

Weather

Weather Patterns

..... Before You Read


What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.		
Before	Statement	After
	3. Precipitation often occurs at the boundaries of large air masses.	
	4. There are no safety precautions for severe weather, such as tornadoes and hurricanes.	

..... Read to Learn

Pressure Systems

Weather is often associated with pressure systems. Air pressure is the weight of the molecules in a large mass of air. Cool air molecules are closer together than warm air molecules. Cool air masses have high pressure, or more weight, than warm air masses do. Warm air masses have low 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. Heavy, high-pressure air inside the system moves away from the center. Air moving from areas of high pressure to areas of low pressure is called wind. The dense air inside the high pressure system sinks and brings clear skies and fair weather.

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. 

Key Concepts

- What are two types of pressure systems?
- What drives weather patterns?
- Why is it useful to understand weather patterns?
- What are some examples of severe weather?

Study Coach

Learning with Graphics

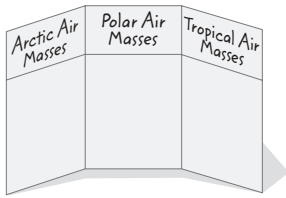
Maps, diagrams, charts, and graphs can help you understand what you've read. Trace the details on each graphic with your finger after you read the description.

Key Concept Check

1. Compare and contrast two types of pressure systems.

FOLDABLES®

Make a three-column book from a sheet of paper and record information about types of air masses.



Air Masses

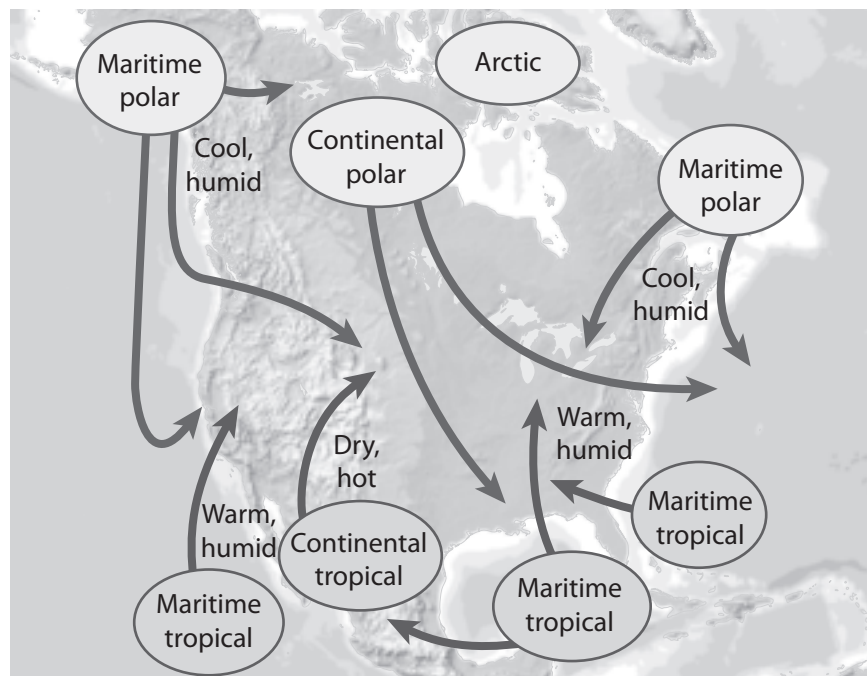
Have you ever noticed that the weather sometimes stays the same for several days in a row? Air masses are responsible for this. **Air masses** are large bodies of air with distinct temperature and moisture characteristics. An air mass forms when a large, high-pressure system stays over an area for several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



Visual Check

2. Classify Where does continental polar air come from?

Reading Check

5. Specify What types of weather are associated with cold fronts?

Visual Check

6. Describe the difference between a cold front and a warm front.

Visual Check

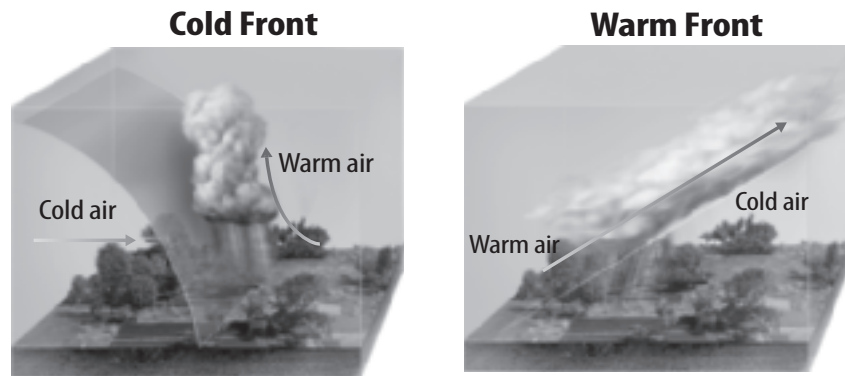
7. Contrast Highlight the label "Warm air" in both of the figures. How is the location of warm air different in the two types of fronts?

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. ✓

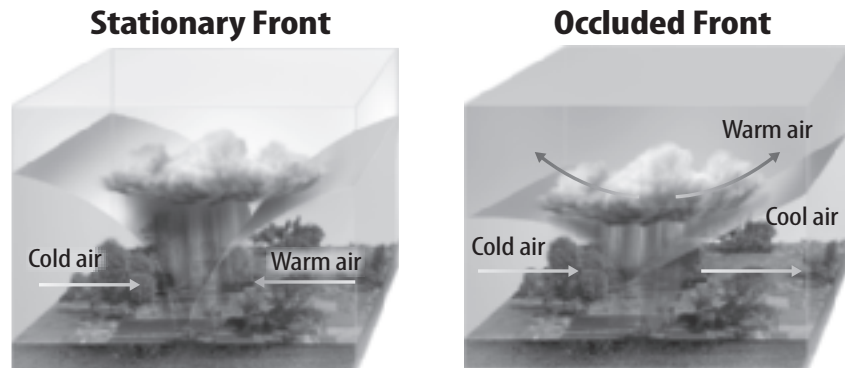
Warm Fronts

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.




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 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.

Key Concept Check

8. Interpret Why is it useful to understand weather patterns associated with fronts?

Reading Check

9. Identify At which stage of the thunderstorm can you expect it to begin to die down? (Circle the correct answer.)

- a. the cumulus stage
- b. the mature stage
- c. the dissipation stage



Think it Over

10. Apply What causes molecules in the air near lightning to make the sound known as thunder?



Reading Check

11. Explain How do tornadoes form?



Think it Over

12. Apply Would you expect an F4 tornado to cause more damage or less damage than an F3 tornado?

WORD ORIGIN

hurricane

from Spanish *huracan*, means "tempest"

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 tornadoes 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




<p>1. Low-Pressure Area 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.</p>	<p>2. Tropical Depression 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.</p>	<p>3. Tropical Storm 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.</p>	<p>4. Hurricane When winds exceed 119 km/h, the storm becomes a hurricane. Only one percent of tropical storms become hurricanes.</p>
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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. When temperatures are close to freezing (0°C), rain can freeze when it hits the ground. Ice storms coat the ground, trees, and buildings with a layer of ice. The weight of the ice can break trees and power lines.

A **blizzard** is a violent winter storm characterized by freezing temperatures, strong winds, and blowing snow. The blowing snow can reduce visibility to a few meters or less. Strong winds and cold temperatures can rapidly cool exposed skin. The loss of body heat can result in frostbite and hypothermia (hi poh THER mee uh), a dangerous condition in which a person's body temperature is lowered. 

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. Paying attention to watches and warnings is important and could save your life.

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.

Visual Check

13. Identify How do hurricanes form?

Key Concept Check

14. Summarize What are examples of severe weather?
