Glencoe Science

Chapter Resources

Air Pollution

Includes:

Reproducible Student Pages

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Mc Graw Hill Glencoe

New York, New York Columbus, Ohio Chicago, Illinois Peoria, Illinois Woodland Hills, California

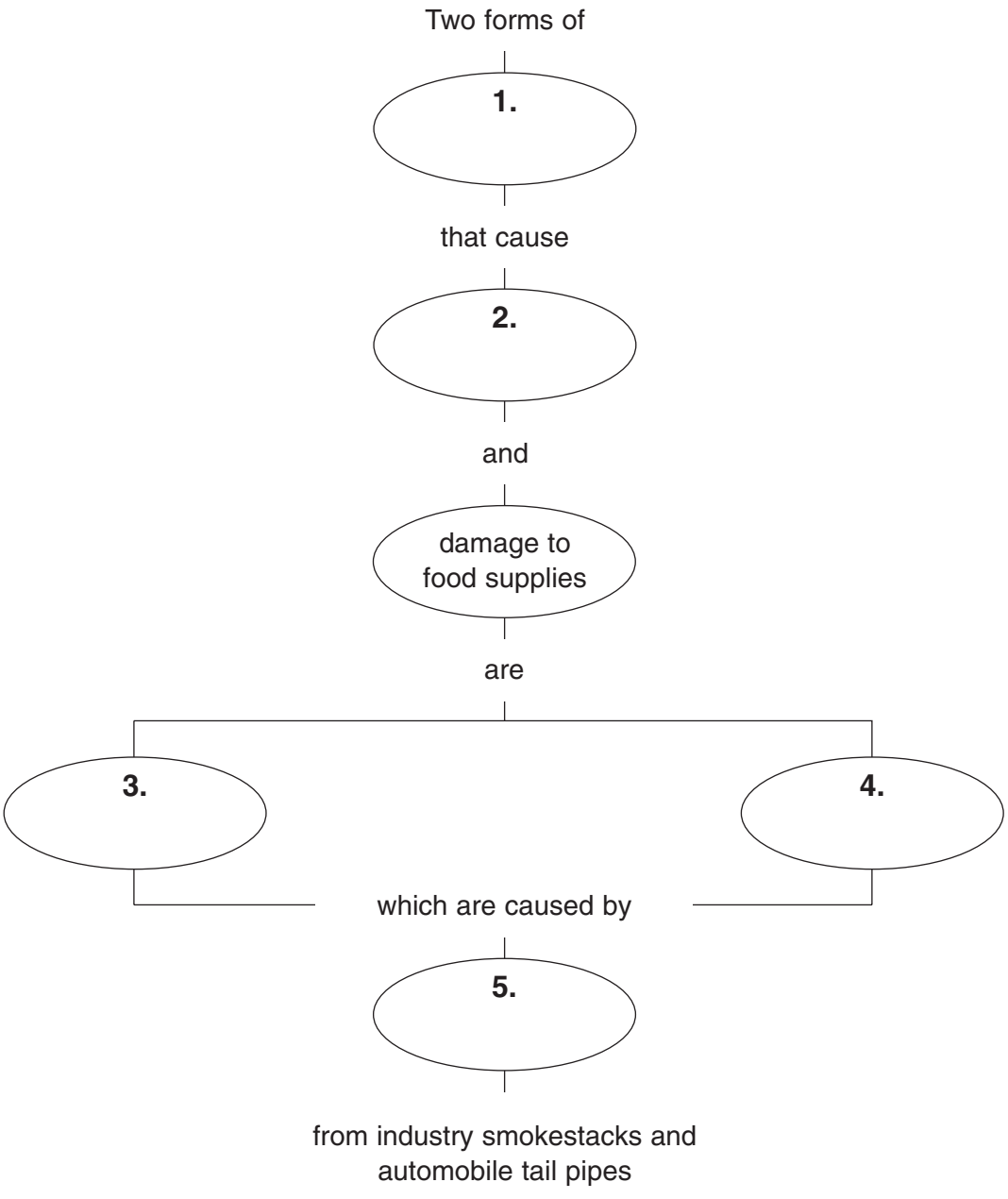
Name Date Class

Directed Reading for Content Mastery

Overview Air Pollution

Directions: *Complete the concept map using the terms in the list below.*

acid rain **air pollution** **health problems** **emissions** **smog**



Meeting Individual Needs

Name Date Class

Directed Reading for Content Mastery

Section 1 ▪ Types and Causes of Air Pollution

Directions: *Use the following words to fill in the blanks below.*

primary pollutants **secondary pollutants**

photochemical smog **acid rain** **particulate matter**

_____ **1.** substances that pollute the air only after they interact with other substances in Earth's environment

_____ **2.** suspended particles in the air

_____ **3.** precipitation with a pH less than 5.6

_____ **4.** the hazy, yellow-brown blanket of air seen near cities

_____ **5.** pollutants released directly into the air in harmful form

Directions: *Match the pollutants on the left with their most likely sources on the right. Some pollutants may have more than one source, and some sources will be used more than once.*

Pollutants	**Sources**
_____ **6.** carbon monoxide	**a.** transportation
_____ **7.** chlorofluorocarbons	**b.** forest fires
_____ **8.** sulfur dioxide	**c.** air conditioners
_____ **9.** coarse particulates	**d.** power plants
_____ **10.** fine particulates	**e.** construction activities

Directions: *Draw a line from the phrase on the left to the phrase on the right to make correct statements.*

11. Coarse particulates come from

12. Fine particulates come from

a. fires, vehicle exhaust, industry, and power plants.

b. vehicles traveling on unpaved roads, construction activities, and dust picked up by wind.

Meeting Individual Needs

Name Date Class

Directed Reading for Content Mastery

Section 2 ▪ Effects of Air Pollution
Section 3 ▪ Solutions to Air Pollution

Directions: *Use the following terms to fill in the blanks in the paragraph below. Some of the terms may be used more than once.*

unhealthy **pollutants** **smog** **monoxide** **acid rain**
radiation **biomagnification**

In the United States, about 62 million people breathe **1.** _____ air. Elderly people are at risk because they have been exposed to **2.** _____ for a long time. Compounds found in photochemical **3.** _____ can cause your eyes to water and sting. Very high levels of carbon **4.** _____ can cause death. When you inhale humid air from **5.** _____, acid can be deposited in your lungs. In humans, increased ultraviolet **6.** _____ is linked to skin cancer. The process in which pollution levels increase through the food chain is called **7.** _____. Certain species of fish have been eliminated by **8.** _____. Scientists estimate that **9.** _____ caused by automobiles damages $10 million worth of crops in California each year. In its various forms, **10.** _____ is known to corrode metals and deteriorate stone and paint.

Directions: *Correctly complete each sentence by underlining the best of the choices in parentheses.*

11. Scientists and government officials recognize that air quality in the United States (does not need to be, needs to be) regulated.

12. The Clean Air Act is a(n) (federal, international) law.

13. Air pollutants released on one part of the country (affect only the local air, can affect the air somewhere else).

14. The release of pollutants into the air is called an (emission, admission).

15. Auto exhaust used to produce (many fewer, many more) pollutants per car than it does today.

16. The air around you is called (ambivalent, ambient) air.

Meeting Individual Needs

Name Date Class

Directed Reading for Content Mastery

Key Terms
Air Pollution

Directions: *Match the description in Column I with the term in Column II by writing the correct letter in the space provided.*

Column I

_____ **1.** rain, snow, fog, and other forms of precipitation that have a pH less than 5.6

_____ **2.** a form of eye damage caused by ultraviolet radiation

_____ **3.** process where pollutant levels increase through the food chain

_____ **4.** the air around you

_____ **5.** pollutant released into the air from a particular source

_____ **6.** harmful rays from the Sun

_____ **7.** pollutant released directly into the environment

_____ **8.** formed with the help of sunlight

_____ **9.** helps Earth's organisms by absorbing some of the Sun's harmful rays

_____ **10.** certain level of pollution in the ambient air that cannot be surpassed

_____ **11.** more than 180 chemicals released into the air which may cause cancer or other serious human health problems

Column II

a. ozone layer

b. toxic air pollutants

c. UV radiation

d. biomagnification

e. air quality standard

f. cataracts

g. emission

h. ambient air

i. photochemical smog

j. acid rain

k. primary pollutants

Meeting Individual Needs

Name Date Class

SECTION 1 Reinforcement

Types and Causes of Air Pollution

Directions: *Complete the following sentences using the correct terms.*

1. Pollutants _____ the environment.

2. Primary pollutants are released _____ into the air in a harmful form.

3. Photochemical smog forms with the help of rays from the _____.

4. Temperature _____ trap cool air and cause pollutants to accumulate near Earth's surface.

5. The _____ layer has been depleted by chlorofluorocarbons in the atmosphere.

6. In many cities, _____ disperse the pollutants that cause smog.

7. _____ particulates are released into the air from fires, vehicle exhaust, industry, and power plants.

8. Most toxic pollution is caused by _____ activities.

Directions: *The following substances correspond to one of the pH values on the diagram. Write the letter of the correct pH value to the left of the substance.*

_____ **9.** lemon

_____ **10.** water

_____ **11.** ammonia

_____ **12.** milk

_____ **13.** tomato

_____ **14.** rain water

_____ **15.** stomach acid

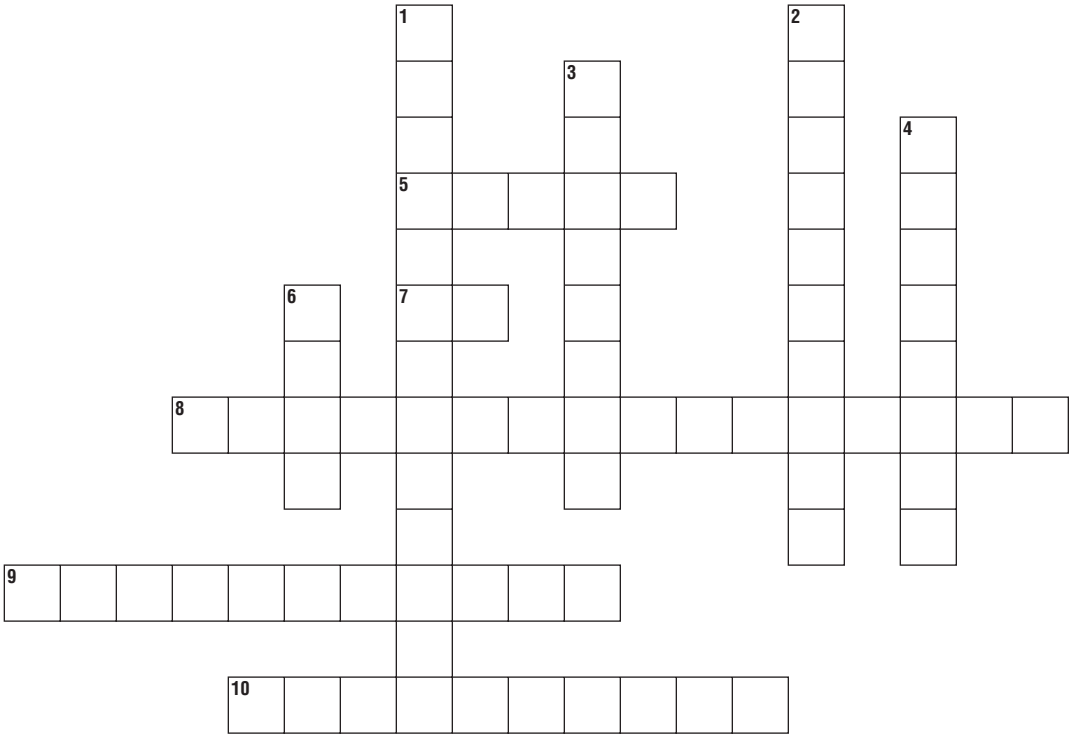
Meeting Individual Needs

Name Date Class

SECTION 2 Reinforcement

Effects of Air Pollution

Directions: *Use the clues below to complete the crossword puzzle.*



Across

5. _____ air pollutants can damage many body systems.

7. The _____ level of some streams, lakes, and rivers can decrease when acid rain falls.

8. _____ is the process through which pollutant levels increase through the food chain.

9. Increased _____ is linked to skin cancer in humans.

10. The _____ protects Earth from the Sun's ultraviolet radiation.

Down

1. Ultraviolet radiation can reduce the ability of _____ to make food.

2. _____ can absorb air pollutants directly through their skin.

3. Humid air from _____ can deposit acids deep inside your lungs.

4. Carbon _____ affects the ability of your blood to carry oxygen.

6. Compounds found in _____ can cause your eyes to water and sting.

Meeting Individual Needs

Name Date Class

SECTION 3 Reinforcement

Solutions to Air Pollution

Directions: *Complete the following sentences using the correct terms.*

A series of laws has been passed beginning in 1955 to limit air **1.** _____. The **2.** _____ Act is a federal law under which some companies may be fined if they exceed air pollution limits. The purpose of the law is to keep pollutants in the **3.** _____ air, which is the air that surrounds us, below a certain level. This level is called an air quality **4.** _____.

The release of pollutants in the air from a **5.** _____ is called an emission. Emissions are measured at industry **6.** _____ and automobile **7.** _____. They can be controlled in two ways—by using **8.** _____ to capture pollutants and by limiting the production of pollutants in the first place. Since 1975, automobiles have been equipped with **9.** _____ converters that change harmful gases in gas exhaust to less harmful ones. Compounds are added to **10.** _____ to reduce tailpipe emissions. As a result of these efforts, air quality has **11.** _____ since 1990. Even so, some pollutants, such as nitrogen **12.** _____ continue to rise.

Each of us can help to **13.** _____ air pollution. If we use less **14.** _____, less fuel will be burned at power plants. We can also help to keep the air clean by using alternatives to automobile travel such as riding bicycles and using public **15.** _____.

Meeting Individual Needs

SECTION 1 Enrichment

Nuisance—or Potential Killer?

Donora is a small town on the banks of the Monongehela River in western Pennsylvania. In 1948, most of its population was dependent on jobs at the local zinc and iron works. The plants spewed smoke into the air around the clock throughout the year. Most of the smoke rose into the colder air above and was carried off by prevailing winds.

Temperature Inversion

During the last week of October, 1948, a layer of warm air settled above the town, trapping the cold air beneath it. It was a classic temperature inversion. Trapped along with the cold air was the smoke from the plants. At that time there were absolutely no measures taken to reduce sulfur and particulate emissions. A poisonous sulfuric acid mist developed.

The dense mist, along with carbon monoxide and metal dust, soon settled over Donora. It was so thick by noon on the 29th that the streetlights had to be turned on. By the next day, visibility was restricted to the point that officials shut down the city to all traffic. Not even ambulances were allowed to answer the many emergency calls. Over a five-day period, thousands of people experienced serious breathing difficulties and other physical ailments. Some 400 people were treated in hospitals. In the end, 22 people had died.

A Lesson Learned

The news flashed across the country. It was America's first known air pollution disaster. People then came to the realization that air pollution was not just a nuisance, but a potential killer.

1. Locate Donora on a topographical or shaded relief map. Describe the terrain and explain why Donora is particularly well-situated to experience an air-trapping temperature inversion.

2. Using information from the lesson and other resources, explain how sulfur dioxide happened to be in the air over Donora.

3. Using information from the lesson and other resources, explain how a sulfuric acid mist was formed in the streets of Donora.

Directions: *Draw a line connecting the pollutant on the left with its technical description on the right.*

4. sulfuric acid	**a.** primary pollutant
5. carbon monoxide	**b.** particulate
6. metal dust	**c.** secondary pollutant

SECTION 2 Enrichment

Sick Building Syndrome

In recent years the effort to make buildings more energy efficient has had a serious side effect—in some cases the buildings are making people sick. The problem lies in the fact that the buildings are tightly sealed and use heating, venting, and air conditioning (HVAC) systems that recirculate the air. As a result, there can be a build-up of toxins in the air that people inside are breathing.

The indoor air pollution comes from a variety of sources including the walls and furnishings. Many of these products, such as paneling, plywood, upholstery, and drapes, are manufactured with formaldehyde, a compound that causes eye and throat irritation, headaches, and rashes.

Volatile Organic Compounds

Other chemicals such as benzene, carbon tetrachloride, and styrene (known as volatile organic compounds, or VOCs) are also common in office environments. They are found in furnishings, construction materials, cleaning compounds, correction fluids, copy-machine toners, and felt-tip pens. In addition to such short-term effects as headaches and throat irritation, VOCs can be responsible for serious liver, kidney, and central nervous system damage.

Buildings with loading docks and parking garages can have levels of carbon monoxide that exceed government safety standards. Headaches, nausea, and tiredness are just some of the illnesses caused by carbon monoxide inhalation. Under certain conditions, carbon monoxide can kill.

Biological Agents

It isn't just chemical pollutants that can cause health problems. Biological agents can be responsible for watery eyes, dizziness, digestive problems, sneezing, coughing, and many other allergic reactions. What are biological agents? They include pollen, dust mites, viruses, bacteria, and molds. If dirty and poorly maintained air circulation systems can harbor fungi and bacteria, this can lead to serious infections.

There are cures for sick buildings, the most obvious being adequate ventilation. Regularly cleaning and disinfecting all the components in the HVAC system is extremely important. Maintaining humidity between 30 and 50 percent will prevent the growth of molds. A further step would be the identification and removal of furnishings and supplies that create problems.

1. Look around your school for potential sources of indoor air pollution. Describe what you discover.

2. Find out if your school's HVAC system recirculates the air. Ask about the maintenance schedule for cleaning the system. Determine at what level the building's humidity is maintained. Describe your findings.

3. Write your recommendations, if you think any are needed, to improve the air quality in your school.

SECTION 3 Enrichment

Aircraft Emissions and High-Altitude Pollution

Thousands of airplanes fly millions of miles every year. Yet, aircraft mileage amounts to just a small fraction of the miles traveled by land vehicles. As expected, the amount of pollutants emitted by aircraft is comparably small. Emissions of nitrogen oxides (NOx—generic term for any of the nitrogen oxide compounds NO, NO_2, or NO_3) for example, amount to only three to four percent of the total global output. However, this relatively small amount has great significance, as pollutants at high altitudes affect the environment differently than those at Earth's surface.

It is estimated that NOx emissions from jets have 30 times the impact on global warming that a similar amount of surface emissions would have. NOx has negative environmental effects at lower and upper altitudes. At lower altitudes NOx appears to generate ozone which, in turn, contributes to the greenhouse effect.

At very high altitudes, NOx destroys ozone, thereby permitting increased amounts of ultraviolet (UV) radiation to reach Earth.

One solution to an increase in air pollution is to have more fuel-efficient planes. The less fuel burned, the fewer pollutants emitted. Airplane manufacturers, airlines, and government agencies have been working on this problem for years. Since the early 1970s, fuel economy has increased 50%. Advances over the next few years will see even greater improvements. Assuming that pollution emissions will eventually decrease, one question remains: can the conditions that already exist be reversed?

Directions: *In order to understand reports on aircraft emissions problems, it is important to have a working vocabulary of the terms used. Refer to dictionaries, encyclopedias and other sources to write the definitions of these additional terms on the lines provided.*

1. Subsonic aircraft

2. Supersonic aircraft

3. Troposphere

4. Stratosphere

Name Date Class

Note-taking Worksheet

Air Pollution

Section 1 Types and Causes of Air Pollution

A. Human activities and _____ events release pollutants into the air.

1. _____—released directly into the air in a harmful form

a. Examples of primary pollutants from _____ events are volcanic eruptions and forest fires.

b. Examples of primary pollutants from _____ activities are smoke from industry and soot from trucks.

2. _____—are released directly, but become harmful only after they interact with other substances in the Earth's atmosphere; smog, or brown haze, near cities is one effect.

B. _____ forms with the help of sunlight when nitrogen compounds and organic compounds react to form nitrogen dioxide, which reacts in sunlight to form ozone.

1. In some cities wind disperses pollutants so smog does not form, but in other cities such as Los Angeles, _____ such as mountains prevent wind from dispersing pollutants, so smog forms readily.

2. A _____ reduces the amount of air mixing in the atmosphere and can cause pollutants to accumulate near the surface.

C. Precipitation with a pH less than 5.6, the pH of natural rainwater, is called _____.

1. Acid rain damages surfaces and _____ in addition to harming plant and animal life.

2. Winds carry pollutants and cause the _____ U.S. to have more acidic precipitation than other parts of the country.

D. Suspended solid particles and liquid droplets in air are called _____.

1. _____ particles are about one-seventh the diameter of a human hair.

2. Fine particles are about _____ the size of coarse particles.

Meeting Individual Needs

Note-taking Worksheet (continued)

E. _____—cause cancer or other serious human health problems; they also damage other organisms.

F. Chlorofluorocarbons (CFCs) are compounds that destroy the _____ in the Earth's atmosphere. CFCs are used in air conditioners, refrigerators, and _____ sprays.

1. The ozone layer is a portion of the Earth's atmosphere about _____ above Earth's surface.

a. Ozone is a molecule made up of _____ oxygen atoms.

b. High altitude ozone helps organisms by _____ some of the Sun's harmful rays.

c. A severe ozone _____ appeared over Antarctica in the mid-1980's

d. CFCs are no longer produced by industrialized nations, although the effects will take a long time to disappear.

Section 2 Effects of Air Pollution

A. Air pollution can have _____ effects depending on the age of the person, the concentration of pollutants, and the exposure time.

1. _____-term effects include stinging, watery eyes, scratchy sore throat, cough, pneumonia, and headache.

2. _____-term effects include brain damage, liver disease, kidney disease, lung cancer, and heart disease.

3. Carbon monoxide, one compound in smog, affects the blood's ability to carry _____; very high levels can be fatal.

4. Small particulate pollutants can damage _____, and toxic substances can harm many body systems.

5. Acid rain's _____ air can be inhaled and irritate sensitive lung tissue; over time the heart can become stressed and weak.

6. _____ from the Sun can cause skin cancer and **cataracts**, a form of eye damage that makes the lenses of the eye cloudy.

Note-taking Worksheet (continued)

B. Air pollution _____ plants and animals.

1. _____—process in which pollutant levels increase through the food chain
2. Acid rain in lakes and streams can _____ fish and damage plants.
3. Acid rain moving through _____ can strip away nutrients needed by vegetation.
4. Smog irritates animal _____ systems and weakens plants.
5. As the ozone layer thins, increased UV radiation harms organisms such as _____ and affects agricultural crops such as rice, the main food source for more than half the world's population.

C. In addition to being harmful to living organisms, air pollution damages buildings and _____.

Section 3 Solutions to Air Pollution

A. Since 1955, several laws have been passed to help reduce air pollution; they include the _____of 1955, the Clean Air Act of 1963, the Clean Air Act of 1970, and the _____of 1990.

1. The air you breathe, called _____ cannot, by law, contain pollutants exceeding an **air quality standard**.
2. Ambient air is _____ for particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and ozone.
3. If pollutants exceed air quality standards, _____, pollutants released into the air, must be reduced by using devices to capture pollutants created or by limiting the amount produced.

B. _____ can help reduce air pollution by reducing electricity use, setting the furnace lower and air conditioner higher, and using public transportation or car pooling.

C. While air quality in the U.S. has _____ since 1990, some pollutants are still rising.

1. Smog levels are increasing in many _____ areas.
2. Because of _____, more than 2,500 bodies of water in the United States contain fish that are unsafe to eat.