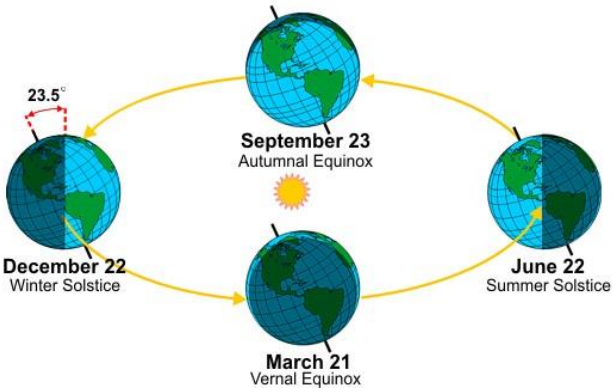
Conditions Controlling Weather

There are many conditions on earth's surface and in the atmosphere which control the weather and cause it to change quickly. To understand these conditions, it is necessary to know where these conditions occur and why.

1. Air Temperature

The part of the atmosphere nearest the earth picks up a great deal of heat from the earth which picked up some of the heat energy given by the sun. The top layer of the stratosphere is warmer than other layers of the troposphere. As air close to the earth is heated, the gas molecules move farther and farther apart causing the air to become lighter in weight. The lighter, warmer air rises. The heavier, cooler air moves toward the surface of the earth.
The time of the day and time of the year also control temperature. The sun is the earth's main source of heat. It is warmer in summer than in winter because the hours of sunshine are longer and the sun's rays hit the earth more directly. Thus, more light energy is received and changed into heat.



2. Air Pressure

Because air has weight, it presses on all the objects it touches. Air pressure is controlled by the temperature of the air, the amount of water vapor in the air, and the altitude. Warm air is lighter than cold air and, therefore, has less pressure than cold air. An increase in pressure can be caused by a decrease in temperature.

3. Air currents and winds

Movements of air in the atmosphere are called air called **air currents**. Horizontal (parallel to ground) movements of air close to earth's surface are called **winds**. A wind is always named for the direction <u>from</u> which it blows. For instance, a wind is always coming from the west and blowing towards the east is called a **west wind**.
When the movements of the air are vertical, either updraft or downdrafts, they are called **convection currents**. Warm, light air raises upward as cooler air, which is denser and heavier, and sinks back to earth. Thus, air rises and falls in a **circular** flow.

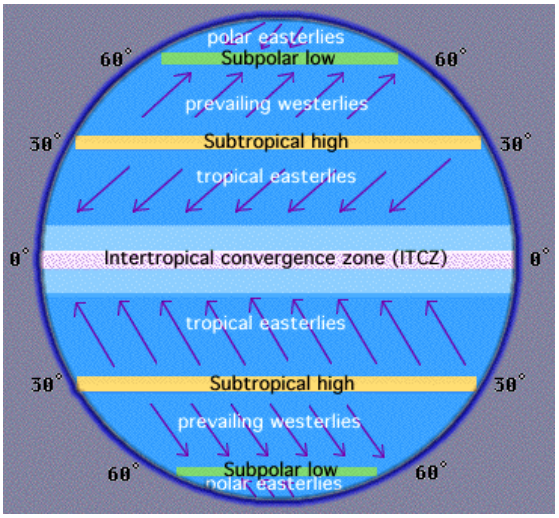
a. **Land and sea breezes**

Land heats up faster than water. On land, radiation from the sun is absorbed by a thin surface layer of soil and rock. The heat spreads out through a layer that is only a few centimeters to a meter thick. Temperatures in this thin layer can get very high. Much of this heat escapes into the air above. At night, the sun's rays no longer heat the land. Then the land begins to cool as it transfers heat to the air above it, from day to night.

When the sun's rays hit the water, the water begins to heat up. Water also loses heat more slowly than does the land. Therefore, there is only a small change in the temperature of the water and the air above it from day to nigh. Because of this difference in heating, the temperature of the air above the land is higher during the day than the temperature of the air over the water. The air over the land, being warmer and lighter, rises upward and the cooler air flows down to take its place. such air movements are called local winds.

When cool air blows from the water toward the land it called a sea breeze.

This cool air pushes up and takes the place of the warmer air over the land. Then, toward sundown, the opposite takes place. Because all the heat is near the surface, the air over the land cools faster than the air over the deep water. This cool air begins to move toward the water and is called a land breeze.



b. **Planetary winds**

There is a great wind system that blows over large parts of the earth. They move in cycles like the local winds. Differences in temperature of air over land and over water causes some of these winds.

As you know, it is hotter at the equator than the poles. The warm air around the equator rises and is replaced by polar (from the earth's poles) air. The warm air flows towards the poles. You would think that it would travel northward and southward. But, because the earth rotates, moving air shifted to the right in the northern hemisphere and to the left in the southern hemisphere.

After traveling from the equator at about 30º latitude most of the air cools and falls back to the earth on both sides to the equator. Of the air that falls back, some flows back to the equator, forming the **trade winds**. Some of the air raises and again flows towards the poles, forming winds known as the **prevailing westerlies**. The prevailing westerlies of both hemispheres flow from west to east. The air that rises at the equator and does reach the poles falls and flows back toward the equator in the form of winds called the **polar easterlies**.

4. Humidity

Water vapor in the air is called humidity. It is an invisible gas that is lighter than air. Water vapor gets into the air by evaporation. Water is always evaporating from oceans, lakes, and rivers into the atmosphere. In fact, about one million metric tons of water is changed into water vapor every day. The amount of water that evaporates depends on the temperature, the wind, and the dryness of the air.

Warm air can hold more vapor than cold air. As the temperatures rises, water evaporates faster and enters the air as water vapor. The actual amount of water vapor in the air at a certain temperature is called the absolute humidity. The greatest amount of water vapor it can possible hold at certain temperature is called its capacity. When air is holding all the water vapor it can possible hold at a certain temperature, the air is said to be **saturated**.

The ratio between the amount of water vapor in the air 9absolute humidity) and the greatest amount the air can hold at a given temperature without the vapor becoming visible (capacity) is **relative humidity**. This ratio or relative amount, tells how close the air is to being saturated.

5. Air masses and fronts

An **air mass** is a very large amount of air that has the same temperature and humidity. The temperature and humidity of an air mass are controlled by the part of the earth over which the mass forms.

An air mass can cover thousands of kilometers of the earth's surface, and it can be many kilometers high. Once formed, the air mass begins to move through the atmosphere. It keeps the same temperature and humidity for long distances as it moves. The mass may stay the same for several days. However, it may be changed by the conditions of the region over which it passes. The speed at which an air mass moves changes. It may move as slow as 8 kilometers an hour, or as fast as 40 kilometers an hour.

An air mass formed over the cold, polar regions of the earth is called a **polar air mass**, and is dry and cloudless. This cold air mass usually brings fair weather with gentle to strong winds.

An air mass that forms over humid, hot parts of the earth is called **tropical air mass**. This warm air mass holds a great deal of water vapor and has many clouds. It brings dew, fog, and steady rains.

As air masses move, sometimes a cold air mass meets a warm air mass. The boundary or surface where the two masses meet is called **front.** If a cold air mass flows under a warm

air mass a **cold front** is formed. A cold front brings heavy rains and thunderstorms. If a warm air mass takes the place of a cold air mass, a **warm front** is formed.

6. Precipitation

Water vapor in the air condenses (changes from gas to liquid) to form tiny droplets of water. When these droplets become too heavy to hang in the air they fall to the earth as rain, snow, sleet, or hail. This is known as **precipitation.**

The figure below is an illustration of the hydrologic cycle. Evaporated moisture from oceans, rivers, lakes, and soil is distributed by atmospheric processes. It eventually falls as precipitation and returns to the soil and bodies of water. The groundwater percolates downward through the zone of aeration until it reaches the level (water level) where the ground is saturated with water.