

### What You'll Learn

- what causes Earth's wind and pressure systems
- how weather patterns form
- about important weather systems and storms

### ● Before You Read

Have you ever noticed that a storm was on the way? Describe the things that tell you a storm is coming.

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**Study Coach**

### Two-Column Notes

As you read this section, write important words and concepts in the left column. Write details or other information about each word or concept next to it in the right column.

### ● Read to Learn

#### Atmospheric Pressure

The atmosphere exerts a force on all surfaces in contact with it. This force is equal to the weight of the atmosphere above the surface. The pressure on a surface is produced by molecules bumping into other molecules.

When air is heated, it expands and becomes less dense. This means that warm air weighs less and exerts less pressure than an equal volume of cold air. As a result, the uneven heating of Earth's surface causes differences in air pressure in the atmosphere. Differences in air pressure set air in motion as wind. Air masses move from a region of high pressure to a region of low pressure.

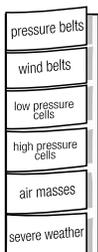
#### What are global wind and pressure systems?

Weather patterns result from the complex interaction of wind and pressure around the globe. Major pressure belts give rise to Earth's major wind belts. The most important of these are the westerlies and the trade winds. Westerlies are winds that blow from the west to east in the middle latitudes. The trade winds blow from east to west in the tropics.

Global wind patterns are caused by unequal heating between the equator and poles and by Earth's rotation. Warm air rising over the equator and sinking over the poles produces general north-south wind circulation. Earth's rotation produces an east-west deflection of this general circulation.

**FOLDABLES™**

**B Define** Make a six-tab Foldable to record the meanings of the terms that explain weather. Include pressure belts, wind belts, low pressure cells, high pressure cells, air masses, and severe weather.



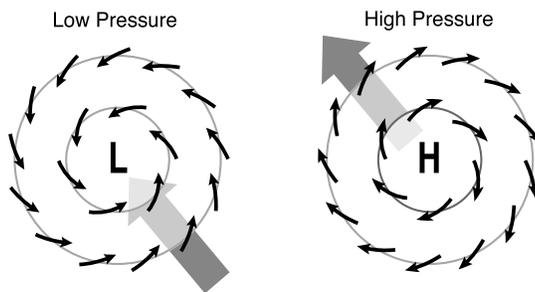
## What are jet streams?

Some strong winds are part of the larger patterns of wind and pressure. **Jet streams** are fast, powerful winds that control many weather processes, such as storm development. In the United States, the most important jet stream is the polar front jet stream. It occurs about 12 km above Earth's surface, is part of the westerlies, and can move faster than 500 km/h. Major storm tracks follow this jet stream as it moves north and south seasonally. ✓

## High and Low Pressure Systems

A low-pressure system, or low, is a region in the troposphere where the air pressure is lower than the surrounding air. Because air flows from areas of high pressure to areas of low pressure, air flows toward the center of a low-pressure system. Low pressure regions are composed of warm air. Warm air is less dense and rises. Warm air can hold lots of moisture, which forms clouds as it rises. Lows are associated with precipitation.

A high-pressure system, or high, is a region in the troposphere where the air pressure is higher than the surrounding air. The denser air in a high pressure system sinks and flows outward. Because sinking air does not lead to cloud formation, clear skies are often associated with highs.



## What is the Coriolis Effect?

The direction of airflow is affected by Earth's rotation. The deflection of an object due to Earth's rotation is called the **Coriolis effect**. In the northern hemisphere, the Coriolis effect causes air masses and winds to be deflected to the right. The figure shows how the Coriolis effect causes air to flow around highs and lows. Because of the Coriolis effect, in the northern hemisphere air flows counter-clockwise around a low and clockwise around a high.

### ✓ Reading Check

1. **Explain** What are jet streams and what do they control?

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### Picture This

2. **Label** the direction of the wind on each pressure cell in the figure. Use *Clockwise* and *Counterclockwise*.

## Air Masses and Weather Fronts

Weather around low-pressure cells is produced by the interaction of air masses. **Air masses** are large units of air containing about the same amount of moisture and having about the same temperature. Air masses form when air remains stationary for a time, as in areas of high pressure. Air masses can be polar or tropical and continental or maritime. Continental air masses form over land and are usually dry, but can be very hot or very cold. Maritime air masses are moist because they form over the ocean. Maritime air masses that affect the United States come from the Atlantic or Pacific Oceans or from the Gulf of Mexico. ✓

### ✓ Reading Check

3. **Explain** What are air masses?

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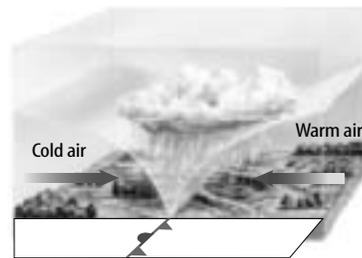
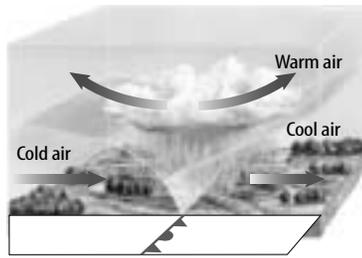
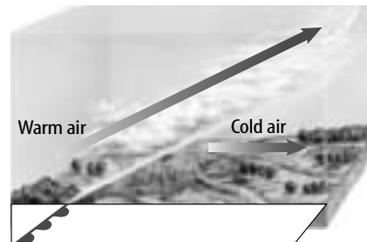
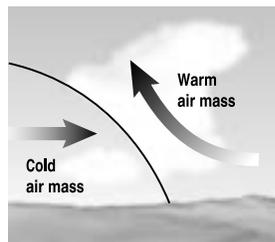
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### What are weather fronts?

Air masses interact in zones called **weather fronts**, which are associated with low-pressure systems. Warm and cold fronts produce different types of precipitation. In a warm front, warm air rises gently above cold air. It forms layered stratus clouds or fog. Fog is a cloud with its base on the ground. Most layered clouds produce only drizzle or steady rain. In a cold front, cold air pushes warm air upward in a random and chaotic way. Cumulus clouds form that often produce thunderstorms. The figure below shows interactions between fronts.



### Picture This

4. **Describe** What is the difference between the location of the air in a cold front and the location of air in a warm front?

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### Severe Weather

The continental United States experiences severe weather because of the extreme temperatures of warm and cold air masses and moisture available from tropical oceans. Unstable conditions lead to severe thunderstorms, hurricanes, tornadoes, and violent wind storms called downbursts.

**Thunderstorms** As cumulonimbus clouds form, they produce thunderstorms. Rapidly rising and falling air currents produce electric charges that result in lightning. As lightning is discharged, the heating and collapsing of the air produces thunder. Heavy rain and sometimes hail are produced by these conditions. ✓

**Downdrafts and Squalls** The force of falling precipitation during a thunderstorm may pull cold air from high in the cloud down with it. That is why the air often feels cool after a thunderstorm. The sinking cold air is called a downdraft. When a downdraft hits the surface with strong force, it spreads out in a series of windy gusts called squalls. In dry regions, squalls produce dust storms.

**Downbursts** Downdrafts can produce even more severe types of weather. Downbursts, often called wind shear, occur when cold air hits the ground and bursts outward like the spokes of a wheel. Downbursts are dangerous for aircraft during take-off and landing. Today, there are automatic warning systems to warn pilots if there are signs of downbursts near an airport.

**Tornadoes and Hurricanes** Tornadoes and hurricanes are two different types of violent wind storms. Tornadoes are intense, brief, and localized mid-latitude storms. Tornadoes are produced in cumulonimbus clouds. In the United States, most tornadoes occur when dry air from the deserts of Mexico and the southwest overrides warm, moist air from the Gulf of Mexico. This happens often in the Midwest and South.

A twisting, funnel-shaped tornado can move over land at speeds up to 50 km/h. It can create a path that is 150 m wide and 10 km long. The intense, spinning winds of a tornado may reach speeds of 400 km/h. There is a low-pressure area at the center of a tornado. That extreme low pressure can do a lot of damage.

Hurricanes form over warm ocean water, cover huge areas, and last for days. Hurricanes that affect the United States form as tropical depressions over the warm waters of the southern Atlantic off the coast of Africa. When the winds exceed 118 km/h, the storm is called a hurricane. A typical hurricane consists of vast cloud bands that spiral out of a clear center, or eye. Scientists often fly into the eye of a hurricane to study the storm. In the western Pacific, these types of storms are called typhoons.

✓ **Reading Check**

5. **Describe** What kind of clouds are associated with thunderstorms and hail?

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 **Think it Over**

6. **Apply** Where do the hurricanes that hit the eastern United States normally begin?

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# ● After You Read

## Mini Glossary

**air mass:** a large volume of air with uniform moisture and temperature

**coriolis effect:** deflection of an object due to Earth's rotation

**jet stream:** fast, powerful winds that control many weather processes, such as storm development

**weather front:** zone in which air masses most often meet a low-pressure system

1. Review the vocabulary terms and their definitions in the Mini Glossary. Use one or two terms to describe wind patterns over the United States.

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2. Complete the table below by writing a description of how each type of severe weather occurs.

Severe Weather	Cause
thunderstorm	
tornado	
hurricane	
downburst	

3.  **Study Coach** You used two-column notes as you read this section. How did this help you understand the information in the text?

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