

# Particulate Matter in the Air

**Skills:** Science, Language Arts, Social Studies

**Objective:** Students will gather information pertaining to particulate matter by conducting an experiment that collects particles that settle from the air in different settings.

## Background

Pollution is not just a concern for people living in the cities. Farmers and ranchers must worry about it too. Air pollution can harm fields and gardens located near cities. It can also harm trees, grass and other greenery in city parks, on traffic medians and around people's homes. Plants can be injured by dust and other particles in the air as well as by gases such as ozone. Sulfur dioxide contributes to acid rain, which damages lakes, rivers and forests.

Ozone is a gas that occurs in the atmosphere at ground-level and the upper atmosphere. It can be "good" or "bad" for people's health and the environment, depending on its location.

Stratospheric or "good" ozone extends in layers from about six to 30 miles above the earth. It protects the earth from harmful UV (ultraviolet) rays. As the ozone layer shrinks or has holes caused by man-made chemicals and the burning of fossil fuels, more UV from the sun can reach the ground and cause skin cancer, cataracts, and other health problems.

The troposphere or air closest to the Earth's surface is the "bad" ozone area. Its main ingredient is urban smog. This pollutant poses a significant health risk to children in the form of asthma.

Ozone is most often formed when sunshine hits certain gases from automobile engines. A certain amount of ozone in the air is normal, but the levels in some urban areas reach very high levels, especially in the summer. Ozone hinders photosynthesis in plants and slows or stops their growth. The stomata, the openings that permit gaseous exchange, close when ozone is in the atmosphere, limiting gas exchange and other processes which depend on the exchange of carbon dioxide and oxygen.

Dust and other particles from cement plants, quarries, mineral processing operations and some agricultural practices can also cause injury to plants. At its most damaging, it can destroy seedlings by sandblasting them. When dust and other particles coat leaves, photosynthesis can be impaired. Finer particles may block the stomata openings so that gas exchange is inhibited. The quality of some crops may be affected if airborne particles settle on them.

Air pollution may be caused by many things, but the largest amounts of air pollution are caused by harmful chemicals that are added to gasoline to help it work better in automobile engines. Researchers have been working on several possible solutions to this problem. One possible solution is using chemicals made from corn and other plant material in place of some of the

## P.A.S.S.

### GRADE 6

**Reading**—1.1a; 3.1b; 5.1a

**Writing**—2.7,8

**Oral Language**—1.2; 2.3

**Social Studies**—1.3; 2.3

**Science Process**—1.1; 2.1;

3.1,3,4,5; 4.1,3,4,5;

5.1,2,3,4

**Earth Science**—5.1

**Physical Science**—1.1

### GRADE 7

**Reading**—1.1; 3.1a; 5.1a

**Writing**—2.8,9

**Oral Language**—1.2

**Social Studies**—1.1; 2.1;

4.5; 5.2; 6.3

**Science Process**—1.1; 2.1;

3.1,3,4,5; 4.1,3,4,5;

5.1,2,3,4

**Physical Science**—1.1

### GRADE 8

**Reading**—1.1; 3.1a; 5.1a

**Writing**—2.8,9

**Oral Language**—1.2

**Social Studies**—1.1,5

**Science Process**—1.1; 2.1;

3.1,3,4,5; 4.1,3,4,5;

5.1,2,3,4

more harmful chemicals added to gasoline.

The US Environmental Protection Agency (EPA) was established in 1970 by President Richard Nixon. The agency is charged with protecting human health and with safeguarding the natural environment: air, water, and land.

The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in September 16, 1987. Today, 20 years later, 191 countries have ratified the treaty and continue to phase out the production of chemicals that deplete the ozone layer. They are continually searching for ozone-friendly alternatives.

### ACTIVITY 1

1. Read and discuss the background information and vocabulary.
2. Collect six glass microscope slides.
  - Students will select three sites on the school grounds to monitor for air pollution. Make sure students choose sites where their experiments will not be disturbed by other students or animals.
  - At each site, students will label two slides to indicate location.
  - Students will coat each slide with petroleum jelly.
  - Students will use a journal or lab book to record the starting time and date of the experiment, wind direction, and any other contributing weather factors at each site.
  - After 24 hours, students will pick up one slide from each location and return them to the classroom for study.
  - Students will record the ending time and date before analyzing the slides with a hand lens and under low power on a microscope.
  - Students will identify all the particles they can—metal shavings, pollen grains, hair, dust, and natural debris, etc.—and record observations in their journals, noting size, shape and color of the particles.
  - Students will classify the particles as natural or man-made and determine if any of the particles are related to the agriculture industry.
  - Lead a discussion based on these questions:
    - What types of air pollution do we find in our area?
    - What particles did we find on our slides that give us clues about the kind of air pollution in our area?
  - After a week, students will pick up the remaining slides and repeat the experiment.

### ACTIVITY 2

1. Enlist the help of family or friends that live away from your area to repeat the above experiment.
  - Mail each participant a package containing a letter with directions and all the necessary supplies. (You may use plastic slides.)
  - Instruct the participants to return the results, along with information gathered about the site (temperature, wind direction, etc.)
  - Ask participants to take photos of the site and the surrounding area and include a brief description.
  - Instruct the participant to take another photo of the slide before return-

#### Resources Needed

slides (glass and flexible plastic)

petroleum jelly

microscopes

hand lens

radish seeds

paper towels

journal or lab book

ing the used supplies.

- Students will track the slides by pinpointing the sites on a US map.
- After all experiments are collected, students will study the results and make a class hypothesis, or students will write their own views.

### ACTIVITY 3

(This activity can be completed while students are waiting to complete Activities 2 and 3.)

1. Students will use online search engines or library resources to research one or more of the following topics:
  - A. How many US cities exceed federal standards for air pollution?
  - B. Where are ozone holes located in the atmosphere? Are they shrinking or getting larger? Give reasons for your answers.
  - C. What is acid rain? What environmental laws have curbed the production of acid rain?
  - D. What have automobile industries done in the last decade to help curb air pollution?
  - E. What are other achievements of the EPA?
  - F. What is “the greenhouse effect” and “global warming?”
  - G. What is green building, green farming, etc? What are the purposes?

### EXTENSIONS

1. Invite a city or county planner or environmental engineer to your classroom to discuss the environmental regulations that govern your area.
2. Provide radish seeds and two small dishes for each student.
  - Students will place the radish seeds in the dishes.
  - Students will each cover one of the dishes with wet paper towels and cover the other dish with paper towels moistened with a salt solution.
  - Students will observe and record the percentage of germination.
  - As a class discuss the results and possible causes

### Extra Reading

- Allen, John L., *Student Atlas of Environmental Issues*, McGraw-Hill/Dushkin, 1997.
- Edom, Helen, Kate Davies and Moira Butterfield, *Science with Air*, Usborne, 1992.
- George, Jean Craighead, *Who Really Killed Cock Robin: An Ecological Mystery*, Harper Collins, 1991.
- Getis, Judith, *You Can Make A Difference: Be Environmentally Responsible*, McGraw-Hill Science/Engineering/Math, 1998.
- Kalman, Bobbie and Janine Schaub, *Squirmy Wormy Composters*, Crabtree, 1992.
- O’Neill, Mary, *Air Scare*, Troll. 1990.
- Stevens, Leonard A., *How a Law Is Made: The Story of a Bill Against Air Pollution*, Thomas Y. Crowell Company, 1970.

### Vocabulary

**acid rain**—rain that contains dilute acid derived from burning fossil fuels and that is potentially harmful to the environment

**germination**—to start to grow from a seed or spore into a new individual.; to be created and start to develop

**ozone**—a gaseous form of oxygen with three oxygen atoms per molecule, formed by electrical discharge in oxygen

**photosynthesis**—a process by which green plants and other organisms turn carbon dioxide and water into carbohydrates and oxygen, using light energy trapped by chlorophyll

**quarry**—an open excavation from which any useful stone is extracted for building and engineering purposes

**sandblast**—to clean, polish, or mark the surface of glass, metal, or stone by applying a jet of pressurized air or steam mixed with sand

**stomata**—in plants, the openings that permit gaseous exchange

**stratosphere**—the region of the Earth’s atmosphere between the troposphere and mesosphere, from 10km/6 mi to 50km/30 mi above the Earth’s surface

**troposphere**—the lowest and most dense layer of the atmosphere, extending 10 to 20km/6 to 12 mi, in which temperature decreases with rising altitude and most weather occurs

**ultraviolet (UV)**—relating to or producing electromagnetic radiation of wavelengths from about 5 to about 400 nanometers, beyond the violet end of the visible light spectrum