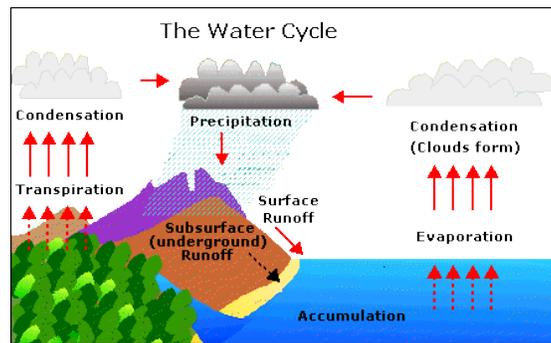


The Water Cycle

The **water cycle** is the journey water takes as it circulates from the land to the sky and back again.

The Sun's heat provides energy to evaporate water from the Earth's surface (oceans, lakes, etc.). The water vapor eventually condenses, forming tiny droplets in clouds. When the clouds meet cool air over land, precipitation (rain, sleet, or snow) is triggered, and water returns to the land (or sea). The water flows downhill as runoff (above ground or underground), eventually returning to the seas as slightly salty water. And then the cycle starts over.



Water naturally exists on Earth in all three states:

1. solid (e.g., hail, snow, ice)
2. liquid (e.g., rain, lakes, oceans)
3. gas (e.g., in the air)

Weather

The Earth's **weather** is greatly affected by the sun. The sun heats some parts of the planet more than others. The equator receives more heat from the sun than the north and south poles. And the land in each of these areas heats up faster than the bodies of water.

These differences in temperature cause changes in temperature, air pressure, precipitation, and wind around the world.

Many of the changes occur in a predictable way, and allow scientists to forecast future weather conditions.

The way air masses move affects weather in a predictable way. When a cold air mass overtakes a warm air mass, it is referred to as a cold front. Rainy conditions can be expected in the area between the two air masses, as the cold air lifts the lighter, warm air mass and replaces it. After that, cooler weather can be expected.

Looking at the sky can also offer clues about the weather. Certain clouds indicate certain weather. Cirrus clouds are white, wispy, thin clouds located high in the troposphere. They are usually associated with pleasant weather.

Stratus clouds are low clouds that seem to cover the sky with a gray blanket. These clouds can mean light rain. Cumulonimbus clouds are tall, fluffy heaps of clouds which indicate thunderstorms and other types of violent weather.



This satellite image shows the water vapor over the U.S. at a certain altitude in the atmosphere.

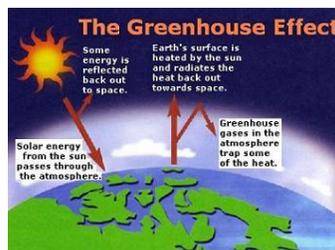
Picture found at <http://www.goes.noaa.gov/GIFS/ECW2.JPG>.

SEASONS AND CLIMATE

The tilt of the Earth on its axis is responsible for the patterns of weather we know as the seasons. As the seasons change, different parts of the Earth are heated more or less than other parts. These patterns are also used to predict what types of weather can be expected. Patterns of weather over a long period of time create the **climate** of an area.

Climate is influenced by many things, including rainfall, temperature, and location. Even though an area's climate is basically stable, it can change over long periods of time.

For example, greenhouse gases trap heat in our atmosphere. An increase of these gases traps more heat. This extra heat affects the whole world. It can create changes over hundreds of years. Higher temperatures may be found in all climate zones around the world in the future. An extreme condition could be severe drought.



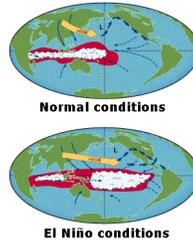
Picture adapted from http://www.climatechange.gc.ca/english/climate_change/understanding.asp.

Predictable patterns in weather influence the temperature, wind speed, precipitation, air pressure, and even cloud cover.

For example, we know the equator is the warmest region on Earth. The warm air rises, and the difference in air pressures causes winds, carrying heat from these warm areas to cooler areas. This happens constantly as air masses try to reach a balance in temperature around the world. Thus, the atmosphere is always in motion. Fronts develop between the warm and cold air masses. The fronts and low pressure areas cause warm air to rise and form clouds and precipitation.

EL NIÑO

Other predictable weather patterns occur less frequently. For example, "**El Niño**" is a short term change in the climate of the Pacific. It usually occurs every 3 to 7 years, when strong westward-blowing tradewinds in the Pacific Ocean subside, allowing warm Pacific waters to shift slowly eastward.



Picture adapted from <http://www.soest.hawaii.edu/soest/about.research.html>.

Because the atmosphere and ocean are closely related, weather is impacted. The southeastern US can expect a wet winter from this phenomenon. The West Pacific can expect droughts. Australia has experienced bush fires as a result of El Niño. When there is extra rain in one area of the world, drought can generally be expected in another.

Weather

Many factors influence our daily weather. Weather is one thing in our lives that influences our day-to-day living and is also always changing. Weather influences everything from the type of clothes we wear to the outdoor activities we can perform.

Weather is the condition of the outside air at a certain time and place.

Weather has many features. It can be hot or cold, moist or dry, calm or windy, cloudy or clear. **Temperature** is the degree of heat or cold.

Weather is influenced by many conditions in the atmosphere including heat energy, moisture in the atmosphere, the winds, and the air pressure itself all interacting to create our weather and weather patterns.

Even though the Earth is warmed by the sun's rays shining down and by heat rising from the surface, the air temperature varies from area to area.

The warmest areas on Earth are at or near the **equator**, the imaginary line that wraps around the middle of the earth. The farther away from the equator an area is the colder the overall weather will be. The areas that are closest to the equator receive the most direct sunlight from the sun's rays. More direct sunlight means warmer temperatures for that area.

JET STREAM

The jet stream can also influence the weather. The jet stream is a high-speed wind current located high up in the atmosphere. The jet stream can cause air masses in the lower atmosphere to spread out, producing areas of **low pressure**. Low-pressure areas are usually the center of local storms.

CLOUDS

Another factor that influences the weather is moisture in the air. Moisture in the air condenses and that air can then fall to the earth as rain, hail, snow, or sleet. **Water vapor** in the atmosphere can condense into **clouds**. There are several different types of clouds.

- **Cumulus clouds** are tall and puffy. When sunlight hits these clouds, they are bright white.



- In **stratus clouds**, water droplets collect into flat shapes like pancakes. The "pancakes" can be thick or thin. Stratus clouds can often be seen as low, grayish clouds that cover the whole sky, like fog that doesn't reach the ground.



- In **cirrus clouds**, water droplets collect to form thin curves with no clear shape. Cirrus clouds are found high in the sky (at about 18,000 feet or above).



- The **cumulonimbus clouds** can't hold all their water droplets. These drops can become so heavy that they fall as rain, snow, or hail. These clouds look tall, puffy, and gray. They may bring thunder and lightning.



Important weather map symbols are shown below:



Warm front—A warm front is a "boundary" that is created when a warm air mass moves in to meet an area of cold air.



Cold front—A cold front is a "boundary" that is created when a cold air mass moves in to meet an area of warm air.



Stationary front—A stationary front occurs when a warm air mass has met a cold air mass and both air masses are at a standstill.



Trough—A trough is an elongated area of low pressure.

Climate

Weather and climate are both ways of looking at weather conditions.

Weather looks at *short-term conditions* and describes conditions in a certain place at a certain time. **Climate**, on the other hand, looks at *long-term weather patterns* and describes the weather that is usual for a certain area.

For example, saying that today was warm and sunny is describing the weather. Saying that conditions in summer are normally warm and sunny is describing the climate.

The climate of an area is defined based on the weather patterns of the area. Some of the major types of climate and their weather patterns are listed below.

- **Polar** climates have cold temperatures throughout the year and snow.
- **Desert** climates have very low rainfall and high temperatures throughout the year.
- **Temperate** climates have moderate rainfall and moderate temperatures, and both remain about the same throughout the year.
- **Tropical** climates have moderate to high temperatures throughout the year. Tropical climates also have a wet season and a dry season.



A **polar** climate has continual cold temperatures, and usually a lot of snow and ice.



Species that can survive for long periods without water, such as cacti, are well-suited for the **desert** climate.



Seattle, Washington has a **temperate** climate with moderate temperatures and rain year-round.



A tropical climate will have a yearly wet season.

Weather data is compiled and used to understand the climate of an area and to show any trends in weather patterns. Temperature and rainfall data throughout the year can indicate the type of climate. Temperature, rainfall, and snowfall data throughout the year can also show seasonal trends. Wind is also commonly measured and trends in wind speeds and directions are identified.

Measurements of *barometric pressure* and *humidity* can also be used to predict weather patterns: Low humidity normally indicates dry conditions, while high humidity indicates wet conditions. Low barometric pressure usually means rain, while high barometric pressure usually means sunny weather.

The weather that an area experiences also depends on its *geography*. This includes its placement on earth, such as places near the poles experiencing lower temperatures than places near the equator. This also includes *local geography*, with mountains and water bodies having a major impact on an area's weather and climate.

BODIES OF WATER

Water bodies are important because clouds form over water bodies as the water evaporates. Places near water bodies tend to have more rain because the clouds produced then release the water as rain.

In the ocean, clouds forming over the sea can create tropical storms. This occurs when a low pressure region over the ocean causes air and water vapor to be pulled up and to form a spiral. The tropical storm can become a hurricane or cyclone and impacts the weather of places on land near where it is forming.

The oceans are also important because of the winds that travel across them. These winds have set patterns and this affects the climate of areas that are in the wind's path. At the coast, sea breezes blow in from the sea during the day, and normally blow toward the sea at night. This is a daily trend that is part of the coastal area's climate.

MOUNTAINS

Mountains are important because of the effect that they have on rainfall. Rain clouds normally blow in from the coast toward mountain ranges. As the wind blows the clouds over a mountain, the clouds cool, condensing more, and the water is released as rain.

The rain normally falls on the near side of the mountain, which is the side that the wind hits first. Because the rain falls before it crosses the mountain, the far side usually receives very little rain.



This mountainside is green because it faces the sea, and so receives a lot of rain and humidity.