Exercise 2C

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

Acid Rain and Plants

This activity lets students observe the effects of acid rain on plants in a simulated experiment using vinegar or lemon water. The results from the experiment could be used as an introductory presentation to an EPA representative who is an expert on acid rain. The representative could then follow up with a presentation to the class about EPA's efforts to reduce acid rain in the United States and internationally.

Critical Objectives

- Observe the impact of acids on plants
- Recognize how acid rain can affect the environment

Skills

- Observing
- Comparing

Guest Presenters

Guest presenters could include EPA acid rain specialists, botanists, chemists, ecologists, EPA environmental protection specialists, or environmental scientists.

Target Grade Level

4th - 5th

Duration

45 minutes (with possible extensions)

Vocabulary

Acid rain
Acidic
Alkaline
Base
Logarithm
Neutral
pH
Precipitation

Materials

- Three small and healthy potted plants, all the same type
- Three large jars with lids
- Vinegar
- Water
- Measuring cup
- Masking tape
- Paper

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Background

Acid rain is precipitation that is more acidic than normal. The terms "acidic" and "basic" (or "alkaline") are used to describe two chemical extremes, much like hot and cold describe two temperature extremes.

Mixing acids and bases can cancel out their extreme effects, much like mixing hot and cold water moderate the temperature. A substance that is neither acidic or basic is called "neutral."

The pH scale measures how acidic or basic a substance is. The pH scale ranges from 0 to 14. A pH of 7 is neutral. A pH lower than 7 is acidic; higher than 7 is basic. Pure water is neutral. But when chemicals are mixed with water, the mixture can become either acidic or basic. For example, lemon juice is acidic; the pH of lemonade is between 2 and 3. Ammonia, on the other hand, is alkaline; its pH is just over 11. Each unit of pH is ten times greater or smaller than the next unit. For example, a pH of 5 is 100 times more acidic than a pH of 7. This is called a "logarithmic" scale.

Air pollution is a major cause of acid rain. When precipitation becomes more acidic than normal, it can damage soil, water, building materials, plants, animals, and humans. The effects of acid rain may not be immediately apparent in all places. For example, at a glance, a lake might look clear and beautiful. But when you look closely, you might begin to see some problems. Where are the fish? Why are there few or no plants?

Many lakes in the Adriondack Mountains of New York, the upper Midwest, and many streams in the Appalachian Mountains, in particular, have experienced losses of aquatic life. Nature can cope with some changes in acidity.

Areas with limestone (which reacts with acid) are able to neutralize acidic rainfall so the damage is reduced. However, large parts of the world do not have this acid rain coping ability and, in any case, no area can handle

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very large amounts of acid rain.

Acid rain can affect plants in many ways. It takes nutrients away from the soil so that plants can't grow. It weakens trees so that they become diseased more easily. Branches at the top of trees lose their leaves. Tree leaves might be an unusual color. Trees may not have as many leaves or may lose their leaves earlier each year. Eventually, trees die. In this experiment, with potted plants, the more acid rain in the plant water, the sooner a plant dies. The plants are watered with solutions that have a lower pH than most rainfall. (See reading materials on "Air Pollution" and "Acid Deposition.")

What to Do

1. Divide the class into 3 teams. Give each group a 1-gallon container (a milk container would work). Have one team fill their container with 1 gallon (3.8 liters) of tap water. They can use a piece of masking tape to label the container "tap water."

2. Have another team fill their container with 1 pint (0.5 liters) of vinegar and 7 pints (3.3 liters) of tap water. Have them use a piece of masking tape to label the container "slightly acidic."

3. Have the third team fill their container with 2 pints (0.9 liters) of vinegar and 6 pints (2.8 liters) of tap water. Have them use a piece of masking tape to label the container "very acidic."

4. Give each team one of the plants and have them label it the same as their container. Make each team responsible for watering their plant from the container with the matching label.

5. Place all three plants in the same spot so that they get the same amount of light. Students should water the plants when they need it (every two to four days). Make sure the plants get the same amount of water in each watering cycle. Have team members examine their plants every day and write down what they look like—what color they are, if their leaves are

dropping, whether they look healthy.

6. Continue this activity for two to three weeks. Then have students examine the plants and discuss the results of the experiment. What happened to the plants watered with acid solutions? How long did it take to see the effects of the acid? Do the plants differ in color? If so, why? Which plant showed the most effects?

Suggested Extensions (Optional)

- If you live in an area affected by acid rain, take students on a field trip and have students write down what they observe about the area. Can they see dying or dead plants or trees, stained or eroded building surfaces or statues? If there is a lake or stream nearby, can they see any wildlife? Discuss ways that the area may be saved. Discuss the sources of the pollution that may have contributed to the acid rain that falls in the area.

- In a follow-up class with an EPA representative working on acid rain, have the students present their results from the experiment. The EPA representative could discuss the results and provide some additional information on acid rain.

Suggested Reading

Acid Rain Kids Handbook. Washington, DC: National Geographic Society (1988).

Acid Rain: The Invisible Threat (VHS videotape). Scott Resources (1992).

Baines, John. *Conserving Our World, Conserving the Atmosphere*. Austin, TX: Steck-Vaughn Company (1990).

Berreby, David. "The Parasol Effect." *Discover*, 14 (July 1993) p. 44.

Boyle, Robert H., and Alexander R. Boyle. *Acid Rain*. New York: Schocken Books (1983).

Gay, Kathlyn. *Acid Rain*. New York: Franklin Watts (1983).

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Gutnik, Martin J. *The Challenge of Clean Air*. Hillside, NJ: Enslow Company (1990).

Hare, Tony. *Save Our Earth: Acid Rain*. New York: Gloucester Press (1990).

Lucas, Eileen. *Acid Rain*. Chicago: Children's Press (1991).

McCormick, John. *Acid Rain*. Gloucester Press (1986).

Miller, Christina G., and Louise A. Berry. *Acid Rain: A Sourcebook for Young People*. New York: Julian Messner (1986).

O'Neill, Catherine. "Saving Statues from Acid Rain." *Washington Post (Washington Health)*, 116 (6 April 1993) p. WH18.

Pringle, Laurence P. *Rain of Trouble: The Science and Politics of Acid Rain*. New York, NY: Macmillan (1988).

Problems of Conservation: Acid Rain (VHS videotape). EBE (1990).

Stubbs, Harriet, Mary Lou Klinkhammer, and Marsha Knittig. *Acid Rain Reader*. Raleigh, NC: Acid Rain Foundation (1989).

How acid rain affects stonework.
The picture on the left was taken in 1908.
The picture on the right was taken in 1968