

Weather

Weather is what the lower atmosphere is like at any given place and time. Weather describes a short period of time.

Climate is the average weather pattern of a region. Climate is the measure of weather patterns over a long period of time.

Meteorologists are scientists that study the weather.

Weather Instruments

Thermometer – a tool used to measure temperature

Anemometer – a tool that indicates wind speed

Wind Vane – a tool that indicates wind direction

Rain gauge – a tool that measures the amount of precipitation that falls during a particular time period

Barometer – a tool used to measure air pressure (barometric pressure)

Hygrometer – measures humidity – the amount of moisture in the air.

Air pressure is the measure of air pressing down on a given area of Earth's surface. Air pressure measuring 29.5 and higher indicates sunny or fair (happy) weather. Air pressure measuring lower than 29.5 is rainy, stormy (lousy) weather.

Global Wind Zones

Trade Winds – a belt of winds set in motion around Earth by air moving from high pressure zones toward the low pressure at the equator. Located in the tropical climates zone.

Prevailing Westerlies – winds from the west. The United States is in the zone of westerly winds.

****Weather Patterns in the United States move from west to east.****

Polar Easterlies – Cold dry air at the poles has high pressure. It moves down toward 60° latitude, forming winds. Easterly means the wind blows from the east. Located in the polar climate zone.

Factors that Affect Climate

Latitude – The Sun's energy is more intense at the equator where the Earth receives direct sunlight. The sun's energy disperses from the equator and strikes the Earth's surfaces at different angles due to its shape. Latitudes closer to the equator are where the temperatures are the warmest. As latitude increases, temperatures become cooler.

Bodies of Water – because land and water heat at different rates, temperatures over land are warmer in summer and cooler in winter than they are over land at the same latitude. Large bodies of water can also cause increased precipitation, such as lake effect snow.

Wind patterns – Westerlies, which are found in middle latitudes, bring warm, moist air to the west coast. They push air masses and fronts across the country.

Elevation – Altitude is a measure of how high above sea level a place is. As elevation rises, the temperature decreases.

Climate Zones

Tropical Zones – Near the equator, temperatures are high all year. Rainfall is plentiful. At about 30° latitude in each hemisphere are deserts, areas of high temperatures and low precipitation.

Temperate Zones – In the middle latitudes, summers are warm and winters are cool or cold. Precipitation may be plentiful. The United States is in the temperate zone.

Polar Zones – At high latitudes, winters are long and cold. Summers are short and warm. Precipitation all year is low.

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Breezes

Warm air is less dense than cold air. **Warm air rises** because it is less dense.

Water and land heat at different rates. Land heats up faster in the sunlight than water does. Land also cools off faster than water. Air moves because of the uneven heating of the surface of the Earth by the sun and this moving air is called **wind**.

The rate at which water and land heat up and cool down causes breezes.

Sea Breeze - During the day, when the land is warm, the warm air rises over the land. Cooler air from over the ocean replaces the rising warm air. A wind blows on to the land *from* the sea.

Land Breeze - At night, air over the land cools more rapidly than the air over the water. Warm air from over the ocean rises over the ocean. Cooler air from over the land replaces the rising warm air. A wind blows toward the water *from* the land.

Air Currents

The **jet stream** is a narrow band of air that moves around the earth at relatively high speeds.

Air currents moving from the North Pole and South Pole bring cool or cold air, causing temperatures to be lower.

Air currents moving from the Equator bring warmer air, causing warmer temperatures.

Prevailing winds and upper air currents are most often responsible for the movement of air masses.

Ocean currents also affect temperature on land.

Ocean currents that move from the equator bring warmer weather. Ocean currents that move from the poles (the Arctic and Antarctic Circles) bring colder weather.

El Nino and La Nina change normal weather patterns.

Fronts

An **air mass** is a large body of air with the same temperature and moisture throughout.

A **front** is a boundary between air masses with different temperatures. (When cold air masses meet warm air masses.)

A **cold front** occurs when cold air moves in under a mass of warm air. Cold fronts often bring brief, heavy storms. After the storm, the skies are usually clearer, and weather is usually cooler and drier.

A **warm front** occurs when warm air moves in over a cold air mass. Warm fronts often bring light, steady rain or snow. Afterward the weather is usually warmer and more humid.

A **stationary front** is an unmoving front where a cold air mass and a warm air mass meet.

An **occluded front** is formed when a cold front moves in under a warm front.

Hurricanes are very large, swirling storms with very low pressure at their center. They form over warm, tropical oceans, near the equator.

Lake effect snow is a storm that results from a blast of cold air meeting a large body of warm water. The cold air picks up water vapor, which quickly condenses and is deposited as snow.

The rain shadow effect happens in areas that have mountain ranges. Warm air moves up the slope of the mountain, cooling as it rises. As it cools, this causes condensation.

The front of the mountain is called the **windward side** of the mountain. Because of the warm air rising and cooling, there is more condensation. This causes the windward side of the mountain to have more rain, and therefore, more vegetation (plant life).

The backside of the mountain is called the **leeward side** of the mountain. As air moves down the leeward side, it warms and expands. The leeward side of the mountain often has deserts due to the dry, warm air that is left. Therefore, it has little plant life.

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Clouds

Clouds form when warm moist air meets cooler air. The warm air rises and cools, the water vapor in it condenses into tiny water droplets, and it forms clouds.

Water vapor is water in the form of a gas. The warmer the air, the more water vapor it can hold.

Stratus clouds – form in blanket like layers. These clouds usually form at low altitudes and cover large areas of the sky. Stratus clouds often indicate rain, and in winter months, snow.

Cumulus clouds- puffy white clouds with a flat bottom. Cumulus clouds indicate sunny or *fair weather*. Cumulus clouds can bring thunderstorms if they grow larger. Cumulus clouds that bring thunderstorms are called **cumulonimbus** clouds.

Cirrus clouds – thin wispy clouds that form high in the sky. Cirrus clouds are made of ice crystals. Cirrus clouds can indicate a change in the weather.

Clouds are classified by shape and altitude. Stratus, cumulus, and cirrus indicate their shape. Altitude is classified by the following prefixes:

Cirro – clouds that form at high altitudes.

Alto – clouds that form at middle altitudes.

Strato – clouds that form at low altitudes

When **nimbo-** or **-nimbus** is added to a cloud name, it indicates rain or other precipitation.

A cloud at ground level is **fog**. Fog is a stratus cloud that forms near Earth's surface.

The Water Cycle

The Water Cycle consists of water rising into the air as gas (Evaporation), the gas turning back into a liquid inside of clouds (Condensation), the water falling back to the Earth (Precipitation), and the water running back into bodies of water (Run-off). This process happens over and over again.

Energy from the sun drives the water cycle.

Precipitation occurs when cloud droplets or ice crystals join together and become heavy enough to fall from the cloud. Some examples of precipitation are rain, snow, sleet, and hail. If there is less precipitation than normal in a location over a period of several years, there may be a drought.

Evaporation is the process in which a liquid changes into a gas. (This gas is water vapor.) When water is heated, it evaporates into the warm air.

Condensation is when water vapor (gas) turns back into a liquid. As water vapor rises high in the sky, it cools and condenses. Condensation forms clouds. It can also happen on the outside of a cold glass on a hot day. The water vapor turns into droplets of water on the side of the glass.

Runoff is water that runs off of Earth's surfaces. It can run into streams, oceans, lakes, rivers, or other bodies of water. It also causes puddles after a rain storm.

Heat Transfer

Heat is transferred in three ways – conduction, convection, and radiation.

Convection takes place when warm particles move in currents. Water boiling in a pot or wind currents are examples. Warm air or water rises, and cooler air or water sinks down.

Conduction occurs when particles are in contact with each other. For example, when a pot heats directly on a stove top.

Radiation is heat transfer through electromagnetic waves. This heat transfer can occur through matter or through empty space. An example is a person warming their hands by a fire.

Conductors are materials in which energy passes through easily. Examples are metal, glass, iron, or aluminum.

Insulators are materials that do not allow energy to flow through it easily. Examples are rubber, plastic, wood, or styrofoam.

When materials are heated, their volume can increase. This is what causes the fluid in a thermometer to increase during warm temperatures. The fluid increases in volume when heated.