Weather

Weather Patterns

Read to Learn

Pressure Systems

Weather is often associated with pressure systems. Air pressure is the weight of the molecules in air. Cool air molecules are closer together and denser than warm air molecules. Cool air has higher pressure than warm air masses. Warm air masses have lower pressure.

A **high-pressure system** *is a large body of circulating air with high pressure at its center and lower pressure outside of the system*. Air moves from high pressure to low pressure. Because dense air sinks, it moves away from the center to areas of low pressure. High pressure systems brings sunny skies and fair weather. Air moving from areas of high pressure to areas of low pressure is called wind.

A **low-pressure system** *is a large body of circulating air with low pressure at its center and higher pressure outside of the system*. Air on the outside of the system will spiral in toward the center. This causes air inside the low-pressure system to rise. The rising air cools and the water vapor condenses. Clouds form, and sometimes precipitation, such as rain or snow, also forms.

Air Masses

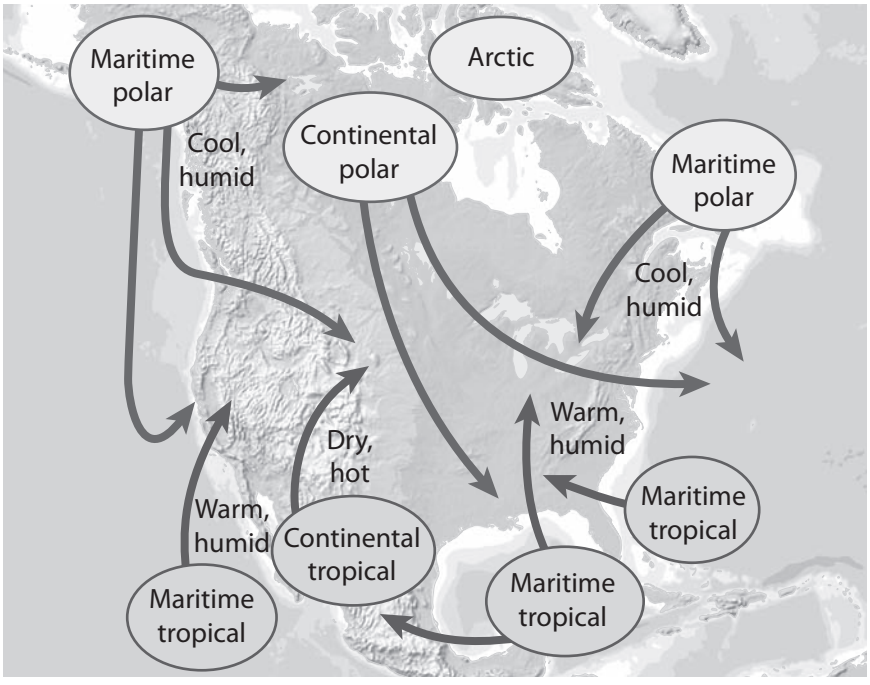
Have you ever noticed that the weather sometimes stays the same for several days in a row? Air masses are responsible for this. **Air masses** *are large bodies of air with distinct temperature and moisture characteristics*. An air mass forms when a large, high-pressure system stays over an area for several days. The air circulating in the high-pressure system comes in contact with Earth. This air takes on the temperature and moisture characteristics of the surface below it.

Air masses, like high- and low-pressure systems, can extend for a thousand kilometers or more. Sometimes one air mass covers most of the United States. Air masses affect weather patterns.

Air Mass Classification

The figure below identifies types of air masses and the regions where they form. The arrows on the map show the general paths that the air masses commonly follow. Air masses are classified by their temperature and moisture characteristics. Air masses that form over land are called continental air masses. Air masses that form over water are called maritime air masses. Air masses that form near the equator are called tropical air masses. Those air masses that form in cold regions are called polar air masses. Air masses that form near the poles are called arctic and antarctic air masses.

Air Mass Classifications



Arctic Air Masses Arctic air masses form over Siberia and the Arctic. These air masses contain bitterly cold, dry air. During the winter, an arctic air mass can bring temperatures to −40°C.

Continental Polar Air Masses Land cannot transfer as much moisture to the air as oceans can. Thus, air masses that form over land are drier than air masses that form over oceans. Continental polar air masses are fast moving. They bring cold temperatures in winter and cool temperatures in summer. Polar air masses that affect North America often form over Alaska and Canada.

Maritime Polar Air Masses Air masses that form over the northern Atlantic and Pacific Oceans are maritime polar air masses. These air masses are cold and humid. Maritime polar air masses often bring cloudy, rainy weather.

Continental Tropical Air Masses Air masses forming in the tropics over dry, desert land are continental tropical air masses. These hot and dry air masses bring clear skies and high temperatures. Continental tropical air masses usually form only during summer.

Maritime Tropical Air Masses These air masses form over the Gulf of Mexico, the Caribbean Sea, and the eastern Pacific Ocean. Maritime tropical air masses are moist air masses. They bring hot, humid air to the southeastern United States in summer. In winter, they can bring heavy snowfall.

Air masses can change as they move over the land and ocean. Warm, moist air can lose its moisture and become cool. Cold, dry air can move over water and become moist and warm.

Fronts

In 1918, Norwegian Jacob Bjerknes (BYURK nuhs) and his coworkers developed a new method for forecasting the weather. Bjerknes noticed that specific types of weather occur at the boundaries between different air masses. He used the word *front,* a military term, to describe this boundary.

A military front is the boundary between opposing armies. *A weather* **front** *is the boundary between two air masses.* As wind carries an air mass away from the area where it formed, the air mass will eventually bump into another air mass. Major weather changes often occur at fronts. Changes in temperature, humidity, clouds, wind, and precipitation are common at fronts.

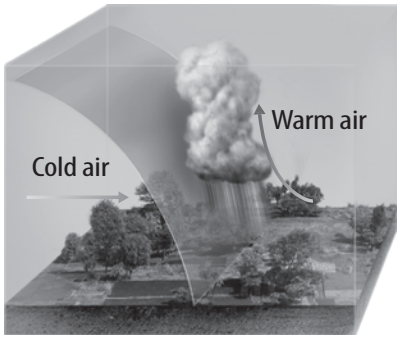
Cold Fronts

The figure below on the left shows a cold front. A cold front forms when a colder air mass moves toward a warmer air mass. Cold air is denser than warm air. As a result, the cold air pushes underneath the warm air mass. The warm air rises and begins to cool. Water vapor in the air condenses, and clouds form. Rain showers and thunderstorms often form along cold fronts. It is common for temperatures to decrease. The wind becomes gusty and changes direction. In many cases, cold fronts give rise to severe storms.

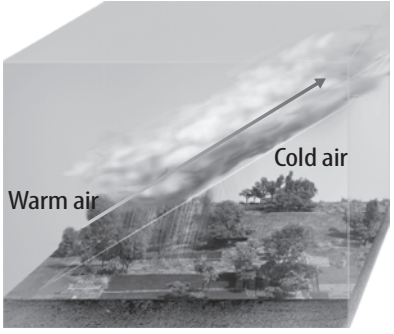
Warm Fronts

The figure on the right shows a warm front. A warm front forms when less dense, warmer air moves toward colder, denser air. The warm air rises above the cold air mass. When the water vapor in the warm air condenses, a wide blanket of clouds forms. These clouds often bring steady rain or snow for several hours or days. A warm front brings warmer temperatures and causes the wind to shift directions.

Cold Front



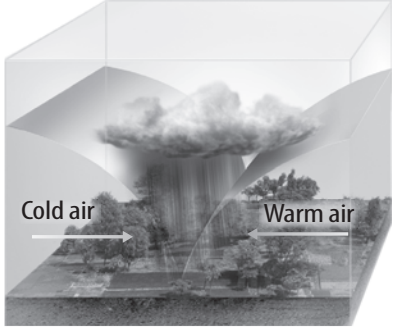
Warm Front



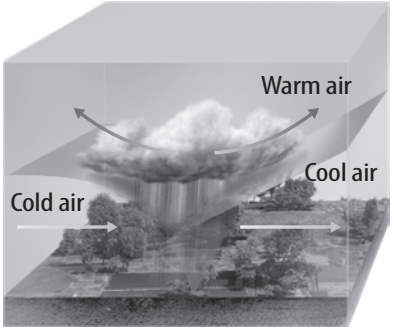
Stationary and Occluded Fronts

In addition to cold fronts and warm fronts, meteorologists have identified stationary fronts and occluded fronts. These two types of fronts are illustrated below and described on the next page.

Stationary Front



Occluded Front



Stationary Front Sometimes an approaching front stalls, or stops, for several days. Warm air is located on one side of the front and cold air on the other side. When the boundary between two air masses stalls, the front is called a stationary front. Cloudy skies and light rain are common along stationary fronts.

Occluded Front Cold fronts move faster than warm fronts. When a fast-moving cold front catches up with a slow-moving warm front, an occluded, or blocked, front forms. Occluded fronts usually bring precipitation.

Severe Weather

Severe weather can cause major damage, injuries, and death. Types of severe weather include thunderstorms, tornadoes, hurricanes, and blizzards.

Thunderstorms

Thunderstorms are also known as electrical storms because of their lightning. Thunderstorms have warm temperatures, moisture, and rising air. A low-pressure system brings these conditions. Thunderstorms can form quickly. For example, a cumulus cloud can grow into a 10-km-tall thundercloud in as little as 30 minutes.

A typical thunderstorm has three stages. During the cumulus stage, clouds form and updrafts occur. Updrafts are air currents that move vertically up from the ground. After the cumulus cloud has been created, downdrafts begin to appear. Downdrafts are air currents that move vertically down toward the ground. In the mature stage, heavy winds, rain, and lightning occur. Within 30 minutes of reaching the mature stage, the thunderstorm begins to fade, or dissipate. In the dissipation stage, updrafts stop, winds die down, lightning stops, and precipitation weakens.

Strong updrafts and downdrafts in a thunderstorm cause tiny ice crystals to crash into each other. This creates positively and negatively charged particles in the cloud. The difference between the charges of the particles in the cloud and the charges of the particles on the ground creates electricity. This electricity is seen as a bolt of lightning. Lightning can heat the nearby air to more than 27,000°C.

Lightning can move from cloud to cloud, cloud to ground, or ground to cloud. The extreme thermal energy from the lightning causes air molecules to rapidly expand and then contract. Thunder is the sound made by the rapid expansion and contractions of the air molecules.

Tornadoes

A **tornado** *is a violent, whirling column of air in contact with the ground*. Most tornadoes have a diameter of several hundred meters. The largest tornadoes are more than 1,500 m in diameter.

Wind speeds within a tornado can reach more than 400 km/h. The strong, swirling wind in a tornado can send cars, trees, and houses flying through the air. Most tornadoes last only a few minutes. The more destructive ones, however, can last for several hours.

Formation of Tornadoes A tornado forms when thunderstorm updrafts begin to rotate. Swirling winds spiral downward from the base of the thunderstorm. This creates a funnel cloud. When the funnel reaches the ground, it becomes a tornado. Swirling air is invisible. The funnel cloud you see is the dirt and debris lifted by the tornado.

Tornado Alley More tornadoes occur in the United States than anywhere else on Earth. The most tornadoes occur in an area in the central United States. This area has been named Tornado Alley. It extends from Nebraska to Texas. In Tornado Alley, cold air blowing southward from Canada often bumps into warm, moist air moving northward from the Gulf of Mexico. These conditions are ideal for severe thunderstorms and tornadoes.

Classifying Tornadoes Dr. Ted Fujita developed a system for classifying the strength of tornadoes. Tornadoes are classified on the Fujita intensity scale based on the damage they cause. F0 tornadoes cause little damage. Damage might include broken tree branches and damaged billboards. F1 through F4 tormadoes cause moderate to devastating damage. F5 tornadoes cause incredible damage. Concrete and steel buildings can be destroyed. F5 tornados can pull bark from trees.

Hurricanes

Hurricanes are the most destructive storms on Earth. *A* **hurricane** *is an intense tropical storm with winds exceeding 119 km/h*. Hurricanes typically form in late summer over warm, tropical ocean water.

Hurricanes, like tornadoes, have strong, swirling winds. A hurricane is much larger than a tornado. A typical hurricane is 480 km across, more than 150 thousand times larger than a tornado. At the center of a hurricane is the eye. The eye is an area of clear skies and light winds.

Hurricane Formation

1. Low-Pressure Area	2. Tropical Depression	3. Tropical Storm	4. Hurricane
Warm, moist air rises. As air rises, it cools. Water vapor condenses and clouds form. More rising air creates an area of low pressure over the ocean.	Air moves toward the low pressure in the center. The center begins to rotate. The storm becomes a tropical depression with winds of 37–62 km/h.	Air continues to rise and rotate. The storm builds to a tropical storm with winds of more than 63 km/h. The storm produces strong thunderstorms.	When winds exceed 119 km/h, the storm becomes a hurricane. Only one percent of tropical storms become hurricanes.

The figure above shows how a hurricane forms. Damage from hurricanes occurs as the result of strong winds and flooding. Hurricanes create high waves that can flood coastal areas. As a hurricane crosses the coastline, strong rains contribute to flooding that can damage or destroy entire areas. Once a hurricane moves over land or colder water, it loses energy and dies out. In Asia, this type of storm is called a typhoon. In Australia, it is called a tropical cyclone.

Winter Storms

Winter weather can be severe and hazardous. Ice storms can down power lines and tree branches. Driving is dangerous. *A* **blizzard** *is a violent winter storm characterized by freezing temperatures, strong winds, and blowing snow*. During a blizzard, swirling snow reduces visibility and freezing temperatures can cause frostbite and hypothermia (hi poh THER mee uh).

Severe Weather Safety

The U.S. National Weather Service issues watches and warnings for severe weather. A watch means that severe weather is possible. A warning means that severe weather is already occurring.

During thunderstorms, stay inside and away from metal objects and electrical cords. If you are outside, stay away from water, high places, and trees that stand alone. When wind-chill temperatures are below −20°C, dress in layers, keep your head and fingers covered, and limit your time outdoors.

The Sun's ultraviolet (UV) radiation also can cause health risks, including skin cancer. The weather service issues a daily UV Index Forecast. On sunny days you should cover up, use sunscreen, and wear a hat and sunglasses. Snow, water, and beach sand can double the effects of the Sun's UV radiation.