mostly in the area between the Tropic of Cancer (23.5° north latitude) and the Tropic of Capricorn (23.5° south latitude). These forests cover much of northern South America (shown above), Central America, central Africa, and southeast Asia.

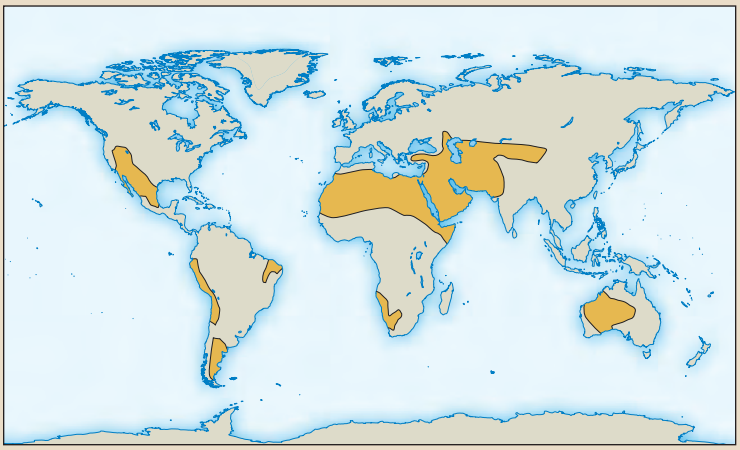
Climate: Rainfall is about 250 cm per year. Temperature is 20°C to 25°C year-round.

Physical features: The soil is poor as nutrients are quickly recycled and not retained. The soil is also poor because heavy rain washes minerals away. The forest floor is very dark, which limits plant growth.

Plant adaptations: This biome has the largest number of different plant species. Plants grow in many layers. Tall trees form a dense canopy that absorbs most of the sunlight. Only shrubs adapted to shade thrive in the understorey. Vines climb tree trunks into the canopy where there is more light. Many plants, such as orchids, reach sunlight by growing on tall trees. Leaves have narrow tips that allow rain to run off quickly, which reduces weight on the branches.

Animal adaptations: This biome has the greatest diversity of animals on Earth but has few large mammals. Most animals are adapted to live in trees since there is little vegetation on the forest floor. Many are specialists, adapted to a particular food or habitat, which reduces competition. Nut eaters like parrots and toucans have big, strong beaks that cut nuts from the trees and crack open the tough shells. Some rainforest animals secrete poisons that protect them from predators. The slow movement of the South American three-toed sloth, an adaptation to its low-calorie diet of leaves, also makes it less noticeable to predators such as jaguars.

Desert (Hot and Cold)



Location: Hot deserts are found on every continent around latitudes about 30° north and south and include the Kalahari and Sahara of Africa, the Simpson of Australia, the Atacama of South America, and the Sonoran (shown above) in the United States. Cold deserts are found in dry regions in the interior of continents above 30° north latitude and below 30° south latitude and in the rain shadows of mountains. Cold deserts include the Great Basin Desert of North America (which includes Canada's Pocket Desert), the Patagonian Desert of Argentina, and the Gobi Desert of central Asia.

Climate: In hot deserts, the rainfall is less than 25 cm annually, with hot days averaging 38°C and cold nights averaging 7°C. In cold deserts, the rainfall is also less than 25 cm annually, with summer days averaging 21°C to 26°C and winter days averaging −2°C to 4°C.

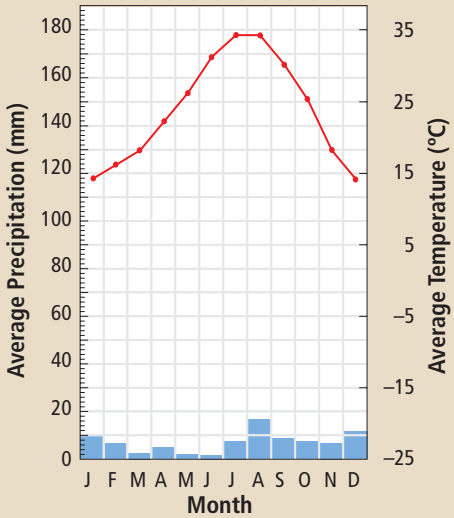
Physical features: In hot deserts, there is either very little rainfall or there is a lot of rain in a very short period. The soils are often salty because minerals do not get washed away. In cold deserts, most precipitation falls as snow, but there is rain in the spring. The soil is often salty and little water erosion occurs.

Plant adaptations: In hot deserts, there are few plant species. Spiny cacti that have thick, fleshy stems that conserve water are common. Their roots extend metres away from the plant to absorb water. Other plants have small, thick, waxy leaves that also store water. Many plants have spines or produce chemicals that protect them from being eaten. In cold deserts, there are few plant species and most are less than 1 m tall. Many plants, such as sagebrush, are deciduous and have spiny leaves. Sagebrush roots can extend 30 m and absorb water when available.

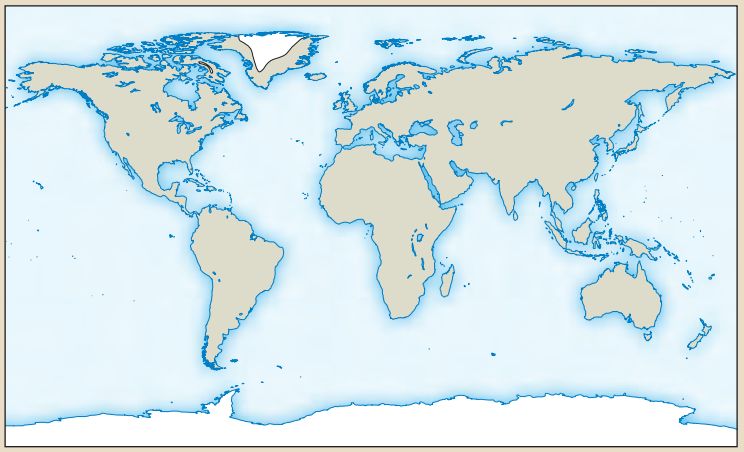
Animal adaptations: In the hot desert, reptiles are common and have thick skin and scales that prevent water loss. Animals such as desert spadefoot toads and scorpions bury themselves in the ground and sleep during times of heat and drought. Animals are active mainly at night when temperatures are lower. In the cold desert, fan-throated lizards, small mammals, such as foxes, coyotes, jackrabbits, and pocket mice burrow to escape the cold.

Scorpion

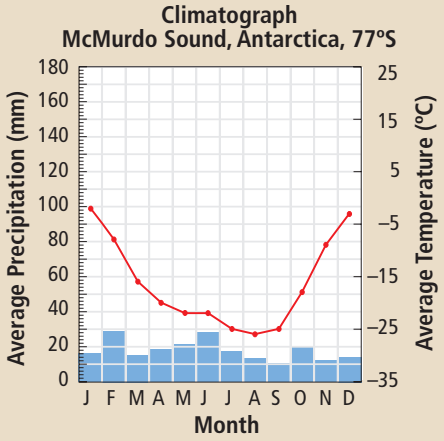
Climatograph
Yuma, Arizona, 32.5°N



Permanent Ice (Polar Ice)



King penguins of Antarctica



Location: This biome includes the polar land masses and large polar ice caps of the Arctic, Greenland, and Antarctica (shown above).

Climate: Annual precipitation is less than 50 cm, most falling as snow. Antarctica has recorded a temperature as low as −89°C. Average Arctic winter temperatures are −30°C. Average Antarctic summer temperatures range from 9°C on the coast to −30°C inland. Average Arctic summer temperatures range from 3°C to 14°C.

Physical features: This biome has very strong winds and little soil. Little fresh water is available because of freezing conditions. Antarctica is very cold almost all year-round.

Plant adaptations: Lichens (organisms that consist of fungi and algae) can tolerate drought and cold and are dark-coloured, thus absorbing more sunlight. Many species of moss survive in the Arctic, but few species of moss grow in Antarctica. There are only two flowering plants in Antarctica, but there are more than 100 species of flowering plants in the Arctic because of its brief growing season.

Animal adaptations: The Arctic has polar bears, walruses, seals, arctic foxes, and some insects. Antarctica has mostly penguins and marine mammals, such as leopard seals. Penguins have fat layers and tightly packed feathers that retain heat. Polar bears, seals, and walruses have thick coats and fat layers for warmth. Walruses have no external ear, which reduces heat loss, and they lie close together in herds of over a thousand animals, thus retaining heat.