

Teaching Tips

Acids Unveiled

Grade Level: 4-12

Goal: To determine the acidity of familiar liquids and draw comparisons between the acidity of these liquids and acid rain.

Materials:

- full-range litmus paper (available at biological supply companies and some drug and pet stores)
- clean glass containers (small beakers, petri dishes, baby food jars)
- solutions to test (tap water, distilled water, rain water, soft drink, coffee, tea, lemonade, liquid antacid, other liquids you would like to test)
- tape and marker for labels
- notebook for each group

Background:

The acidity of a liquid is determined by its concentration of hydrogen ions (H^+). This concentration is designed using a **pH** scale (Figure 1). The scale ranges from 0.0 (most acidic, highest H^+ concentration) to 14.0 (most **basic**, lowest H^+ concentration). A solution with a pH of 7.0 is neutral. The pH scale is a negative logarithmic scale in base 10. This means that a solution with a pH of 4.0 is ten times more acidic than a solution with a pH of 5.0, and one hundred times more acidic than a solution with a pH of 6.0. *Normal precipitation* (precipitation from clean air) is slightly acidic because carbon dioxide that occurs naturally in the air mixes with water to form a mild solution of carbonic acid. Normal precipitation has a pH of about 5.6. States affected by acid rain have rainfall with a lower pH; rain in Wisconsin has a pH between 4.4 and 4.8.

Procedure: Divide the class into small groups. Give to each group one glass container for each solution to be tested. Students should:

1. Label each container with the name of the solution that will be placed in it.
2. Draw a data sheet in their notebook with columns labeled: solution, predicted pH, actual pH, acidic/neutral/basic?
3. Place enough of the appropriate solution in each container to cover the bottom (about $\frac{1}{2}$ inch).
4. Predict the pH of each solution and record it.
5. Test the pH of each solution by dipping the full-range litmus paper in the solution. Record results.

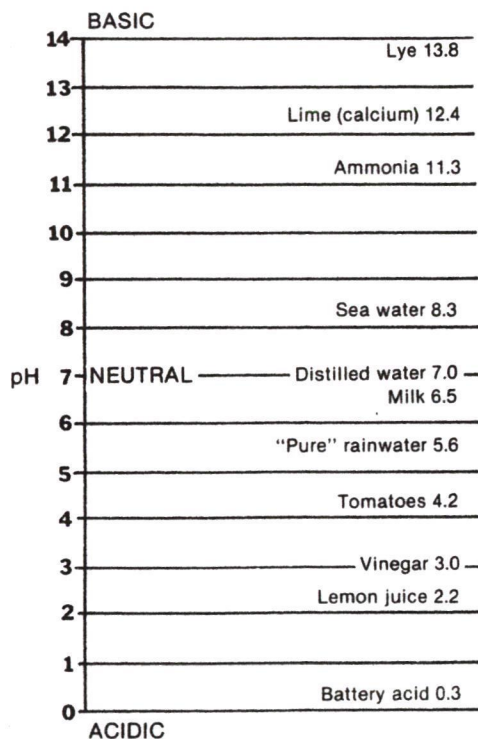


Figure 1. pH Scale

Questions:

1. Which solution is most acidic? Which is neutral? Which is most basic?
2. Which solution has the lowest pH? Which has the highest pH?
3. Which solution has the highest concentration of H^+ ? Which has the lowest concentration of H^+ ?
4. What was the pH of tap water? What might determine the pH of tap water in your area?

Going Beyond:

1. Have students draw a pH scale and write the name or draw a picture of each solution they tested next to its corresponding pH on the scale. (See Figure 1 for sample pH scale.)
2. Collect rain or snow samples in clean glass containers, at school and/or home. Note where samples were collected – runoff from roofs or trees may have an altered pH. Record the data on a data sheet with columns labeled: sample #, date collected, location, type of precipitation, pH.

Collect samples over a period of three weeks to several months. Compare the pH of samples collected at different locations during the same storm, or of samples collected at different times at the same location. Do the pH's differ at all? What are possible explanations for similarities or differences? For example, how might the path of a storm affect the pH of its precipitation? Check weather reports and maps to track where the storm came from. Remember, normal rain has a pH of 5.6.

3. Take a field trip to collect water samples from nearby streams, lakes, bogs, or ponds. Be sure to label the samples. If possible, collect several samples from each location so you can get an average pH reading. Compare the pH's of the samples and record them on a data sheet. What might the pH tell you about what aquatic organisms can live in the water from which you got the samples?

Adapted from Acid Rain Study Guide, Wisconsin Dept. of Natural Resources, May, 1986. Editor and Project Coordinator of the guide is Anne Hallowell, ANSS Board Member.

Teaching Tips are a service of the American Nature Study Society.