Lesson Plans: Acid Rain

Objective

The objective is to help students understand the concept of acid rain and what impact this may have on vegetation.

Materials

Each group of students will need the following:

- 2 or 3 small plants of the same type
- Vinegar and/or lemon juice (or other citrus juice)
- Water

Note: Vinegar is acetic acid and lemon juice is citric acid and variations on this theme include using different liquids or different plants.

Important Points to Understand

Volcanoes (and factories) can emit gases, like sulphur dioxide (SO_2), which can react chemically within water vapor in the atmosphere to form weak acids. Even though these acids are typically too weak to harm humans who may come in direct contact with them (either in the form of acidic mist or rain), over time these acids can affect clothing, plants, buildings, and other materials.

Acid rain may leach out metals naturally found in the soil, which then flow into lakes and streams and the ocean. Metals such as mercury, lead, and copper adversely affect water life if they are put into the water in quantities much greater than would naturally be found. Even those plants that seem to initially do well in areas of acid rain eventually die due to the destructive effects of the precipitation. Acid rain depletes soils of nutrients necessary for healthy plant growth, and makes plants vulnerable to a variety of diseases.

Many substances can be described as being either acidic or basic (alkaline). Acids and bases (alkalis) are the opposite of each other. The pH scale tells us how acidic or how basic a substance is. It tells us the degree of acidity. Although we will not discuss the details of what pH is in a chemical sense, for those who might be curious we can note that pH stands for potential hydrogen.

The pH scale ranges from 0 to 14. A pH of 7 means that a substance is neutral. That is, a substance with a pH of 7 is neither acidic nor basic. A pH lower than 7 means the substance is an acid. The smaller the pH, the more acidic the substance. A pH greater than 7 means the substance is a base or alkalis. The larger the pH, the more basic or alkaline the substance.

Unpolluted rain water has a pH of more than 5.5. Any rain that has a pH lower than this is called acid rain. When the pH of water in lakes and streams drops much below 5 on the pH scale, most fish species die. Vinegar has a pH between

2.4 and 3.4, while lemon juice has a pH around 2.2. In 1978, rain from a storm in western Pennsylvania in the United States was measured to have a pH as low as lemon juice. By spraying the plants with vinegar or lemon juice, you are simulating - at a more accelerated rate - what these plants experience in regions where acid rain falls. Laboratory experiments have shown that while most plants are seriously harmed by acid rain, there are also some trees which seem to do well (at least for a short time) in rain water that is more acidic. Experiments may be conducted on local wild plants or weeds in cultivated areas.

Procedure

1. Place two or three plants, preferably in separate pots, in an environment where they will thrive (that is, sunlight if they like Sun, or shade if they like shade and carefully watered as appropriate).
2. Designate one of the plants to be sprinkled only with water and one to be sprinkled only with vinegar or lemon juice (if you have three plants, you could sprinkle one with water, one with vinegar, and one with lemon juice).
3. Sprinkle each plant with its designated liquid several times each day, making sure that the leaves of the plant are damp. In addition, when the soil dries, each plant should be watered only with its designated liquid.
4. After several days, note the condition of each of the plants. What, if anything, is different about the plants subjected to the acid precipitation? What can you conclude based on this experiment?
5. The experiment may be repeated with different concentration of the acids.

Courtesy: U.S. Department of Energy's Atmospheric Radiation Measurement Program.