

Chemistry of Solutions
Relating pH and the Environment

Grade Level: 8

Time: 2 Days (40 minute sessions)

Goals & Objectives:

Goals:

- Work collaboratively
- Interdisciplinary work
- Have student present findings to the class
- Determine the pH of various solutions using pH paper and cabbage juice

Objectives:

Students will be able to:

- Apply research methods
- Explain how acid rain affects rocks
- Explain how humans can affect the pH of rainwater
- Demonstrate chemical reactions between acids and bases

Materials:

For each group of students

- 10 small clear cups
- pH indicator paper
- Red cabbage juice
- wax pencil (to label test tubes)
- Various solutions: lemon juice, apple juice, coffee, tea, vinegar, milk, soda, seawater, pure water, detergent, baking soda solution, Tums antacid, etc.
- Small piece of marble
- Vinegar w/straw
- Rainwater solution (pH~ 5.6)

NJCCS:

4.1.8A2, 5.1.8A2, 5.1.8B1, 5.1.8B3, 5.6.8A1, 5.6.8A4, 5.6.8B1, 5.6.8B4, 5.8.8B1, 5.8.8D2, 5.10.8A1, 5.10.8B1

Procedures:

Day 1: Intro to pH

1. Lead class discussion:
 - Define pH: based on the amount of Hydrogen ions in a substance. Acid-has a higher concentration of hydrogen ions and a sour taste. Base-has a lower concentration of hydrogen ions and a bitter taste. Neutral-intermediate

concentration of hydrogen ions. pH is inversely proportional to the concentration of hydrogen ions. (high pH → low concentration of H^+)

- Discuss acid rain: rainwater has a pH around 5.6 and is naturally acidic. Sometimes the pH level of rain is reduced and becomes more acidic, this occurs when certain chemicals mix with atmospheric water and form sulfuric acid and nitric acid. Cars and factories introduce excess sulfur oxide and nitrogen oxide through the combustion of fossil fuels, which are released into the air. Some Earth processes, such as volcanic eruptions, add these chemicals to the air.
2. Distribute supplies to each group.
 3. Have students measure approximately 10 ml of each substance to be tested.
 4. Write the name of each substance in the data table.
 5. Label each cup with the name of each substance you obtained
 6. Using the pH indicator paper, dip one end of the pH paper into your cup of substance and compare the color of your pH paper to the chart and determine the pH.
 7. Add a dropper full of cabbage juice into to each cup.
 8. An acidic solution will appear red, a basic solution will appear green, and a neutral solution will be violet/blue.
 9. Record the color onto the data table.

Day 2: Mixing solutions

10. Hand each group a small piece of marble and a small cup of vinegar. Describe how marble is a rock made of Calcium Carbonate ($CaCO_3$).
11. Use a straw to place a drop of vinegar onto the marble. Test the pH of the bubbles that formed on the rock.
 - What happened?
 - How does this relate to acid rain?
 - Why don't we use marble in outdoor statues or gravestones?
12. Obtain three new cups and place 10ml of acid rain solution into each.
13. Pick three (3) substances with the with different pH levels (4, 6, 10). Place 5ml of each substance into one of the three cups from step 2.
14. Test the pH of each mixture by dipping the pH indicator paper into the cup.
15. Add a dropper full of cabbage juice to each mixture and record the color
16. Lead follow-up discussion:
 - What substances surprised you?
 - What did you notice when you mixed the solutions?
 - How does this relate to the formation of acid rain?
 - Water seeps through cracks in rocks. What might happen to the pH of rain that seeps through a marble or limestone mine?

Accommodations:

SLD

- Assign groups
- Assign specific tasks
- Provide activity sheet

- Assist certain groups with measuring and procedure

ELL

- Assign groups (allow students to work/communicate with bilingual students)
- Allow all students express data with drawings
- Highlight key words; give explanation in native language, if possible.

Assessment:

- Make observations as students work together
- Collect activity sheets and homework
- Have students present results to their peers

Follow-up/Homework:

Assign homework problems:

Day 1: What factors in the environment may affect pH? Think about household items going down the drain.

Day 2: Answer notes section: *The mixtures represent acid rain that has mixed with other substances. Explain what happened when you mixed an acid and a base? What happened when you mixed an acid with a stronger acid (lower pH)?*

References:

Cabbage juice recipe from

<http://www.ncsu.edu/sciencejunction/depot/experiments/water/lessons/pH/pHindicator.html>

Chemistry of Solutions

Using Acid Base Indicators to Test Substances

Name: _____

Partners names: _____

Materials:

- 10 small clear cups
- pH indicator paper
- Red cabbage juice
- wax pencil (to label test tubes)
- Various solutions: lemon juice, apple juice, coffee, tea, vinegar, milk, soda, seawater, pure water, detergent, etc.

Procedure:

Part 1

1. Measure approximately 10 ml of each substance to be tested.
2. Write the name of each substance in the data table.
3. Label each cup with the name of each substance you obtained
4. Using the pH indicator paper, dip one end of the pH paper into your cup of substance and then lay the paper onto a sheet of white paper and write the name of the substance onto the paper next to the pH strip.
5. Compare the color of your pH paper to the chart and determine the pH.
6. Add a dropper full of cabbage juice into to each cup.
7. An acidic solution will appear red, a basic solution will appear green, and a neutral solution will be violet/blue.
8. Record the color onto the data table below:

Substance	pH Paper Reading	Color after adding Cabbage juice
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

For the Teacher:

Red Cabbage Juice Recipe

Materials:

- head of red cabbage
- food processor or knife and cutting board
- saucepan (not aluminum) or 1000 ml beaker
- large glass container or 500 ml beaker
- storage jars
- sieve or tea strainer
- rubbing alcohol
- filter paper or coffee filter

Chop the red cabbage. Bring 2 cups of water (500 ml) to boil in saucepan. Add the cabbage to the boiling water and carefully remove from heat. Let the saucepan stand for 30 minutes. Strain the liquid-cabbage mixture and discard the cabbage. For storage, make a solution of the cabbage liquid and alcohol, using 1 part alcohol to 5 parts cabbage liquid. Label carefully to prevent accidents. The cabbage liquid can also be stored by freezing in ice cube trays.

To use as an indicator, add a drop or two of cabbage juice to the substance to be tested. Observe the color change.

<http://www.ncsu.edu/sciencejunction/depot/experiments/water/lessons/pH/pHindicator.html>