CLIMATE

What Is Climate?

The condition of the atmosphere at a specific time in a specific place is known as the **weather**. **Climate** is the average weather of a region over an extended period of time. A number of global and local, natural and human-made factors affect climate.

The Causes of Climate

The two most important factors that determine the characteristics of climate are temperature and precipitation. Temperature and precipitation, in turn, are affected by a number of other factors.

One key factor affecting climate is **latitude**. Because the Earth is a globe, the sun's rays hit the equator more directly than they do near the poles. This means the sun's radiation is more concentrated near the equator and the same energy is more spread out nearer the poles.

A se ees on its axis as it r nd Southern h m the sun's rays. er temperatu s predictabl rth and south of th mperature swings throughout the year, including hot summers and cold winters. The poles, because they receive the most indirect radiation from the sun, are exceptionally cold throughout the year and have alternating periods of six months of sunlight and six months of darkness (hence the saying, "Land of the midnight sun.")

Climates are also affected by winds. Various regions of the Earth have winds that blow mostly from one direction. They have an important impact on the region's climate because they influence temperature and moisture in the area. These are called **prevailing winds**. Prevailing winds that travel across water are more humid as they pick up water vapor. Prevailing winds that travel across broad expanses of land tend to be very dry.

Geographical features, like mountains, also affect climate. There are two ways that mountains affect climate.

- First, the climate at the top of the mountain is colder than at the foot of the mountain because the atmosphere is less dense and therefore cannot hold as much heat.

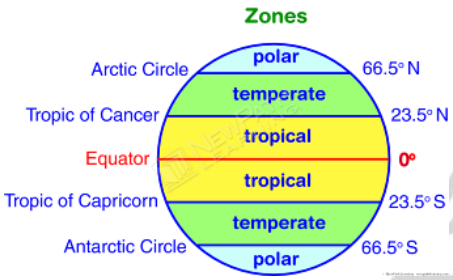
- Second, mountains affect the distribution of precipitation (rain and snow). When moisture-laden clouds come to a mountain, they are pushed upward. The altitude of mountains causes air to rise and then cool. When it cools, rain or snow comes out of the air mass. The air mass is now dry as it descends the other side of the mountain. The dry air now absorbs moisture. The result is a desert environment. This is called the **rain shadow** effect.

Another factor affecting climate is ocean currents. The oceans' surface currents help distribute temperatures around the globe. Cool polar surface currents move toward the equator bringing cooler temperatures to southern regions. By contrast, warm tropical surface currents from the equator carry warmer temperatures to northern regions.

Lesson Checkpoint:
Name two ways that mountains affect climate.

Climate Regions and Types of Climate

Climate zones are geographical regions of relatively similar climate with similar temperatures and precipitation. Latitude defines these zones. The climate zones between the equator and 23.5 degrees North and South are **tropical zones.** The climate zones between 23.5 degrees and 66.5 degrees North and South of the equator are described as **temperate zones.** The climate zones between 66.5 degrees North and South and the poles are the **polar zones**. Temperature and precipitation are highest at the equator and both gradually decrease toward the poles.



Climates are usually described not only by their average temperature and precipitation, but also by the flora and fauna that particular climate supports. The term **biome** refers to a large geographical region, the climate found there *and* the plants and animals that live in that region. Many of the world's different biomes are described below.

The biome characterized by low precipitation (0 to 25 cm/yr), soil poor in organic matter and average temperatures between 60 and 120 degrees F is the **tropical desert**. A similar biome is the **temperate desert**. Temperate deserts and tropical deserts are very similar in regard to plant and animal life, annual precipitation and soil quality. Th serts can be much c

The cm/yr, average te scattered trees, and **opical savanna**.

The prairies of North America have the most fertile soil of all of the biomes. Average annual precipitation is about 60 cm/year. Temperatures vary widely from very hot summers to very cold winters (upwards of 100 degrees F in the summer and 20 below zero F in the winter.) The land supports large grazing animals like bison. This biome is called the **temperate grassland**.

The biomes known as the tundra and taiga belong to the polar zone. The **tundra** is marked by low temperatures and very short growing seasons. Tree growth here is limited. Instead, small shrubs and small plants like grasses, lichens and mosses are abundant. The **Arctic tundra** is the large region indicated in this map near the North Pole. A**lpine tundra** is found high in mountainous regions.

Just south of the tundra is the biome called the **taiga**. It is marked by coniferous forests, acidic soil, and relatively low annual precipitatio rs roam this biome where tree growt

A **temperate forest** is a biome marked by very rich soil, thick woods of maple, cherry and oak trees. It is inhabited by birds, squirrels, owls and other woodland creatures. As the name indicates, this biome is found in temperate regions where temperatures and precipitation allow rich deciduous forest growth.

Lesson Checkpoint: Describe one biome.

What causes climate change?

Climate change is both a natural phenomenon as well as one created by human activity.

Geologic evidence has shown that there have been a number of **glacial** and **interglacial** periods. During glacial periods, dramatic decreases in global temperatures have allowed the advance of massive ice sheets from the North Pole well down the North American continent. During interglacial periods, global warming melted the glaciers causing the leading edge of the glaciers to retreat back to more northern regions.

Glacial and interglacial periods are episodes that occur within **ice ages**. There are a number of theories explaining the cause or causes of ice ages. The Milankovitch Theory says that changes in the Earth's orbit around the sun and changes of the tilt of the Earth on its axis combine to cause periods of glaciation and other periods of warming. (This theory was proposed by the Yugoslavian scientist Milutin Milankovitch.)

Another theory proposes that the ice ages occurred because a single land
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These are all theories. Studies continue and more theories will most likely be developed as our knowledge of Earth history increases. It is always possible, if not probable, that a combination of these factors each had a role to play in the ice ages. The ice ages indicate that the Earth has experienced periods of global cooling and global warming.

Global Warming Theories

Many scientists believe that we are now in another period of global warming. This time, however, human activity may be a cause in this trend. Energy from the sun comes to the Earth as electromagnetic radiation. This energy causes materials to heat up.

The heat created at the Earth's surface is held near the surface by a natural phenomenon called **the Greenhouse Effect**. We tend to think of the greenhouse effect as a phenomenon caused by the emission of massive amounts of greenhouse gases created by burning

fossil fuels. The greenhouse effect, however, is the natural process by which gases hold heat near the Earth's surface. Without this effect, Earth would not be habitable because it would be too cold. However, the concern is that the creation of massive amounts of **greenhouse gases** from the burning of fossil fuels could be enhancing this natural phenomenon and causing more dramatic global warming than otherwise would occur.

There are a number of factors influencing global warming. Gases like carbon dioxide from burning fossil fuels (oil, natural gas and coal) accumulate in the atmosphere. This is compounded by massive deforestation which removes trees and plants that consume carbon dioxide in the process of photosynthesis.

Greenhouse gases are also produced by volcanoes, decomposing plant material (like swamp gases), and other natural sources.

Global warming will lead to a number of environmental changes which in turn will dramatically affect climates and biomes all over the world. Some of the evidence that is presently cited as proof of a global warming trend includes the melting polar ice caps, changes in regional w
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Ozone and Ozone Depletion

The Earth is protected from harmful ultraviolet radiation from the sun by a layer of **ozone** in the atmosphere. Ozone is a molecule of three oxygen atoms. When ozone forms near the Earth's surface it is considered pollution and hazardous to human health. But when it forms in the stratosphere, it filters out harmful ultraviolet radiation from the sun. Exposure to ultraviolet radiation is known to be a cause of skin cancer and may also be linked to damage to the eyes.

In the 1970's scientists determined that a type of chemical called chlorofluorocarbons (CFC's) was destroying the ozone layer and literally leaving a hole in it. Environmental laws were enacted that eliminated production and use of chlorofluorocarbons.

Lesson Checkpoint:
How does the ozone layer help humans?