

Lesson A3–3

Determining Sources of Environmental Pollution

Unit A. Agricultural Literacy

Problem Area 3. Identifying the Relationship Between Agriculture and the Environment

Lesson 3. Determining Sources of Environmental Pollution

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VIII: Understand environmental service systems.

Benchmark: VIII-A: Understand pollution control measures to maintain a safe facility environment.

Performance Standard: 1. Identify types of pollution (e.g. ground, surface water, air, noise, radioactive contamination). 2. Describe environmental impact from industrial and non-industrial processes.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Describe environmental pollution.
2. Identify the major sources of air pollution.
3. Explain the major sources of water pollution.
4. Describe the major sources of agricultural pollution.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany this lesson:

Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources*. Albany, New York: Delmar Publishers, 1994. (Textbook, Chapters 3, 8, 9, and 16)

Porter, Lynn, et al. *Environmental Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapters 1, 15, and 19)

Other Resources. The following resources will be useful to students and teachers:

Applied Environmental Science. Alexandria, Virginia: National Council for Agricultural Education, 1996.

Arms, Karen. *Environmental Science*. Austin, Texas: Holt, Rinehart and Winston, Inc., 1996.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of Student Lab Sheet

Terms. The following terms are presented in this lesson (shown in bold italics):

Acid rain
Air quality
Eutrophication
Nonpoint source pollution
Particulate matter
Pathogens
Photochemical oxidants
Point source pollution
Pollutant
Pollution
Sediment
Water quality

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring two quart jars to class. Fill one with tap water and a tablespoon of chocolate syrup. Fill the other with tap water and rubbing alcohol. Ask the students which they would choose to drink and why. Ask the students to describe the contents of each jar. Have a student remove the lid of each jar to smell and describe each. Relate to the students that water may be polluted by many sources. In this lesson students will learn of the major sources of pollution.

Summary of Content and Teaching Strategies

Objective 1: Describe environmental pollution.

Anticipated Problem: What is environmental pollution?

- I. **Pollution** is anything that damages the usefulness or productivity of the environment.
 - A. A **pollutant** is any substance or condition that causes pollution.
 - B. Pollution affects two primary parts of the environment: air and water.
 1. **Air quality** is the condition of air for a particular use.
 - a. Air quality is reduced when substances like methane, dust, and carbon monoxide are released.
 2. **Water quality** is the condition of water for a particular use.
 - a. Water quality is reduced when substances like fertilizers, lawn chemicals, and detergents are released.

Many techniques can be used to help students master this objective. Students need text materials to help understand the environment and achieve mastery learning. Chapter 1 in Environmental Science and Technology or Chapter 3 in Managing Our Natural Resources are recommended.

Objective 2: Identify the major sources of air pollution.

Anticipated Problem: What are the major sources of air pollution?

- II. The two major causes of air pollution are gases and solid particles.
 - A. Most gases are similar to the gases normally found in the atmosphere, making them difficult to detect.
 1. Carbon gases in the air are carbon monoxide and carbon dioxide.
 - a. They result from combustion of petroleum fuels and other organic materials.
 - b. Carbon monoxide is considered more harmful than carbon dioxide.
 2. Sulfur oxides can be harmful to human lungs.

- a. They are released when sulfur-containing substances, like coal, are burned.
- b. **Acid rain** is precipitation more acidic than normal. It results from the formation of sulfuric acid from the combination of sulfur oxides and water vapor.
- 3. Nitrogen oxides convert to acids in the atmosphere.
 - a. Nitrogen oxides are released when fuel is burned.
 - b. HNO_3 (nitric acid) damages plants and property during precipitation.
- 4. **Photochemical oxidants** are primary ingredients in fog.
 - a. Ozone is a major product of the reaction that forms fog.
 - b. Ozone aids in the screening of UV rays.
- B. **Particulate matter** is small solid particles of dust and droplets of liquid.
 - 1. Most particulate rises from the earth's surface.
 - 2. Larger particulate falls to earth as rain.
 - 3. Scrubbing cleans the air of industrial pollutants.

Many techniques can be used to help students master this objective. Use TM: A3–3A to show the sources of primary air pollutants. Use TM: A3–3B to illustrate how a wet scrubber works. Utilize TM: A3–3C and TM: A3–3D to discuss acid rain. Students need text materials to help understand the environment and achieve mastery learning. Chapter 19 in *Environmental Science and Technology* or Chapter 16 in *Managing Our Natural Resources* are recommended.

Objective 3: Explain the major sources of water pollution.

Anticipated Problem: What are the major sources of water pollution?

- III. Water is polluted by a wide range of materials.
 - A. **Sediment** is tiny soil particles in water.
 - 1. Soil suspended in runoff water is deposited as sediment.
 - 2. Sediment reduces photosynthesis of phytoplankton by blocking sunlight.
 - 3. It destroys habitat for aquatic organisms.
 - B. **Pathogens** are disease-causing agents.
 - 1. Bacteria, protozoa, and viruses are major living pathogens in water.
 - 2. Coliform bacterium is a particularly harmful pathogen.
 - C. Organic wastes pollute water.
 - 1. Organic wastes are decomposed by aerobic bacteria.
 - 2. Not only is the water unfit for consumption, dissolved oxygen will be reduced by the bacterial action.
 - D. Inorganic substances diminish water quality.
 - 1. Some inorganic substances make water unfit to drink.
 - 2. **Eutrophication** is excessive plant growth in water caused by large amounts of inorganic substances, like plant nutrients.

- E. Organic chemicals are hazardous to humans and animals.
 - 1. Detergents, oils, solvents, paint, and pesticides are examples of organic chemicals.
 - 2. Careless use is the primary source of organic chemical pollution.
 - F. Thermal pollution results when water is heated above its normal temperature.
 - 1. Electric power plants and other industrial applications use water for cooling and then discharge warmed water.
- IV. Sources of water pollution are considered point source pollution or nonpoint source pollution.
- A. **Point source pollution** is pollution discharged into water at specific points and is easily identified.
 - 1. Point sources are easy to locate (i.e. pipes from a factory).
 - 2. Point sources can also be controlled and regulated.
 - B. **Nonpoint source pollution** is pollution from sources not easily identified or from multiple sources.
 - 1. Nonpoint sources may be scattered over an area.
 - 2. Soil nutrients from numerous farms along a stream may be carried with runoff after a rain.

Many techniques can be used to help students master this objective. TM: A3–3E shows examples of point source and nonpoint source pollution. TM: A3–3F illustrates how a single home can produce nonpoint pollution. Students need text materials to help understand the environment and achieve mastery learning. Chapter 15 in Environmental Science and Technology or Chapters 8 and 9 in Managing Our Natural Resources are recommended.

Objective 4: Describe the major sources of agricultural pollution.

Anticipated Problem: What are the major sources of agricultural pollution?

- V. Agricultural pollution of water has four primary sources.
 - A. Soil erosion is the most visible source of agricultural water pollution.
 - 1. Erosion depletes the land of its most productive soil.
 - 2. Erosion is the result of vegetation removal and mismanagement.
 - B. Agriculture chemicals are another important agricultural pollutant.
 - 1. Persistence in the soil is an environmental concern.
 - 2. Chemicals sometimes affect organisms they are not intended to affect.
 - 3. Improper application is a major concern.
 - C. Chemical fertilizers can enter and pollute a water supply.
 - 1. Fertilizers, especially nitrate-containing ones, are often unstable in soil; therefore, they are easily leached into groundwater.
 - 2. Use of soil tests and variable rate technology in fertilizer applications can reduce needless applications of fertilizer.

- D. Animal production creates a potential for water pollution.
 - 1. Disposal of animal waste most often occurs by spreading it over the ground.
 - 2. Excess applications of animal waste allow for leaching into groundwater or runoff into surface water.

VI. Agricultural air pollutants include methane emissions and dust.

- A. Methane is a toxic, colorless, odorless gas.
 - 1. Methane contributes to the greenhouse effect.
 - 2. Wet rice production is the largest agricultural producer of methane.
- B. Agricultural production contributes dust into the air.
 - 1. The dust is a suspended particulate that may create allergic reactions and respiratory discomfort.

Many techniques can be used to help students master this objective. Students need text materials to help understand the environment and achieve mastery learning. Chapter 1 in Environmental Science and Technology.

Review/Summary. Focus the review and summary of the lesson around the student learning objectives. Call on students to explain the content associated with each objective. Questions at the end of each chapter in the recommended textbooks may also be used in the review/summary.

Application. Application can involve the following student activity using the attached lab sheet:

Collecting Particulate Samples—LS: A3–3A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used in evaluation, such as student performance on the application activity. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=e, 2=a, 3=d, 4=b, 5=c, 6=g, 7=h, 8=f

Part Two: Completion

1=point source

2=pollution

3=Coliform bacterium

4=plant nutrients

5= Wet rice production

6=thermal

Part Three: Essay

Answers will vary. Example: Nitrate in the water supply. Farmers use nitrate fertilizers to increase crop production. Nitrate has a tendency to leach easily and make its way into groundwater. By encouraging farmers to carefully apply fertilizers, it would assist in reducing water pollution. Keeping detailed yield records would provide nitrogen requirements for a field based on yield potential. This prevents unnecessary fertilizer usage.

Test

Lesson A3–3: Determining Sources of Environmental Pollution

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|---------------------------|------------------------------|
| a. pollutant | e. pathogens |
| b. point source pollution | f. nonpoint source pollution |
| c. acid rain | g. water quality |
| d. eutrophication | h. sediment |

- _____ 1. Disease-causing organisms.
- _____ 2. A substance that causes pollution.
- _____ 3. Excessive growth of plant life in water.
- _____ 4. Pollution occurring from an easily identified source.
- _____ 5. Precipitation that has an unusually high level of acidity.
- _____ 6. The necessary condition of water for a specific use.
- _____ 7. Occurs as a result of deposition of eroded soil.
- _____ 8. Pollution occurring from a source that is difficult to identify.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

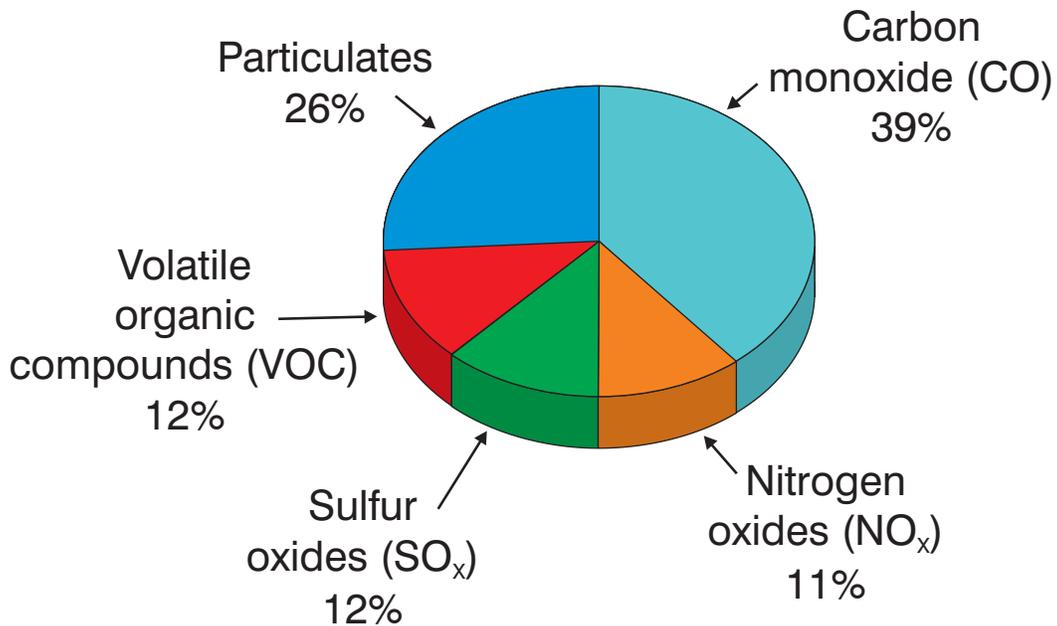
1. A chemical spill is an example of _____ pollution.
2. Scrubbing is used to reduce industrial air _____.
3. _____ is a particularly harmful pathogen.
4. Eutrophication occurs due to high concentrations of _____.
5. _____ is the major agricultural producer of methane gas.
6. Electric power plants that utilize water as a coolant often contribute to _____ pollution.

Part Three: Essay

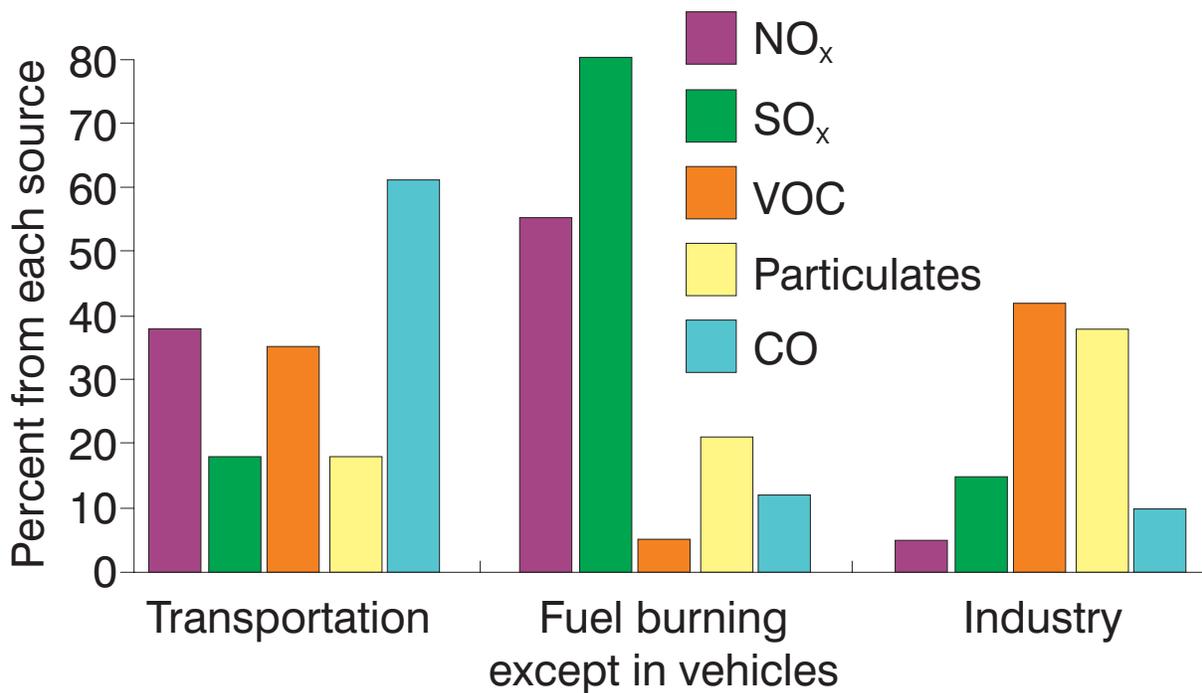
Instructions. Complete the following.

- A. Choose a nonpoint source pollution problem and describe how it could be stopped.

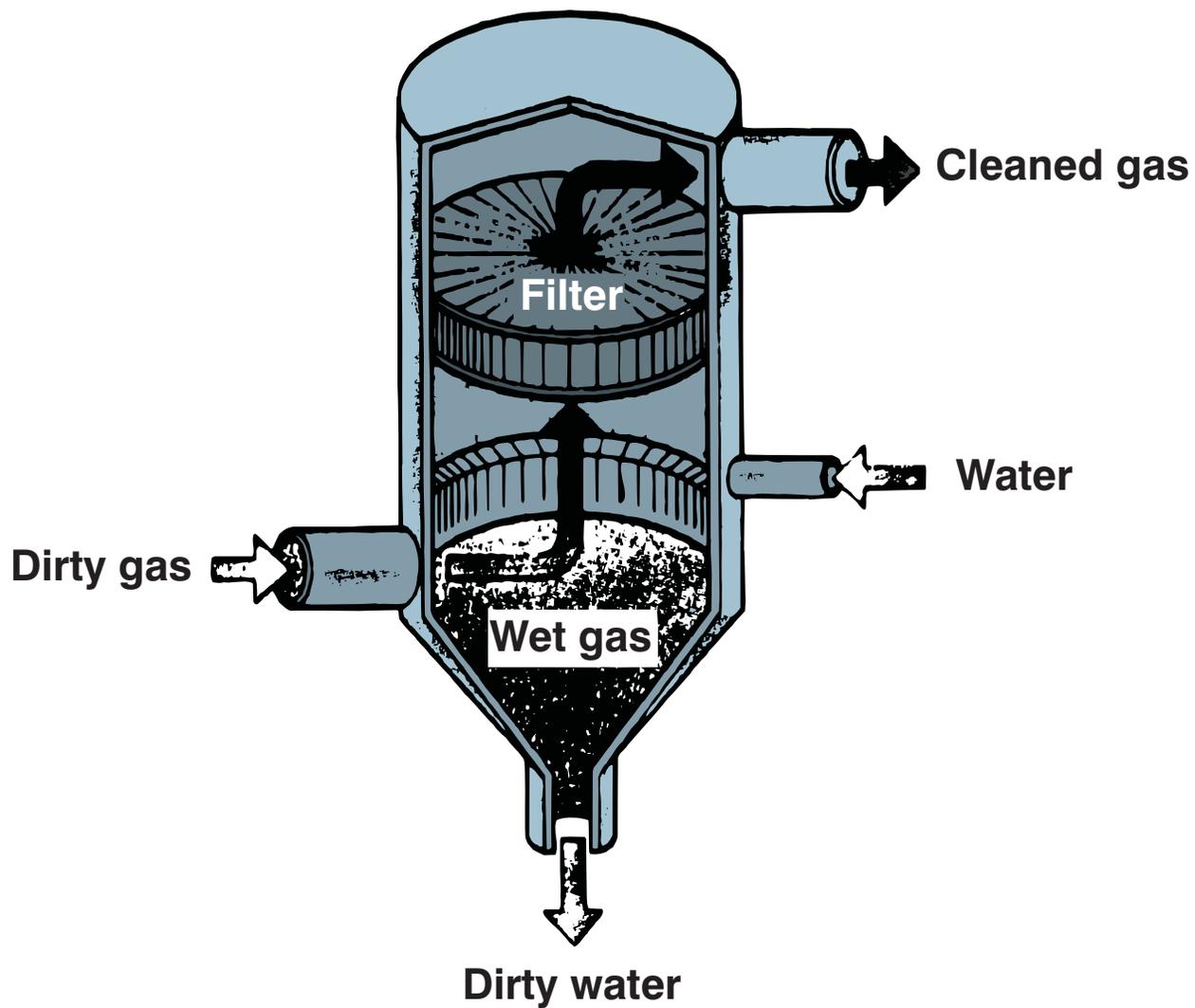
Primary Air Pollutants



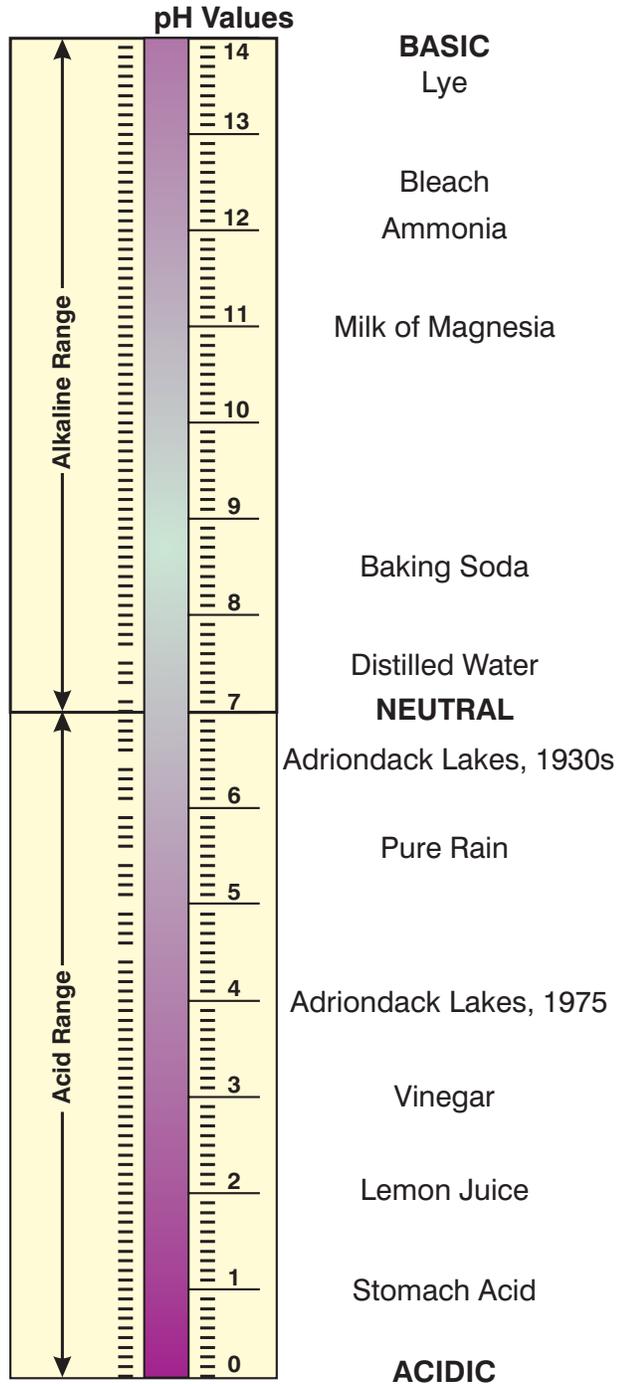
Sources of Primary Air Pollutants



Wet Scrubber

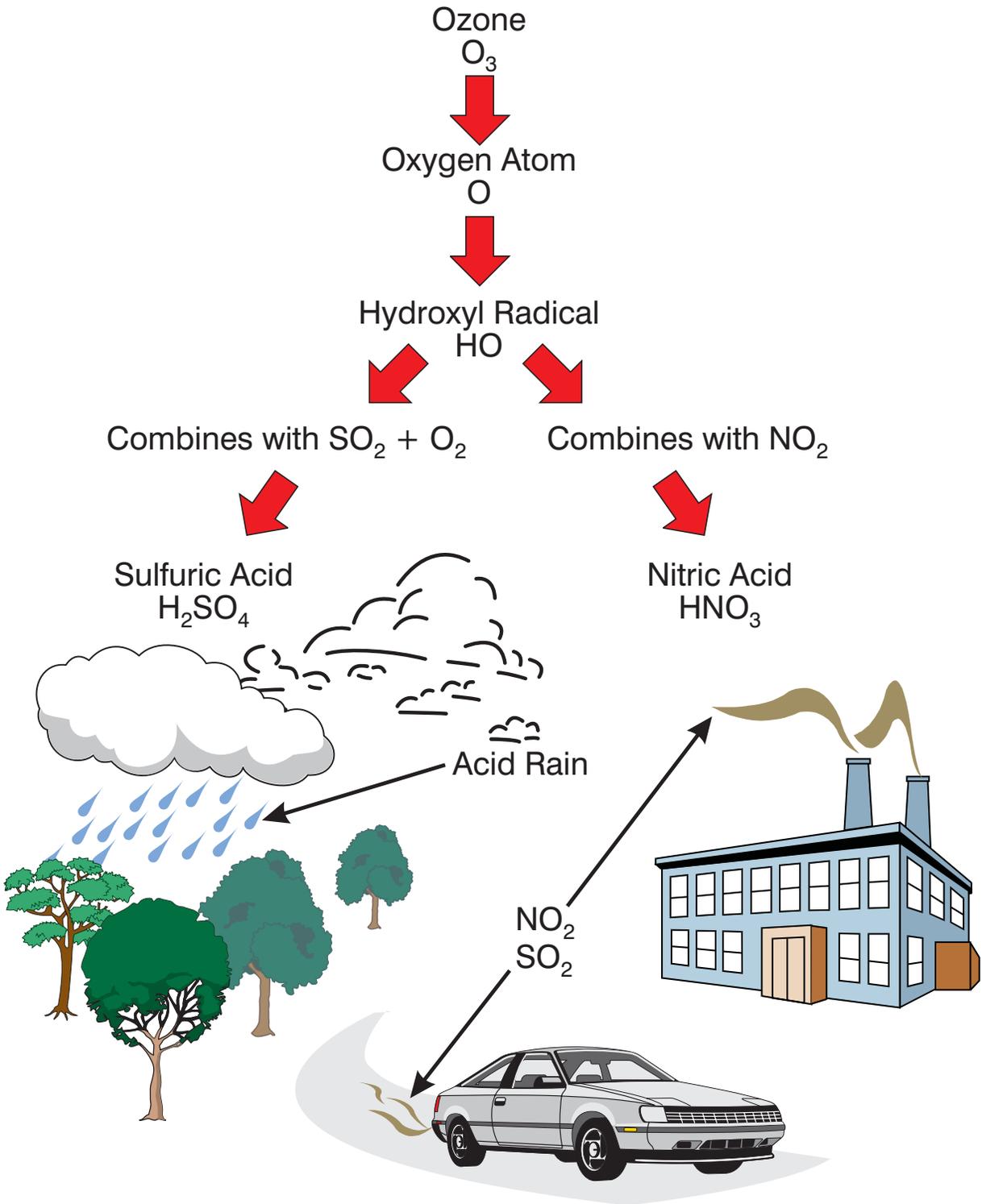


The pH Scale



This scale shows the pH of common substances and the change in the pH of the Adirondack lakes. Normal rain is slightly acidic with a pH of 5.6. This is due to atmospheric carbon dioxide which combines with rain to form a weak acid called carbonic acid.

Acid Deposition



Where Does Water Pollution Come From?

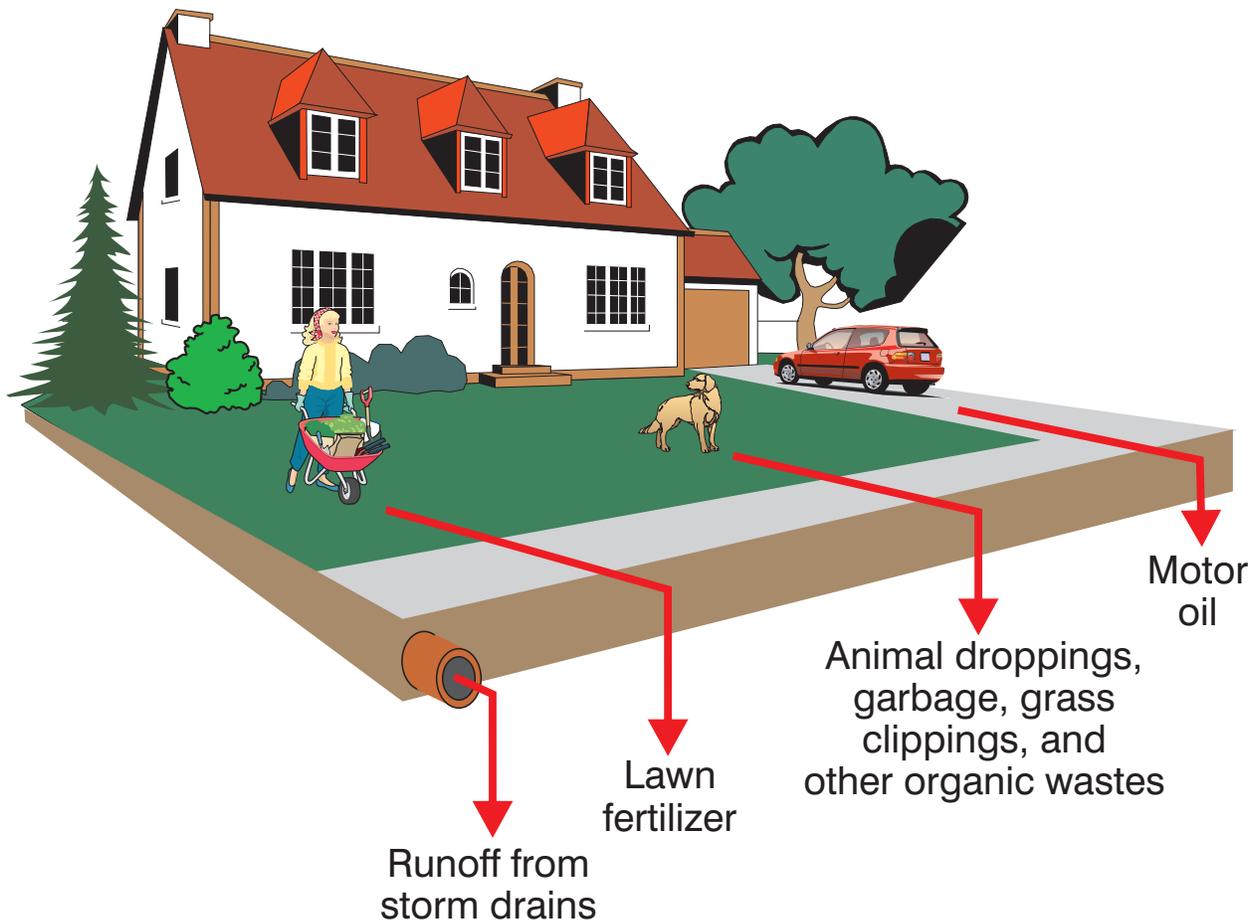
Sources of Point Pollution

- 23 million septic tank systems
- 190,000 storage lagoons for polluted waste
- 9,000 municipal landfills
- about 2 million underground storage tanks containing pollutants, such as gasoline
- thousands of public and industrial wastewater treatment plants

Sources of Nonpoint Pollution

- highway construction and maintenance: eroding soil and toxic chemicals
- storm water runoff from city and suburban streets: oil, gasoline, feces, litter
- pesticides from 112 million hectares of treated crop land annually
- 50 million tons of fertilizer applied to crops and lawns
- 10 million tons of dry salt applied to highways for snow and ice

Single Home Nonpoint Source Pollution



Lab Sheet

Collecting Particulate Samples

This activity will allow you to investigate an area for the presence of particulate in the air.

Purpose:

1. Conduct an experiment.
2. Collect and analyze data.
3. Observe the difference in particulate presence in different areas.

Materials:

3" × 5" index cards
Petroleum jelly
Pencil
String

Procedure:

1. Select 4–5 sites for study, preferably in town, near a factory, near a farm, etc.
2. On the back of the index cards, write your name, starting date, and site location.
3. Make a circle (2" diameter) with petroleum jelly on the front of each card.
4. Secure cards at each site using string.
5. After 2–3 days, collect the cards.
6. Analyze each card under a microscope to identify particulate collected.
7. Answer the following questions.

Questions:

1. Draw a diagram of the cards indicating the concentration of particulate matter.

2. For each site, list the particulate matter found.

3. What conclusions can be drawn regarding the type of air pollution present?