

Carolina BioKits™

Acid Rain

TEACHER'S MANUAL
AND STUDENT GUIDE



Carolina BioKits™ Acid Rain

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TEACHER'S MANUAL

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*Photocopy the Student Guide as needed for use in your classroom.

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Carolina BioKits™

Acid Rain

Overview

In this series of hands-on activities, students learn about the biological, environmental, and chemical mechanisms that are associated with acid rain. First, students determine the pH of unpolluted rain and observe the effects of acid rain on seed germination. Students then investigate the buffering effects of types of bedrock (granite, marble, and basalt) and explore the effects of surface water alkalinity. The series of activities will span the course of four days. This kit contains materials for 30 students working cooperatively in 10 groups of 3.

Objectives

Students will

- estimate the pH of unpolluted rain.
- examine the effects of acid rain on seed germination.
- determine the buffering effects of different types of bedrock (granite, marble, and basalt).
- explain the relationship between surface water alkalinity and pH change.
- test the pH of solutions using pH strips.

Content Standards

To view the national and local standards met by this kit, visit www.carolina.com/correlations.

Time Requirements

Preparation50 minutes

Day 1:

Activity 1: Determining the pH of Normal Rainfall10 minutes

Activity 2: Effect of Acid Rain on Seed Germination15 minutes

Activity 3: Effect of Bedrock on Acid Rain25 minutes

Day 2:

Activity 2: Effect of Acid Rain on Seed Germination5 minutes

Activity 3: Effect of Bedrock on Acid Rain10 minutes

Activity 4: Buffering Capacity of Surface Water20 minutes

Days 3 and 4:

Activity 2: Effect of Acid Rain on Seed Germination5 minutes

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Materials

Included in the kit:

- 50 petri dishes
- 50 pieces of filter paper*
- bottle of vinegar*
- 30 plastic vials
- 30 plastic columns
- rubber bands
- 60 twist ties
- 14 pipets
- 10 straws*
- sodium bicarbonate, 2 g*
- vial of pH test strips*
- 10 pH color charts
- Bogen Universal Indicator with dropper, 15-mL*
- Bogen Universal Indicator chart
- soil*
- plastic wrap*
- marble chips, 500 g*
- granite chips, 100 g*
- basalt chips, 100 g*
- radish seeds*
- Teacher's Manual and reproducible Student Guide*

*Items included in the Acid Rain refill kit (RN-653076)

Needed, but not supplied:

- 10 10-mL graduated cylinders
- 11 50-mL graduated cylinders
- 20 100-mL beakers or plastic cups
- 10 50-mL beakers or plastic cups
- 10 rulers
- 10 scissors
- 10 thumbtacks
- 10 permanent markers
- 2 1-L bottles for simulated acid rain and buffered water
- 4 100-mL or larger bottles for vinegar solutions
- 3 plastic spoons
- distilled water (approx. 1500 mL)
- 350 mL or larger container for distilled water
- tap water
- paper towels

Safety

Use this kit only in accordance with established laboratory safety practices, including appropriate personal protective equipment (PPE) such as gloves, chemical splash goggles, and lab coats or aprons. Ensure that students understand and adhere to these practices. Know and follow all federal, state, and local regulations as well as school district guidelines for the disposal of laboratory wastes. Students should not eat, drink, or chew gum in the lab and should wash their hands before and after entering or exiting the lab.

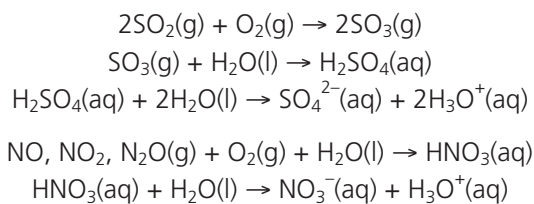
Bogen Universal Indicator solution may stain skin and clothing. Use caution when working with Bogen Universal Indicator, as it can irritate eyes and skin. It contains ethanol, which is a flammable solvent. Keep flames and sources of ignition away from this solution.

Background

Note: Additional background information can be found in the Student Guide.

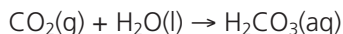
Acid Deposition

Despite significant reductions in air pollutant emissions, acid deposition remains a threat to human-made structures, aquatic organisms, forests, and human health. Acid deposition forms when gaseous sulfur dioxide and nitrogen oxides (nitrogen monoxide, nitrogen dioxide, and dinitrogen monoxide) are released into the atmosphere. These gases react with oxygen and water in the atmosphere to form sulfuric and nitric acids and sulfate and nitrate salts.



The Hydrologic Cycle

As precipitation falls, carbon dioxide present in the atmosphere dissolves in the water and reacts to form carbonic acid, H_2CO_3 , a weak acid. For this reason, unpolluted rainwater is acidic, with a pH value around 5.6.



When precipitation reaches the ground, it runs off into surface water or infiltrates the soil. The water that infiltrates the soil percolates through permeable rock and into groundwater. Both surface water and groundwater proceed to the ocean. Water returns to the atmosphere when surface water evaporates and plants transpire.

Areas Affected by Acid Deposition

The major sources of sulfur dioxide emitted in the United States are coal-burning electric utilities (70%), whereas the major sources in Canada are industrial plants (60%). The gases rise into the atmosphere where they are carried east and

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