Acids and Bases

Background

Scientists use many skills to assist them in their research. Among other things, they need to be able to conduct tests and analyze and classify the data. For example, scientists use the pH scale to identify and classify compounds. The pH scale is a measure of how acidic or basic a sample is.

Acids are nonmetallic chemical compounds that react with some metals to produce hydrogen gas. They have a pH less than 7. An acid will neutralize a base. Bases are metallic chemical compounds that react with water and have a pH greater than 7. A base will neutralize an acid. A substance that is neither an acid nor a base is considered neutral, and has a pH of 7. Water is an example of a neutral substance.

An indicator is used to test a solution for its pH. It may be in the form of a liquid or paper that has been soaked in an indicator liquid. For example, one easily prepared indicator is the Cabbage Juice Indicator.

Skills

- Conducting experiments
- Reading scales
- Interpreting data
- Classifying compounds

Objective

Students will:

- Analyze everyday materials to determine whether they are acids, bases, or neutral.

Overview

In this activity, students will test common solutions by using the pH scale. They will interpret this data and classify the solutions as acids, bases, or neutral.

Key Question

How do scientists conduct experiments to classify acids and bases?

Key Concepts

- Interpreting the pH scale
- Classifying acids and bases

Materials & Preparation

Each of the following solutions: water, bleach, ammonia, vinegar, milk, lemon juice, tomato juice, tea, and liquid soap

- 9 Small plastic cups (20 ml) per group
- 2 Eyedroppers per group
- 2 Large plastic cups (250 ml) per group
- 9 Test tubes per group
- 1 Pair of safety goggles per student
- 1 Apron per student
- 1 head of red cabbage
- 1 Graduated cylinder
- Water

1. Gather materials and assign students to cooperative groups.
2. Prepare the red cabbage indicator: Cut a red cabbage into eight parts. Place cabbage in a non-aluminum pan, cover with water, and boil for 10-15 minutes. (You may wish to use bottled water to ensure neutral pH.)
3. Pour the pan contents through a strainer and discard the cabbage leaves.
4. Cool the juice and store covered in the refrigerator. Freeze the juice in ice cube trays for extended use.
5. Prepare the bleach, ammonia, soap, and vinegar solutions by mixing 1 teaspoon of each liquid with 250 ml of water.
6. Have students look at the list of household products on the chart below. For each solution, have students predict and record if they think it is an acid, base, or neutral.
7. Label the small cups 1-9.
8. Label one large cup *water* and the other *indicator*.
9. Fill the nine small cups half full of each solution.
10. Fill one large cup half full of water.

11. Fill one large cup half full of the cabbage juice indicator.
12. Label the test tubes 1-9.
13. Students will use an eyedropper to put 10 drops of indicator into the test tube labeled 1. Place this eyedropper back into the cup of indicator.
14. Students will use the other eyedropper to put 10 drops of solution "1" into the test tube labeled 1.
15. Students will gently shake the test tube to mix the solutions.
16. Students will observe the color and record their observations on the chart below, indicating if the solution is an acid, base, or neutral.
17. Students will clean their solution eyedropper in the water cup and repeat steps 13-16 for each of the solutions.
18. Afterwards, have students clean up test tubes and area.
19. Discuss the results.

Management

This activity will take one class period.
Be sure to follow all safety rules for working with chemicals.

Reflection & Discussion

1. What types of solutions tended to be acidic? What characteristics do they have in common?
2. What types of solutions tended to be basic? What characteristics do they have in common?
3. What types of solutions tended to be neutral?
4. Were you surprised by any of your findings? If so, how?
5. Hypothesize what other liquids you would expect to be bases, acids, and neutral.
6. What other ways are there to test for acids and bases?
7. Why is it important to know if items are acids or bases?

Transfer & Extension

1. Research acid rain.
2. Collect water samples from local water sources to test for pH.
3. Make paper indicators by cutting white blotting paper into strips and soaking the strips in the red cabbage indicator.
4. Use commercially sold synthetic indicators to compare and contrast test results.
5. Experiment to find other plants, fruits, or vegetables that can be used as indicators for an acid, base, or neutral substance.
6. Discuss the role of maintaining pH in swimming pools and salt water aquariums.

STUDENT WORKSHEET

Acids and Bases

Student Procedures

1. Look at the list of household products on the chart below. For each solution, record your prediction of whether you think it is an acid, base, or neutral.
2. Use an eyedropper to put 10 drops of indicator into the test tube labeled 1. Place this eyedropper back into the cup of indicator.
3. Use another eyedropper to put 10 drops of solution "1" (lemon juice) into the test tube labeled 1.
4. Gently swirl the test tube to mix the solutions.
5. Observe the color and record your observations on the chart below. Indicate whether the solution is an acid, base, or neutral. The chart lists which colors correspond to an acid, base, or neutral.
6. Clean your solution eyedropper in the water cup and repeat steps 2-5 for each of the solutions.
7. Test your own ideas for numbers 10 and 11.

Data Log for Classification of Solutions

Solution Name	Prediction	Color	Acid, Base, or Neutral
1. lemon juice			
2. bleach			
3. water			
4. tomato juice			
5. milk			
6. ammonia			
7. tea			
8. vinegar			
9. soap			
10.			
11.			

indicator + acid = pink **indicator + base = green** **indicator + neutral = purple**