Science Ch. 12

Climate and Weather

Career

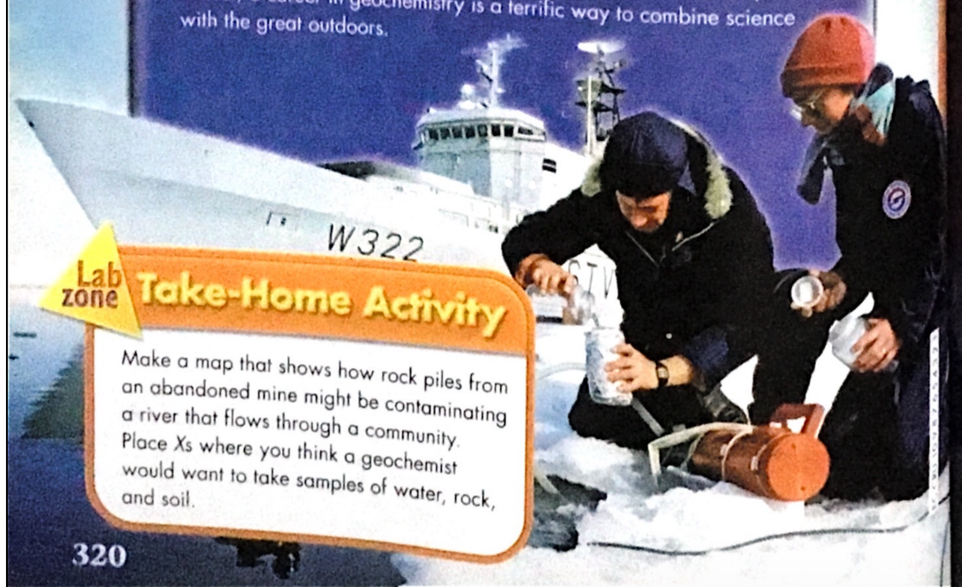
GEOCHEMIST

Suppose that an abandoned mine is located near your community. People want to know if rainwater is becoming contaminated with metals as it trickles through the mine on its way to the groundwater. Who can answer this question? A geochemist can.

A geochemist studies the chemicals that make up Earth materials such as rocks, minerals, water, and oil. Many geochemists work on environmental issues. For example, a geochemist might analyze samples of water and rock from a mine. This person could tell if the water is being contaminated and what kinds of rocks are causing the contamination. The geochemist can then help people take steps to clean up the area.

Many other geochemists specialize in finding resources such as oil or minerals. They use their knowledge to help companies obtain these materials with as little environmental damage as possible.

No matter what the specialty, geochemists must be good observers and problem solvers. Some of their work takes place in a lab, but much is also done outside where they have to be on site to collect samples. In fact, a career in geochemistry is a terrific way to combine science with the great outdoors.



Lab zone

Take-Home Activity

Make a map that shows how rock piles from an abandoned mine might be contaminating a river that flows through a community. Place *X*s where you think a geochemist would want to take samples of water, rock, and soil.

You Will Discover

- characteristics of Earth's atmosphere.
- how winds form.
- how water vapor causes humidity and clouds.
- different ways precipitation forms.
- the role of air masses in weather.
- how to be safe in severe weather.
- what factors can affect climate.

Chapter 12

Climate and Weather

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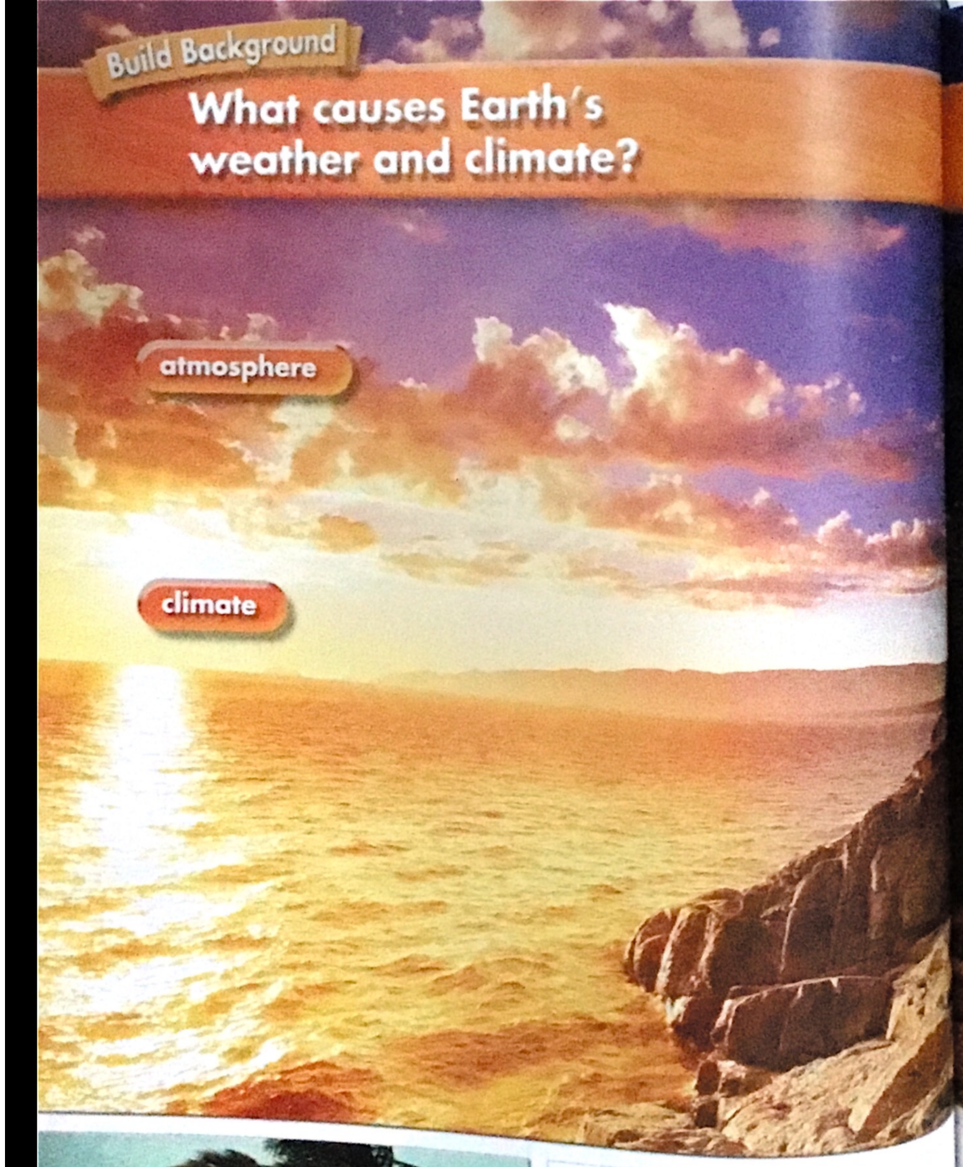
Build Background

What causes Earth's weather and climate?

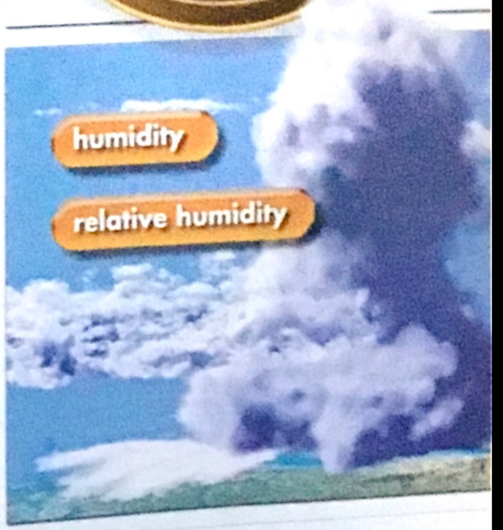


meteorologist

A scientist who studies weather

Chapter 12 Vocabulary

- **atmosphere** page 327
- **air pressure** page 328
- **humidity** page 332
- **relative humidity** page 332
- **weather** page 336
- **air mass** page 336
- **front** page 336
- **meteorologist** page 336
- **climate** page 342

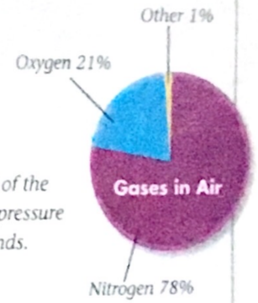


You Are There!

You can hear the gentle waves of the ocean as they break against the rocks. The last of the Sun's warmth keeps the rocks hot as the Sun slowly slips towards the horizon. As the Sun sets through the clouds, light is filtered by particles in the atmosphere. Will tomorrow be as beautiful? Or do the clouds mean that a storm is on its way?

Lesson 1

What is Earth's atmosphere?



Earth's atmosphere is made up of gases. Each layer of the atmosphere has its own characteristics, including air pressure and temperature. Differences in air pressure cause winds.

Gases in Air

Usually you can't see it, smell it, or even hear it, but Earth's air surrounds you all the time. The blanket of air that surrounds a planet, including Earth, is called its **atmosphere.** Earth's atmosphere is made up mostly of nitrogen and oxygen gases. Very small amounts of about ten other gases also are part of it. Gravity keeps these gases from escaping into space. Compared to Earth's total size, its atmosphere is a very thin layer.

Where did the gases in Earth's atmosphere come from? Would it surprise you to learn that many of them were once part of the molten rock within Earth? As molten rock cooled, gases such as nitrogen, water vapor, and carbon dioxide were released. Some of the gases were trapped within Earth. Many escaped as volcanoes erupted, a process that has been going on for more than four billion years.

Earth's atmosphere didn't always have the oxygen it has today. As plants spread across the planet, they took in carbon dioxide from the atmosphere and released oxygen during the process of photosynthesis. Over millions of years, the amount of oxygen in Earth's atmosphere reached its present level.

Today the amounts of nitrogen, oxygen, and some other gases remain about the same from one place on Earth to another. But the amount of water vapor in the atmosphere can change. In some areas of the world, such as polar regions, the amount of water vapor in the air might be almost zero. In other areas, such as tropical regions, as much as four percent of the air may be made up of water vapor.

1. **Checkpoint** How do the gases in Earth's air differ from place to place?
2. **Cause and Effect** What change caused oxygen to build up in Earth's atmosphere?

Air Pressure and Altitude

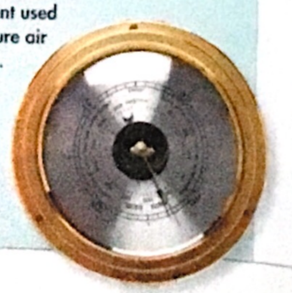
When air was pumped out of the metal can above, the outside air pressure became greater than the inside air pressure. The force of air pushing in caused the can to collapse.

If you have ever driven up or down a mountain, flown in a plane, or ridden a fast-moving elevator in a tall building, you may have felt the effects of a change in air pressure. Your ears may have "popped" as you rose. They may have felt full and possibly ached when you descended. This happens because air pressure changes with altitude.

When you descend, the pressure on your ears is increasing. The "popping" that you feel in your ears happens as the pressure inside your ears becomes equal to the pressure outside your ears.

Airplane cabins are pressurized to help passengers stay comfortable at the high altitudes at which most planes fly. The air pressure at the part of the atmosphere where many planes fly is less than half of that at Earth's surface.

A barometer is the instrument used to measure air pressure.



Air Pressure and Temperature

When you look at the air, you probably don't think much is going on. But the gases in air are made of particles that are constantly moving. They bump into and off other matter. **Air pressure** is the measure of force per unit area with which air particles push on matter. For example, when you blow up a balloon, the air particles that you blow into the balloon push on the side of the balloon to make it get larger. In other words, the balloon gets larger because of air pressure.

Air in the atmosphere pushes on matter too. Air pushes on all sides of an object, not just down. Right now air is pushing on all parts of your body. Can you feel it? Probably not. The reason is that air pushes equally from all sides. That means that the air inside your body pushes out with the same force that air on the outside pushes in.

The force with which air pushes on matter is related to the temperature of the air. The particles in cool air are closer together than those in warm air—they are packed together more tightly. The result is that cool air has greater air pressure. The amount of water vapor in the air also affects air pressure. Moist air has less pressure than dry air.

Air pressure is greatest at Earth's surface. That's because more air particles are above to push down. As you rise higher above Earth, air pressure decreases.

Layers of the Atmosphere

Earth's atmosphere isn't the same from top to bottom. It is made of layers, and each layer has its own characteristics. Read about the characteristics of each layer on the next page.

A Thermosphere
The air particles in the thermosphere are far apart. Sometimes, particles of gas in this layer are disturbed by electrical energy from the Sun. When this happens, glows, or auroras, occur that can be seen in the night sky at high latitudes.

B Mesosphere
The mesosphere is the coldest layer. Temperatures get cooler as you move higher in this layer.

C Stratosphere
Temperature increases with altitude in the stratosphere. This layer contains most of the atmosphere's ozone. Ozone is a gas that absorbs harmful ultraviolet rays from the Sun, preventing them from reaching Earth's surface.

D Troposphere
The troposphere is the layer in which you live. More than 75 percent of all the air in the atmosphere is in this layer. All weather takes place here. Temperatures are warmest near Earth's surface. As altitude increases, air temperature and pressure decrease.

1. **Checkpoint** What is air pressure?
2. **Health in Science** Altitude sickness can affect people at altitudes above 1,800 meters. Find out what causes altitude sickness and how to prevent it. Summarize your findings in a short report.

Causes of Winds

You step out the door and a gust of wind almost blows you over! It's hard to believe that particles of air can hit you with such force. Where do the forces of wind come from?

Wind is moving air, caused by differences in air pressure. In general, air moves from areas of high pressure to areas of low pressure. Think about a balloon. When you let air out of a balloon, air rushes from inside the balloon where pressure is higher to where pressure is lower outside the balloon. You can feel wind.

Global Winds

Differences in air pressure are caused partly by differences in air temperature. When air is heated, its particles move faster and farther apart. The air becomes less dense. The lighter, warmer air moves upward, as cooler, denser air falls. This transfer of heat by the movement of air particles is called convection. Winds blow across Earth as warm air from regions near the equator rise and cold air from polar regions falls.

Winds do not just move in one big circle between the equator and the poles. As warm air rises over the equator, it begins to cool. At about 30° north and south of the equator, the air cools enough—and the pressure becomes high enough—to cause the air to sink back towards Earth's surface. The sinking air produces winds that blow near Earth's surface back toward the equator. These winds are called the trade winds and blow from east to west. You can see other global winds in the diagram.

Arrows in this picture show the direction of winds over the Pacific Ocean on a particular day. Light winds are blue. Orange areas are strong winds.

The westerlies are winds that blow close to Earth's surface from west to east between 30° and 60° latitude. In the polar regions, between 60° and 90° latitude, winds near Earth's surface generally move from east to west and are called easterlies.

Local Winds

The rising and sinking of air also can create local winds. If you live near a large body of water, such as a lake or the ocean, you've probably experienced an example of this. The temperature of water doesn't change as quickly as the temperature of land. During the day while the sun is shining, the temperature of the land increases. The air above the land also gets warmer and rises. This air is replaced by cool air that blows in from over the water. The result is that winds move from the water toward land.

At night when land has cooled down, the flow of air is reversed. The temperature of the water is warmer than that of the land. Air over the water is warmed and rises. This air is replaced by cooler air that blows out from over the land. This pattern of airflow helps keep the air temperatures of land near bodies of water warmer and more even than temperatures inland.

Winds and Local Weather

When the air rises and cools near the equator, water vapor in the air condenses. The result is that areas near the equator have rains almost every day. At 30° north or south latitude, the air coming back down to Earth's surface is very dry. Some of the world's deserts, such as the Sahara Desert, are located in these regions.

Local weather is affected by another type of wind—the jet stream. A jet stream is a narrow belt of high-speed wind that blows in the upper troposphere and lower stratosphere. Jet streams always move from west to east in direction. In North America the jet stream affects day-to-day weather and seasons. In the winter, this jet stream can bring cold arctic air to states as far south as Kentucky. In the summer, the jet stream brings hot air north into Canada.

Winds are created by differences in air pressure. The greater the difference in pressure between two air masses, the stronger the wind will be.

Lesson Checkpoint

1. How would air pressure change as you drove up and then down a mountain road?
2. What are the layers of Earth's atmosphere? How do they differ?
3. Writing in Science **Narrative** Write an account of winds forming from the viewpoint of a particle of air. Be sure to describe temperatures and movement.

Lesson 2

How do clouds and precipitation form?

Water enters the atmosphere as part of the water cycle. Clouds form when air containing water vapor rises and cools. Precipitation may fall from clouds as rain, sleet, snow, or hail.

Humidity

Are you one of those people whose hair suddenly gets curly when you step outside on hot, muggy days? Or perhaps your straight hair just gets flat. The change in your hair may be due to humidity. **Humidity** is the amount of water vapor in the air.

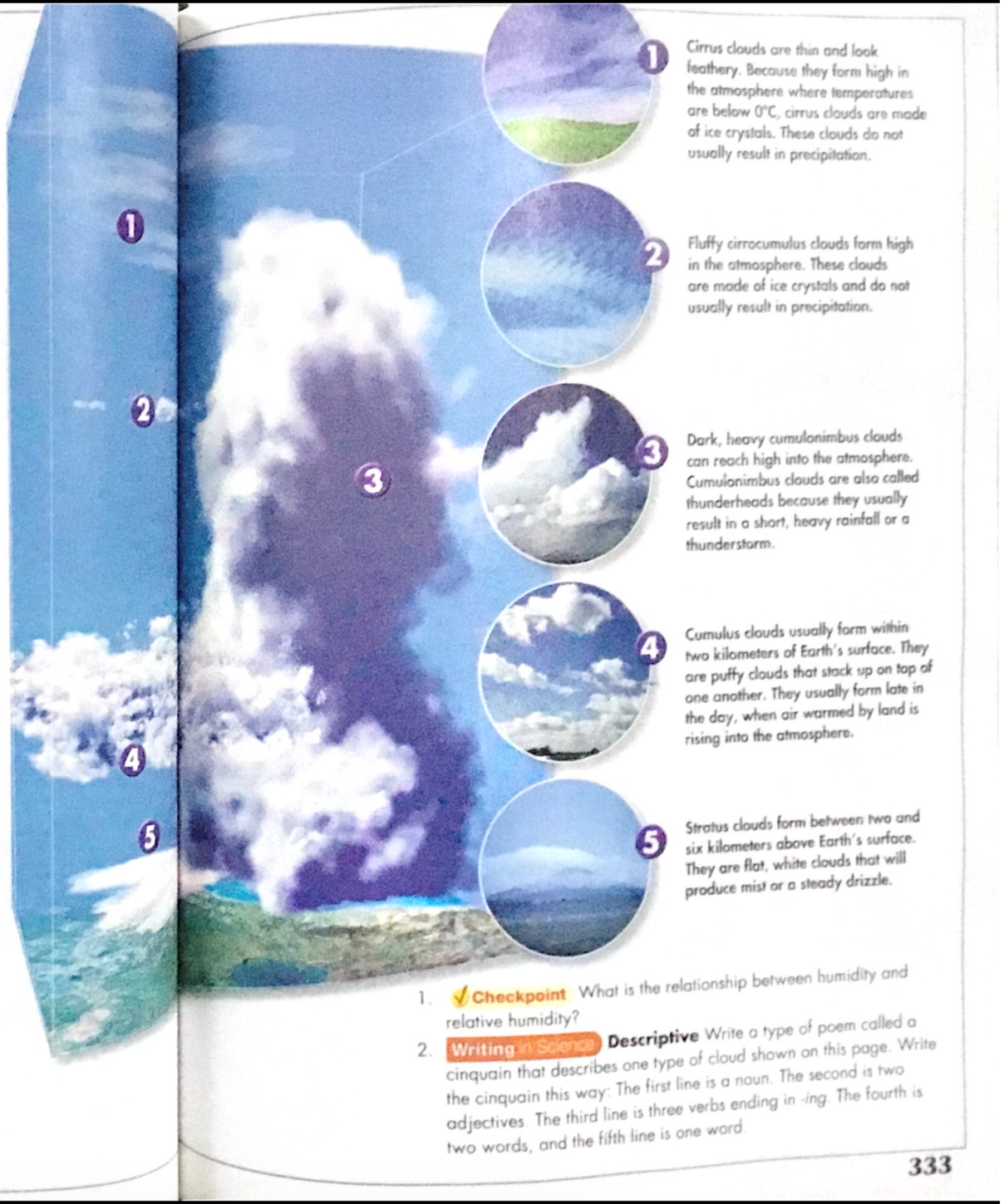
Water enters the atmosphere as part of the water cycle. The amount of water vapor in air depends on the air temperature. Warm air has more water than cool air. As air gets cooler, water vapor condenses—changes from a gas to a liquid—to form dew, fog, or clouds.

Regardless of the temperature, there is a limit to the amount of water air can contain. **Relative humidity** is the amount of water vapor the air *actually* contains compared with the amount it *could* contain at that temperature. For example, if the relative humidity is 50 percent, the air has half of the amount of water it can contain at that temperature. On hot, humid days, the relative humidity can be almost 100 percent. At 100 percent relative humidity, air cannot contain any more water vapor.

Clouds

Clouds form when air rises and cools. Cooler air contains less water vapor, so the water in the rising air condenses to form tiny droplets. The droplets form around tiny particles in the air, such as dust, smoke, and salt. Clouds are a collection of millions of these tiny water droplets. Sometimes the temperature in the clouds is so cold that the water droplets freeze to form ice crystals. A cloud grows in size as more water droplets or ice crystals form.

Clouds are classified according to their shape and their height above Earth's surface. The three main forms of clouds are cirrus, cumulus, and stratus. All others are a modified form or a combination of these forms.



1. Cirrus clouds are thin and look feathery. Because they form high in the atmosphere where temperatures are below 0°C, cirrus clouds are made of ice crystals. These clouds do not usually result in precipitation.
2. Fluffy cirrocumulus clouds form high in the atmosphere. These clouds are made of ice crystals and do not usually result in precipitation.
3. Dark, heavy cumulonimbus clouds can reach high into the atmosphere. Cumulonimbus clouds are also called thunderheads because they usually result in a short, heavy rainfall or a thunderstorm.
4. Cumulus clouds usually form within two kilometers of Earth's surface. They are puffy clouds that stack up on top of one another. They usually form late in the day, when air warmed by land is rising into the atmosphere.
5. Stratus clouds form between two and six kilometers above Earth's surface. They are flat, white clouds that will produce mist or a steady drizzle.

1. **Checkpoint** What is the relationship between humidity and relative humidity?
2. **Writing in Science** **Descriptive** Write a type of poem called a cinquain that describes one type of cloud shown on this page. Write the cinquain this way: The first line is a noun. The second is two adjectives. The third line is three verbs ending in *-ing*. The fourth is two words, and the fifth line is one word.

How Precipitation Forms

Rain, sleet, snow, and hail—chances are the area where you live gets at least one of these forms of precipitation. Precipitation is all the forms of moisture that fall from the atmosphere to Earth's surface. A cloud must have a lot of moisture before it can produce precipitation.

The water droplets and ice crystals in clouds can be very small, but they can get larger as more water clings to them. Precipitation forms when the drops or crystals become large enough to fall. The precipitation can be made of large water droplets, ice crystals, or both. Follow along in the diagram as you read how some types of precipitation form.

Rain and Snow

Some rain forms when water droplets fall from clouds through temperatures that are above freezing—0°C. However, most rain forms from ice crystals. That happens when the temperature directly beneath the clouds is above freezing. As the ice falls from the cloud, it melts to form rain.

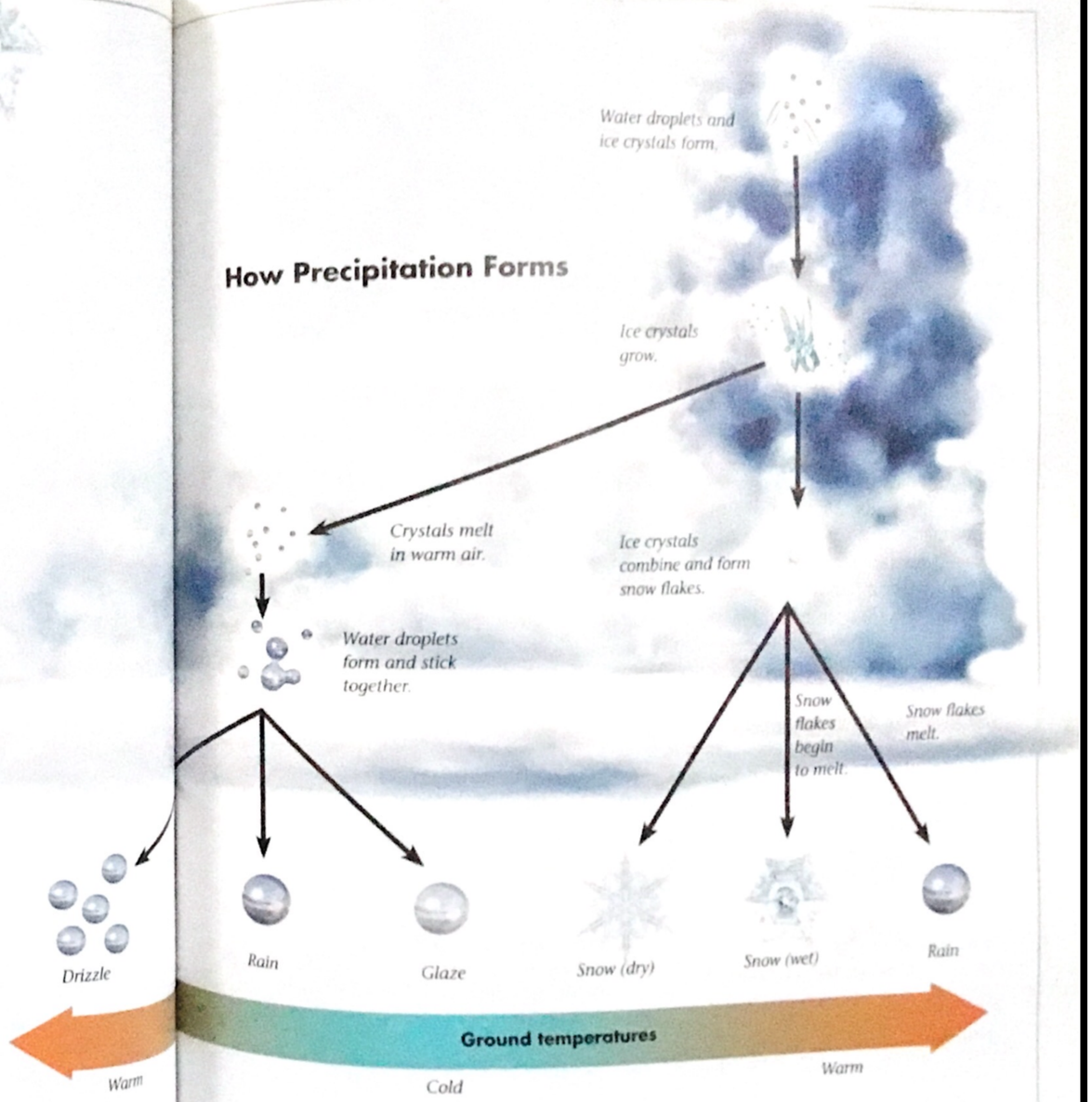
If the temperature below the cloud is below freezing, the falling ice crystals continue to combine to form snowflakes. The crystals that make up snow can be feathery six-sided snowflakes or flat hexagons. The temperature and amount of moisture in a cloud determines the shape of the snowflakes. If the air where the snow falls is very cold, the snowflakes will be in the form of dry snow. Warmer ground temperatures produce a wet snow.

Sleet and Hail

Sleet forms when rain falls through a layer of freezing air that is large enough to freeze the rain. As water drops pass through the colder air, they freeze and reach the ground as small particles of ice that are the size of a raindrop.

Glaze, also called freezing rain, occurs when raindrops pass through cold air that is not cold enough to freeze the drops. The raindrops freeze when they hit a freezing surface.

Hail is precipitation that occurs in the form of hard, round particles of ice. This type of precipitation usually forms in warmer summer months. Hail forms inside cumulonimbus clouds when winds toss the ice crystals up and down. As the crystals move up and down, droplets of water attach to them and freeze. The hailstone continues to grow this way until it becomes too heavy to remain in the clouds. It then falls to the ground. Some hailstones can become as large as baseballs.



Lesson Checkpoint

1. When clouds form, why don't the water droplets in them fall to the ground immediately?
2. What determines whether precipitation falls as rain or snow?
3. **Cause and Effect** What causes hail to form?

Lesson 3

What causes weather and climate?

Weather is the day-to-day condition of the atmosphere. It includes air temperature, humidity, wind speed, and precipitation. Meteorologists make weather forecasts by gathering weather data. Climate is the pattern of weather that occurs in an area over a long period.

Air Masses and Fronts

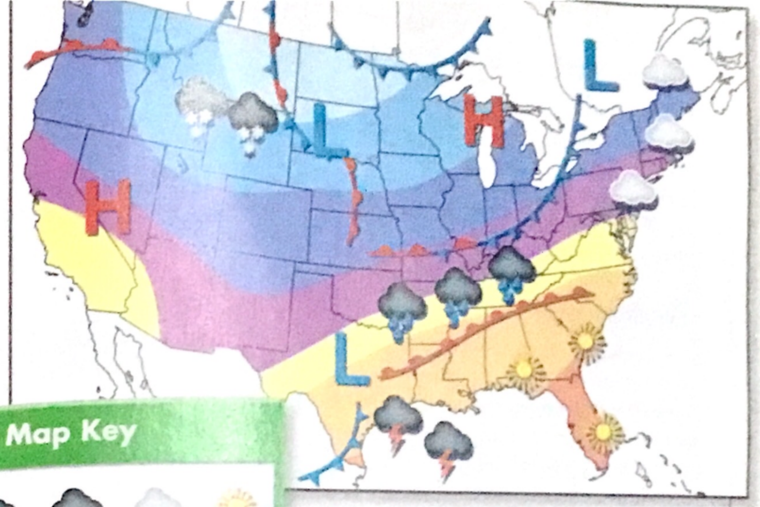
You may have seen a weather map like the ones on these pages. Probably the most noticeable parts of the weather map are the symbols showing air masses and fronts. Air masses and fronts produce the weather around you. **Weather** is the condition of the atmosphere at a particular time and place.

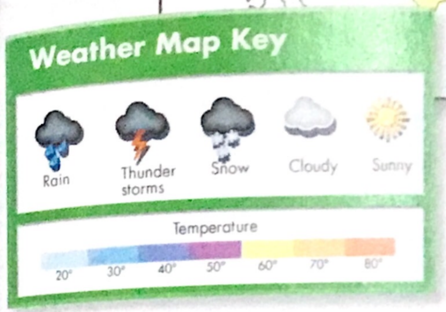
An **air mass** is a very large body of air that has a similar temperature and humidity throughout. An air mass forms when the same air stays over an area for days or even a week or more. The air mass gets its temperature and moisture characteristics from the area of Earth's surface over which it forms. For example, an air mass forming over a polar region would be cold.

Air masses of different temperatures usually do not mix easily. Instead, a boundary forms between them. The boundary that forms between air masses is called a **front.** Weather at a front often is cloudy or stormy. **Meteorologists**—scientists who study the weather—track the movements of air masses to predict weather conditions. Study the diagram below to see what happens when fronts meet.

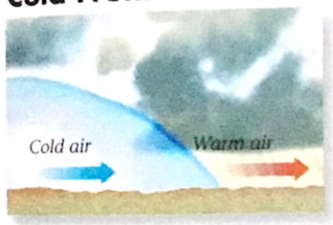
Cold Front
A mass of cold air runs into a mass of warm air, forcing the warm air above the cold air. As the warm air rises, it cools and condenses. Clouds form, and heavy rain or snow may follow. Cold fronts move more quickly than warm fronts.

Stationary Front
A warm air mass and a cold air mass meet but neither one moves toward the other. As the name implies, a stationary front does not move quickly. It can stay over an area for several days. The weather produced is similar to a warm front.





Cold Front



Warm Front

Warm Front
A mass of warm air runs into a mass of cooler air. The warm air is forced above the cooler air. As the warm air rises, it cools and condenses, forming clouds. Periods of steady rain or drizzle result.

1. **Checkpoint** How are air masses and fronts related?
2. **Writing in Science** Write a paragraph that explains how Earth's surface affects the characteristics of an air mass. Use the terms *temperature*, *humidity*, and *moisture*.

Severe Weather

You are outside and suddenly you hear thunder. What should you do? Your friend says that thunder can't hurt you, but you know that the lightning that goes with it can. Knowing what to do when severe weather happens is important. Read about each type of severe weather. Then study the information in the chart on the next page so that you know what to do when severe weather comes your way.

Thunderstorms

A thunderstorm is a small, intense storm that produces strong winds, heavy rain, lightning, and thunder. Thunderstorms occur all the time on Earth. Right now, about 1,800 of them are happening around the world. They tend to happen more in spring and summer months, but they can pop up any time of the year.

Every thunderstorm has lightning, so all thunderstorms are dangerous. Every year lightning kills more people than tornadoes do. And the storm's heavy rain can cause flash flooding, which also is very dangerous.

Tornadoes

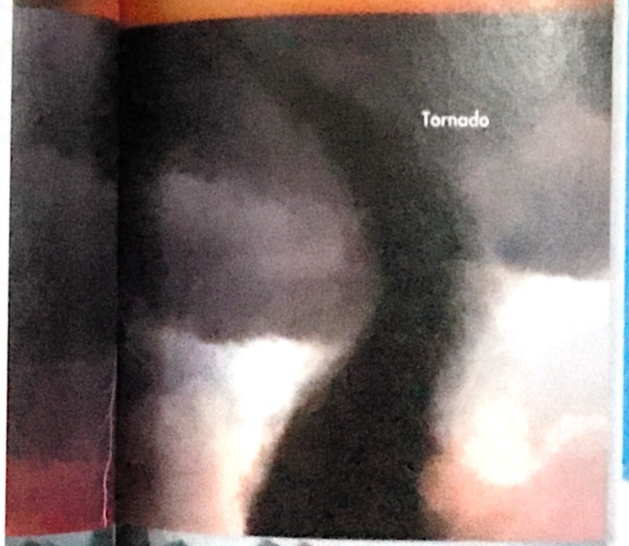
A tornado is a violent, funnel-shaped column of air that extends from a thunderstorm to the ground. The winds of a tornado can reach 512 kilometers an hour. They form very quickly from thunderstorms, so they are difficult to predict. The path of a tornado also can change quickly. That makes predicting their path difficult too.

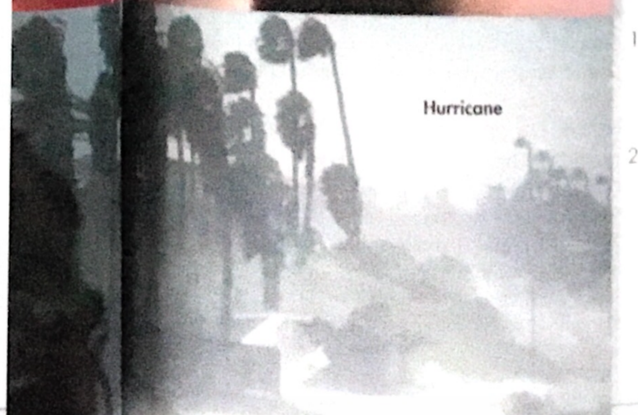
Tornadoes can happen in any part of the United States, but they are most common in the plains area between the Rocky Mountains and the Appalachians. Tornadoes are always dangerous.

Hurricanes

A hurricane is a large spiraling storm that forms over warm ocean waters—the southern Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and eastern Pacific Ocean. The winds of a hurricane blow at least 119 kilometers per hour. These strong winds can cause a lot of damage when they hit land.

Hurricanes begin as thunderstorms in areas of low pressure over warm ocean water. Winds blow into the low-pressure area. Because Earth rotates, these winds spiral around the area. Moisture is added to the warm air of the hurricane by evaporation of ocean water. As the warm air rises, the water condenses. The process releases a lot of energy. Large amounts of warm, moist air keep a hurricane moving. When it moves across colder waters or drier land, the hurricane loses its source of energy and dies.





Severe Weather Safety

Thunderstorms

- Find shelter in a building or car. Keep car windows closed.
- In the woods: Take shelter under the shorter trees. If boating or swimming, go to land and find shelter.
- Outside in an open space: Squat low to the ground. Place your hands on your knees with your head between them. Make yourself as small as possible.

Tornadoes

- Take shelter underground in a basement or storm shelter.
- No basement or shelter: Go to an inside room, hallway, or closet on the first floor away from windows.
- Outside: Lie flat in a ditch. Lie facedown and cover your head with your hands.

Hurricanes

- Prepare a disaster plan and a disaster supply kit ahead of time.
- Evacuate if told to do so. If you don't need to evacuate, stay indoors.
- Avoid using the phone except for emergencies.

1. **Checkpoint** What should you do if you are outdoors when each of these types of storm hits: thunderstorm, hurricane, tornado?
2. **Math in Science** Light travels at 299,792 kilometers per second, so when lightning flashes, you see it immediately. Sound travels much more slowly—about 1.7 kilometers in five seconds. If you see lightning and then hear thunder about 15 seconds later, how far away was the lightning?

Predicting Weather

On your way to the ballpark, you look at the bright Sun in the sky. Good day for a game. By the time you get to the park, dark clouds have filled the sky. Weather can change quickly, and storms can catch you unprepared. A weather forecast can help you prepare for weather. You can find weather forecasts on television, the newspaper, the radio, and the Internet. In the event of severe weather, these sources also give warnings and instructions.

Weather forecasting begins with looking at weather conditions all over the world. Meteorologists gather information about the factors that make up the weather—precipitation, temperature, wind speed, humidity, and air pressure. Then they use computers to analyze the information and make predictions. In the United States, the National Weather Service operates the computers. Forecasters all over the world use this information to predict the weather both nationally and locally.

Gathering Data

What tools do meteorologists use to gather weather information? You probably are familiar with some forecasting tools. Thermometers measure temperatures. Barometers measure air pressure, and anemometers measure wind speed. Simple rain gauges measure any precipitation that falls.

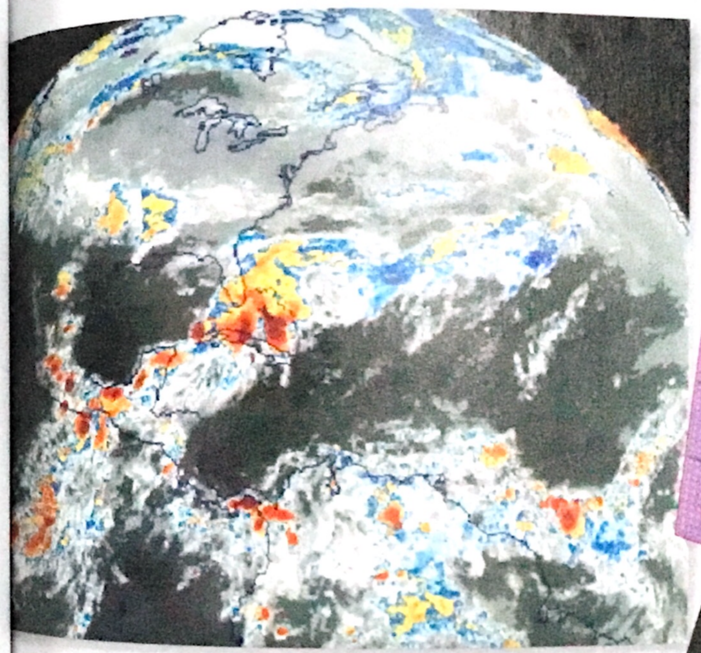
Today meteorologists have more advanced methods for gathering weather data. The Automated Surface Observing System (ASOS) program is run by the National Weather Service, the Federal Aviation Administration, and the Department of Defense. The system is a group of sensors that measures, collects, and broadcasts weather data. ASOS provides up-to-date information 24 hours a day, every day of the year.

Scientists can collect data about global climate changes and weather from this weather station high atop Mount Washington in New Hampshire.

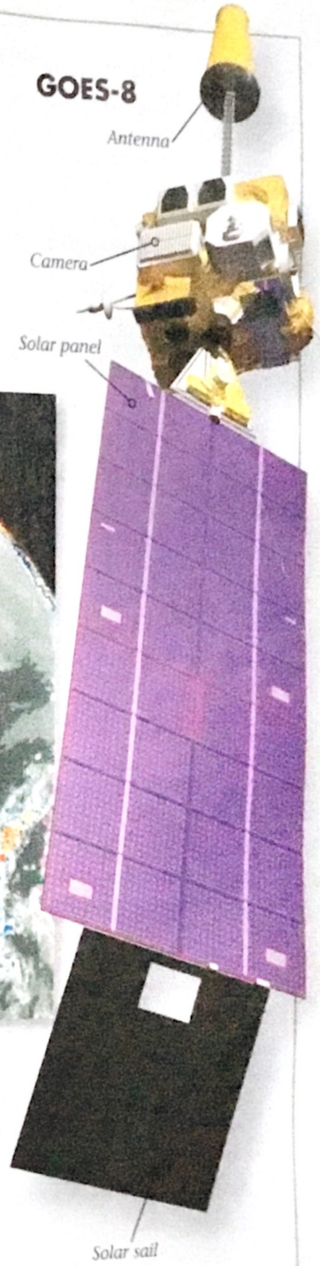
Knowing what is happening on Earth's surface isn't enough to make good weather forecasts. Meteorologists also gather information from above Earth. Twice a day at almost 900 stations around the world, scientists release weather balloons. The balloons gather information about Earth's weather from the troposphere.

Another important tool, Doppler radar, uses radio waves to measure wind speed and precipitation. It also gives scientists information about the direction in which a storm is moving. By watching the movement of a storm and the winds within it, scientists are better able to predict severe weather. Being able to make accurate weather predictions can save lives.

The picture of Earth on this page was taken by a weather satellite. Satellites called GOES orbit Earth about 35,790 kilometers above the equator. They orbit at the same speed as Earth's rotation. That keeps each satellite above the same spot on Earth. This group of satellites sees almost all of Earth. NOAA satellites orbit about 850 kilometers over the North and South Poles. Because they orbit closer to Earth than GOES, the view is more close-up, but they see smaller portions of Earth. Satellites track weather data and other data, such as solar particles moving toward Earth.



GOES view over Earth



1. **Checkpoint** Describe three ways weather data are collected.
2. **Math in Science** Study newspaper weather predictions for your area for the past month. Compare the predictions to the actual weather that occurred. What percent of the time were the predictions correct? What do you think caused scientists to be incorrect in their predictions?

Climate

As you now know, weather is the condition of the atmosphere at a particular time. Weather in an area can change constantly. **Climate,** however, is the pattern of weather that occurs in an area over a long period—usually at least 30 years. The climate of an area is usually described in terms of its average temperatures and average precipitation.

You probably know that climate differs from one area of Earth to another. Do you know what causes the differences? Many factors can affect climate. For example, because Earth is round, different parts receive different amounts of sunlight. Those areas that receive less sunlight will have colder climates.

Large bodies of water also affect climate. Water warms and cools more slowly than does land. As a result, temperatures near oceans and lakes are milder than those further inland. The warm and cold currents in large bodies of water also affect climate.

Pollution is another factor that affects climate. Pollutants such as carbon dioxide, which is produced when fossil fuels burn, can contribute to a worldwide increase in temperature, called global warming. The amount of carbon dioxide in the atmosphere has increased over the last 150 years. Some scientists think that this increase has led to global warming. Rising global temperature can cause sea levels to rise and can affect forests, crops, and water supplies. It could also have an effect on ecosystems and human health.

People can control some factors that affect climate, such as the amount of carbon dioxide in the atmosphere. The photos on these pages show other factors that affect climate. How many of these can people control?

The angle at which sunlight hits a particular area on Earth is one factor that determines the area's climate.

Lesson Checkpoint

1. What is the difference between weather and climate?
2. Explain how warm fronts and cold fronts affect weather.
3. **Cause and Effect** How do large bodies of water affect climate?

Some Factors That Affect Climate

Volcanic eruptions release large amounts of ash and smoke into the atmosphere. These materials can block sunlight, causing Earth to cool.

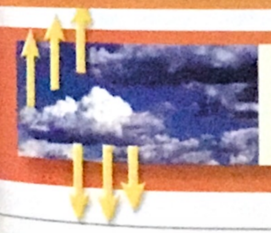
The Gulf Stream, a warm-water current that flows northward through the Atlantic Ocean, brings warmth from the equator toward the North Pole. Air warmed by this current helps keep the climates of England and Ireland in Northern Europe mild in winter.

Earth's polar regions receive less solar radiation, and ice reflects much of it. This keeps these areas cold. Arctic regions have an average winter temperature of about −30°C.

As air rises over mountains, it cools, and water vapor condenses. The areas of the western slopes of mountains receive a lot of rainfall. The eastern slopes are generally dry.

Water from oceans and other bodies of water evaporates and helps make the climate more humid. As moist air moves over land, it can cause precipitation.

When forests burn, carbon dioxide is released into the atmosphere. Also when forests burn or are cut, fewer trees remain to absorb carbon dioxide. Increasing levels of carbon dioxide in the atmosphere may be causing global warming.



Low clouds, such as stratocumulus clouds, reflect sunlight, which makes Earth cooler. However, high clouds, such as cirrus clouds, help keep Earth warm by trapping heat from solar radiation in the atmosphere.

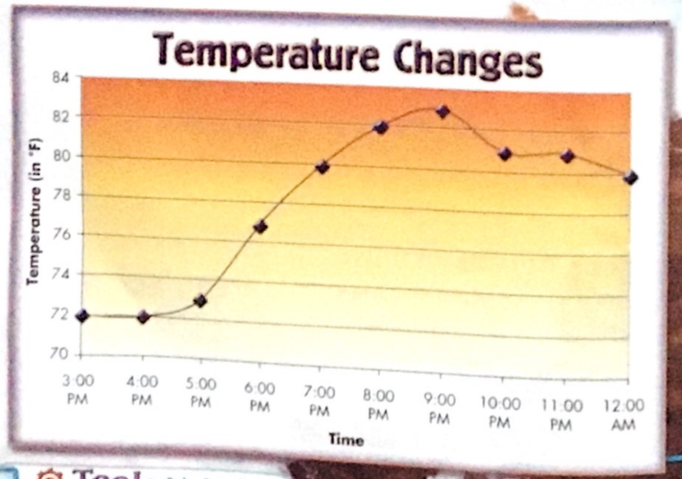
Math in Science

WEATHER UNDER PRESSURE

To better understand air pressure, you might think of a very tall blanket of air. This blanket of air is always pushing on you from all directions.

How hard the air pushes on you depends partly on how thick the blanket is. On a high mountain, air pressure is lower because the blanket is thinner, so there is less air pushing down from above. How hard the air pushes on you also depends on how closely packed the air particles are. The tighter the air particles are packed together, the heavier the air is and the greater the air pressure. When air gets warmer, air particles spread out, reducing air pressure.

Changes in air pressure can give us clues as to what is happening with the weather. The following weather data is for an area into which a warm front is moving. In weather reports, air pressure is usually reported in "inches of mercury," due to the longtime use of the mercury barometer. Some reports use units called "millibars." One inch of mercury equals about 33.87 millibars.



Time	Air Pressure (inches of mercury)	Sky Conditions
3:00 PM	30.86	partly cloudy
4:00 PM	30.77	partly cloudy
5:00 PM	30.71	cloudy
6:00 PM	30.42	cloudy
7:00 PM	29.83	cloudy
8:00 PM	29.71	light showers
9:00 PM	29.59	heavy showers
10:00 PM	29.51	light showers
11:00 PM	29.47	light showers
12:00 AM	29.46	cloudy

Use the graph on page 346 and the chart above to answer the questions.

1. Find the highest and lowest air pressure readings on the chart. Express each of these in millibars. Round your answers to the nearest whole number.
2. What is the highest temperature reading on the graph? At what time of day did this occur? Why is this an unusual time of day for a high temperature reading? Can you explain it?
3. Describe the trend in air pressure through the day.
4. Use the data given to make an argument to support this statement: A drop in air pressure is a warning that a storm might occur.
5. What change in air pressure might you expect as a cold front moves into the area?

Lab zone Take-Home Activity

Collect your own air pressure data at several times during the day or over several days. Hourly readings may be obtained on the Internet or television, or from a barometer. Look for a trend in your data and make your own weather prediction based on the trend. Was your prediction correct?

Chapter 12 Review and Test Prep

Use Vocabulary

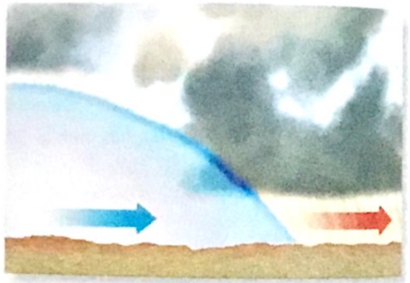
air mass (p. 336)	**front** (p. 336)
air pressure (p. 328)	**humidity** (p. 332)
atmosphere (p. 327)	**meteorologist** (p. 336)
climate (p. 342)	**relative humidity** (p. 332)
	weather (p. 336)

Use the vocabulary term from the list above that best matches each description.

1. The amount of water vapor in the air
2. The boundary that forms between air masses
3. A scientist who studies weather
4. A large body of air that has a similar temperature and humidity throughout
5. The condition of the atmosphere at a particular time and place
6. The blanket of air surrounding a planet
7. The amount of water vapor the air contains compared with the maximum it can hold at that temperature
8. The pattern of weather in an area over a long period
9. The measure of force with which air particles push on matter

Explain Concepts

10. Explain why air pressure decreases as you go higher in the atmosphere.
11. Explain how each of the following can affect climate: mountains, oceans, pollution, and forest fires.
12. The diagram shows a front. Identify the type of front and then explain what is happening.



Process Skills

13. **Model** Draw a diagram to show how a cloud forms.
14. **Infer** A thunderstorm warning has been announced by the local weather forecaster. What should you do?

Cause and Effect

15. Make a graphic organizer like the one shown below. Identify the causes that result in global wind movement.

Test Prep

Choose the letter that best completes the statement or answers the question.

16. Which of the following would meteorologists use to measure the speed and direction of a storm?
    - Ⓐ barometer
    - Ⓑ thermometer
    - Ⓒ humidity
    - Ⓓ Doppler radar
17. In which layer of the atmosphere does most weather take place?
    - Ⓕ thermosphere
    - Ⓖ mesosphere
    - Ⓗ stratosphere
    - Ⓘ troposphere
18. What results from differences in air pressure?
    - Ⓐ rain
    - Ⓑ wind
    - Ⓒ humidity
    - Ⓓ evaporation
19. Explain why the answer you chose for Question 16 is best. For each of the answers you did not choose, give a reason why it is not the best choice.
20. **Writing in Science** **Descriptive** Write a paragraph describing a thunderstorm as it passes over your home. Include details about the clouds, the winds, the precipitation, and the air temperature.