15. WATER AND pH

How are different water sources affected by acid rain?

Objectives

- Explain how different water sources can respond differently to an ecosystem health challenge.

Materials and Equipment

- Data collection system
- pH sensor
- Conductivity sensor
- Beakers (5), 250-mL
- Graduated cylinder, 100-mL
- Stirring rod
- Disposable pipet
- Drink bottles with screw-top cap (3), ~250-mL
- Buffer solution, pH 4 and pH 10
- Dilute vinegar solution, 200 mL
- Distilled water, 200 mL
- Freshwater samples (3), 250-mL each
- Marking pen
- Rinse bottle filled with distilled water

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles at all times.
- Avoid collecting water samples that might contain bacteria or sewage.
- Follow your teacher's guidelines regarding safe water sample collection in the field.

Procedure

Part 1 – Water Sample Collection and Collection Site Observations

1. Rinse 3 screw-top bottles and caps thoroughly with distilled water. Bring the capped bottles, marking pen, pen to write with, and this handout with you to complete Part 1.

2. Collect 3 freshwater samples according to your teacher's guidelines. Sources may include ponds, rivers, wells, swimming pools, tap water, or your favorite brand of bottled water (but do not select more than one bottled water sample). Avoid brackish or saltwater, or water that might contain bacteria or sewage. Label each water sample, for instance “Pool” or "Lake Matthews".

3. Enter the three location names in the Sample Name column in Table 1, Table 3, and Table 4.

4. Record detailed observations of each water sample site in Table 1. Include sketches if you think they will be helpful and attach another piece of paper to Table 1 if necessary. Examples of detailed observations include:
   - The appearance of the water source, including water clarity and water movement.
   - The appearance and types of plants and other organisms.
   - Animal tracks and the appearance of animals.
   - The terrain, holes in the ground, and the geological features of rocks.
   - Nearby buildings and whether nearby roads are asphalt, cement, gravel or dirt.
   - Anything unusual about the area.

- For a bottled sample, list the minerals dissolved in the water and source according to the label.

5. Explain why you chose each water sample site in Table 1.

Part 2 – Establishing Control Benchmarks

1. Select Sensor Data in SPARKvue.

2. Connect the pH sensor and conductivity sensor to your device.

3. Choose the Digits template.

4. Remove the cap and storage bottle from the pH sensor and rinse the probe thoroughly with distilled water, then rinse the conductivity probe.

Note: Rinse the pH and conductivity probes thoroughly with distilled water before and after use in any solution, including water samples and buffer solutions. Remember to perform this procedure throughout the investigation.

5. Select the live pH reading below the digit displays to open the pH sensor menu. Choose Calibrate Measurement and use the pH 4 and pH 10 buffer solutions to calibrate the sensor.

6. Label 5 beakers as follows: distilled water; vinegar; and one beaker per sample name.

7. Select Start to begin collecting data.

8. Measure 200 mL of distilled water and pour it into the appropriate beaker.

9. Rinse the pH and conductivity probes and place them in the distilled water beaker. Wait for the readings to stabilize (up to 60 seconds) and record the readings in Table 2.

Note: Always wait for pH and conductivity readings to stabilize before recording values.

10. Measure 200 mL of vinegar and pour it into the appropriate beaker, then rinse the graduated cylinder with distilled water. Record the pH in Table 2.

11. Measure 200 mL of each sample and pour into the appropriate beaker, rinsing the graduated cylinder between samples.

12. Rinse the probes. Measure pH and conductivity of each water sample; record results in Table 3.

13. Use the pipet to add 20 drops of vinegar to the distilled water beaker and each water sample beaker. Mix each with a stirring rod. Rinse the stirring rod between samples.

14. Rinse the probes. Measure the pH and conductivity of the distilled water and each water sample after adding vinegar and record the results in Table 4.

15. Stop collecting data. Perform a final rinse of both sensors. Replace the storage bottle and cap on the pH sensor.

16. You simulated the addition of acid rain to each water sample when you added vinegar. Calculate the difference in water sample pH and conductivity values before and after adding vinegar for each sample according to the following equation and record the result in Table 4.

    Change = Value before adding vinegar (in Table 3) – Value after adding vinegar (in Table 4)

Data Collection

Table 1: Selecting and observing freshwater collection sites

Sample Name	Observations	Reasons for Choosing This Site

Table 2: pH and conductivity values for control solutions

Sample Name	pH	Conductivity (µS/cm)
Distilled water		
Vinegar ("acid rain")		

Table 3: pH and conductivity values for freshwater samples

Sample Name	pH	Conductivity (µS/cm)

Table 4: pH and conductivity values for water samples after adding "acid rain" (vinegar)

Sample Name	pH	Conductivity (µS/cm)	Change in pH	Change in Conductivity (µS/cm)
Distilled water				

Questions and Analysis

1. The conductivity values indicate how many dissolved solids are present in each solution, and the pH values indicate how many hydrogen ions are dissolved in each solution. List your water samples in order of increasing conductivity level. Make a second list of your samples in order of increasing pH level. Finally, review your data to look for patterns between pH values and conductivity values. Describe your findings.

2. Based on your data, which water sample showed the least amount of pH change when "acid rain" was added? Propose an explanation of why these samples were more resistant to pH change.

3. Choose one of your selected water sample collection sites. Identify one component of the site that likely has the largest impact on the water sample pH. Explain your answer.

4. Identify at least 2 questions you would need to investigate in order to determine if you correctly identified the major contributing factor to water sample pH identified in your previous answer.

5. In high mountain regions, polluted air may result in snow with a low pH. What are the potential consequences of the spring snow melt? Support your answer with data from this investigation.

6. Runoff from an agricultural area often contains soil and dissolved fertilizers. What are the potential consequences of this runoff? Would you expect nearby river water to be as sensitive to acid pollution as high mountain rivers? Support your answer with your data.