

# chapter 2 Weather

## section 2 Weather Patterns

### What You'll Learn

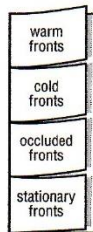
- how weather is related to fronts and high and low pressure areas
- about different types of severe weather

### Mark the Text

**Key Terms** Highlight the key terms and their meanings as you read this section.

### FOLDABLES™

**Classify** Make a four-tab Foldable as shown. As you read, take notes on the four different fronts.



### ● Before You Read

Have you ever gone into a basement or an attic? Describe how the temperature felt compared to the rest of the building.

### ● Read to Learn

#### Weather Changes

Sometimes when you leave school in the afternoon, the weather is different from what it was earlier in the morning. Weather constantly changes.

#### What are air masses?

An **air mass** is a large body of air that has the same temperature and moisture content as the area over which it formed. For example, an air mass that develops over land is drier than one that develops over water. An air mass that develops in the tropics is warmer than one that develops over northern regions. When weather changes from one day to the next, it is because of the movement of air masses.

#### How does air pressure affect the weather?

Pressure in the atmosphere varies over Earth's surface. You may have heard a weather forecaster talk about high- and low-pressure systems. Low-pressure systems are masses of rising air. When air rises and cools, clouds form. That's why areas of low pressure usually have cloudy weather. But high-pressure air masses have a sinking motion. As a result, it's hard for air to rise and for clouds to form. So, high pressure usually means nice weather.

## What are cyclones and anticyclones?

Winds blow from areas of high pressure to areas of low pressure. In the northern hemisphere, when wind blows into a low-pressure area, Earth's rotation causes the wind to swirl in a counterclockwise direction. These large, swirling areas of low pressure are called cyclones. Cyclones are associated with stormy weather. ✓

Winds blow away from an area of high pressure. In the northern hemisphere, Earth's rotation causes these winds to swirl in a clockwise direction. High-pressure areas are associated with fair weather and are called anticyclones.

## Fronts

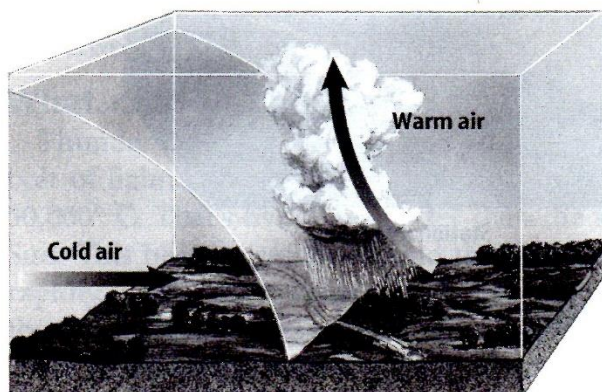
A boundary between two air masses that have different temperature, density, or moisture is called a **front**. There are four main types of fronts, including cold, warm, occluded, and stationary.

### What is a cold front?

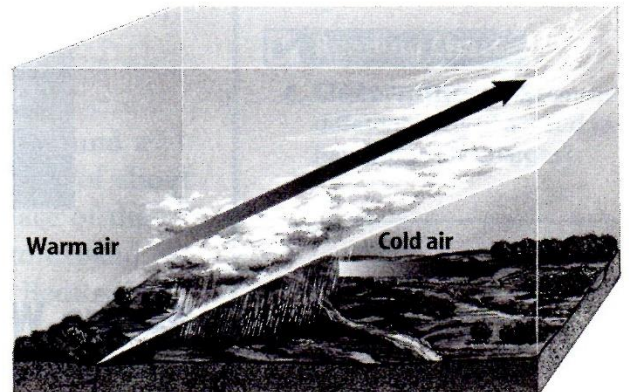
A cold front occurs when cold air moves toward warm air, as shown on the left in the figure below. The cold air goes under the warm air and lifts it. As the warm air is lifted, it cools and water vapor condenses, forming clouds. If there is a large difference in temperature between the cold air and the warm air, thunderstorms and tornadoes may form.

### What is a warm front?

Warm fronts form when lighter, warmer air moves over heavier, colder air, as shown on the right in the figure below. In a warm front, wet weather may last for days.



Cold Front



Warm Front

### ✓ Reading Check

1. **Describe** What type of weather are cyclones associated with?

### Picture This

2. **Identify** Color the arrow showing cold air movement in the cold front blue. Color the arrow showing warm air movement in the warm front red.

### Picture This

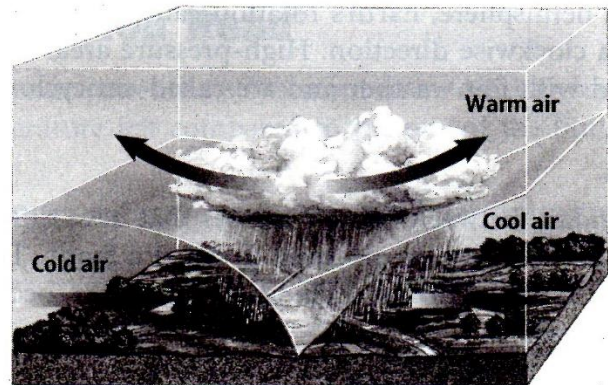
- 3. Interpret** Color the arrows red that show where the warm air is closed off from the surface in the occluded front.

### Picture This

- 4. Identify** Circle the area in the stationary front where neither the cold air nor warm air is moving.

## What is an occluded front?

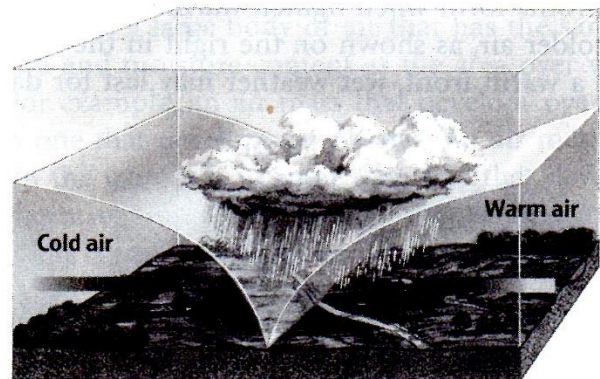
Most fronts involve two air masses. But occluded fronts involve three air masses—cold air, cool air, and warm air. An occluded front, as shown in the figure below, may form when a cold air mass moves toward cool air with warm air in between. The cold air forces the warm air up. The warm air is then closed off from the surface. The term *occlusion* means “closure.”



Occluded Front

## What is a stationary front?

A stationary front occurs when a boundary between air masses stops moving, as shown in the figure below. Stationary fronts can stay in the same place for several days. Often there is light wind and precipitation at the stationary front.



Stationary Front

## Severe Weather

You usually can do your daily activities regardless of the weather. However, some weather conditions, like blizzards, tornadoes, and hurricanes, can force you to change your plans.

## What causes thunderstorms?

During thunderstorms, heavy rain falls, lightning flashes, and thunder rumbles. Hail might fall. What causes these weather conditions?

Thunderstorms occur in warm, moist air masses and along fronts. Warm, moist air is forced up. It cools and condensation begins, forming cumulonimbus clouds. When rising air cools, water vapor condenses into water droplets or ice crystals. Smaller droplets collide and form larger ones. The larger, heavier droplets fall through the cloud toward Earth's surface. The falling droplets collide with more droplets and get bigger. Raindrops cool the air around them. The cool, dense air sinks. Sinking, rain-cooled air and strong updrafts of warmer air cause the strong winds that often come during thunderstorms. Hail may form as ice crystals fall. ✓

## What damage do thunderstorms cause?

Sometimes thunderstorms stall in one area, causing heavy rains. When streams can no longer hold all the water running into them, flash floods occur. Because they occur with little warning, flash floods are dangerous.

Thunderstorms often bring strong winds that can cause damage. If a thunderstorm has winds over 89 km/h, it is called a severe thunderstorm. Hail from thunderstorms can dent cars, break windows, and flatten crops.

## What causes lightning?

Inside a storm cloud, warm air is lifted rapidly as cooler air sinks. This movement of air can cause different parts of a cloud to have opposite charges. When an electrical current runs between areas with opposite charges, lightning flashes. Lightning can occur between two clouds, inside one cloud, or between a cloud and the ground. ✓

## What causes thunder?

Thunder comes from the rapid heating of air around a bolt of lightning. Lightning can reach temperatures of about 30,000° C. That's five times hotter than the surface of the Sun. This heat causes air around the lightning to expand rapidly. Then the air cools quickly and shrinks. Because of the sudden expanding and shrinking, molecules in the air move more rapidly. The rapid movement of molecules creates sound waves. Thunder is the sound waves you hear.

### ✓ Reading Check

5. **Explain** How do water droplets falling out of a thundercloud get bigger as they fall toward Earth's surface?

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### ✓ Reading Check

6. **Determine** What causes different parts of a cloud to have opposite charges?

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## What are tornadoes?

Some severe thunderstorms produce tornadoes. A **tornado** is a violently rotating column of air that touches the ground. Severe thunderstorms produce wind at different heights which blow at different speeds and in different directions. This difference in wind speed and direction is called wind shear. Wind shear creates a rotating column parallel to the ground. Updrafts in a thunderstorm can tilt the rotating column upward, creating a funnel cloud. If the funnel cloud touches the ground, it is called a tornado. ✓

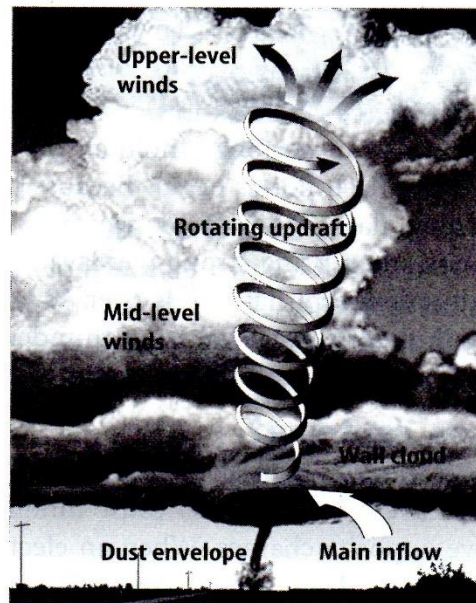
The figure below shows a diagram of a tornado. Notice the different levels of winds and the rotating updraft. The strong updraft usually forms at the base of a type of cumulonimbus cloud called a wall cloud.

### ✓ Reading Check

7. **Identify** What is a violently rotating column of air that touches the ground called?

### Picture This

8. **Identify** Find the updraft and trace over it with your pencil.



## How much damage can a tornado do?

Winds from tornadoes can rip apart buildings and tear trees from the ground. If the winds of a tornado blow through a house, they can lift off the roof and blow out the walls. It can look as though the building exploded. In the center of a tornado is a powerful updraft. The updraft can lift animals, cars, and even houses into the air. Tornadoes do not last long, but they are very destructive. In May of 1999, thunderstorms produced more than 70 tornadoes in Kansas, Oklahoma, and Texas. These tornadoes caused 40 deaths, 100 injuries, and more than \$1.2 billion in damage.

## How are tornadoes ranked?

As you have read, winds from tornadoes can cause severe damage. Theodore Fujita, a tornado expert, created a scale to describe and rank tornadoes. The scale, named the Fujita Scale after him, is shown below. The Fujita Scale ranks tornadoes based on how much damage they cause. Tornadoes range from F0 which cause only light damage to F5 which cause incredible damage. Luckily, only about one percent of all tornadoes are in the category of F4 and F5.

### The Fujita Scale

Rank	Wind speed (km/h)	Damage
F0	<116	Light: broken branches and chimneys
F1	116–180	Moderate: roofs damaged, mobile homes upturned
F2	181–253	Considerable: roofs torn off homes, large trees uprooted
F3	254–332	Severe: trains overturned, roofs and walls torn off
F4	333–419	Devastating: houses completely destroyed, cars picked up and carried elsewhere
F5	420–512	Incredible: total demolition

## What is a hurricane?

The most powerful storm is a hurricane. A **hurricane** is a large, low-pressure system that forms over the warm Atlantic Ocean and has winds of at least 119 km/h. It is like a machine that turns heat energy from the ocean into wind. Similar storms are called typhoons in the Pacific Ocean and cyclones in the Indian Ocean.

Hurricanes are similar to low-pressure systems over land—only stronger. In the Atlantic and Pacific Oceans, low-pressure systems sometimes develop near the equator. In the northern hemisphere, winds around this low pressure rotate counterclockwise. As the storms move across the ocean, they gain strength from the heat and moisture of warm ocean water.

## What happens when a hurricane reaches land?

Hurricanes can strike land with great force. The high winds sometimes produce tornadoes. Heavy rains and high waves cause large amounts of damage. Sometimes floods follow the heavy rains and cause additional damage. Hurricanes can destroy crops, tear down buildings, and kill humans and animals.

## Picture This

**9. Determine** Circle the category that describes severe damage.

### Reading Check

**10. Identify** What are two storms similar to hurricanes?

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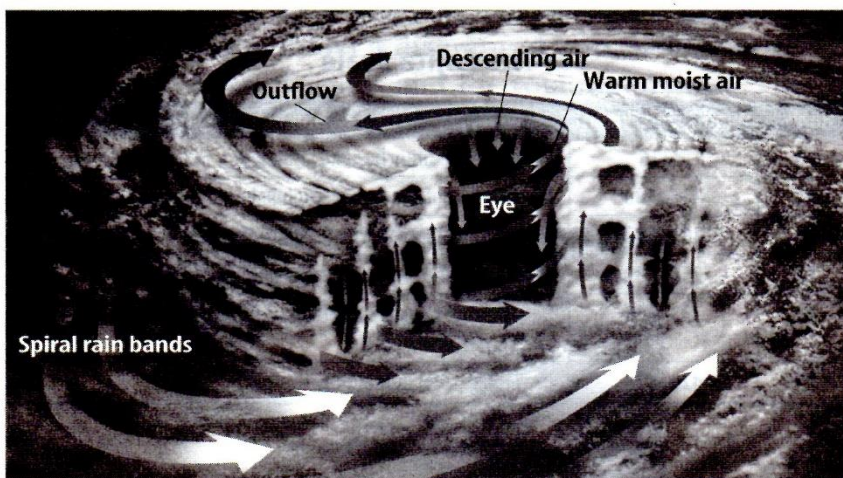
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## What happens to the hurricane on land?

As long as the hurricane remains over water, it gets energy from the warm moist air rising from the ocean. In the figure below, small rising arrows show the movement of warm air from the water below. Cool air goes down through the eye, or center, of the hurricane. The storm needs this energy from the ocean water. When a hurricane reaches land, it loses its energy supply and the storm loses its power.

### Picture This

11. **Identify** Highlight all the arrows moving counterclockwise.



## What is a blizzard?

Severe storms also can occur in the winter. If you live in the northern United States, you may have experienced the howling wind and blowing snow of a blizzard. A **blizzard** is a winter storm with conditions that include very cold temperatures, high winds, and blowing snow that makes it difficult to see. A blizzard usually lasts at least three hours.

## How can you stay safe during severe storms?

When severe weather approaches, the National Weather Service issues a watch or a warning. A watch tells you that even though the weather isn't dangerous yet, it may become dangerous soon. During a watch, stay tuned to a radio or television station that is reporting the weather. ✓

When a warning is given, the weather is already severe. During a severe thunderstorm or tornado warning, go to a basement or to a room in the middle of the house away from windows. When a hurricane or flood watch is given, be prepared to leave home. During a blizzard, stay indoors.

### ✓ Reading Check

12. **Explain** What does a weather watch tell you?

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## ● After You Read

### Mini Glossary

**air mass:** large body of air that has the same characteristics of temperature and moisture content as the area where it formed

**blizzard:** severe winter storm with temperatures below  $-12^{\circ}\text{C}$ , winds of at least 50 km/h, and blowing snow that causes poor visibility that lasts at least three hours

**front:** boundary between two air masses with different temperature, density, or moisture

**hurricane:** large, severe storm that forms over tropical oceans and has winds of at least 119 km/h

**tornado:** violently rotating column of air in contact with the ground

1. Review the terms and their definitions in the Mini Glossary. Then write a sentence explaining how hurricanes get and keep their strength.

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2. Write the name of the correct weather front above each description.

**warm front, stationary front, occluded front, cold front**

Cold air goes under warm air.  
Warm air is lifted.

3 air masses: cold, cool, warm  
Warm air closed off from Earth.

Neither warm nor cold air is moving.

Lighter, warmer air moves over cold air.

3. Did highlighting key terms and their meanings help you learn the information about weather patterns? Would you use this study strategy again?

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