

Chapter 5. The Idea of pH

Lesson 2. Measuring pH

Overview: Contaminants that influence the quality and usefulness of water can be chemical, physical, or biological. Many household and industrial items washed down the sink contaminate our water supply and reduce water quality. Pollutants like car exhaust, industrial smoke, anti-icing agents for highways and roads, highway oil and spilled gasoline end up in our water as chemical contaminants. Indirectly, exhaust and smoke end up in our water as part of acid rain precipitation and deposition. An important property of water that determines its reaction with many substances is acidity, which we measure as a property called pH. To understand chemical contamination of water, a person must consider pH. Many chemical contaminants have the ability to raise and lower the pH of water from its natural systems, and the health of their associated fisheries, aquatic insects and plants.

Purpose: The purpose of this activity is to introduce students to the idea of pH and its affect on the quality of surface water systems.

Ideas taught: Household chemicals that are potential contaminants can be acidic, basic, or neutral.

Materials Needed:

- Any or many of the following items: Limeaway liquid cleaner, grape juice, grapefruit juice, tomato juice, vinegar, orange juice, black coffee, milk, water, baking soda solution, milk of magnesia, household ammonia, weak solution of household bleach, mouthwash, distilled water, weak solution of liquid dish soap
- PH paper or pH indicator strips or pH meters
- Supply of plastic or paper cups
- Stirring sticks

Procedure:

1. _____ Before class begins, pour cups about 1/4" deep with each of the above items and label the cups to identify what is in it. There should be enough cups of each liquid for each group assembled in Lesson 1 (The pH Scale). Leave the original container of these items with the cups on a table so that the students can recognize what the substances are. When class begins, have the students assemble in their groups from Lesson 1. Tell them to order on their table the pieces of string associated with pH's 14-10 and the strips of paper associated with pH's 9-1. Give

each group a box of pH paper, pH indicator strips, or a pH meter. Explain to them that the paper is a very quick method to measure the pH of a liquid. Show them how to use the paper with a cup of water. To conserve paper, have them cut one strip of paper into thirds. A small piece is necessary to determine the pH. Ask the students to guess which items are acidic, which items are neutral, and which items are basic.

2. _____ At this point, allow the students to measure the pH of each of their liquids. Ask them to place the cup of liquid next to the string or strip of paper that correlates to the pH of that liquid. Remind them that they are measuring the hydrogen ion concentration of each item. When they are finished, begin discussion the pH of each item. Ask them to recall what the acidic items taste like, versus the neutral and/or basic items. Which items would they not drink? Ask them how it would feel to spill any of these liquids in their eyes. Again, persuade them to be specific in describing their feelings associated with acidity. Talk about the hydrogen ions in each liquid. Relate this to the uses of each item.

3. _____ After your discussion, explain to the class that when acids and bases mix, a more neutral solution will result. First collect all the ammonia and Chlorox solutions from each table. Handout new cups and stirring sticks and ask them to mix equal amounts of an acidic and a basic solution. Have them use the weak baking soda and vinegar solutions, or the vinegar and tap water or the liquid soap and juice mixes. It is important that they stir the solution well before they measure its pH. If the students wish to mix a more neutral solution with an acid or base, this is ok. Discourage their using water, since it will be used in the next exercise. Ask them to predict the pH when the neutral solution is mixed with an acid or base. Have each group report their results on the chalkboard. Discuss their results.

4. _____ Now explain that water, although it is neutral, can behave as an acid or a base. Have them mix equal amounts of an acid with water in an empty cup. Tell them to mix enough of the two liquids to fill the cup 1/4 full. Again, have them report the new pH of their solution to the class. Repeat the process, this time using a base and water. At this point, it is appropriate to remind them that many surface and ground water systems work at pH's of 5-8. If enough chemical contaminant is introduced to that system, the pH of water will change. Many fish, aquatic insect and plant species cannot survive in the water if the pH change is significant enough. Have them add small amounts of acid or base to their solution and have them measure the pH after each addition. It is important they stir the solution well before they measure the pH. You may want to stop between each addition and have the students report the change in pH of their solution.

Lesson Learned: Many common household chemicals that are potential contaminants are acidic. Many are basic. Some are neutral.

The lesson above was adapted from "What is Water Quality? A Resource Guide for 4-H Leaders and Teachers," 80 pages of activities and experiments related to water quality. (\$5.00) Order from the Montana 4-H Program at Montana State University-Bozeman. Phone 406-994-3501.