


Exercise 2D


From: EPA Project A.I.R.E. <http://www.epa.gov/region01/students/teacher/aire.html>

SMOG

This activity lets students create artificial “smog” in a jar. Teachers can use this module as an introduction to a planned visit from an air-quality scientist, or as the basis for extended discussions on the health problems associated with smog. Further reading materials are located on the EPA Project A.I.R.E. website.

CRITICAL OBJECTIVES

 Recognize that invisible air pollutants and weather conditions are involved in creating smog

 Understand that not all air pollution is visible
Appreciate that human activities can cause air pollution

SKILLS

 Observing

 Drawing conclusions

GUEST PRESENTERS

Guest presenters could include EPA air quality monitoring specialists, state or local air quality managers, chemists, laboratory technicians, or meteorologists.

TARGET GRADE LEVEL

3rd - 5th

DURATION

20 minutes

VOCABULARY

Hydrocarbons

Ozone

Photochemical

Precursor

Smog

Thermal inversion

MATERIALS

- Clean, dry, widemouth glass jar (such as a mayonnaise jar)
- Heavy aluminum foil
- Two or three ice cubes
- Ruler
- Scissors
- Stop watch or watch with a second hand
- Matches

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BACKGROUND

The expression “smog” was first used in “Turn-of-the-Century” London to describe a combination of “smoke” and “fog.” Smog occurred when water vapor in the air condensed on small particles of soot in the air, forming small smog droplets. Thousands of Londoners died of pneumonia-like diseases due to the poisonous air. Today, smog is usually produced photochemically, when chemical pollutants in the air (notably nitrous oxide and hydrocarbons from automobile exhausts) are baked by the sun and react chemically. Ground-level ozone is produced by a combination of pollutants from many sources such as automobile exhausts, smokestacks, and fumes from chemical solvents like paint thinner or pesticides. When these smog-forming pollutants (called “precursors”) are released into the air, they undergo chemical transformations and produce smog. Weather conditions, such as the lack of wind or a “thermal inversion,” also cause smog to be trapped over a particular area.

Smog causes health problems such as difficulty in breathing, asthma, reduced resistance to lung infections, colds, and eye irritation. The ozone in smog also can damage plants and trees, and the haze reduces visibility. This is particularly noticeable from mountains and other beautiful vistas such as National Parks.

Severe smog and ground-level ozone problems exist in many major cities, including much of California from San Francisco to San Diego, the mid-Atlantic seaboard from Washington, DC to southern Maine, and over major cities of the Midwest. (See reading materials on “Smog,” “Air Pollution,” “Ozone,” and “Automobiles and Air Pollution,” located on the EPA’s Project A.I.R.E. website.)

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Note!

Be careful to supervise students using matches. DO NOT let anyone breathe the “smog” produced in the experiment, and when the experiment is completed, be sure to release the "smog" outside.

WHAT TO DO

1. Explain that the class will perform an experiment in which they will create artificial “smog” in a jar. Make sure that students understand that the jar is only a model, and models by nature are limited. For example, the purpose of this model is to illustrate the appearance and behavior of smog, not the composition or effects. It is important to understand that smog is not just a “smoky fog,” but a specific phenomenon.
2. Select students to perform the experiment. Have them cut a strip of paper about 6 inches by 2 inches. Fold the strip in half and twist it into a rope.
3. Have them make a snug lid for the jar out of a piece of aluminum foil. Shape a small depression in the foil lid to keep the ice cubes from sliding off. Carefully remove the foil and set it aside.
4. Have the students put some water in the jar and swish it around to wet all the inside of the jar. Pour out the extra water.
5. Have them light the paper “rope” with a match and drop it and the match into the damp jar. Put the foil lid back on the jar and seal it tightly. Put ice cubes on the lid to make it cold. (The ice cubes will make the water vapor in the jar condense.) You must do this step very quickly, perhaps with some assistance.
6. Ask students to describe what they see in the jar. How is this like real smog? What conditions in the jar produced “smog”? (Moisture plus soot

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particles from the burning matches plus carbon dioxide and other solvent vapors.)

7. Ask the students if they have ever seen smog (not fog). Have they ever breathed air outside that smelled funny?

SUGGESTED EXTENSIONS (OPTIONAL)

Have students put a glass thermometer (not plastic) into the jar before they do the experiment. Have them record the temperature before proceeding to step 4. Have them record the temperature during step 5. Ask them to describe what the temperature did and why. Let them try it again without adding water.

SUGGESTED READING

Bailey, Donna. *What Can We Do About Noise and Fumes*. New York: Franklin Watts (1991).

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"Study Finds Source of Canyon Haze." *National Parks*, 63 (July 1989) p. 10.

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