

World Temperature Zones

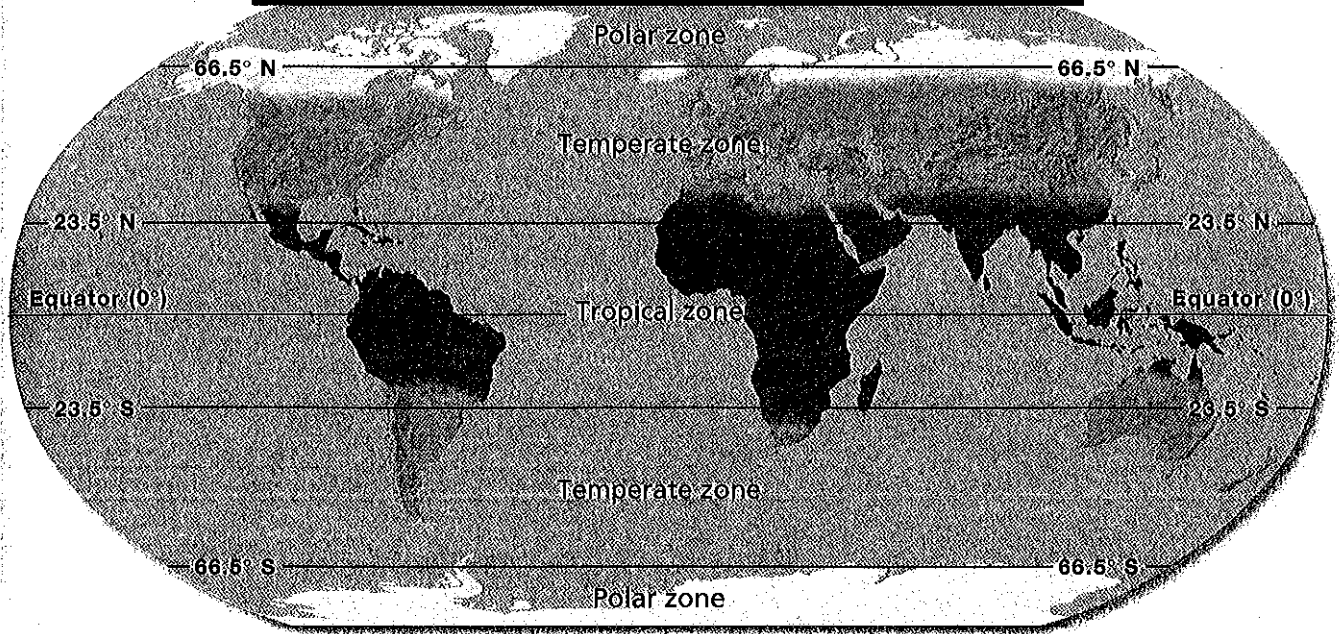


FIGURE 1

The tropical zone has the warmest climates. Cold climates occur in the polar zone. In between lies the temperate zone, where climates vary from warm to cool.

Interpreting Maps In which temperature zone is most of the United States located?

Factors Affecting Temperature

Why are some places warm and others cold? **The main factors that influence temperature are latitude, altitude, distance from large bodies of water, and ocean currents.**

Latitude In general, climates of locations near the equator are warmer than climates of areas far from the equator. The reason is that the sun's rays hit Earth's surface most directly at the equator. At the poles, the same amount of solar radiation is spread over a larger area, and therefore brings less warmth.

Recall that latitude is the distance from the equator, measured in degrees. Based on latitude, Earth's surface can be divided into the three temperature zones shown in Figure 1. The **tropical zone** is the area near the equator, between about 23.5° north latitude and 23.5° south latitude. The tropical zone receives direct or nearly direct sunlight all year round, making climates there warm.

In contrast, the sun's rays always strike at a lower angle near the North and South poles. As a result, the areas near both poles have cold climates. These **polar zones** extend from about 66.5° to 90° north and 66.5° to 90° south latitudes.

Between the tropical zones and the polar zones are the **temperate zones**. In summer, the sun's rays strike the temperate zones more directly. In winter, the sun's rays strike at a lower angle. As a result, the weather in the temperate zones ranges from warm or hot in summer to cool or cold in winter.

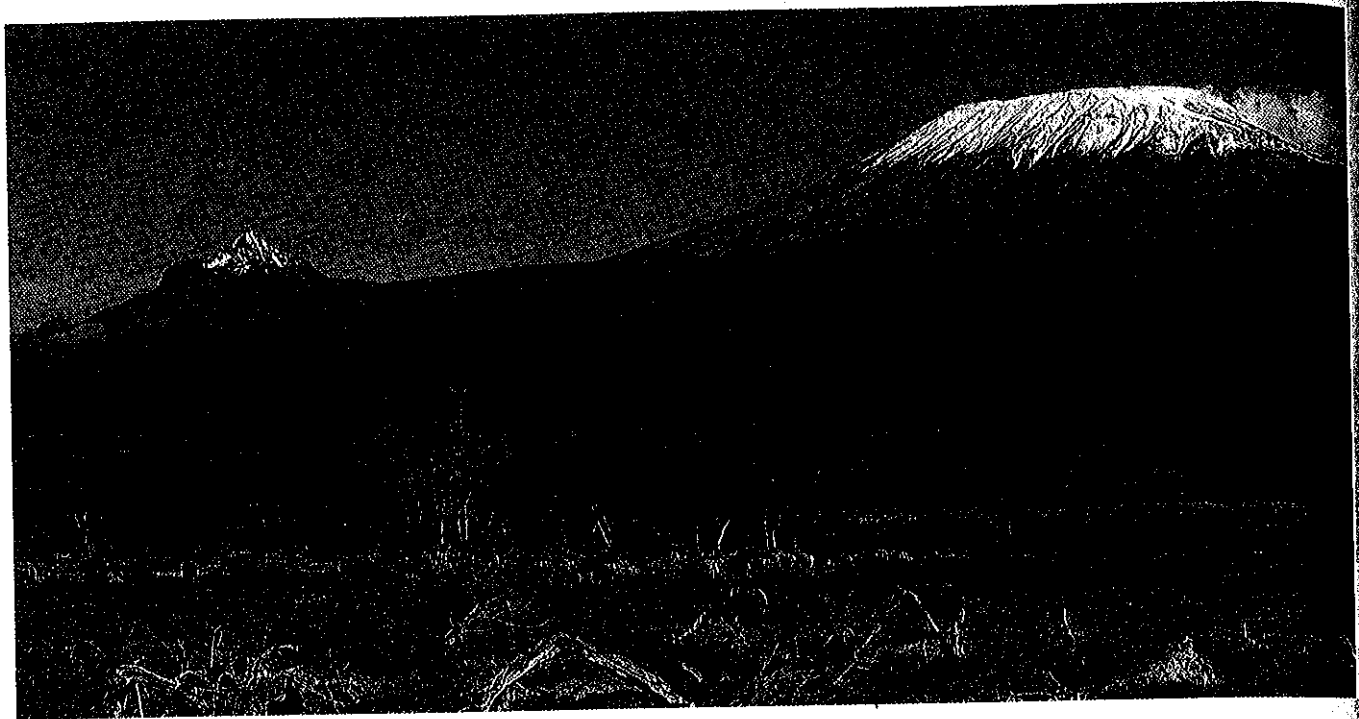


FIGURE 2

Effect of Altitude

Mount Kilimanjaro, in Tanzania, is near the equator.

Relating Cause and Effect *What factor is responsible for the difference between the climate at the mountaintop and the climate at the base?*

Altitude The peak of Mount Kilimanjaro towers high above the plains of East Africa. Kilimanjaro is covered in snow all year round, as shown in Figure 2. Yet it is located near the equator, at 3° south latitude. Why is Mount Kilimanjaro so cold?

In the case of high mountains, altitude is a more important climate factor than latitude. In the troposphere, temperature decreases about 6.5 Celsius degrees for every 1-kilometer increase in altitude. As a result, highland areas everywhere have cool climates, no matter what their latitude. At nearly 6 kilometers, the air at the top of Kilimanjaro is about 39 Celsius degrees colder than the air at sea level at the same latitude.

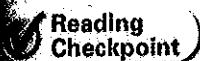
Distance From Large Bodies of Water Oceans or large lakes can also affect temperatures. Oceans greatly moderate, or make less extreme, the temperatures of nearby land. Water heats up more slowly than land. It also cools down more slowly. Therefore, winds off the ocean often prevent extremes of hot and cold in coastal regions. Much of the west coasts of North America, South America, and Europe have mild **marine climates**, with relatively mild winters and cool summers.

The centers of North America and Asia are too far inland to be warmed or cooled by the ocean. Most of Canada and of Russia, as well as the central United States, have continental climates. **Continental climates** have more extreme temperatures than marine climates. Winters are cold, while summers are warm or hot.

Ocean Currents Marine climates are influenced by ocean currents, streams of water within the oceans that move in regular patterns. Some warm ocean currents move from the tropics towards the poles. This affects climate as the warm ocean water warms the air above it. The warmed air then moves over nearby land. In the same way, cold currents bring cold water from the polar zones toward the equator. A cold current brings cool air.

As you read about the following currents, trace their paths on the map in Figure 3. The best-known warm-water current is the Gulf Stream. The Gulf Stream begins in the Gulf of Mexico, then flows north along the east coast of the United States. When it crosses the North Atlantic, it becomes the North Atlantic Drift. This warm current brings mild, humid air to Ireland and southern England. As a result, these areas have a mild, wet climate despite their relatively high latitude.

In contrast, the cool California Current flows southward down the West Coast of the United States. The California Current makes climates along the West Coast cooler than you would expect at those latitudes.



Reading Checkpoint

What effect do oceans have on the temperatures of nearby land areas?

Lab
zone

Skills Activity

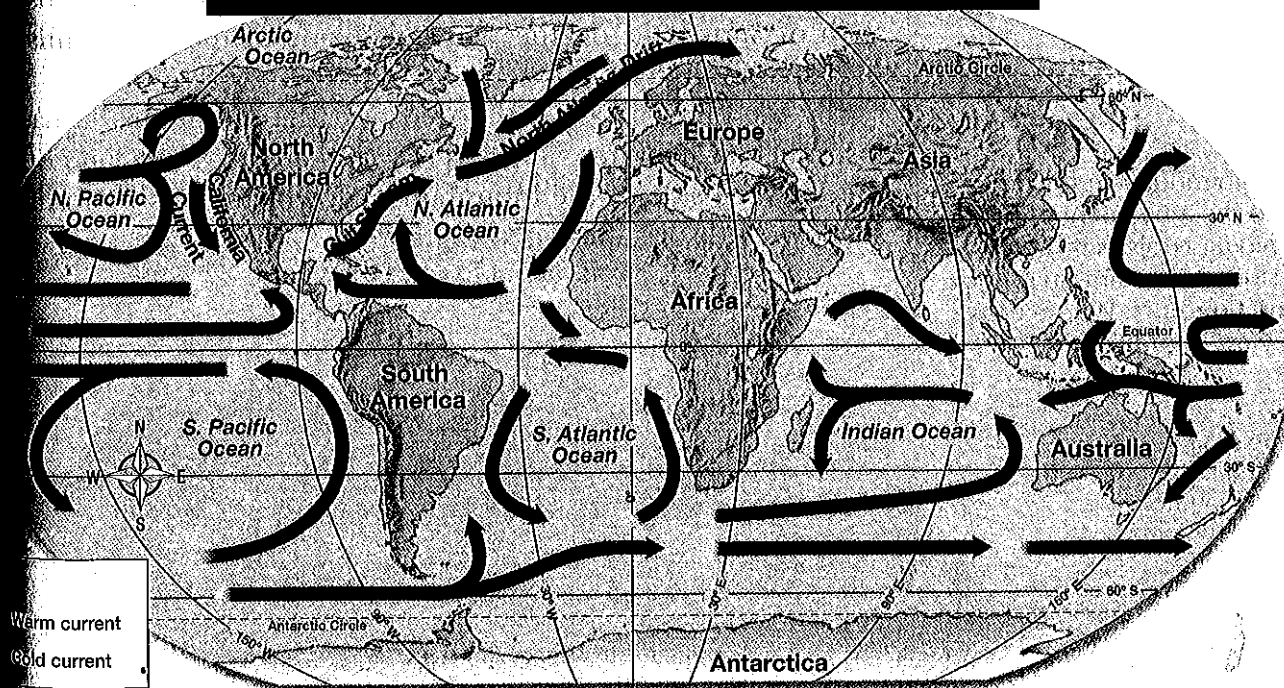
Inferring

Look at the currents in the South Pacific, South Atlantic, and Indian oceans. What pattern can you observe? Now compare currents in the South Atlantic to those in the North Atlantic. What might be responsible for differences in the current patterns?

FIGURE 3

On this map, warm currents are shown in red and cold currents in blue. **Interpreting Maps** What type of current occurs around Antarctica?

Major Surface Ocean Currents



Factors Affecting Precipitation

The air masses that pass over an area may bring rain or snow. The amount of precipitation varies from year to year. But over time, total precipitation tends toward a yearly average. What determines the amount of precipitation an area receives? **The main factors that affect precipitation are prevailing winds, the presence of mountains, and seasonal winds.**

Prevailing Winds As you know, weather patterns depend on the movement of huge air masses. Air masses are moved from place to place by prevailing winds, the directional winds that usually blow in a region. Air masses can be warm or cool, dry or humid. The amount of water vapor in the air mass influences how much rain or snow will fall.

The amount of water vapor in prevailing winds also depends on where the winds come from. Winds that blow inland from oceans or large lakes carry more water vapor than winds that blow from over land. For example, winter winds generally blow from west to east across the Great Lakes. The winds pick up moisture that evaporates from the lakes. As a result, areas that are downwind can receive large amounts of snow.

Mountain Ranges A mountain range in the path of prevailing winds can also influence where precipitation falls. When humid winds blow from the ocean toward coastal mountains, they are forced to rise, as shown in Figure 4. The rising air cools and its water vapor condenses, forming clouds. Rain or snow falls on the **windward** side of the mountains—the side the wind hits.

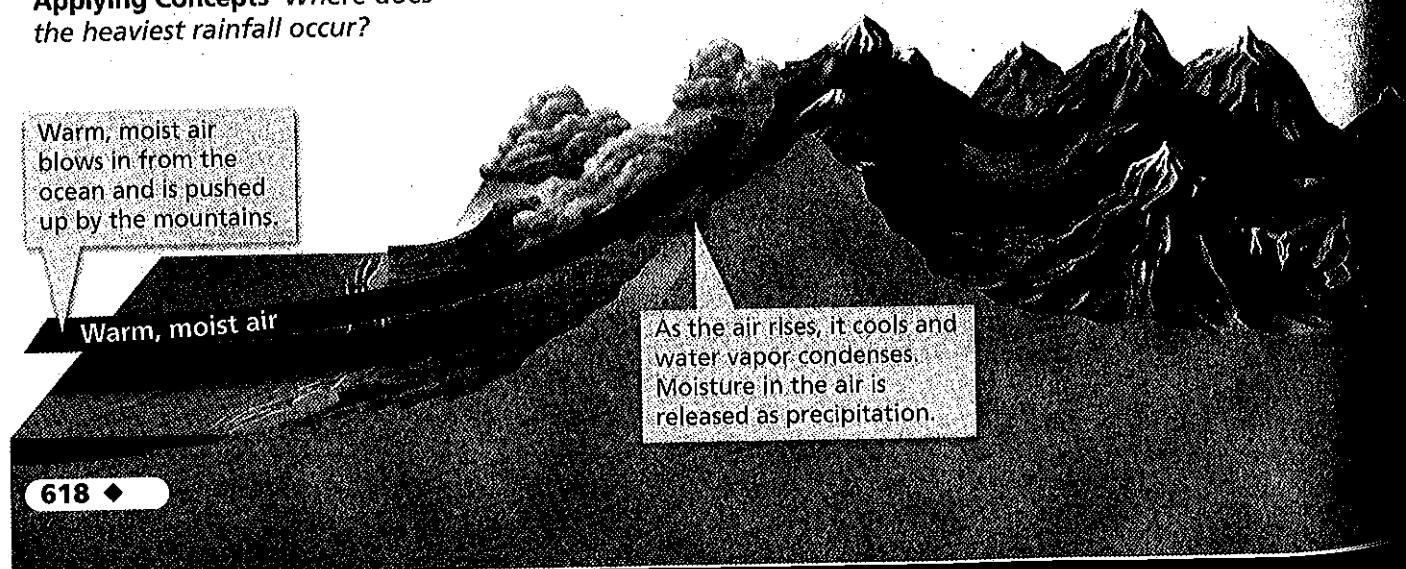
By the time the air has moved over the mountains, it has lost much of its water vapor, so it is cool and dry. The land on the **leeward** side of the mountains—downwind—is in a rain shadow. Little precipitation falls there.

FIGURE 4

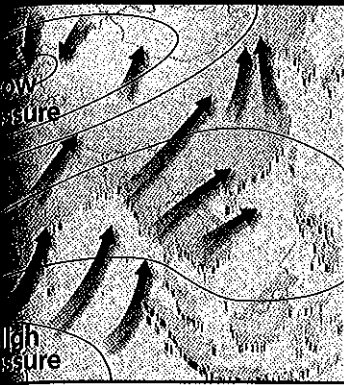
Rain Shadow

A mountain range can form a barrier to the movement of humid air. Humid air cools as it is blown up the side of a mountain range.

Applying Concepts *Where does the heaviest rainfall occur?*



Summer Monsoon



Winter Monsoon

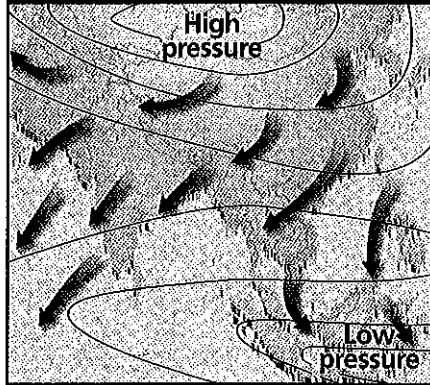


FIGURE 5
Monsoons

In a summer monsoon, wind blows from the ocean to the land. In the winter, the monsoon reverses and blows from the land to the ocean. Summer monsoons in Nepal cause heavy rain (above).

Monsoonal Winds A seasonal change in wind patterns can affect precipitation. These seasonal winds are similar to land and sea breezes, but occur over a wider area. Sea and land breezes over a large region that change direction with the seasons are called **monsoons**. What produces a monsoon? In the summer in South and Southeast Asia, the land gradually gets warmer than the ocean. A “sea breeze” blows steadily inland from the ocean all summer, even at night. The air blowing from the ocean during this season is very warm and humid. As the humid air rises over the land, the air cools. This causes water vapor to condense into clouds, producing heavy rains.

Thailand and parts of India receive much of their rain from the summer monsoons. These rains supply the water needed for rice and other crops. Monsoon winds also bring rain to coastal areas in West Africa and northeastern South America.

Regions affected by monsoon winds receive very little rain in winter. In the winter, the land cools and becomes colder than the ocean. A “land breeze” blows steadily from the land to the ocean. These winds carry little moisture.

Reading Checkpoint Why does precipitation fall mainly on the windward sides of mountains?

