

Lesson Title: Pollution on the Move

Ohio Standards Connection:

Standard(s): Earth and Space Sciences, Life Science

Benchmark(s): (grades 3-5) C. Describe Earth's resources including rocks, soil, water, air animals and plants and the ways in which they can be conserved.

Indicator(s): Earth Systems

Grade(5) 6. Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained.

Benchmark(s): (grades 6-8) C. Describe the interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g. water cycle, weather and pollution).

Indicator(s): Earth Systems

Grade(7) 2. Explain that Earth's capacity to absorb and recycle materials naturally (e.g., smoke, smog and sewage) change the environmental quality depending on the length of time involved (e.g., global warming).

Benchmark (s): (grades 6-8) **Life Sciences**

C. Explain how energy entering the ecosystem as sunlight supports the life of organisms through photosynthesis and transfer of energy through the interactions of organisms and the environment.

Indicator(s): Diversity and Interdependence of Life

Grade(7) 3. Explain how the number of organisms an ecosystem can support depends on adequate biotic (living) resources (e.g., plants, animals) and abiotic (non-living) resources (e.g., light, water, soil). 6. Summarize the ways that natural occurrences and human activity affect the transfer of energy in Earth's ecosystems (e.g., fire, hurricanes, roads, oil spills).

Lesson Summary: Students will be able to: (a) describe pollution; (b) identify sources of natural and human-made pollutants; (c) explain how pollutants enter and move throughout the environment; and (d) explain how recycling reduces pollution.

Estimated Duration: 60 minutes

Background: Pollution is something that contaminates the environment, affecting air, water and land. Contamination can be in varying degrees, from litter that creates a visual blight to hazardous substances that reach drinking water sources and threaten human health. Contaminates, in the form of pollutants, include waste materials, litter, noise, heat, gas, radiation and particulate matter. Nature, as well as humans, can be the cause of

pollution. However, the intermittent and dispersed nature of natural pollutants generally weakens their impact on the environment.

Natural pollutants include particulate matter and gases from volcanoes, wastes and gases from living and dying matter, and particulate matter from dust storms and burning forests. Human-generated pollutants include litter and material dumped illegally, sewage, automobile emissions and fluids, and various land, water and air pollutants from extraction industries (mining, drilling and harvesting), manufacturing industries and power plants. Natural and human-generated pollutants enter the environment from various sources and spread throughout the environment in pathways that are influenced by soil porosity, slope of terrain, waterways and wind and air currents. Some pollution has a well-defined source, such as power plant smokestacks that release emissions into the air or factory drainpipes that release waste matter into rivers or lakes. Other sources of pollution, referred to as non-point source pollution, are broader in scope and originate from many sources. These include rainwater runoff from parking lots, lawns, driveways, fields and mining areas that can deposit potentially harmful substances into soil and waterways, or cause soil erosion. Both point and non-point source pollutants can be hazardous to living organisms depending on their chemical makeup and/or particle size. Some human activities reduce pollution and its negative impacts on the environment. Hazardous materials reduction practices and pollution control technology can be applied by industry to reduce pollution. Farmers can reduce the use of pesticides and fertilizers and practice tilling methods that prevent runoff into waterways. People can avoid littering and reduce the amount of household hazardous materials and lawn chemicals they use. Recycling is an effective pollution reduction method involving people and industry.

Recycling reduces pollution at the early stages of a product's lifecycle. First, it reduces the need to extract and process natural resources. Resource extraction and processing can pollute air, land and water with hazardous materials. These processes require a great deal of energy. Burning fossil fuels (coal, oil, natural gas) release pollutants (sulfur dioxide, nitrogen oxide and carbon monoxide) into the air. Second, the use of recycled materials can reduce the amount of energy (and air pollution) required to manufacture products or consumer goods. Finally, using recycled materials also generates less solid wastes to be landfilled or incinerated.

The U.S. EPA provides the following summation of specific pollutants reduced by recycling:

*A recent analysis of several studies concluded that the environmental impacts of recycled-content products are less than those of virgin products when the two are compared over their entire lifecycles. The analysis found that when compared to a system based on the use of virgin materials and landfilling or incineration, recycling and manufacturing products from recovered materials results in a net reduction in 10 major categories of air pollutants (aldehydes, ammonia, carbon dioxide, carbon monoxide, hydrocarbons, methane, nitrogen oxides, other organics, particulates and sulfur oxides) and eight major categories of water quality indicators and water pollutants (biochemical oxygen demand, chemical oxygen demand, dissolved solids, iron, metal ions, oil, sulfuric acid and suspended solids).**

It is important to note that the ability of recycling to accomplish reductions in pollution is variable, depending upon the material and manufacturing processes utilized. Each

material and product has a unique lifecycle that must be analyzed in the context of specific conditions.

*R. A. Denison, "Environmental life-cycle comparisons of recycling, landfilling, and incineration: A review of recent studies," *Annu. Rev. Energy Environ*: 21:191-237; as cited in *Puzzled About Recycling's Value? Look Beyond the Bin*, U.S. Environmental Protection Agency, EPA530-K-97-008 (January 1998), p. 7.

Student Resources

Books

Earthday Activities, Huntington Beach, California: Teacher Created Materials, Inc., 1996.

Earth Book For Kids, by Linda Schwartz, California: The Learning Works, Inc.

EarthSearch, by John Cassidy, Palo Alto, California: Klutz Press, 1994.

Facts on Domestic Waste and Industrial Pollutants, by Hugh Johnstone, New York: Aladdin Books Ltd, 1990.

How Cities Work, unknown, California: Ziff-Davis Press, 1995.

Media

Think Earth and "e" (video). A series of two videos for grades K-3 and 4-6. May be obtained by contacting the Educational Development Specialists, 5505 East Carson Street, Suite 250, Lakewood, CA 90713.

Educator Information

The ABCs of Environmental Education, Can Manufacturers Institute, 1997, 1625 Massachusetts Avenue, NW, Washington, DC 20036, (202) 232-4677.

A Breath of Fresh Air, Akron, Ohio: Akron Health Department, 1991.

Cartons, Cans and Orange Peels, Where Does Your Garbage Go?, by Joanna Foster, Clarion Books, 1991.

Common Questions about Health Effects, Citizens Clearinghouse for Hazardous Wastes, 1992.

Earth Science: 100 Reproducible Activities, Grand Rapids, Michigan: Instructional Fair, Inc., 1991.

Green Teacher – Education for Planet Earth (quarterly magazine), P.O. Box 1431, Lewiston, NY 14092.

Garbage! Where It Comes from, Where It Goes, by Evan and Janet Haddingham, Simon & Schuster, 1990.

Instructional Procedures:

1. Preparation: Explain to students that they will be studying pollution. As a pre-assessment activity, have each student write his/her own definition of the word pollution without any discussion. Students should fold their responses and seal them in envelopes and write their names on the envelopes. Collect all envelopes for later use.
2. Divide students into groups, and distribute the handout, [Mapping Pollution](#), to each student. Explain that the illustration depicts how pollution is generated by humans and by nature.
3. Have students identify sources of natural pollution and sources of human-made pollution. Collect all the envelopes for later use.
4. Discuss the term *pathway*. Explain that there are three basic pathways: air, land and water. Identify one source of pollution on the map and a specific pollutant from that source and discuss potential pathways for that pollutant.
5. Distribute the handout, [Pollution Clues](#), to each student in each group. Working in groups, have students complete the handout, referring to the illustration, *Mapping Pollution*, if needed. If students have difficulty making inferences to complete the handout, *Pollution Clues*, you may wish to write the answers (out of order) on the board and have students choose the answers that match the clues.

ANSWERS for handout, *Pollution Clues*:

1. leaves
2. methane gas
3. non-point source pollution
4. people who litter
5. fuel for energy
6. fire
7. mining
8. illegal dumping

Review group answers and discuss.

6. Have students identify each source of pollution on the handout, *Mapping Pollution*, which is described on the handout, *Pollution Clues*. They might trace with a different colored marker or crayon each of the different pathways for each source of pollution. **NOTE:** When the word “contamination” appears in the clues, discuss with students how contamination may represent hazardous materials, some harmful to human health. You may wish to discuss how some hazardous materials accumulate in food chains (algae to fish to larger fish) until they reach humans who then ingest those chemicals, which may cause serious diseases or other disorders. Discuss ways that pollution can be prevented in each of the examples.
7. Have students identify the recycling center in the illustration, *Mapping Pollution*. Have them identify three pollutants (sources of pollution) that are reduced when recycled materials are used to make products.

ANSWERS to teacher inquiry:

- potential water, land and air pollutants are reduced by recycling because there is less need for mining
 - air (energy) pollution and potential water pollution from the *factory* are reduced by recycling
 - land, air and potential water pollutants from the *landfill* are reduced by recycling
8. If you did not conduct Activity 1, *The “Costly” Thing*, review the background information and explain the recycling concepts (how recycling reduces pollution) to students.
 9. **Assessment:** Have each student write a new definition for pollution. Return envelopes made by students at the beginning of the activity. Have them compare their original definition of pollution to their new definition.

Have students add a source of pollution (not already provided) to the illustration on the handout, *Mapping Pollution*, and trace a pathway for it.

Using the handout, [Venn Diagram](#), have students compare and contrast the difference between natural pollutants and human-generated pollutants.

10. **Extensions:** Have students identify pollution reduction strategies they can employ at home and at school.
Create a pollution action bulletin board.
Have students identify ways to measure their impact.

Materials and Resources:

One envelope (for each student), notebook paper, crayons

Handouts ([Mapping Pollution](#), [Pollution Clues](#), [Venn Diagram](#))

Vocabulary:

Adapted from Windows on Waste: An Elementary, Environmental Studies Activity Guidebook about Solid Waste and Environmental Issues, ODNR, 1999. For information, contact:

Education Specialist

Ohio Department of Natural Resources

Division of Recycling and Litter Prevention

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