

SECTION

2

READING WARM-UP

Objectives

- Identify the four kinds of air masses that influence weather in the United States.
- Describe the four major types of fronts.
- Explain how fronts cause weather changes.
- Explain how cyclones and anticyclones affect the weather.

Terms to Learn

air mass                      cyclone  
front                          anticyclone

READING STRATEGY

**Reading Organizer** As you read this section, make a table comparing cold, warm, occluded, and stationary fronts.

# Air Masses and Fronts

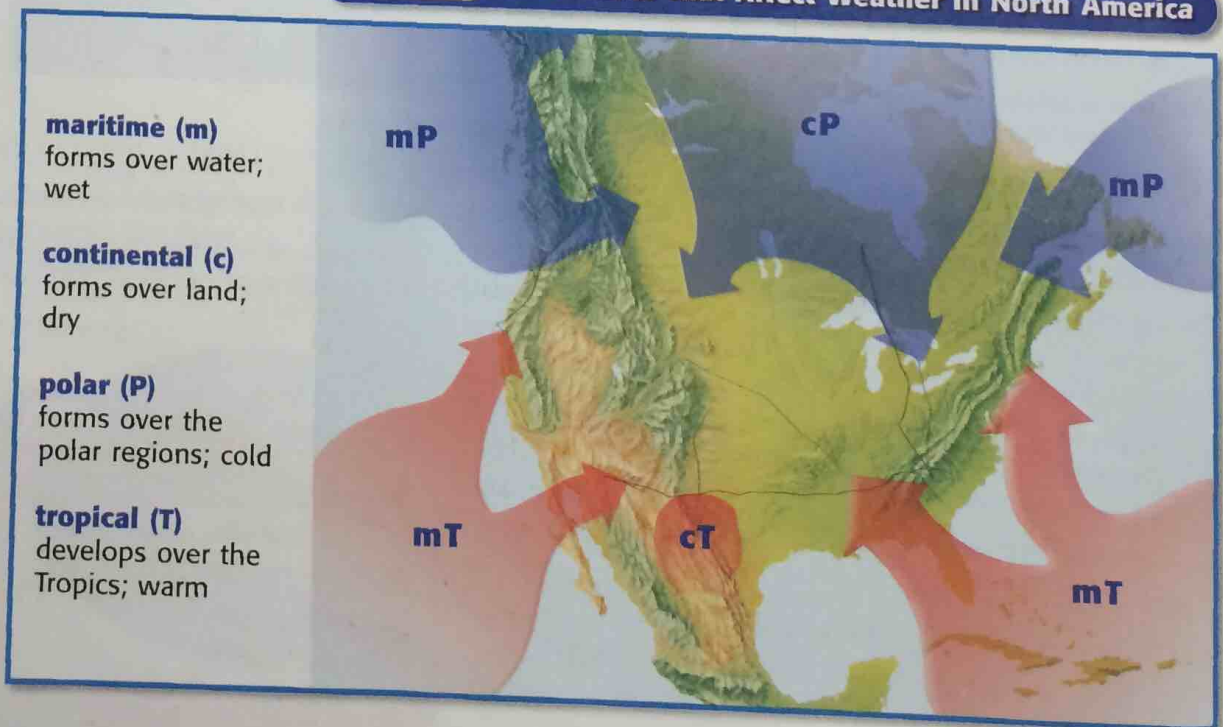
Have you ever wondered how the weather can change so quickly? For example, the weather may be warm and sunny in the morning and cold and rainy by afternoon.

Changes in weather are caused by the movement and interaction of air masses. An **air mass** is a large body of air where temperature and moisture content are similar throughout. In this section, you will learn about air masses and their effect on weather.

## Air Masses

Air masses are characterized by their moisture content and temperature. The moisture content and temperature of an air mass are determined by the area over which the air mass forms. These areas are called *source regions*. An example of a source region is the Gulf of Mexico. An air mass that forms over the Gulf of Mexico is warm and wet because this area is warm and has a lot of water that evaporates. There are many types of air masses, each of which is associated with a particular source region. The characteristics of these air masses are represented on maps by a two-letter symbol, as shown in **Figure 1**. The first letter indicates the moisture content that is characteristic of the air mass. The second letter represents the temperature that is characteristic of the air mass.

**Figure 1** Air Masses That Affect Weather in North America





**Figure 2** Cold air masses that form over the North Atlantic Ocean can bring severe weather, such as blizzards, in the winter.

## Cold Air Masses

Most of the cold winter weather in the United States is influenced by three polar air masses. A continental polar (cP) air mass forms over northern Canada, which brings extremely cold winter weather to the United States. In the summer, a cP air mass generally brings cool, dry weather.

A maritime polar (mP) air mass that forms over the North Pacific Ocean is cool and very wet. This air mass brings rain and snow to the Pacific Coast in the winter and cool, foggy weather in the summer.

A maritime polar air mass that forms over the North Atlantic Ocean brings cool, cloudy weather and precipitation to New England in the winter, as shown in **Figure 2**. In the summer, the air mass brings cool weather and fog.

## Warm Air Masses

Four warm air masses influence the weather in the United States. A maritime tropical (mT) air mass that develops over warm areas in the Pacific Ocean is milder than the maritime polar air mass that forms over the Pacific Ocean.

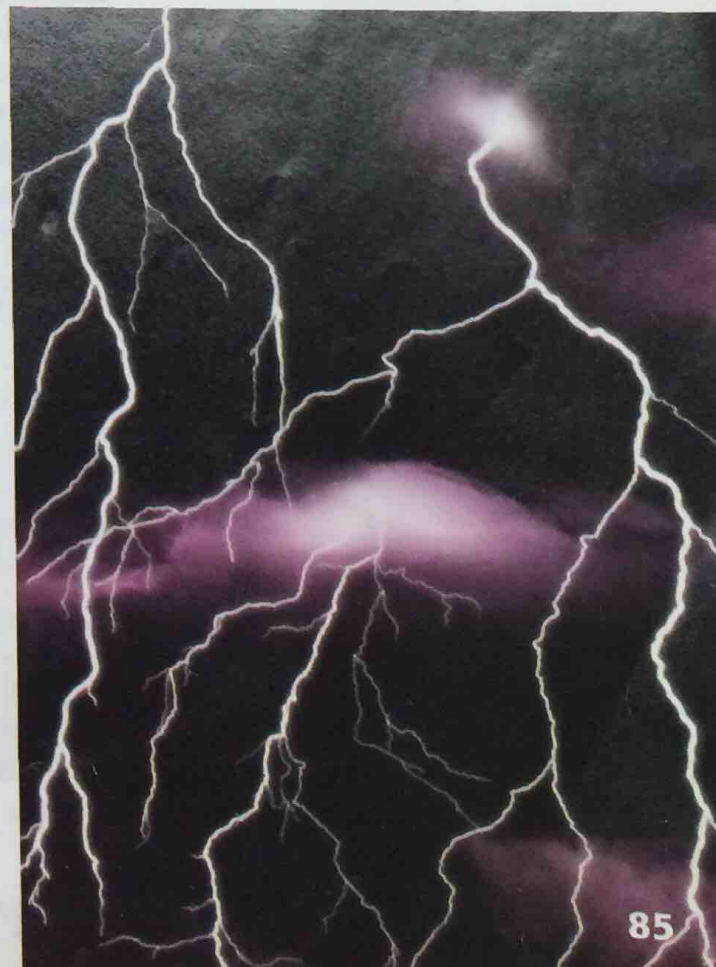
Other maritime tropical air masses develop over the warm waters of the Gulf of Mexico and the Atlantic Ocean. These air masses move north across the East Coast and into the Midwest. In the summer, they bring hot and humid weather, hurricanes, and thunderstorms, as shown in **Figure 3**. In the winter, they bring mild, often cloudy weather.

A continental tropical (cT) air mass forms over the deserts of northern Mexico and the southwestern United States. This air mass moves northward and brings clear, dry, and hot weather in the summer.

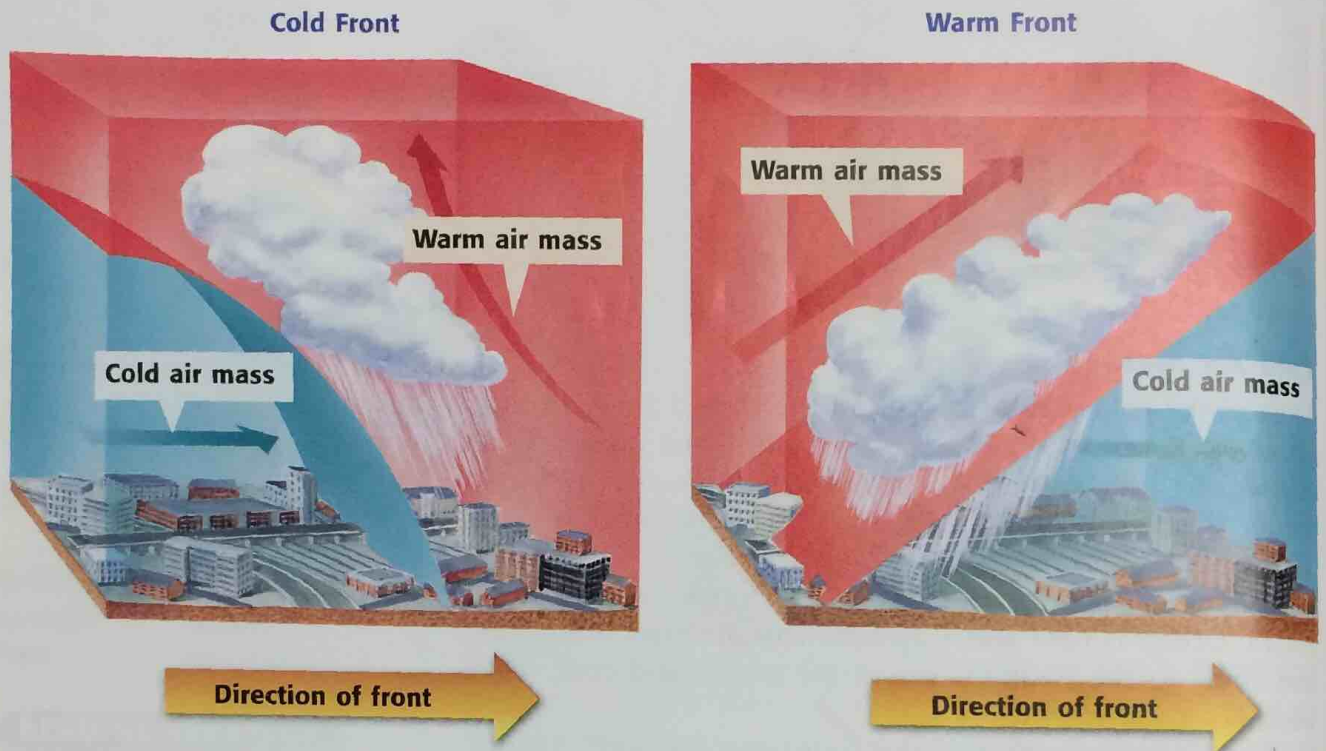
**✓ Reading Check** What type of air mass contributes to the hot and humid summer weather in the midwestern United States? (See the Appendix for answers to Reading Checks.)

**air mass** a large body of air where temperature and moisture content are constant throughout

**Figure 3** Warm air masses that develop over the Gulf of Mexico bring thunderstorms in the summer.



**Figure 4** Fronts That Affect Weather in North America



**front** the boundary between air masses of different densities and usually different temperatures

## Fronts

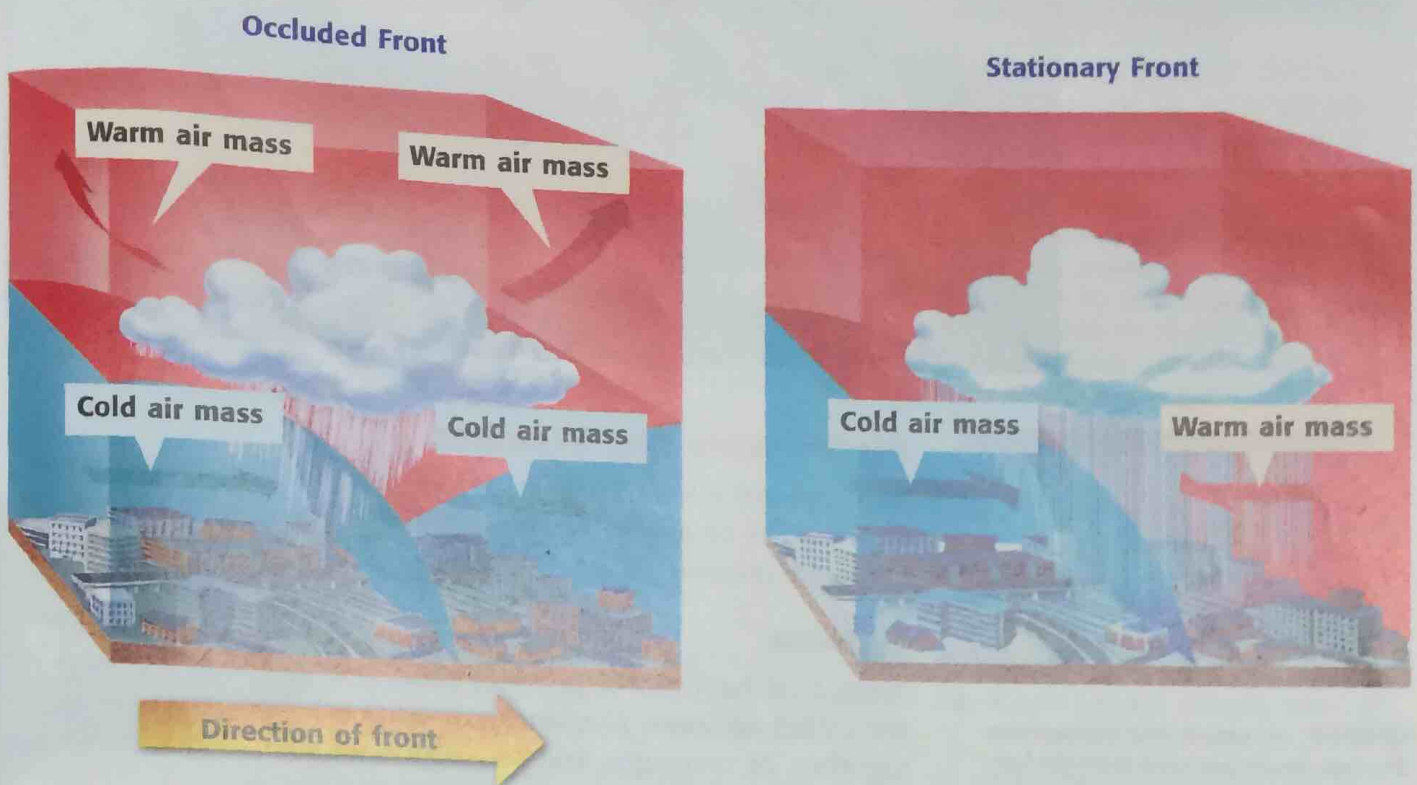
Air masses that form from different areas often do not mix. The reason is that the air masses have different densities. For example, warm air is less dense than cold air. So, when two types of air masses meet, warm air generally rises. The area in which two types of air masses meet is called a **front**. The four kinds of fronts—cold fronts, warm fronts, occluded fronts, and stationary fronts—are shown in **Figure 4**. Fronts are associated with weather in the middle latitudes.

### Cold Front

A cold front forms where cold air moves under warm air, which is less dense, and pushes the warm air up. Cold fronts can move quickly and bring thunderstorms, heavy rain, or snow. Cooler weather usually follows a cold front because the air mass behind the cold front is cooler and drier than the air mass that it is replacing.

### Warm Front

A warm front forms where warm air moves over cold, denser air. In a warm front, the warm air gradually replaces the cold air. Warm fronts generally bring drizzly rain and are followed by clear and warm weather.



### Occluded Front

An occluded front forms when a warm air mass is caught between two colder air masses. The coldest air mass moves under and pushes up the warm air mass. The coldest air mass then moves forward until it meets a cold air mass that is warmer and less dense. The colder of these two air masses moves under and pushes up the warmer air mass. Sometimes, though, the two colder air masses mix. An occluded front has cool temperatures and large amounts of rain and snow.

**✓ Reading Check** What type of weather would you expect an occluded front to produce?

### Stationary Front

A stationary front forms when a cold air mass meets a warm air mass. In this case, however, both air masses do not have enough force to lift the warm air mass over the cold air mass. So, the two air masses remain separated. This may happen because there is not enough wind to keep the air masses pushing against each other. A stationary front often brings many days of cloudy, wet weather.

**Figure 5** This satellite image shows a cyclone system forming.



## Air Pressure and Weather

You may have heard a weather reporter on TV or radio talking about areas of low pressure and high pressure. These areas of different pressure affect the weather.

### Cyclones

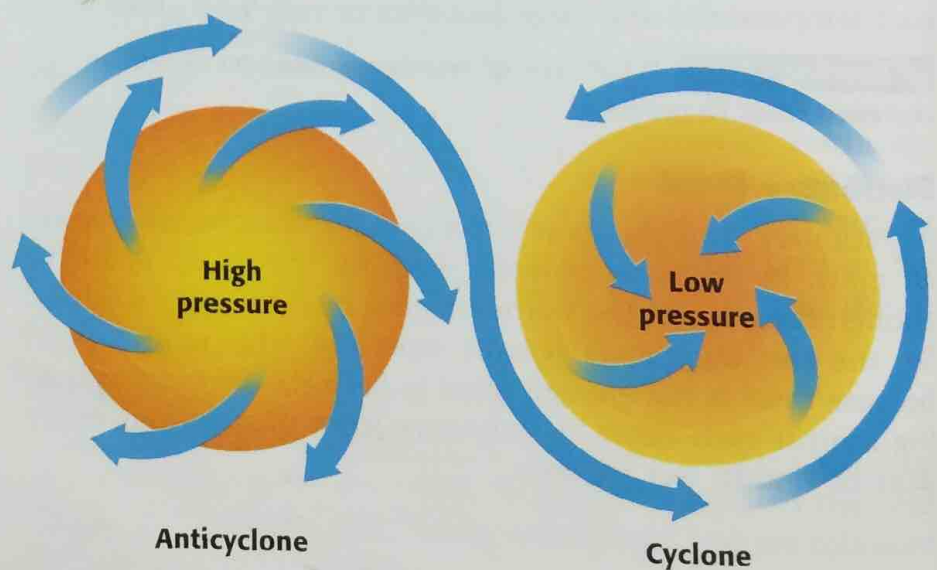
Areas that have lower pressure than the surrounding areas do are called **cyclones**. Cyclones are areas where air masses come together, or converge, and rise. **Figure 5** shows a satellite image of the formation of a cyclone system.

**cyclone** an area in the atmosphere that has lower pressure than the surrounding areas and has winds that spiral toward the center

**anticyclone** the rotation of air around a high-pressure center in the direction opposite to Earth's rotation

### Anticyclones

Areas that have high pressure are called **anticyclones**. Anticyclones are areas where air moves apart, or diverges, and sinks. The sinking air is denser than the surrounding air, and the pressure is higher. Cooler, denser air moves out of the center of these high-pressure areas toward areas of lower pressure. **Figure 6** shows how wind can spiral out of an anticyclone and into a cyclone.



**Figure 6** As the colder, denser air spirals out of the anticyclone, it moves towards areas of low pressure, which sometimes forms a cyclone.

## Cyclones, Anticyclones, and Weather

You have learned what cyclones and anticyclones are. So, now you might be wondering how do cyclones and anticyclones affect the weather? As the air in the center of a cyclone rises, it cools and forms clouds and rain. The rising air in a cyclone causes stormy weather. In an anticyclone, the air sinks. As the air sinks, it gets warmer and absorbs moisture. The sinking air in an anticyclone brings dry, clear weather. By keeping track of cyclones and anticyclones, meteorologists can predict the weather.

**✓ Reading Check** Describe the different types of weather that a cyclone and an anticyclone can produce.

## CONNECTION TO Astronomy

**Storms on Jupiter** Cyclones and anticyclones occur on Jupiter, too! Generally, cyclones on Jupiter appear as dark ovals, and anticyclones appear as bright ovals. Jupiter's Great Red Spot is an anticyclone that has existed for centuries. Research the existence of cyclones and anticyclones on other bodies in our solar system.

## SECTION Review

### Summary

- Air masses are characterized by moisture content and temperature.
- A front occurs where two air masses meet.
- Four major types of fronts are cold, warm, occluded, and stationary fronts.
- Differences in air pressure cause cyclones, which bring stormy weather, and anticyclones, which bring dry, clear weather.

### Using Key Terms

For each pair of terms, explain how the meanings of the terms differ.

1. *front* and *air mass*
2. *cyclone* and *anticyclone*

### Understanding Key Ideas

3. What kind of front forms when a cold air mass displaces a warm air mass?
  - a. a cold front
  - b. a warm front
  - c. an occluded front
  - d. a stationary front
4. What are the major air masses that influence the weather in the United States?
5. What is one source region of a maritime polar air mass?
6. What are the characteristics of an air mass whose two-letter symbol is cP?
7. What are the four major types of fronts?
8. How do fronts cause weather changes?
9. How do cyclones and anticyclones affect the weather?

### Math Skills

10. A cold front is moving toward the town of La Porte at 35 km/h. The front is 200 km away from La Porte. How long will it take the front to get to La Porte?

### Critical Thinking

11. **Applying Concepts** How do air masses that form over the land and ocean affect weather in the United States?
12. **Identifying Relationships** Why does the Pacific Coast have cool, wet winters and warm, dry summers? Explain.
13. **Applying Concepts** Which air masses influence the weather where you live? Explain.

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Topic: Air Masses and Fronts

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