

# Air Pollution

## BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is air pollution?
- What causes air pollution?
- How does air pollution affect the environment?
- How can people reduce air pollution?

## What Is Air Pollution?

**Air pollution** is the addition of harmful substances to the atmosphere. An *air pollutant* is anything in the air that can damage the environment or make people or other organisms sick. Some air pollution comes from natural sources. Other forms of air pollution are caused by things people do.

There are two kinds of air pollutants: primary pollutants and secondary pollutants. Primary pollutants are pollutants that are put directly into the air. Dust, sea salt, volcanic ash, and pollen are primary pollutants that come from natural sources. Chemicals from paint and other materials and vehicle exhaust are primary pollutants that come from human activities.

*Secondary pollutants* form when primary pollutants react with each other or with other substances in the air. Ozone is an example of a secondary pollutant. It forms on sunny days when chemicals from burning gasoline react with each other and with the air. Ozone damages human lungs and can harm other living things as well. ✓



**Describe** As you read, make a table describing the sources of air pollution discussed in this section.



**1. Explain** Why is ozone called a secondary pollutant?

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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Pollutant	Primary pollutant or secondary pollutant?	Natural or caused by people?
Car exhaust	primary	human-caused
Dust		
Ozone		
Paint chemicals		
Pollen		
Sea salt		
Volcanic ash		

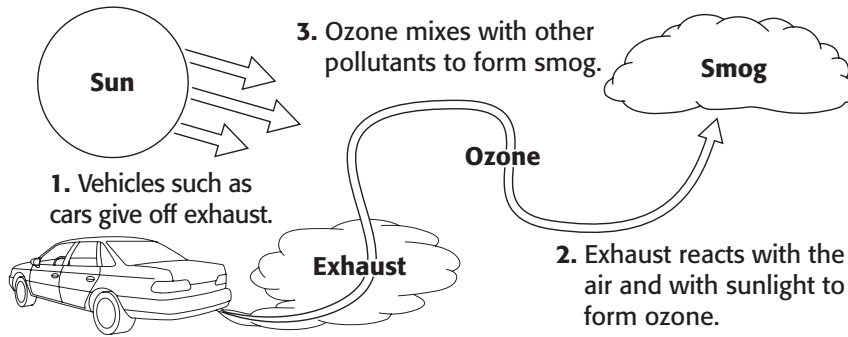
## TAKE A LOOK

**2. Describe** Fill in the blanks in the table.

**SECTION 4** Air Pollution *continued*

**TAKE A LOOK**

**3. Identify** What is the primary pollutant in this figure?



**What Is Smog?**

On a hot, still, sunny day, yellowish brown air can cover a city. This is called *smog*. Smog forms when ozone mixes with other pollutants. During summer in cities such as Los Angeles, a layer of warm air can trap smog near the ground. In the winter, a storm can clear the air.

**Say It**

**Discuss** In a small group, discuss how the pollution shown in this photograph formed.



This is what Los Angeles looks like on a clear day.



This is what Los Angeles looks like when smog is trapped near the ground.

**How Do Humans Cause Air Pollution?**

Many of our daily activities cause air pollution. The main source of human-caused air pollution in the United States is motor vehicles. Cars, motorcycles, trucks, buses, trains, and planes all give off exhaust. *Exhaust* is a gas that contains pollutants that create ozone and smog. ✓

Factories and power plants that burn coal, oil, and gas also give off pollutants. Businesses that use chemicals, such as dry cleaners and auto body shops, can add to air pollution.

**READING CHECK**

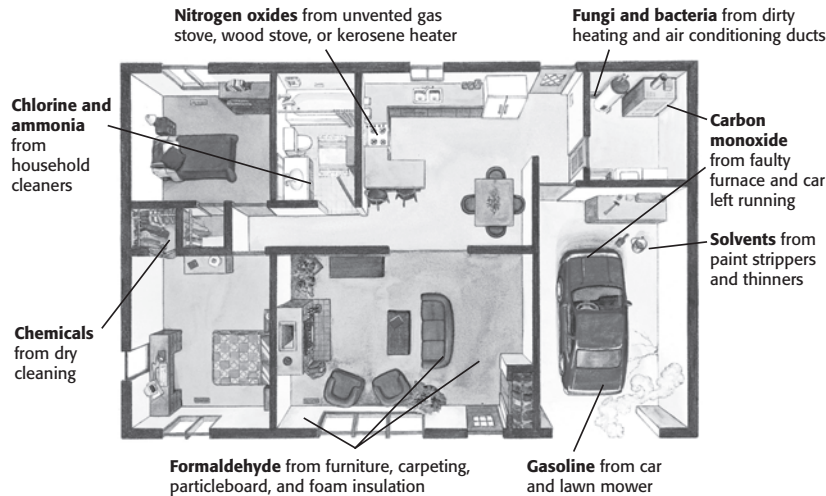
**4. Identify** What is the main source of human-caused air pollution in the United States?

**SECTION 4** Air Pollution *continued*

## What Causes Air Pollution Indoors?

Sometimes the air inside a building can be more polluted than the air outside. There is no wind to blow pollutants away and no rain to wash them out of the air indoors. Therefore, they can build up inside. It is important to air out buildings by opening the windows or using fans that bring fresh air in from outside. ✓

### Sources of Indoor Air Pollution



✓ **READING CHECK**

**5. Explain** Why can air pollution indoors be worse than air pollution outdoors?

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**TAKE A LOOK**

**6. Identify** Name two sources of indoor air pollution shown here that may be in your own home.

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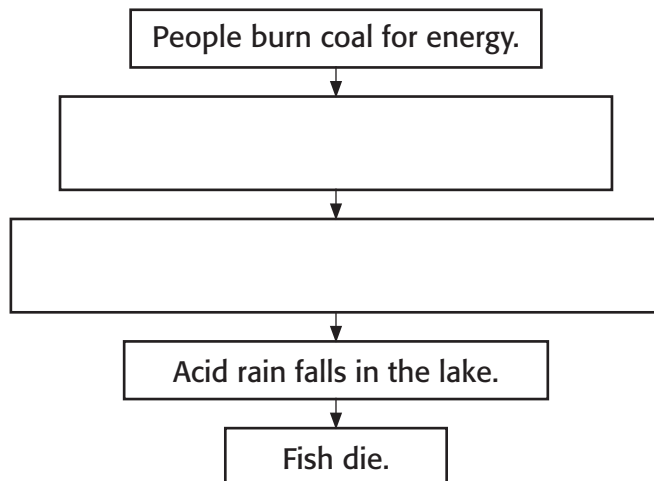


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## What Is Acid Precipitation?

**Acid precipitation** is rain, sleet, or snow that contains acids from air pollution. When we burn fossil fuels, such as coal, pollutants such as sulfur dioxide are released into the air. These pollutants combine with water in the atmosphere to form acids.

Acid precipitation can kill or damage plants, damage soil, and poison water. When acid rain flows into lakes, it can kill fish and other aquatic life.



**TAKE A LOOK**

**7. Sequence** Complete the graphic organizer to show how burning coal can cause fish to die.

**SECTION 4** Air Pollution *continued*

### What Is the Ozone Hole?

Close to the ground, ozone is a pollutant formed by human activities. However, high in the stratosphere, ozone is an important gas that forms naturally. The ozone layer absorbs harmful ultraviolet (UV) radiation from the sun. Ultraviolet radiation can harm living things. For example, it can cause skin cancer in humans. ✓

In the 1980s, scientists noticed that the ozone layer over the poles was getting thinner. This hole in the ozone layer was being caused by chemicals called CFCs, which destroy ozone. CFCs were being used in air conditioners and chemical sprays. Many CFCs are now banned. However, CFCs can remain in the atmosphere for 60 to 120 years. Therefore, the ozone layer may slowly recover, but it will take a long time.

**READING CHECK**

**8. Explain** How is the ozone layer helpful to humans?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### TAKE A LOOK

**9. Compare** Fill in the chart to show the differences between ozone in the atmosphere and ozone near the ground.

Ozone in the stratosphere	Ozone near the ground
Forms naturally	
Not a pollutant	
	harmful to living things

### How Does Air Pollution Affect Human Health?

Air pollution can cause many health problems. Some are short-term problems. They happen quickly and go away when the air pollution clears up or the person moves to a cleaner location. Others are long-term health problems. They develop over long periods of time and are not cured easily. The table below lists some of the effects of air pollution on human health. ✓

**READING CHECK**

**10. Compare** What is the difference between short-term effects and long-term effects of air pollution?

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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Long-term effects	Short-term effects
Emphysema (a lung disease)	Headache
Lung cancer	Nausea and vomiting
Asthma	Eye, nose, and throat irritation
Permanent lung damage	Coughing
Heart disease	Difficulty breathing
Skin cancer	Upper respiratory infections
	Asthma attacks
	Worsening of emphysema

**SECTION 4** Air Pollution *continued*

**What Can We Do About Air Pollution?**

Air pollution in the United States is not as bad now as it was 30 years ago. People today are much more aware of how they can cause or reduce air pollution. Air pollution can be reduced by new laws, by technology, and by people changing their lifestyles.

The United States government and the governments of other countries have passed laws to control air pollution. These laws limit the amount of pollution that sources such as cars and factories are allowed to release. For example, factories and power plants now have scrubbers on smokestacks. A *scrubber* is a tool that helps remove pollutants from smoke before it leaves the smokestack.

Many cars are more efficient now than they used to be, so they produce less pollution. Individuals can do a lot on their own to reduce air pollution, as well. For example, we can walk or bike instead of driving.



In Copenhagen, Denmark, companies lend bicycles for anyone to use for free. The program helps reduce automobile traffic and air pollution.

*Critical Thinking*

**11. Analyze Processes**  
 Electric cars don't give off any exhaust. They don't cause pollution in the cities where they are driven. However, driving them can cause pollution in other places. How? (Hint: Where does most electricity come from?)

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# Section 4 Review

## SECTION VOCABULARY

**acid precipitation** rain, sleet, or snow that contains a high concentration of acids

**air pollution** the contamination of the atmosphere by the introduction of pollutants from human and natural sources

**1. Identify Relationships** How are fossil fuels related to air pollution and acid precipitation?

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**2. Compare** Complete the table below to compare different pollutants.

Pollutant	Source	Negative effects	Solutions
CFCs			banning CFCs
Ozone			
Sulfur dioxide	burning of fossil fuels		

**3. Infer** Name three things, other than humans, that can be harmed by air pollution.

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**4. Explain** Why is the hole in the ozone layer dangerous?

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# 1 Weather and Climate Answer Key *continued*

5. trade winds, westerlies, polar easterlies

Wind belt	Location (latitude)	Toward the equator or toward the poles?
Trade winds	0° to 30°	toward the equator
Westerlies	30° to 60°	toward the poles
Polar easterlies	60° to 90°	toward the equator

- The trade winds meet and rise here. The air is moving up rather than along the surface.
- Earth's rotation causes surface currents to follow curved paths.
- toward the west
- upper troposphere, lower stratosphere
- The jet stream is in different places. The pilot would want to catch or avoid the jet stream.
- Global winds blow in one direction, but local winds can blow in any direction.
- An **L** should be on the arrow end of each wind path; winds blow from **H** to **L**.

## Review

- Arrows can go clockwise or counterclockwise; arrows should point from **H** to **L**; sinking air should be labeled "**C**"; rising air should be labeled "**W**."
- westerlies
- During the day, the mountains warm up and the air above them warms and rises. At night, as the mountains cool off, the air cools down and sinks, producing winds.
- No. Winds are caused by differences in air pressure, which are caused by differences in temperature.

## SECTION 4 AIR POLLUTION

- Ozone forms when other pollutants react with one another and with air in the presence of sunlight.

Pollutant	Primary pollutant or secondary pollutant?	Natural or caused by people?
Car exhaust	primary	human-caused
Dust	primary	natural or human-caused
Ozone	secondary	human-caused
Paint chemicals	primary	human-caused
Pollen	primary	natural
Sea salt	primary	natural
Volcanic ash	primary	natural

- vehicle exhaust
- motor vehicles
- If there is not enough ventilation, pollutants can get trapped inside.
- Answers will vary.
- People burn coal for energy. Pollutants are released. Pollutants combine with water in the air. Acid rain falls in the lake. Fish die.
- Ozone in the stratosphere blocks UV light, which can be harmful to humans.

Ozone in the stratosphere	Ozone near the ground
Forms naturally	from human activity
Is not a pollutant	a pollutant
Protects Earth from UV rays	harmful to living things

- Short-term effects happen quickly and go away once the pollution is gone. Long-term effects develop over a long time and do not go away easily.
- The electricity to run them must be generated. Many electrical power plants burn fossil fuels to generate electricity. This causes pollution in the areas near, and downwind of, the power plants.

## Review

- Burning fossil fuels puts primary pollutants into the air, causing air pollution. Some of these pollutants can combine with water in the atmosphere to make acid precipitation. Vehicle exhaust combines with sunlight and forms secondary pollutants such as ozone.

<b>2.</b>	<b>Pollutant</b>	<b>Source</b>	<b>Negative effects</b>	<b>Solutions</b>
	CFCs	<u>air conditioners and aerosol sprays</u>	<u>holes in the ozone layer</u>	ban on CFCs
	Ozone	<u>vehicle exhaust that reacts with air</u>	<u>lung damage</u>	<u>driving limits, vehicle emission controls</u>
	Sulfur dioxide	burning of fossil fuels	<u>acid rain</u>	<u>less fossil fuel use</u>

- Answers include: soil, water, plants, animals, buildings
- The thinning ozone layer lets harmful UV radiation reach Earth. UV can cause skin cancer.

## Chapter 2 Understanding Weather

### SECTION 1 WATER IN THE AIR

- Weather is a description of what is going on in the atmosphere at a certain time and place.
- condensation
- Warmer air can hold more water vapor.
- about 30 g/cm<sup>3</sup>
- $10 \text{ g/m}^3 \div 23 \text{ g/m}^3 = 0.43$   
 $0.43 \times 100 = 43\%$  relative humidity
- Humidity is the absolute amount of water vapor in the air. Relative humidity is a measure of how saturated with water vapor the air is.
- wet-bulb and dry-bulb thermometers
- about 87%
- Water vapor condenses into liquid water.
- The glasses are as cold as the air outside. They absorb heat from the air inside. As a result, the air inside cools below its dew point. Water condenses on the glasses.
- water vapor in the air
- by shape and by altitude
- A nimbostratus cloud is producing precipitation.
- water that falls to Earth from clouds
- They get bigger.
- several ice crystals joined together
- when it is too heavy to be carried by updrafts

### Review

- Possible answer: Water can condense from air that is below its dew point.
- the sun
- Air rises and cools. When it cools below its dew point, water vapor condenses to form liquid water droplets or ice crystals. These droplets or ice crystals form a cloud.
- Sleet forms when liquid water freezes in clouds and falls to the ground as ice. Snow forms when water vapor turns directly into a solid.

<b>5.</b>	<b>Name</b>	<b>Altitude</b>	<b>Shape</b>	<b>Precipitation?</b>
	Cirro-stratus	high	<u>layered</u>	no
	Alto-cumulus	middle	puffy	no
	Nimbo-stratus	low	<u>layered</u>	yes
	Cumulo-nimbus	low to middle	<u>puffy</u>	yes

### SECTION 2 AIR MASSES AND FRONTS

- by water content and temperature of the air
- dry, warm
- northern Canada
- Warm air masses form over warm water or land, and the North Atlantic and Pacific are cold.

<b>5.</b>	<b>Air mass</b>	<b>How it affects weather</b>
	cP from northern Canada	<u>very cold winter weather and cool, dry summer weather</u>
	mP from the North Pacific Ocean	<u>rain and snow in the Pacific in the winter, fog in the summer</u>
	mT from the Gulf of Mexico	<u>heat, humidity, hurricanes, thunderstorms in East Coast and Midwest</u>
	cT from the deserts	<u>clear, dry, hot weather in the summer</u>

- a place where two or more air masses meet
- It rises because the cold air pushes it up.
- a place where a warm air mass moves over a cold air mass
- The cold air masses push it out of the way.
- Stationary fronts do not move, so the weather they bring stays in one place.
- Cyclones have lower pressures than surrounding areas, but anticyclones have higher pressures. Cyclones bring rainy or stormy weather, but anticyclones bring dry, clear weather.
- anticyclone to cyclone