



What Is This Module About?

What comes into your mind when you hear the word “pollution?” Does “smog” enter your mind?

Do you see smoke-belching jeeps and buses along the busy roads and highways? Do you see factories and power plants emitting hazardous fumes and gases into the air? Do you also see commuters crossing the street covering their noses with handkerchiefs? How about beauticians using aerosol hair sprays on their clients’ hair? Do all these things remind you of air pollution?

In this module, you will learn about various air pollutants, as well as sources of air pollution. We will study atmospheric changes caused by air pollution such as acid rain, global warming and ozone depletion. We will also learn more about the impact of air pollution on our health, environment and economy. Ways to reduce air pollution will also be discussed in this module so you can better protect environment and your health.

The module has three lessons:

Lesson 1 – *What Is Air Pollution?*

Lesson 2 – *What Are the Harmful Effects of Air Pollution?*

Lesson 3 – *What Can You Do to Help Solve Air Pollution?*



What Will You Learn From This Module?

After studying this module, you should be able to:

- ◆ define air pollution;
- ◆ describe environmental problems and atmospheric changes caused by air pollution;
- ◆ identify various air pollutants and their sources;
- ◆ explain harmful effects of air pollution on our health, environment and economy;
- ◆ discuss the government’s efforts in addressing the problem of air pollution;
- ◆ identify possible solutions to address air pollution as individuals; and
- ◆ demonstrate a sense of responsibility for our atmosphere and environment.



Let's See What You Already Know

Before studying this module, try answering the questions below to determine how much you already know about this topic.

Write the letter of the correct answer in the space before each number.

- _____ 1. What is the protective layer that surrounds the earth and shields us from the ultraviolet rays of the sun?
 - a. Atmosphere
 - b. Exosphere
 - c. Ozone
 - d. Troposphere
- _____ 2. Which of the following does not emit chlorofluorocarbons (CFCs)?
 - a. Insect sprays
 - b. Styrofoam
 - c. Freon of refrigerators
 - d. Non-aerosol hair sprays
- _____ 3. Which of the following is not an airborne toxic pollutant?
 - a. Hydrogen
 - b. Smog
 - c. Lead
 - d. Particulate matter
- _____ 4. It is another example of an atmospheric change that causes heat-related stress and death due to extreme weather or heat wave.
 - a. Ozone depletion
 - b. Acid rain
 - c. Thermal pollution
 - d. Greenhouse effect
- _____ 5. Which pollutants come from automobiles like cars and buses?
 - a. Nitrogen dioxide
 - b. Carbon monoxide
 - c. Smog
 - d. All of the above
- _____ 6. What is Republic Act 8749?
 - a. Anti-Air Pollution Act
 - b. Bantay Kalikasan Act
 - c. Clean Air Act
 - d. Lead Ban Act

- _____7. What is still the most effective way of reducing air pollution in the atmosphere?
- Keeping the environment clean
 - Energy conservation
 - Tree planting
 - Banning illegal logging
- _____8. What should our government do to reduce air pollution?
- Enforce stricter emission standards
 - Enforce stiffer penalties for pollutants
 - Implement motor vehicle inspection systems
 - All of the above
- _____9. Which of the following practices promote energy conservation?
- Use of products that are energy-demanding
 - Absence of proper insulation in your homes
 - Turning off lights when not in use
 - Setting the air-conditioner at a higher temperature
- _____10. What are the two acids that make up acid rain?
- Sulfuric and nitric acids
 - Nitric and boric acids
 - Hydrochloric and sulfuric acids
 - Boric and hydrochloric acids

Well, how was it? Do you think you fared well? Compare your answers with those in the *Answer Key* on page 46.

If all your answers are correct, very good! This shows that you already know much about the topic in this module. You may still study the module to review what you already know. Who knows, you might learn a few more new things as well!

If you got a low score, don't feel bad. This means that this module is for you. It will help you understand some important concepts that you can apply in your daily life. If you study this module carefully, you will learn the answers to all the items in the test and a lot more! Are you ready?

You may now go to the next page to begin Lesson 1.

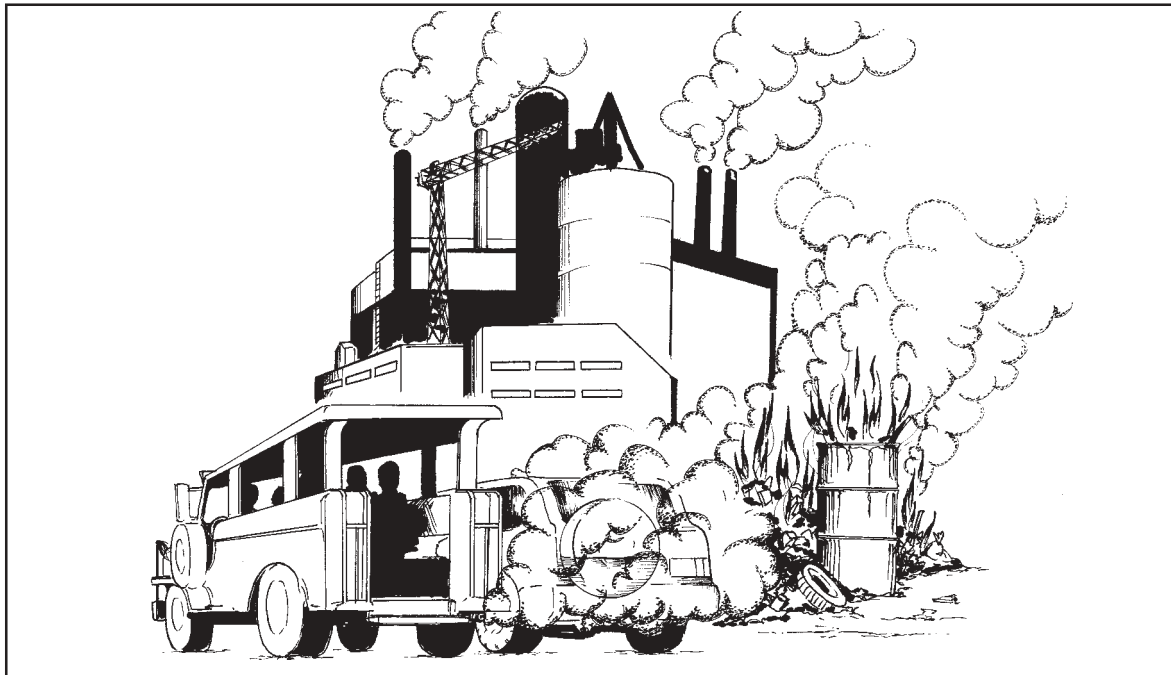
What Is Air Pollution?

In this lesson, you will learn what air pollution is all about. You will be able to name a number of air pollutants that are present in our atmosphere, as well as the sources of air pollution. You will also learn more about air pollution problems.



Let's Study and Analyze

Study and analyze the illustration below.



What did you notice? Write down your observations.

Compare your answers with those in the *Answer Key* on page 46.

What Is Air Pollution?

1. Do you know what air pollution is? Write down what you know and understand about air pollution.

2. Can you give examples of pollutants that are present in the air? *Pollutants* are materials that cause pollution.

3. Where do you think do air pollutants come from?

Let's now find out if your answers are correct.

Air pollution refers to any large amount of toxic gases and particles such as smoke, fumes or mechanically generated dust particles that decrease the quality of air. Let us read the following story about Samuel to learn more about air pollution. Be ready to identify the existing pollutants and their sources mentioned in the story.

Samuel's Vacation

Samuel lives with his parents and younger brothers in the province. They live in a wooden house built on a cliff. Every morning, Samuel takes his dog for a walk along the vast grassland along the cliff. Every time he takes a morning walk, he can feel the fresh wind blowing against his face. It is very refreshing to breathe in the fresh, clean air.

One day, his uncle who lives in Manila paid them a visit. It has always been Samuel's dream to see Manila. He has heard so much about the city from his classmates. He was happy and excited when he learned that his uncle was taking him to Manila. Samuel and his uncle boarded a plane bound for Manila after a few days.



Just before the plane was about to touch down, Samuel looked out the window and saw brown, smoky haze in the sky over the city landscape. He was startled with what he saw but did not pay too much attention to it.



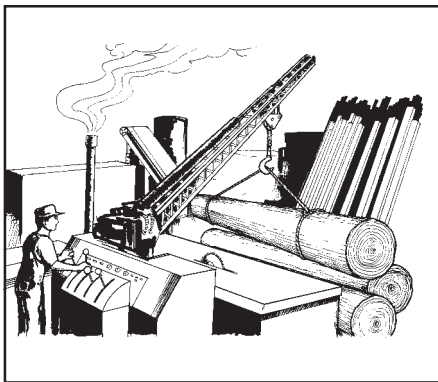
Samuel and his uncle left the airport after claiming their baggage. They walked toward the main highway and took an air-conditioned bus going to northern suburb of Quezon City. On their way to his uncle's house, Samuel looked around the main road. He noticed the buses and jeepneys emitting dark smoke. He also saw factories and power plants releasing

smoke, fumes and gases into the air. He felt his throat becoming sore after getting off the bus. He started coughing to clear his throat. Before reaching his uncle's house, Samuel's allergies started acting up when they passed several car painting shops. He might have smelled the cleaners and paints emitted by the compressors.

Upon arriving, Samuel was accompanied by his aunt to a room next to his cousin's to take a rest. While waiting for lunch to be served, Samuel entered his cousin's room and saw her fixing her hair. She then reached for the aerosol hair spray and sprayed her hair.



Outside his window, Samuel saw three men clearing a weeded area with gas-powered lawn mowers. He saw another man burning the dried leaves and garbage at the other end of the empty lot. Samuel saw a timber sawmill situated just two blocks away from his uncle's house, with smoke belching from machines used to cut and stack logs.



Samuel was so tired when evening came. He thought about his day's experience. He remembered the brown smoky haze that he saw from the plane's window and felt a bit sick. Samuel wanted to go back home to their province with its clean and fresh air. Thus, he waited patiently for Sunday to come so he could go home and see his family again. His dream of seeing Manila has wore off with the realization that the air in the city was very polluted.



Let's Think About This

Did you like Samuel's story? Have you learned something from it? What did you learn after reading Samuel's vacation experience in Manila? Were you able to identify the air pollutants and pollutant sources in the story?

1. List down the pollutants Samuel saw during his vacation in Manila.

2. List down all the sources of pollution mentioned in the story.

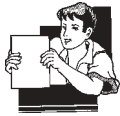
How many pollutants and their sources were you able to list down? Here are some clues to make things a bit easier for you.

What did Samuel notice while he was staring out the plane's window? What was that brown smoky haze in the sky? Smog, right? And what was inside the public bus that he traveled in from the airport to his uncle's house? That's right! It was an air-conditioning unit! Did you know that the freon of air-conditioning units emits CFCs or chlorofluorocarbons which have a harmful effect on the earth's atmosphere? We will learn more about CFCs and their harmful effects later in this lesson.

Next, can you tell me what Samuel noticed while passing along the main road? He saw power plants, factories and smoke-belching vehicles. Do you have any idea about what these sources emit? Automobiles like buses and jeepneys release pollutants such as smoke, fumes, carbon monoxide, nitrogen dioxide and lead. Factories and power plants, likewise, emit smoke, fumes and nitrogen dioxide.

Can you enumerate other sources of pollution that Samuel found while he was in Manila? The odorous cleaners and paints, used by several car painting shops, contribute to smog. The aerosol hair spray that his cousin used increases CFCs in the atmosphere. The gas-powered lawn mowers used by the three men to clear the weeded area of the nearby lot emit carbon monoxide and smog. The burning of dried leaves and garbage produces smog and domestic smoke. Lastly, the timber sawmill that was situated just two blocks away from his uncle's house contributes to smog.

Let's have a little review about the causes of air pollution. Where do you think air pollution comes from? Air pollution may come from different sources. In urban areas, air pollution may be caused by automobiles like cars, buses, planes, trains, as well as industrial and construction sites. In rural areas, it may be caused by dust from tractors plowing the fields, trucks and cars driving on dirt roads and smoke from wood and crop fires.

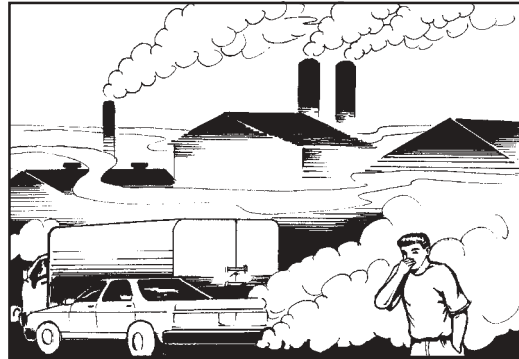


Let's Learn

Our atmosphere is full of invisible gaseous substances or air pollutants. Of these, the seven (7) major ones are discussed below.

(1) Smog

Do you know what smog is? Smog is a mixture of smoke and fog. It is formed when engine and fuel gases are released into the air in the presence of sunlight. Smog remains a daytime problem during summer months because sunlight plays a major role in its formation. The motor vehicles that Samuel saw along the main road, the paints and cleaners used by car painting shops, and the machines in the timber sawmill all contribute to the creation of smog.



Other sources of smog are large industries and combustion sources, gasoline dispensing facilities, lawn and garden equipment, construction equipment, and off-road engines such as aircraft and trains.

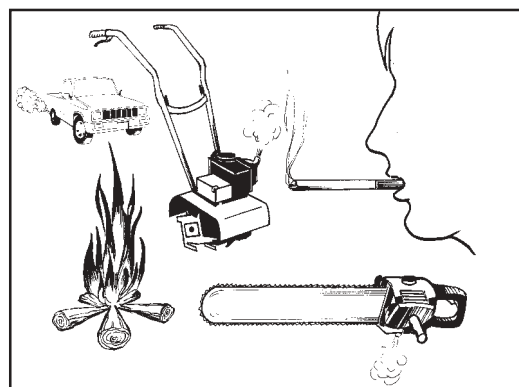
(2) Particulate Matter

This refers to tiny particles floating around in the air that can get stuck deep in the lungs and lead to respiratory problems. They are found in liquid and solid aerosols. Particulate matter includes volcanic ash, pollen, dust blown by the wind, dirt, soot and smoke. Coal and oil burned by power plants, and diesel fuel burned by vehicles are primary sources of man-made particulate matter. Waste burning and the use of wood burning stoves or wood in fireplaces produce amounts of particulate pollutants that are much smaller than those from vehicles, plants and industries.



(3) Carbon Monoxide

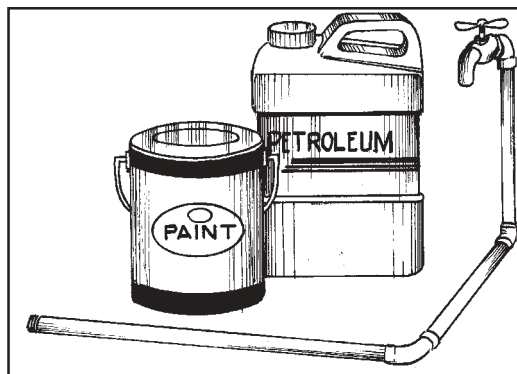
Carbon monoxide is a deadly, colorless and odorless gas that is formed by the combustion of oil, gasoline, coal and wood. Like smog and particulate matter, it is also abundant in heavy traffic. It can also be present in cigarettes and tobacco. It can be formed when using gas-powered lawn mowers, chainsaws, space heaters and charcoal.



What does carbon monoxide do to our body? Low concentrations of carbon monoxide can cause fatigue in healthy people and chest pain in people with heart disease. Carbon monoxide can cause dizziness, nausea, blurred vision, headaches, weakness, confusion, disorientation, drowsiness and slow reflexes.

(4) **Lead**

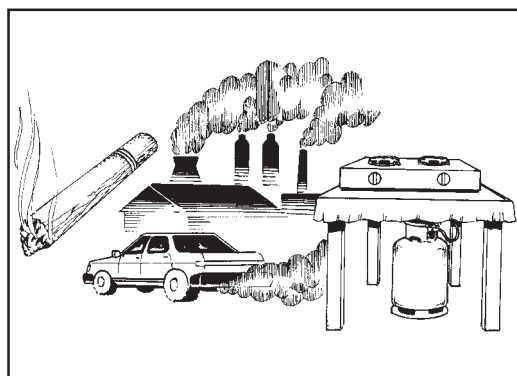
Lead is an ordinary metal that has been found to be harmful to human health. It is commonly used in gasoline, paints, batteries, water pipes and welding, among others. As a form of air pollution, lead is problematic during its production and during smelting. It becomes a source of land and water pollution once it is in the form of paint and water pipes.



Do you know how harmful lead is to children? Effects of lead on fetuses and young children can be severe. It delays the physical and mental development, lowers IQ levels, shortens attention spans and increases behavioral problems. Lead affects all systems within the body. High levels can cause convulsion, coma and even death. Lower levels can affect the brain, central nervous system, blood cells, kidney and behavioral system.

(5) **Nitrogen Dioxide**

Nitrogen dioxide forms black smoke or urban smog. It is present in motor vehicles, power plants and other fossil fuel burning industries. It is also present in kerosene heaters, gas stoves, space heaters and tobacco smoke.



Nitrogen dioxide can cause eye, nose and throat irritation. It may also harm the lungs and cause respiratory infections in young children.

(6) **Sulfur Dioxide**

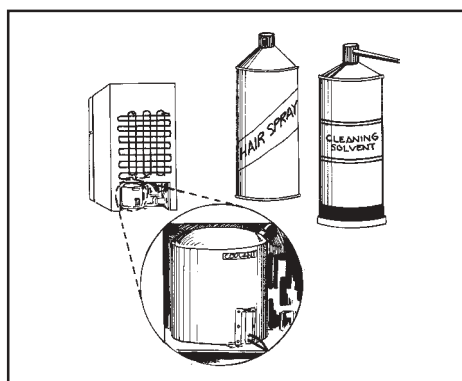
Sulfur dioxide is formed during combustion of sulfur-containing fossil fuel. It is found in processes like metal smelting, paper manufacturing, food processing, industrial processes, acid rain and acid aerosols.



(7) Chlorofluorocarbons (CFCs)

Chlorofluorocarbons or CFCs are odorless, man-made gases used in a variety of industrial, commercial and household applications. CFCs are non-toxic, non-flammable and non-reactive to other chemical compounds.

They are commonly used as coolants for commercial and residential refrigeration units, aerosol propellants and electronic cleaning solvents. It has been proven that the chlorine component of CFCs destroys the upper-level ozone. The formation of the ozone hole over Antarctica is believed to be caused by CFCs.



Let's Review

A. Matching Type. Write the correct letter of the answer in the space before each number.

- | | |
|-----------------------------|---|
| _____ 1. Carbon monoxide | a. found in liquid and solid aerosols |
| _____ 2. Sulfur dioxide | b. formed when engine and fuel gases are released into the air and interact in the presence of sunlight |
| _____ 3. Smog | c. forms black smoke or smog |
| _____ 4. Particulate matter | d. deadly, odorless and colorless gas that is formed by burning oil, gasoline, coal and wood |
| _____ 5. Nitrogen dioxide | e. found in acid rain, metal smelting, paper manufacturing and food processing |
| _____ 6. Lead | f. a major threat to the health of children |
| _____ 7. CFCs | g. odorless gas found in aerosol and refrigeration units |

B. Identify the air pollutant that is emitted by the following activities.

Air Pollutant	Activities
1. _____	Open burning Motor vehicles Industrial factories and sites Mining areas
2. _____	Motor vehicles
3. _____	Burning of coal and rubbish
4. _____	Sulfuric acid producing factories
5. _____	Open burning
6. _____	Factories producing nitric acid
7. _____	Use of leaded petroleum
8. _____	Aerosol sprays
9. _____	Refrigerators

Compare your answers with those in the *Answer Key* on page 47.

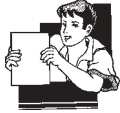


Let's Think About This

1. Do you experience problems with air pollution? Does your community experience problems with air pollution? Enumerate air pollutants that are found in your home, workplace and community.

2. Identify the possible causes of air pollution in your home, workplace and community.

Ask your Instructional Manager or Facilitator to check and discuss your answers with you.



Let's Learn

Read the short article below.

Air pollution in Metro Manila has reached a dangerous level. It is four times higher than the tolerable limit. The World Health Organization (WHO) in 1993 included Metro Manila among 20 major cities in the world worst hit by air pollution.

In Metro Manila alone, population has reached close to 20 million. Over 70% of Manila's air pollution is caused by traffic. There are about 3.2 million registered vehicles in Manila. Diesel-driven vehicles make up over 40% of the traffic.

On the other hand, there are more than 4,000 industries in Metro Manila. It is estimated that 100 tons of air pollution are emitted by factories.

Sources: Asian Development Bank, 2000. ADB Funds Get-Tough Plan To Clean Up Monitor Air. <http://www.adb.org/documents/nes/1998/nr1998100.asp>. January 9, 2001, date accessed

Hangin Organization, 2000. Metro Manila Air Quality Improvement Sector and Development Project. <http://www.hangin.org>. January 9, 2001

The above information shows that in large urban areas such as Metro Manila, the level of air pollution is indeed very high. Great amounts of air pollutants are found in the air which the residents of Metro Manila breathe every day. The large population in Metro Manila and the presence of factories and industries contribute to the problems of air pollution.



Let's See What You Have Learned



Study the picture above and answer the questions below.

1. Identify the different sources of air pollution found in the illustration.

2. Name the air pollutants emitted by the sources you have identified.

3. Describe what air pollution is.

Compare your answers with those in the *Answer Key* on pages 47–48.



Let's Remember

In this lesson, you have learned that:

- ◆ **Air pollution** refers to the large amounts of toxic gases and particles such as smoke, fumes or mechanically generated dust particles that decrease the quality of air.
- ◆ The seven (7) principal pollutants are urban smog, particulate matter, carbon monoxide, lead, nitrogen dioxide, sulfur dioxide and CFCs.
- ◆ Great amounts of air pollutants are found in the air which the residents of Metro Manila breathe every day. The presence of motor vehicles, factories and industries contribute to air pollution problems.

What Are the Harmful Effects of Air Pollution?

The presence of man-made gases and chemicals in the air have tremendous effects on our environment and surroundings. In most urban areas, the air we breathe poses a great risk to our health. The effects of air pollution can greatly change the earth's climate patterns and the normal condition of the atmosphere. With all these atmospheric changes such as **acid rain**, **global warming** and **ozone depletion** that are brought about by air pollution, our living conditions change. And so, human health deteriorates and the nation's economy suffers greatly.

In this lesson, the three different atmospheric changes mentioned above shall be discussed and explained. We will also study the effects of air pollution on our health, environment and economy.



Let's Study and Analyze

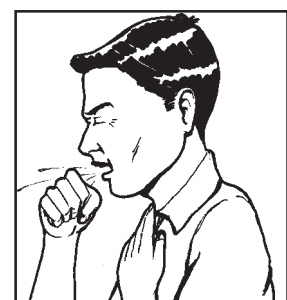
In the previous lesson, we have identified and studied the seven primary pollutants. As a review, list down the seven major air pollutants. If you don't remember all of them, you can review Lesson 1.

How do these air pollutants affect people and the community? How do they affect our health, environment and economy?

To check if your answers are correct, continue reading.

◆ How Does Smog Affect Our Health?

When we breathe in polluted air, we experience cough. Our throat becomes irritated and our chest starts to tighten. Air pollution lowers our resistance to respiratory diseases and may even lead to serious chronic lung diseases such as asthma attacks, bronchitis and even death if no proper medication is sought. Air pollution can also cause eye and skin irritation aside from the common respiratory illnesses.



◆ **How Does Air Pollution Affect Our Surroundings?**

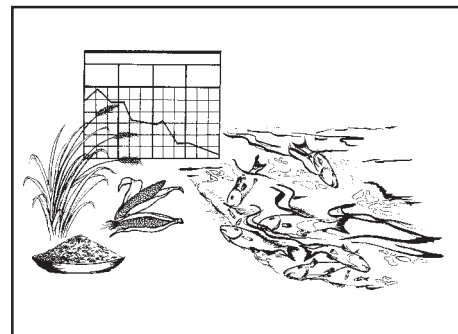
The presence of smog or other tiny pollutant particles in our atmosphere makes our surroundings dirty. Our homes, furnishings and the clothes we wash and hang on the clotheslines outside our homes become filthy with dust particles and ashes blown by the wind.



Later in this lesson, we shall discuss further the more serious effects of air pollution on our environment and surroundings. These are the atmospheric changes such as acid rain, global warming and ozone depletion.

◆ **How Does Air Pollution Affect Our Economy?**

A change in the earth's temperature or climate patterns would affect every factor that contributes to our economic growth. For instance, our food or agricultural production will decrease, due to damaged crops and barren soil caused by global warming and acid rain. Our fishing industry will likewise weaken due to contamination of water bodies caused by acid rain. In urban areas, the poor health of workers caused by air pollution may disrupt work and decrease productivity. These conditions will definitely affect our industries and economy.



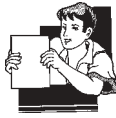
Having discussed the effects of air pollution on our health, environment and economy, let's move on to our study of the atmospheric changes. Are you familiar with acid rain, global warming and ozone depletion? Are you aware that all these atmospheric changes are caused by air pollution? These changes greatly affect our atmosphere, climate patterns and environment.



Let's Think About This

1. Have you heard about *Acid Rain*? Did you know that acid rain is more acidic than normal rain? _____
2. Write down what you know and understand about acid rain.

Continue reading the lesson to see if your answers are correct.



Let's Learn

What Is Acid Rain?

Many people think that air pollution affects only the air they breathe. But this is not the case. Chemicals and toxic fumes found in the air are poisons that remain in the atmosphere and mix with tiny water droplets in the air. The acid droplets return to the ground as raindrops or snowflakes.

During the rainy season, rainwater washes away the chemicals found in the air, contaminating the ground and bodies of water. This is known as **acid rain**. Acid rain is more acidic than normal rain. It contains sulfuric acid and nitric acid that come from carbon, gas and oil emitted by car exhausts, factories and electrical plants. Natural sources that emit sulfur dioxide such as volcanoes, sea spray, rotting vegetables and plankton also generate acid rain.



Let's Think About This

How does acid rain affect our lives? Think it over and write down your thoughts on how acid rain can possibly affect our lives.

Did you know that acid rain causes harm and damage to rivers, trees, buildings and people? We will now study in detail the harmful effects of acid rain on our health, environment and economy. We will be performing an experiment on the effects of acid rain.



Let's Try This

To clearly illustrate the harmful effects of acid rain on our environment, let's try doing this activity. After the activity, you should be able to describe the changes that takes place in objects like stone buildings and metals, or organisms such as animals and fish when there is acid rain in the environment. Try forming your own hypothesis or ideas before performing the following activity.

Prepare the following materials:

- ◆ Vinegar
- ◆ Water
- ◆ 2 pieces of eggshell
- ◆ 2 small green leaves
- ◆ 2 paper clips
- ◆ 2 containers with cover

Procedure:

1. State your own hypothesis. In other words, answer the question: *What is the effect of acid rain on the things in our environment?*

2. Pour vinegar in one container and water in another container. Place an eggshell, a leaf, and a paper clip in both containers. Cover the containers.
3. Leave the two sealed containers overnight.
4. The next day, remove the cover. Observe the changes to each item in the two containers. Write down your observations below.

Finished? If so, read on.



Let's Think About This

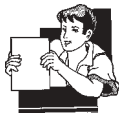
1. What happened to the eggshells, leaves and paper clips that were placed in the vinegar and water?

2. Did the results of the experiment support your earlier hypothesis?

3. Is acidic solution harmful? Why?

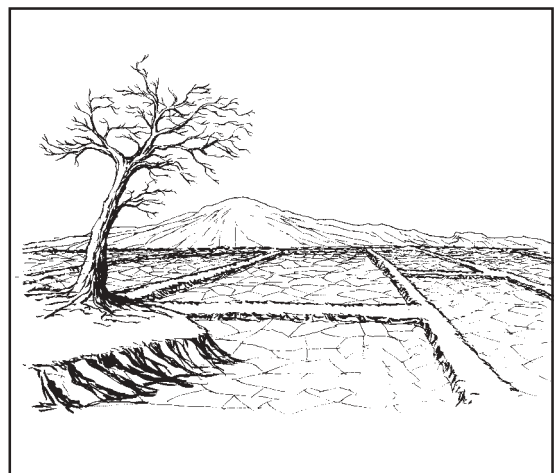
4. What did you observe or learn from this activity?

Compare your answers with those in the *Answer Key* on page 48.

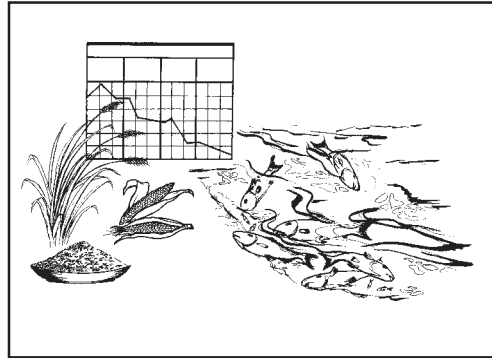


Let's Learn

Acid rain is harmful to fish and other animals living in different bodies of water. In Europe alone, thousands of lakes have become acidified, leading to the decline of fish stocks. Further more, acid rain can harm forests, trees, crops, and may even damage the soil. A study in Pakistan showed that a forty (40%) percent decrease in rice yields was measured and linked to the presence of ozone and sulfur dioxide in the air. Forest decline has also been reported in China and Japan due to increasing pollution. Acid rain can actually destroy stone buildings, bridges, monuments, roads and forests. In major cities of Europe and North America, a number of buildings and cultural monuments have become corroded due to sulfur pollution.



It is clear that acid rain has adverse effects on our economy. Our food production would decline because of damaged crops and barren soil. Fruit-bearing trees would stop producing fruits. Seedlings would not be able to produce new trees. Dead fish are harmful to the fishing industry. The production of canned tuna and salmon would diminish because there would be fewer fish in the rivers and oceans. Also, acid rain could cause damage to infrastructure.



Furthermore, the effects of acid rain on human health would be very serious. Some lakes contain high amounts of mercury. This is why people are advised not to eat fish caught in waters that have mercury content. As the acid increases, it could react with lead and copper water pipes and could contaminate drinking water. Large amounts of copper could cause diarrhea in young children and could damage the liver and kidneys.

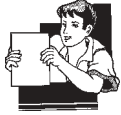
We have just finished our discussion on acid rain. In the previous section, we have learned what acid rain is and how it affects our lives. Are you ready to proceed to Global Warming, the second atmospheric change?



Let's Think About This

1. Have you heard about the *greenhouse effect*? _____
2. What do you know about the greenhouse effect or global warming?

To know more about global warming, continue reading.



Let's Learn

What Is Global Warming?

Global warming is another effect of air pollution. It is also known as the “greenhouse effect.”



Do you know what a greenhouse is? Do you know how it works? A greenhouse is a building with a glass roof and glass sides that is generally kept warm for growing plants. Do you know why it gets hotter and hotter inside a greenhouse? It is because the glass panels allow sunlight to come in but prevent the heat from escaping. What actually happens inside a greenhouse is similar to global warming.

Global warming suggests that human beings are responsible for making the world a warmer place due to air pollution. The carbon dioxide that our cars, trucks, and industries emit contributes to global warming. Normally, certain atmospheric gases or “greenhouse gases” absorb some of the heat that the earth releases.

The heat that the earth releases comes from solar radiation, without which, the earth would have a temperature of about 18 degrees centigrade (18°C). Water vapor, carbon monoxide, carbon dioxide, ozone, methane and nitrous oxide are examples of greenhouse gases.

Due to the increasing amount of carbon dioxide and water vapor in the air, a thick polluting layer covers the atmosphere. Because of this, the heat gets trapped and the concentration of the greenhouse gases increases. The result is an increase in global temperature. Now you know why the world gets hotter and hotter.



Let's Think About This

1. Can you explain what the greenhouse effect is?

2. How do you think will global warming affect our lives?

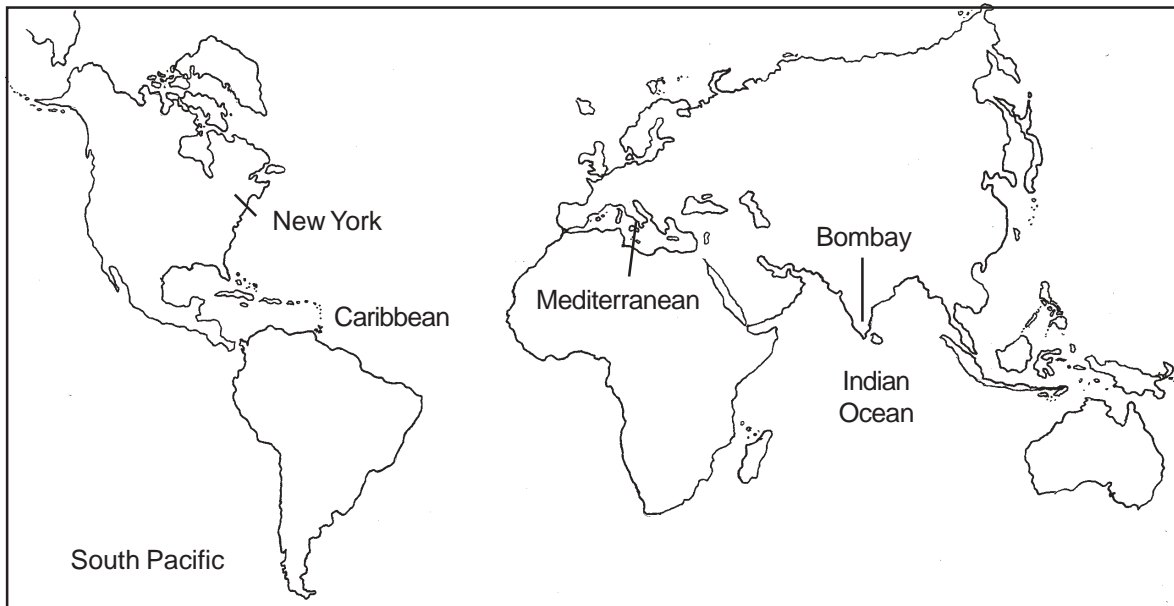
To know if your answers are right, compare them with those in the *Answer Key* on pages 48–49.

What will happen if the earth's temperature rises? Will there be any effects on the earth's ecosystem?

Though the rise in the earth's temperature is not much, the small changes can have large effects. It is because climate affects us in so many ways.

Tropical countries like the Philippines and other sub-tropical regions would be experiencing warmer temperatures. In fact, 1998 was the warmest year ever recorded in the Philippines this century! The scenario for the future suggests that the soil will dry up. Many places will also experience drought. Less food would be produced, causing food prices to increase.

An increase in food prices means malnutrition and hunger for countries with warmer temperatures like us. Furthermore, our water supply will diminish, resulting in a higher incidence of diseases like malaria, diarrhea, cholera and other infections. Moreover, the warming of our seas and oceans would increase the frequency and severity of typhoons in the country.



Aside from this, a warmer world could result in the melting of snow and ice in the North and South Pole. Cities that are built at sea level such as Bombay and New York would be flooded by overflowing seas. Many islands in the Caribbean, South Pacific, Mediterranean and Indian Ocean would even disappear. The frequency of extreme weather events such as heat waves and hurricanes is likely to increase. High temperatures may aggravate air pollution, especially smog. Many species of organisms would become extinct and mortality rates would increase due to heat waves or extreme weather. The effects of global warming could be disastrous and threatening.

In summary, the effects of the greenhouse effect are predicted to be:

- ◆ Warmer temperatures in tropical countries (like the Philippines), which will likely lead to drought, food shortage, higher incidence of certain diseases, and increased frequency and severity of typhoons;
- ◆ The melting of the polar ice caps, which will likely lead to the flooding of certain areas;
- ◆ More heat waves and hurricanes;
- ◆ Increase in air pollution;
- ◆ Higher mortality rates; and
- ◆ Extinction of many species of organisms.

You have just learned what global warming is and how it affects our lives. Now, let's move on to the last atmospheric change which is *ozone depletion*.



Let's Think About This

1. Have you heard about ozone depletion? _____
2. Write down what you know about ozone depletion.

To check if your answers are correct, continue reading.



Let's Read

What Is Ozone Depletion?

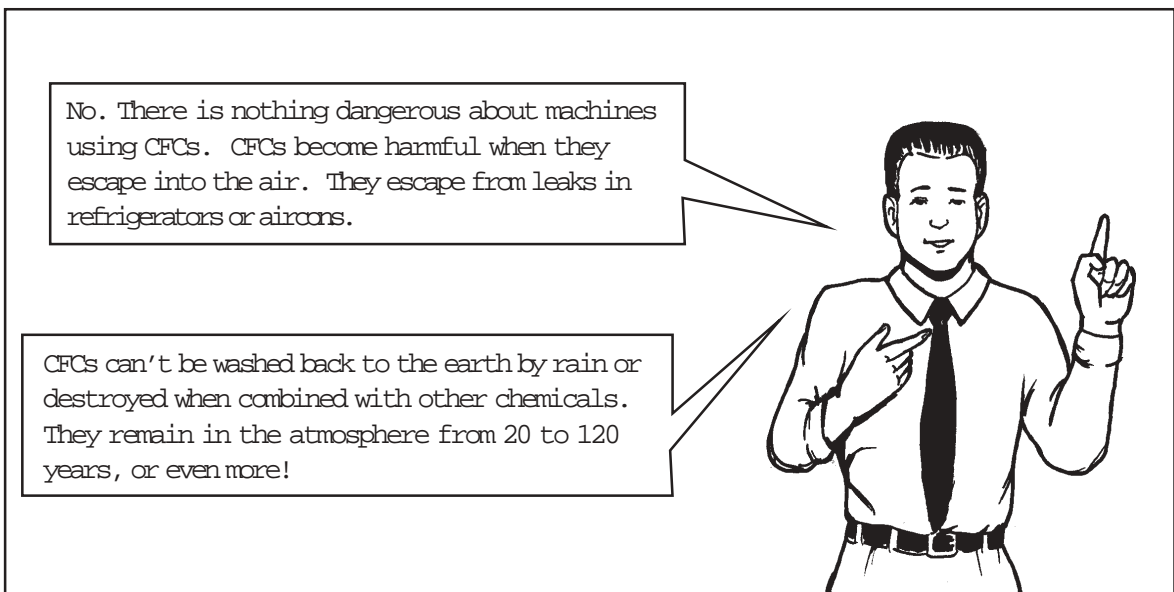
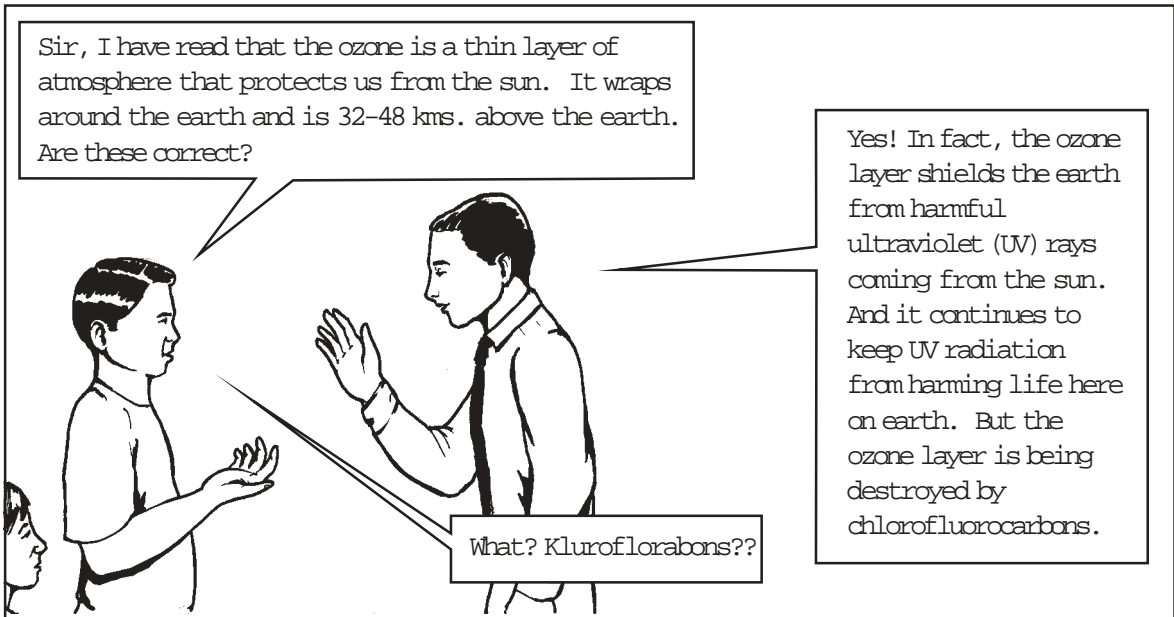
Study the comic strip below. It discusses what the ozone layer is and how the ozone hole is formed.

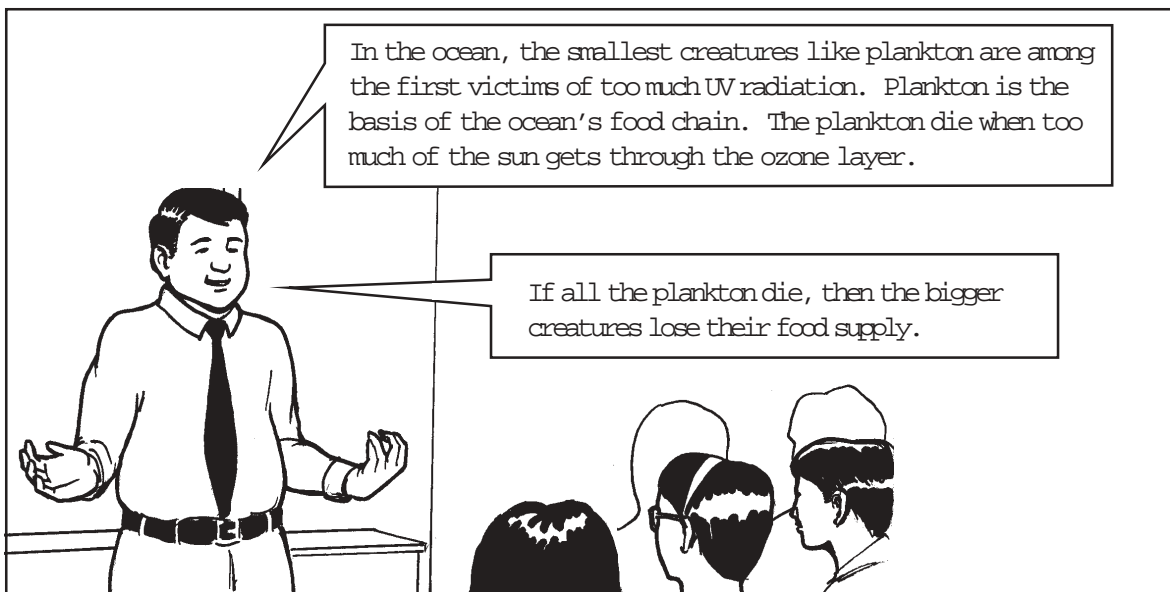
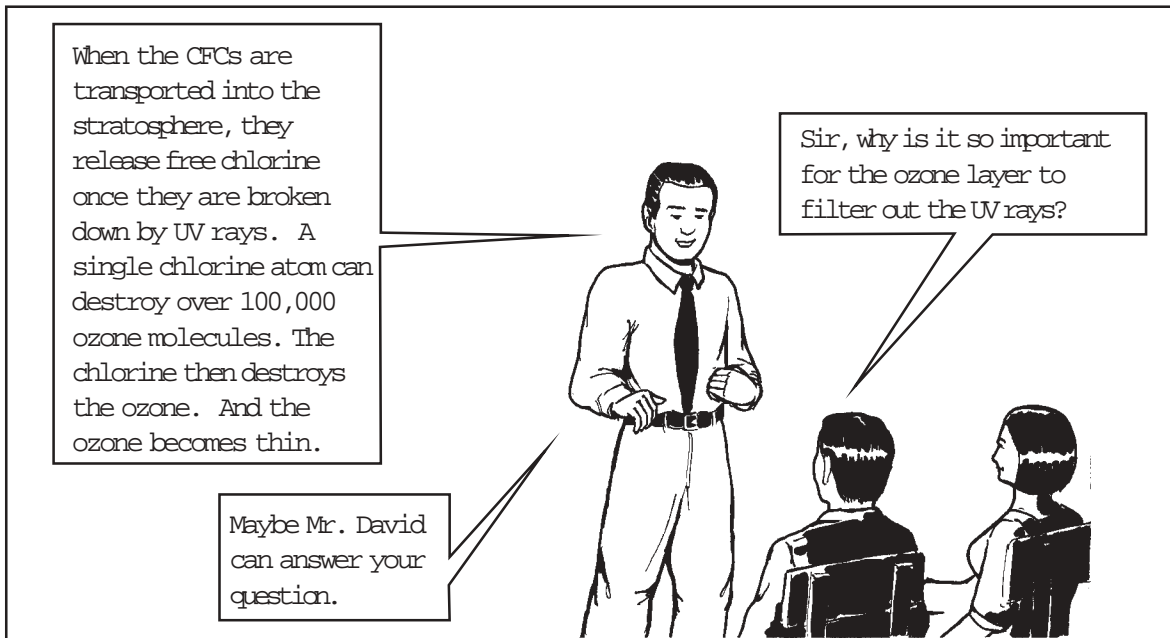
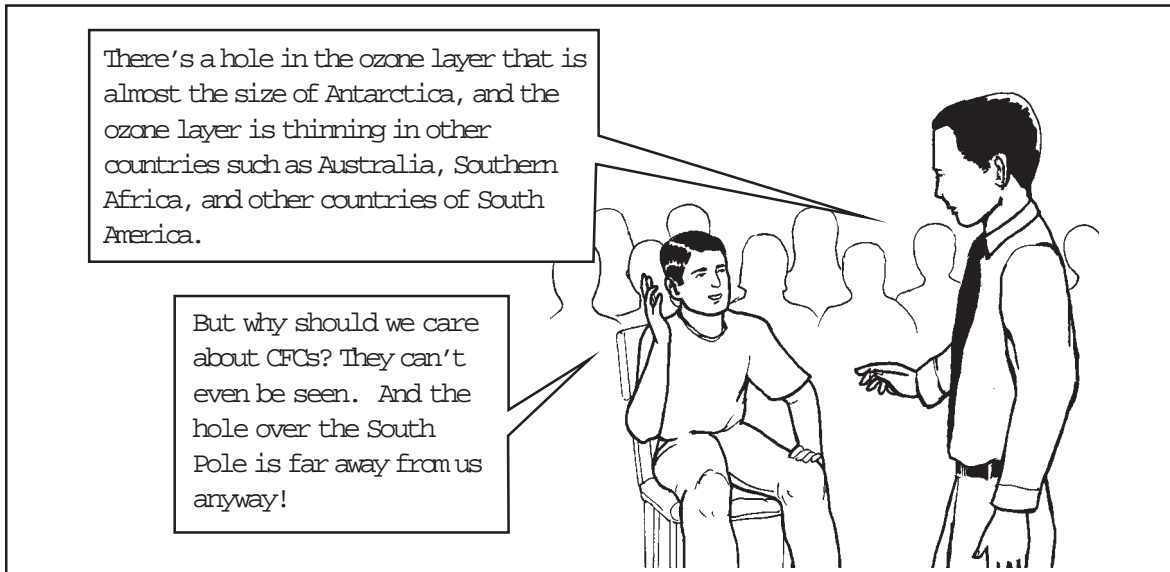
At the Barangay Hall during a seminar on Ozone Depletion, sponsored by the Barangay Council...

Welcome to our seminar. This morning, we have invited resource speakers from the DENR to tell us about ozone depletion. We have heard so much about a huge hole found in the stratosphere over Antarctica.

During the lecture...

"You see, our atmosphere is a mixture of gases that surround the earth. Without it, the earth's temperature can change incredibly. Our atmosphere has many layers and the stratosphere is one of them. The ozone layer can be found within the stratosphere."





Plants form the base of the earth's food chain on land. If some plants are exposed to too much UV radiation, they grow more slowly and produce less food. As the ozone layer thins, the food supply decreases all over the earth. Animals can't get enough food from the plants, and likewise people will also have fewer or less food to eat.

Too much UV radiation for humans can even cause severe sunburns, cataracts and skin cancer. This is already a problem during summer months for the people living in Australia, Netherlands and the countries of Southern Africa and South America.



In the open forum...

Why does the hole in the ozone occur only over Antarctica?

Why isn't there an ozone hole over the North Pole or other countries?




This is because a whirlwind or a whirlwind pattern over Antarctica isolates the ozone hole. This is known as a vortex. What it does is, it traps CFCs during the cold Antarctic winter. When spring begins, CFCs react with the ozone layer and the hole is created.



The most important thing that we can do to prevent the thinning of the ozone layer is to stop using CFCs. Many countries are now passing laws to stop the production and use of CFCs. HCFC or Hydrochlorofluorocarbon is used as a substitute for CFCs.

The treaty that protects the ozone layer is the Montreal Protocol.



Let's Think About This

Try answering the questions below.



1. What is the ozone layer? Why is it important to us?

2. Why is the ozone layer getting thinner and thinner?

3. What will happen if the ozone layer is unable to filter ultraviolet (UV) rays from the sun?

4. What are chlorofluorocarbons? Can you give examples of CFCs?

5. Can you give the harmful effects of UV rays to our health?

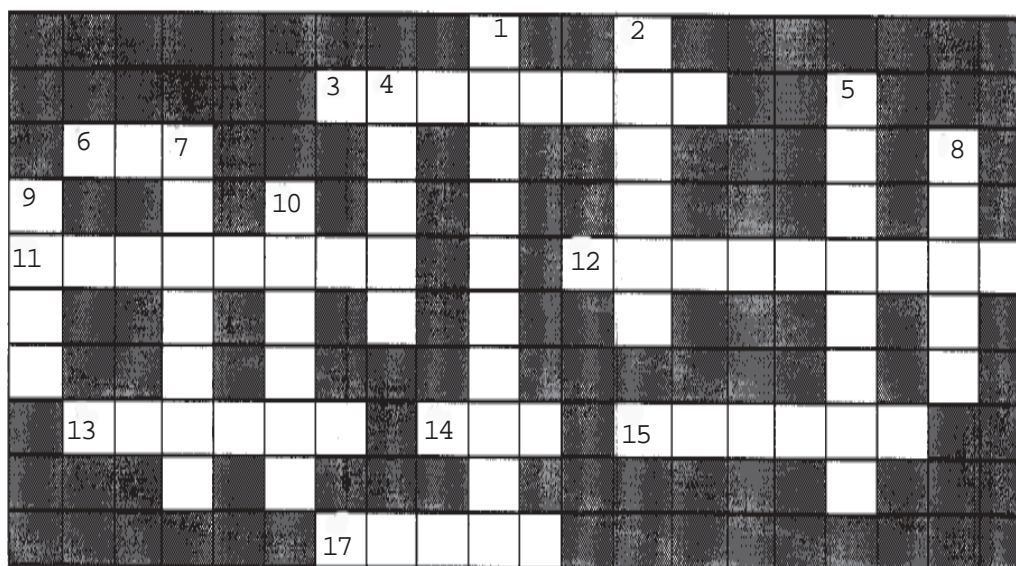
6. What preventive measures will you take to be safe from UV rays?

Compare your answers with those in the *Answer Key* on pages 49–50.



Let's Review

Answer the crossword puzzle below. You can refer to the previous comic strip to solve this puzzle.



Source: <http://www.epa.gov/ozone/puzzles/scipuzzp.html> Sept. 26, 2000

Across

3. Microscopic animal harmed by excessive UV rays.
6. Very harmful band of UV radiation
11. One atom of this can destroy over 100,000 ozone molecules
12. Unnatural thinning of the ozone layer caused by human activities
13. Skin _____: One of the worst health effects of too much sun
14. ____ conditioning: one type of equipment that emits CFCs
15. Unit for measuring column ozone
17. ____osphere: Part of the atmosphere containing the ozone layer

Down

1. The southernmost continent; above it can be found the ozone hole
2. Wind pattern over Antarctica that isolates the ozone hole
4. Ozone ____: region in the atmosphere that contains the most atmospheric ozone
5. Montreal ____: The treaty that protects the ozone layer.
7. Chemical that makes methyl bromide an ozone-depleting substance
8. Molecule that absorbs UVB radiation from the sun, protecting earth
9. A substitute for CFCs that is much less damaging to the ozone layer
10. Ultra ____: Harmful solar radiation

Compare your answers with those in the *Answer Key* on page 50.

Did you like answering the crossword puzzle? Were you able to fill in all the empty squares? You have probably learned so much already. To see how well you understand and remember the important points discussed in this lesson, do the activity below.



Let's See What You Have Learned

- A. Choose the **best** answer among the given choices. Encircle the letter of the correct answer.
1. The combination of nitrogen dioxide and hydrocarbons in the presence of sunlight causes:
 - a. Global warming
 - b. Smog
 - c. Ozone depletion
 - d. Acid rain
 2. What are the two acids that make up the acid rain?
 - a. Sulfuric and nitric acid
 - b. Nitric and boric acid
 - c. Hydrochloric and sulfuric acid
 - d. Boric and hydrochloric acid

3. What makes stone buildings, bridges, monuments, roads and forests corroded?
 - a. Boric acid
 - b. Sulfur
 - c. Carbon
 - d. Lead

4. Once CFCs are transported to the stratosphere, what chemical is emitted causing destruction to our ozone layer?
 - a. Sulfur
 - b. Chlorine
 - c. Carbon
 - d. Acid

5. What makes the world hotter and hotter?
 - a. increased amounts of carbon dioxide and water vapor in the air
 - b. certain greenhouse gases that absorb solar heat and get trapped in the atmosphere
 - c. a thick polluting layer that covers the atmosphere
 - d. all of the above

B. How do atmospheric changes brought about by air pollution affect our lives?
Write down your answers in the table below.

Effects of Atmospheric Changes Due to Air Pollution				
	<i>Smog</i>	<i>Acid Rain</i>	<i>Greenhouse Effect</i>	<i>Ozone Depletion</i>
Health				
Environment				
Economy				

Compare your answers with those in the *Answer Key* on pages 50–51.

Well, what have you learned from our discussion on acid rain, global warming and ozone depletion? Did the readings help you understand about more about the ozone layer and global warming? Having studied these three different effects of air pollution, will you be able to sum up the effects of air pollution on our environment, health and economy? Would you like to do this now?



Let's Remember

In this lesson, you learned that:

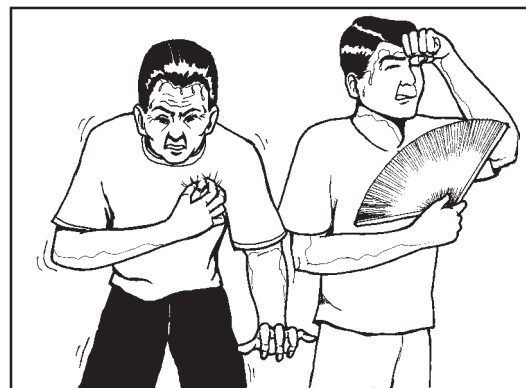
- ◆ Air pollution results in atmospheric changes such as acid rain, global warming and ozone depletion.
- ◆ **Acid rain** takes place when chemicals emitted by factories and power plants combine with tiny water droplets in the air and form acids. The acid droplets return to the ground as raindrops or snowflakes. The effects of acid rain on human health are:

- can affect the respiratory tract, bringing asthma, dry cough, headache, eye, nose, and throat irritations;
- causes tightening of the muscles around the bronchi and bronchioles for young asthmatics; and may lead to illnesses due to water contamination.



- ◆ **Global warming** is also known as the greenhouse effect. This atmospheric change suggests that man's activities contribute to the warming of the earth. The effects of global warming on human health are:

- breathing illnesses;
- heart attacks;
- heat-related stress and death, due to extreme weather conditions such as heat waves;
- malaria due to warmer temperatures;
- increase in the incidence of respiratory diseases;



- higher incidence of food-and-water related infections such as diarrhea and cholera due to spread of microorganisms; and
- increase in malnutrition and hunger.

- ◆ **Depletion of the ozone layer** is caused by chlorofluorocarbons or CFCs. Once the CFCs are transported into the stratosphere, chlorine is emitted and destroys the ozone. The effects of the ozone layer depletion on human health are:



- severe sunburn caused by UV rays;
- premature aging or wrinkling of the skin or skin cancer;
- cataracts, eye damage; and
- weakening of the human immune system

- ◆ These atmospheric changes affects the environment, too. The effects are:

- destroys single-celled plants and algae that serve as food for some fish;
- ruin our food supply or food chain;
- harms our marine and aquatic resources; and
- changes the earth's temperature and climate patterns

- ◆ They also affect our economy through:

- decreases food or agricultural production;
- damages crops and decreases the productivity of the soil;
- affects in the fishing industry due to contamination of water bodies; and
- affects workers health, which may cause work disruption and decreased productivity.

What Can You Do to Help Solve Air Pollution?

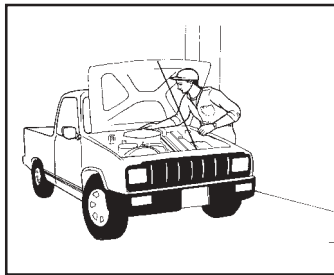
What can you do to help keep the air in our atmosphere clean? Are you aware of our government's efforts in trying to address the problem of air pollution? In this lesson, you will learn about what you can do to address air pollution problems. You will learn ways to keep the air clean and reduce air pollution so you can better protect your health and the environment from harmful air pollutants.

At the end of this lesson, you should be able to describe the government's efforts to address the problem of air pollution. Also, you should be able to demonstrate a sense of responsibility for our atmosphere and environment.

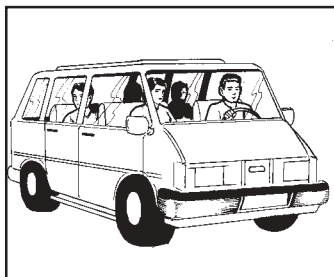


Let's Read

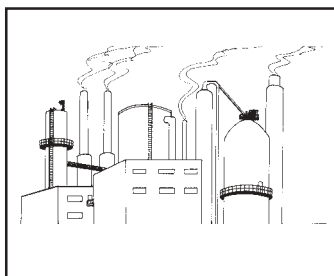
Did You Know?



If 190,000 car owners started to get regular tune-ups, they will keep some 90 million pounds of carbon dioxide out of the atmosphere.



If each commuter car carries one more passenger, 6 million gallons of gasoline will be saved and 12 million pounds of carbon dioxide will be kept out of the air.



If the government would only enforce stricter emission standards, then the emission of 100 trillion tons of sulfur dioxide by various industrial plants would be minimized.

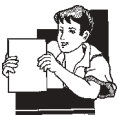


Let's Try This

Try performing the activity below.

1. Look for a weighing scale and try weighing yourself.
2. What is your weight in pounds? _____
3. How many pounds of carbon dioxide would be kept out of the air if 190,000 car owners started to get regular tune-ups? _____
4. How many pounds of carbon dioxide would be kept out of the air if each commuter car carries one more passenger? _____
5. Compare your weight with the weight of the carbon dioxide that would be kept out of the air if we do our part in conserving energy.
6. What can you do to help keep the air in our atmosphere cleaner? Write down measures that could be taken to reduce air pollution.

Have you come up with your answers? Continue reading to check if your answers are right.



Let's Learn

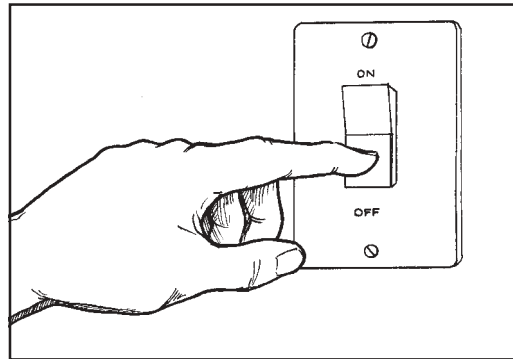
Ways to Help Overcome Air Pollution

How can we solve air pollution problems? How can we keep the air clean? Energy conservation is still the best and most effective way of reducing air pollution. Thus, we should be responsible for the little actions we make. We should conserve energy at home, at work and everywhere. There are a number of ways to conserve energy.

It is also advisable that we use earth and human-friendly alternatives rather than using hazardous chemicals in our homes and in the workplace.

Conservation of Energy

- ◆ The use of products that are energy-demanding should be avoided.
- ◆ Be sure to turn off lights when not in use or when you leave a room.
- ◆ It is good to have proper insulation for your houses.
- ◆ Conserving electricity and setting air conditioners at a lower temperature are also advised.



Use of Earth- and Human-Friendly Alternatives

- ◆ Whenever possible, use environmentally safe paints and cleaning products.
- ◆ Replace hazardous chemicals with earth and human-friendly alternatives.
- ◆ Dispose of household paints, solvents and pesticides properly.
- ◆ Never pour these chemicals down the drain or into the ground and never throw them in the garbage.
- ◆ Seal cleaners, paints and other chemicals properly to prevent evaporation into the air.
- ◆ Don't leave chemical containers standing open when not in use.
- ◆ If possible, lessen the use of gasoline-powered lawn and garden equipment.

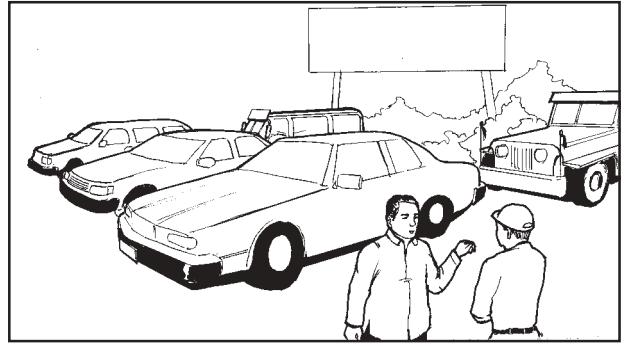


Waste Reduction

- ◆ Reduce waste
- ◆ When you make purchases, consider using products that are durable and reusable or which use less packaging.

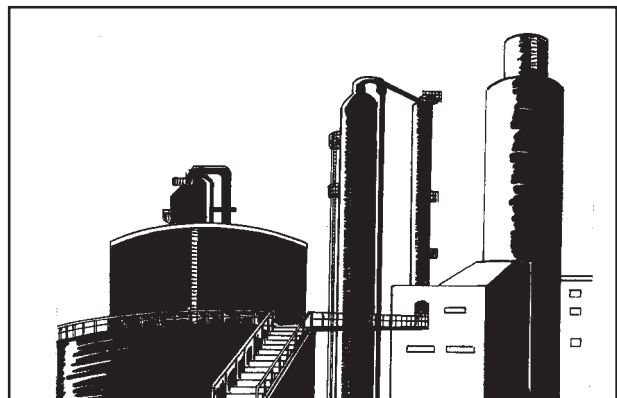
Motorists and Automobiles

- ◆ Motorists should take initiatives to avoid polluting the air.
- ◆ They should ensure their vehicles undergo regular tuning-up to lessen emission of unburned carbon.
- ◆ Government should impound smoke-belching motor vehicles.
- ◆ The use of cleaner fuel or unleaded gasoline should be enforced.
- ◆ The use of emission control technologies should be adopted.
- ◆ Everyone should follow gasoline refueling instructions for efficient vapor recovery.
- ◆ If you drive a car, be careful not to spill fuel and always tighten your gas cap securely.
- ◆ Refuel vehicles after dusk.
- ◆ Share a ride to work or use public transportation.
- ◆ Combine errands and reduce trips.
- ◆ Avoid driving during peak hours or when heavy traffic is at its worst.
- ◆ Use car air-conditioners only when necessary.



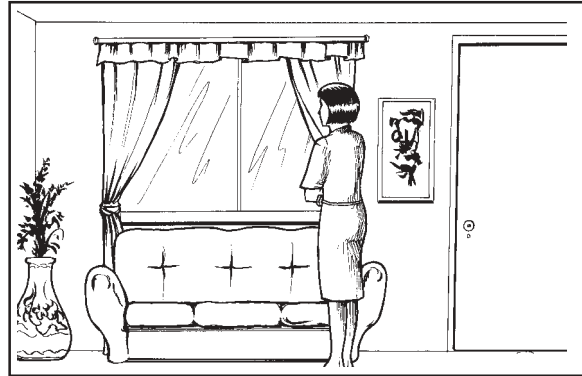
Factories and Industrial Plants

- ◆ Factory operators should avoid polluting the air.
- ◆ Laws have to be passed to force businesses to use alternative energy sources.
- ◆ Factory operators should burn their wastes in incinerators.
- ◆ Factories producing chlorofluorocarbon (CFC) gases should find alternatives or shut down.



Health Precautionary Measures

- ◆ To protect yourself from the effects of air pollution, it is best to stay indoors as much as you can during the day to protect yourself from UV radiation.
- ◆ Limit outside activity to the early morning hours or wait until after sunset. It is at these times that there is less air pollution outdoors.



Let's Think About This

Are you aware of our government's efforts in reducing air pollution? What is our government doing to solve the air pollution problem? Think about these for a while. Write down your ideas in the spaces below.

After writing down your ideas, turn to the next page.



Let's Try This

Read the newspaper article on air pollution below.

METRO MANILA POLLUTION BEYOND TOLERABLE LIMIT

By Alejandro R. Roces

According to the World Health Organization, air pollution in Metro Manila is four times higher than the tolerable limit. Last April, a major step was taken to at least bring this intolerable level down. The sale of leaded gas was banned in the entire metropolis. That, we are sure has done a lot to lessen pollution, but up to now we don't know as to what extent it has reduced the pollution in the city.

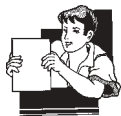
The next step, of course, is to go after smoke-belching vehicles. There is a law against smoke-belching and we have always wondered how buses and private vehicles can get away with smoke-belching when it is not difficult to detect them in the streets. The police force has taken action against smoke-belching buses.

The truth is that most of the buses operating in our roads are old buses that were purchased from more progressive countries abroad. That explains why they belch smoke. We commend the police for doing their job of minimizing air pollution in all of Metro Manila. To begin with, smoke-belching vehicles waste more gasoline. It is a sign that the engine is not properly maintained. What belches out in smoke is insufficiently burned fuel.

The Health Department reported that about two million Filipinos are afflicted with chronic obstructive pulmonary diseases from smoking and pollution. Public health should be the top priority of any administration. It is the only thing that ranks even higher than education. And it is the only wealth that is tax free.

What were the major steps taken by the government to bring down the intolerable level of air pollution?

Compare your answers with those in the *Answer Key* on page 52.



Let's Learn

What is the government going to solve the problem of air pollution?

What steps is the government taking to achieve healthy air quality throughout the country? Are there actual programs being implemented by the government to solve the air pollution problem?

Have you heard about RA 8749 or the *Clean Air Act*? Are you familiar with it? Are the government's existing programs on air pollution control in accordance with the Clean Air Act? Republic Act # 8749 provides an extensive air pollution control policy. This aims to achieve and maintain healthy air quality throughout the country.

In line with this objective, the Department of Environment and Natural Resource (DENR) has set up air quality monitoring and control systems to reduce air pollution. It has also adopted and implemented programs which:

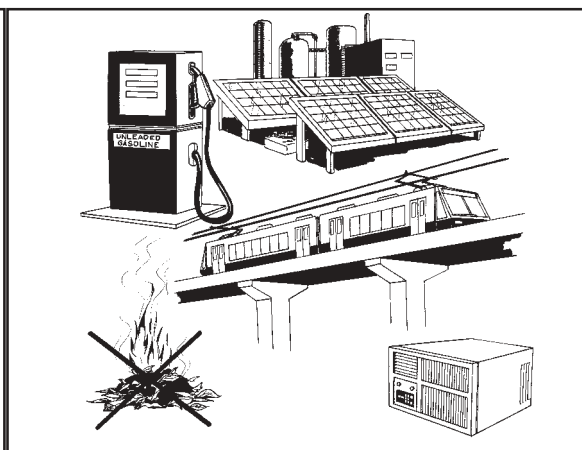
- ◆ enforce stricter emission standards;
- ◆ enforce stiffer penalties for pollutants;
- ◆ implement motor vehicle inspection systems;
- ◆ improve traffic planning; and
- ◆ rehabilitates roads.



Let's Review



Picture 1



Picture 2

1. Study and analyze the two illustrations above. What are your observations? Explain the differences of the two pictures.

2. Discuss what *Republic Act #8749* is.

3. Discuss solutions or ways to overcome air pollution.

Compare your answers with those on the *Answer Key* on page 52.



Let's Talk About This

Visit a particular area in your community where air pollution is very high, posing a threat to human health and environment. Make a listing of the sources of existing air pollutants. Be ready to identify possible solutions and discuss them with your *Instructional Manager* or *Facilitator*, co-learners and family members. It is best if you can talk to some barangay officials. Discuss with them how all of you can help keep the air clean and fresh.

All done? If so, great job! You really play a major part in reducing air pollution and in keeping our air clean and fresh. You certainly have a deep sense of responsibility for our environment. Keep it up!



Let's Remember

- ◆ **Energy conservation** still remains to be the best and most effective way of reducing air pollution.
- ◆ Individuals should be responsible for their actions. We should use earth and human-friendly alternatives rather than hazardous chemicals, in our home and workplace.
- ◆ Republic Act # 8749 or the *Clean Air Act* provides an extensive air pollution control policy which aims to achieve and maintain healthy air quality throughout the country.
- ◆ The DENR has adopted and implemented programs to reduce air pollution which:
 - 1 enforce stricter emission standards;
 - 1 enforce stiffer penalties for pollutants;
 - 1 implement motor vehicle inspection systems;
 - 1 improve traffic planning; and
 - 1 rehabilitate roads.



Let's See What You Have Learned

1. Can you think of specific things that you can do to reduce air pollution in your home and community? Think about this. Write down your answers on the blanks below.

2. Design a poster promoting clean and fresh air. You can use an extra sheet of paper if you want to make a bigger poster.

A large, empty rectangular box with a thin black border, intended for students to design a poster promoting clean and fresh air.

Compare your answer in the first activity with that in the *Answer Key* on page 53. For activity 2, you can show your poster to your Instructional Manager or Facilitator for feedback.



Let's Sum Up

This module tells us that:

- ◆ Air pollution refers to any large amount of harmful gases and particles such as smoke, smog and fumes that decrease the quality of air.
- ◆ The presence of motor vehicles, factories and industries contribute to the air pollution problem.
- ◆ Atmospheric changes such as acid rain, the greenhouse effect and ozone depletion are brought about by air pollution.
- ◆ Energy conservation and the use of non-toxic alternatives are effective ways of reducing air pollution.
- ◆ Our government's programs to reduce air pollution are in accordance with the *Clean Air Act* which enforce stricter emission standards, stiffer penalties for pollutants and implement vehicle inspection system.

Congratulations! You have just completed this module. But before proceeding to the next module, let us answer this one last activity. Do your best and good luck!



What Have You Learned?

- A. Matching Type. Match the items in Column A with those in Column B. Write the letter of the correct answer in the blanks.

Column A

1. Replace hazardous _____ with non-toxic alternatives.
2. _____ is an effective way of reducing air pollution.
3. _____ is also known as the Clean Air Act.
4. Air pollution in Metro Manila is _____ times higher than the tolerable limit.
5. The sale of _____ gas was banned in the entire metropolis.
6. Factory operators should burn their wastes in _____.

Column B

- a. four
- b. RA#8749
- c. Energy conservation
- d. incinerators
- e. chemicals
- f. leaded

- B. Answer the following questions.

1. Explain what air pollution is. Be able to identify and discuss each of the seven primary pollutants.

2. What will happen to the earth if our air pollution problems worsen in the next ten years? What are the consequences of having a highly polluted environment in terms of people's health, the environment and the economy of the Philippines?

3. What should the government do to solve our air pollution problems?

4. What can you do to reduce our air pollution problems?

Were you able to answer the four items? Compare your answers with the ones in the *Answer Key* on pages 53–55.

If you got a score of:

10 Very good! You have learned a lot from this module. You can now start studying another module.

6–9 Good! But review the questions you failed to answer correctly. You may need to refer back to the part(s) of the module that discuss(es) the topics you did not understand very well.

0–5 You need to review the entire module.



Answer Key

A. Let's See What You Already Know (*pages 2–3*)

1. (c) – The ozone layer is an atmospheric layer located at about 32 to 48 kilometers above the earth. It blocks the entry of most ultraviolet radiation into the lower atmosphere.
2. (d) – Non-aerosol hair sprays do not contain and emit CFCs. Most insect sprays, styrofoams and freon of refrigerators emit CFCs.
3. (a) – Smog, lead and particulate matter are examples of principal pollutants. Hydrogen is the only one with the potential to be pollution free. It emits only water vapor.
4. (d) – Better known as the Greenhouse Effect, global warming causes heat-related stress and death due to the rise in the earth's temperature.
5. (d) – All of the above. Pollutants such as nitrogen dioxide, carbon monoxide and smog are released by automobiles like cars and buses.
6. (c) – Republic Act # 8749 is Clean Air Act. It provides an air pollution control policy that will help to achieve and maintain healthy air quality throughout the Philippines.
7. (b) – Energy conservation still remains to be the most effective way of reducing air pollution.
8. (d) – All of the above. Our government should implement anti-pollution programs that enforce stricter emission standards, as well as stiffer penalties for pollutants and motor vehicle inspection systems.
9. (c) – Turning off lights when not in use is a practice that promotes energy conservation. Practices such as using products that are energy-demanding, setting the air conditioner at a higher temperature and not using insulation in the house do not help conserve energy.
10. (a) – Sulfuric and nitric acids are two acids that make up acid rain.

B. Lesson 1

Let's Study and Analyze (page 4)

Observations:

1. Smoke from factories pollute the air.
2. Smoke-belching cars pollute the air.
3. Burning garbage pollutes the atmosphere.

Let's Review (pages 10–11)

A. Matching Type

1. d
2. e
3. b
4. a
5. c
6. f
7. g

B. Activity Table (page 11)

Air pollutants emitted from the given activities:

1. Smog, smoke, fumes
2. Carbon monoxide, Nitrogen dioxide, Particulate Matter
3. Sulfur Dioxide
4. Nitrogen Dioxide, Nitrogen Oxide
5. Lead
6. Chlorofluorocarbons (CFCs)

Let's See What You Have Learned (page 13)

1. Different sources of air pollution found in the picture:
 - a. a car emitting smokes and fumes
 - b. factories and power plants
 - c. a man lighting a cigarette
 - d. an old lady cooking, using a wood-burning stove
 - e. a gardener using a gas powered lawn mower
 - f. backyard burning
2. Air pollutants released by sources of air pollution in No. 1:
 - a. car – smoke, fumes, smog, particulate matter, carbon monoxide, nitrogen dioxide, lead
 - b. factories and power plants – smoke, fumes, nitrogen dioxide
 - c. cigarette – carbon monoxide
 - d. use of wood stove – nitrogen dioxide
 - e. use of gas-powered lawn mower – carbon monoxide, smog
 - f. backyard burning – domestic smoke, smog

3. Air pollution refers to any large amount of toxic gases and particles such as smoke, fumes or mechanically generated dust that decrease the quality of air.

C. Lesson 2

Let's Try This (page 17)

Here are some possible hypotheses:

- ◆ Acid rain is more acidic than normal rain.
- ◆ Acid rain can be harmful to people's health, animals, forests, rivers, fishes, statues and buildings

You can ask your Instructional Manager for help in forming your hypothesis.

Let's Think About This (page 19)

1. In the container with water, the items did not show any noticeable changes. In the container with vinegar, the eggshell became soft. The leaf developed brown spots. The paper clip didn't show any noticeable change.
2. Yes.
3. Yes, from what we have observed from the experiment, acid burns some materials. Other materials, like the leaf, developed dark spots or rashes. In fact, acid causes allergic reactions in human bodies. Acid rain also damages things like the paint of cars, clothes drying on clothes lines and even stone buildings and metals over a period of time.
4. The activity shows that acidic solutions can be harmful and destructive.

Let's Think About This (page 22)

1. "Greenhouse Effect" is also known as global warming. It suggests that human beings are responsible for making the world a warmer place due to air pollution. Due to the increasing amount of carbon dioxide that is emitted by cars and power plants into the air, a thick polluting layer covers the atmosphere. Because of this, the heat gets trapped and the concentration of the greenhouse gases increases. The result is an increase in global temperature.

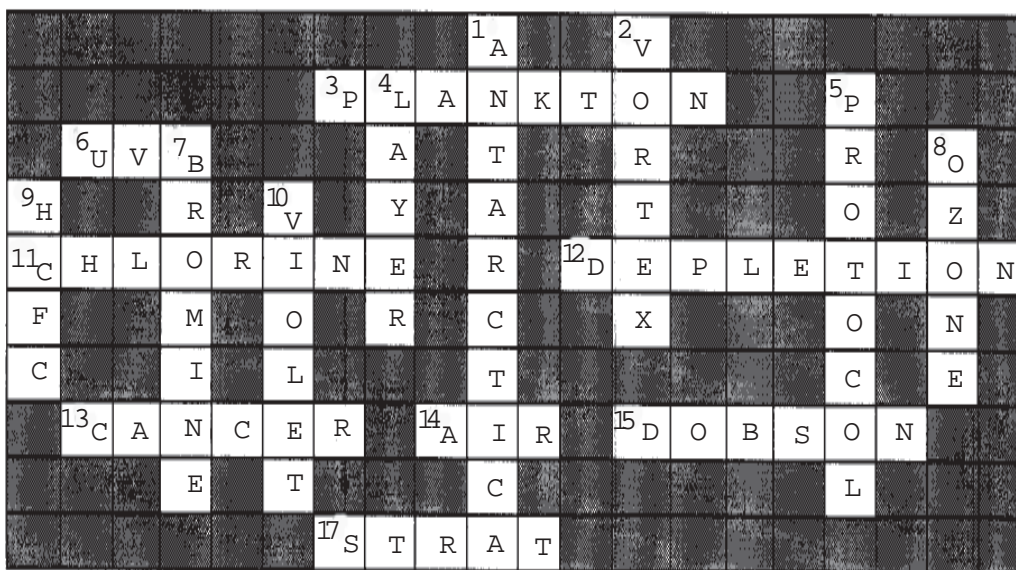
2. Effects of Global Warming:
 - a. On the Environment:
 - ◆ increase in the number and severity of heat waves;
 - ◆ changes in the average global climate or extreme weather events;
 - ◆ destruction of lives and property due to natural disasters;
 - ◆ flooding in low-lying areas;
 - ◆ rising sea level; and
 - ◆ increased air pollution, especially smog.
 - b. On Health:
 - ◆ breathing illnesses;
 - ◆ heart attacks;
 - ◆ heart-related stress;
 - ◆ death;
 - ◆ malaria;
 - ◆ increase in food and water infections;
 - ◆ malnutrition and hunger; and
 - ◆ increased incidence of respiratory diseases.

Let's Think About This (pages 28–29)

1. The ozone layer is a thin layer of atmosphere that wraps around the earth. It is 32 to 48 kilometers above the earth. The ozone layer shields the earth from ultraviolet rays (UV) coming from the sun. It continues to keep UV radiation from harming life here on earth.
2. The ozone layer gets thinner because of the presence of chlorofluorocarbons in the atmosphere. Once the CFCs are transported into the stratosphere, chlorine is released. Chlorine destroys the ozone.
3. It can disrupt biological processes and damage a number of materials (e.g. plankton will die and bigger creatures will lose food supply, plants will produce lesser food, food supply reduces, etc.). People will also be prone to skin cancer, severe sunburn, cataracts and eye damage.
4. Chlorofluorocarbons are ozone-depleting chemicals. Some examples of CFCs are refrigerators, air conditioners, aerosols and insect sprays. They are also found in elements used to manufacture plastic foam for equipment and insulation.

5. Harmful effects of UV rays to human health:
 - a. severe sunburn
 - b. premature aging or wrinkling of the skin
 - c. skin cancer
 - d. cataracts
 - e. eye damage
 - f. weakens the human immune system
6. Preventive measures to be safe from UV rays:
 - a. Avoid overexposure to the sun.
 - b. Wear clothes that cover your skin when exposed to the sun's rays including hats, sunglasses, long-sleeved shirts and pants.

Let's Review (pages 29–30)



Let's See What You Have Learned (pages 30–31)

- A.
1. **(b)** – Smog is one of the most difficult air pollution problems to correct. Acid rain, global warming and ozone depletion are examples of atmospheric changes that are caused by air pollution.
 2. **(a)** – Sulfuric and nitric acids are 2 acids that make up acid rain.
 3. **(b)** – Sulfur corrodes stone buildings, bridges, monuments, and roads over a period of time.
 4. **(b)** – Chlorine is emitted once CFCs are transported to the stratosphere, causing the destruction of the ozone layer.
 5. **(d)** – All of the above. The earth gets hotter and hotter due to the increasing amounts of carbon dioxide that is emitted by cars and power plants into the air. The heat gets trapped because a thick polluting layer covers the atmosphere. The concentration of greenhouse gases increases.

B.

Effects of Atmospheric Changes Due to Air Pollution				
	<i>Smog</i>	<i>Acid Rain</i>	<i>Greenhouse Effect</i>	<i>Ozone Depletion</i>
Health	Coughing, throat irritation, chest tightness, low resistance to respiratory diseases; serious chronic lung diseases such as asthma attacks, bronchitis, death; eye and skin irritations	Respiratory infections; tightening of muscles around the bronchi and bronchioles for young asthmatics	Breathing illnesses; heart attacks; heat-related stress; death; malaria; food-and-water related infections; cholera; malnutrition and hunger; respiratory diseases	Severe sunburn; premature aging or wrinkling of the skin; skin cancer; cataracts; eye damage; weakening of human immune system
Environment	Dirty surroundings, dust in our homes, furnishings, clothes on clotheslines, etc.	Water contamination; death of fishes and other animals in water bodies; damage to infrastructure; destroys trees; damages soil and forests	Warmer temperatures in tropical and sub-tropical regions; drought; drying of soil; hurricanes; landslides; Melting of snow and ice in the North and South poles; flooding, disappearing of cities; aggravate air pollution; extinction of other species; increase in mortality rate, etc.	Disrupt biological process; destroy a number of materials, etc.
Economy	Adverse effects: Lesser food and agricultural production; decline in fishing industry; disruption of work and decreased workers' productivity due to respiratory illnesses	Adverse effects; lesser food production; decline in fishing industry; damage to infrastructure; disruption of work and decreased workers' productivity due to sicknesses caused by water contamination	Adverse effects: decreased food production; damage to infrastructure; disruption of work and decreased workers' productivity due to illnesses caused by water contamination, etc.	Adverse effects: lesser food production; lower agriculture production, etc.

D. Lesson 3

Let's Try This (page 39)

Major steps taken by the government to bring down the intolerable level of air pollution:

1. Banning of the sale of unleaded gas
2. Prohibiting smoke-belching vehicles

Let's Review (pages 40–41)

1. In the first picture, air pollution is extremely bad. No measures have been implemented to stop air pollution. In the second picture, the environment is cleaner. Examples of measures taken to reduce air pollution include:
 - a. use of unleaded gas
 - b. use of CFC free refrigerants
 - c. use of alternative energy source by industries
 - d. use of emission control technologies; and
 - e. no backyard burning
2. Republic Act #8749 is the Clean Air Act. It provides an extensive air pollution control policy which aims to achieve and maintain healthy air quality throughout the country.
3. Ways to help overcome air pollution:
 - a. Do your part in conserving energy to reduce air pollution.
 - b. Use environmentally safe paints and cleaning products.
 - c. Replace hazardous chemicals with earth and human-friendly substitutes.
 - d. Defer use of gasoline-powered lawn and garden equipment.
 - e. Reduce waste.
 - f. Motorists should undergo regular tuning-up to lessen emission of unburned carbons.
 - g. Be careful not to spill fuel and always tighten your gas cap securely.
 - h. Share a ride with a co-worker or use public transportation.
 - i. Combine errands and reduce trips.
 - j. Avoid driving during peak hours or when traffic is at its heaviest.
 - k. Limit unnecessary use of engines or car air-conditioners.
 - l. Use air-conditioners wisely.
 - m. Educate your neighbors about the danger of household chemicals.

Let's See What You Have Learned (page 42)

You may have other answers aside from those given below. Show your answers to your Instructional Manager or Facilitator for additional feedback.

Ways to help overcome air pollution:

- a. Do your part in conserving energy to reduce air pollution.
- b. Use environmentally safe paints and cleaning products.
- c. Replace hazardous chemicals with earth and human-friendly substitutes.
- d. Defer use of gasoline-powered lawn and garden equipment.
- e. Reduce waste.
- f. Motorists should undergo regular tuning-up to lessen emission of unburned carbons.
- g. Be careful not to spill fuel and always tighten your gas cap securely.
- h. Share a ride with a co-worker or use public transportation.
- i. Combine errands and reduce trips.
- j. Avoid driving during peak hours or when traffic is at its heaviest.
- k. Limit unnecessary use of engines or car air-conditioners.
- l. Use air-conditioners wisely.
- m. Educate your neighbors about the danger of household chemicals.

E. What Have You Learned? *(page 44)*

A. Matching Type

1. (e)
2. (c)
3. (b)
4. (a)
5. (f)
6. (d)

- B. 1. Air pollution refers to the contamination of the atmosphere especially by smoke, fumes, and dust particles from machines. Pollutants decrease the quality of air.

Seven principal air pollutants:

- a. *Smog* – is formed when engine and fuel gases are released into the air in the presence of sunlight.
 - b. *Particulate Matter* – lives in the air and travels on the wind. It makes things dirty and carry harmful chemicals into the lungs as well.
 - c. *Carbon monoxide* – a deadly colorless and odorless gas that comes from car exhaust. It makes people dizzy and gives them headaches.
 - d. *Lead* – contaminates air, food and water. It is usually found in old plants.
 - e. *Nitrogen dioxide* – forms black smoke or smog that is present in motor vehicles, power plants and other fossil fuel burning industries.
 - f. *Sulfur dioxide* – emitted by smokestacks of power plants and industries. It can hurt people’s eyes, noses and lungs. It can also eat away iron and steel.
 - g. *Chlorofluorocarbons* – odorless gases that are man-made chemicals used in industrial, commercial and household applications. They are used as coolants for refrigeration units, aerosol propellants and electronic cleaning solvents.
2. Consequences of a highly polluted environment:
- a. Health - coughing, throat irritation, chest tightness; lower resistance to respiratory diseases; serious chronic lung diseases such as asthma attacks, bronchitis, death; eye and skin irritation.
 - b. Environment – causes dirt in our surroundings such as dust particles in our homes, furnishings, clothes hanging on the clotheslines; atmospheric changes (i.e. acid rain, climate warming and ozone depletion) and its effects on our environment.

- c. Economy – adverse effects on our economy due to decreased food and agricultural production, decline in fishing industry, and work disruption and decreased in workers’ productivity due to respiratory infections and illnesses.
3. Ways on how government can solve the air pollution problem:
- a. Impound smoke-belching motor vehicles
 - b. Install anti-pollution devices or facilities
 - c. Set-up monitoring stations to monitor carbon monoxide, solid particles and other air pollutants.
 - d. Impose higher fines on motored vehicles which emit excessive amount of fumes.
 - e. Ban open burning by the public.
4. Ways to help overcome air pollution:
- a. Do your part in conserving energy to reduce air pollution.
 - b. Use environmentally safe paints and cleaning products.
 - c. Replace hazardous chemicals with earth and human-friendly substitutes.
 - d. Defer use of gasoline-powered lawn and garden equipment.
 - e. Reduce waste.
 - f. Motorists should undergo regular tuning-up to lessen emission of unburned carbons.
 - g. Be careful not to spill fuel and always tighten your gas cap securely.
 - h. Share a ride with a co-worker or use public transportation.
 - i. Combine errands and reduce trips.
 - j. Avoid driving during peak hours or when traffic is at its heaviest.
 - k. Limit unnecessary use of engines or car air-conditioners.
 - l. Use air-conditioners wisely.
 - m. Educate your neighbors about the danger of household chemicals.



Glossary

Acid Is a chemical compound with a sour or bitter taste that unites with a base to form salt. It changes blue litmus paper to red. Acidic solutions can burn some materials. Similarly, acid rain can corrode metal and stone structures over a period of time

Acid rain Rain that has a high concentration of sulfuric and nitric acids due to air pollution

Aerosol A suspension of fine solid or liquid particles in gas (i.e. smoke, fog, mist, etc.) It is a substance dispensed from a pressurized container

Air pollution The contamination of the air especially by industrial waste gases, fuel exhaust, or smoke.

Atmosphere The air that surrounds the earth.

Atmospheric changes Refers to the changes of the atmosphere including natural changes such as volcanic emissions of particulate matters and man-made changes such as global warming and ozone depletion.

Carbon dioxide A colorless, odorless, very poisonous gas formed when carbon burns with an insufficient supply of air. It is part of the exhaust of automobile engines

CFCs or Chlorofluorocarbons Any of several simple gaseous compounds that contain carbon, chlorine, fluorine, and sometimes hydrogen, that are used as refrigerants, cleaning solvents, and aerosol propellants and in the manufacture of plastic foams. These are suspected to be a major cause of ozone depletion

Combustion An act or process of burning

Ecosystem A system made up of a group of living organisms and its physical environment, and the relationship between them. A pond, a lake, a forest, or an ocean may be an ecosystem. An ecosystem includes such factors as food supply, weather, and natural enemies

Energy Is the resources for producing such power. Also it is usable power as heat or electricity

Energy conservation The act or practice of saving or preserving energy

Environment The condition of the air, water, soil, plants, animals; natural surroundings

Global warming Also known as the “greenhouse effect”

Greenhouse Is an enclosed structure made of glass used for cultivation and or protection of tender plants

Greenhouse effect Takes place when the amount of carbon dioxide and water vapor increases in the air and a thick polluting layer covers the atmosphere. Because of this, the heat gets trapped and the concentration of gases increases. The result is an increase in global temperature

Heat wave A period of very hot weather

Lead Is an ordinary metal that is found to be harmful to human health. It is commonly used in gasoline, paints, batteries, water pipes and welding. As a form of air pollution, lead is problematic during its production and smelting

Nitric Acid A clear, colorless, fuming liquid that eats into flesh, clothing, metal, and other substances. It has a sharp smell and is used in making dyes, fertilizers and explosives and in etching and metallurgy

Nitrogen dioxide An extremely poisonous, brownish gas that forms black smoke or urban smog. It is present in motor vehicles, power plants and other fossil fuel burning industries. It is also present in kerosene heaters, gas stoves, space heaters, and tobacco smoke

Ozone A colorless gas that can be found in the air we breathe

Ozone layer An atmospheric layer located about 32 to 48 kilometers above the earth that is normally characterized by high ozone content which blocks the entry of most solar ultraviolet radiation into the lower atmosphere

Ozone hole An area of the ozone layer, near the South pole, that is seasonally depleted of ozone

Particulate matter Very small and separate particles, such as particles of dust

Pollutant Something that pollutes or contaminates

Pollution The action of polluting especially by environmental contamination with man-made waste

Smog Is a mixture of smoke and fog. It is formed when engine and fuel gases are released into the air in the presence of sunlight

Stratosphere The part of the earth's atmosphere which extends from about 11 kilometers above the surface to 50 kilometers and in which temperature increases gradually to about 32 degrees Fahrenheit or (0°C) and clouds rarely form

Sulfur dioxide A heavy, colorless, poisonous gas or liquid with a sharp odor usually formed during combustion of sulfur-containing fossil fuel. It is found in activities like metal smelting, paper manufacturing, food processing, industrial processes, acid rain and in acid aerosols

Sulfuric acid A heavy, oily, colorless, and very corrosive acid derived from sulfur. It is used in making explosives and fertilizers, refining petroleum, and in many other industrial processes. It can be found in acid rain that corrodes stone buildings and metals over a period of time.

Ultraviolet rays The invisible rays in the part of the spectrum beyond the violet. They are present in sunlight and light from sun lamps, and are used for healing, forming vitamins, and as sterilizers and disinfectants.

Weather Refers to the daily conditions of the atmosphere including heat or cold, wetness or dryness, calm or storm, clearness or cloudiness. Weather changes constantly from week to week, day to day, and even hour to hour.



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