

Bay Area Scientists in Schools Presentation Plan

Lesson Title: Acids and Bases: Cabbage Juice Indicator

Grade Level: 5th

Standard Connection: chemical reactions, making observations and recording data, drawing conclusions

Introduction (5 min)

- Introduce ourselves
- Chemistry is important because chemical reactions happen all around us every day (body, gasoline, cooking).
- Learning chemistry helps us to understand our world better and improve our world (understand what chemicals are polluting our air, make new medicines)

Background (10 min)

Chemical Reaction – process in which molecules rearrange into different products that have different properties

- Sometimes we can see chemical reactions occurring (bubbles, color change). In today's reaction we'll see a color change

We will learn about 2 types of chemicals called acids and bases:

Many things around your house are acids and bases and we'll explore this more today

- An acidic solution has excess H⁺ molecules
- A basic solution has excess OH⁻ molecules
- A neutral solution is neither acidic or basic
- Scientists use something called a pH scale to measure how acidic or basic a solution is. The scale goes from 0 to 14.
 - Acidic solutions have a pH of 0-6
 - Neutral solutions have a pH of 7
 - Basic solutions have a pH of 8-14

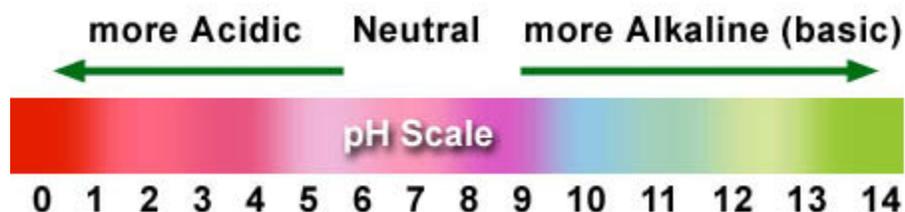
Today's chemical reaction:

- A purplish colored molecule in cabbage juice + **acids** = a **red/pink** colored molecule
- Also the molecule in cabbage juice + **bases** = **blue/green** colored molecule
- The molecule in cabbage juice does not react with **neutral molecules** = **no color change**

Therefore cabbage juice can be used to indicate if a solution is acidic or basic so it is called an indicator.

Demonstration (10 min)

- Show how the cabbage juice strips change color in different solutions showing examples of the colors.
- Explain how to perform experiment and fill in work sheet and safety concerns



Hands-on Experience (30 min)

Will have prepared cabbage juice paper strips and solutions of common household acids and bases : sprite, vinegar, water, lemon juice, laundry detergent, windex, and alka seltzer.

Students will pair up and drop the solutions on the strips. The color change will indicate to them whether the solution is acidic, basic, or neutral. They can even try to approximate the pH by looking at the pH color scale or just say whether the pH is 0-6, 7, or 8-14. They will fill in the table with their observations.

Wrap Up (5 min)

- Give directions for clean up
- Ask what did we learn today?
- Ask if they can think of any other chemical reactions we can see by color change?
- Give the students cabbage juice strips to take home and experiment with



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Directions for Preparing Cabbage Juice Indicator

Source: Center of Science and Industry (COSI) www.cosi.org

Materials for Cabbage Juice Indicator:

- Red cabbage
- Knife
- Boiling water
- Filter paper (coffee filters work well)
- One large glass container

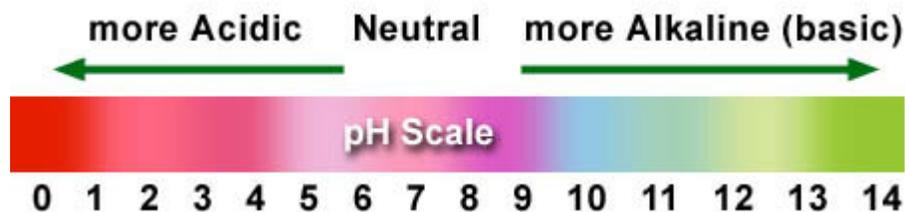
For pH Testing:

- Small glass containers
- Household ammonia
- Baking soda
- Washing soda
- Lemon juice
- Vinegar

Instructions:

1. Chop the cabbage into small pieces until you have about 2 cups of chopped cabbage. Place the cabbage in a large glass container and add boiling water to cover the cabbage. Allow at least ten minutes for the color to leach out of the cabbage.
2. Filter out the plant material to obtain a red-purple-bluish colored liquid. This liquid is at about pH 7.
3. Pour about 50 - 100 mL of your red cabbage indicator into each small glass container. Use separate containers for each chemical. Add the chemicals to the indicator until a color change is obtained. (Chemicals used in this demo may be safely washed down the drain with water.)

Optional: You can also make pH test strips by soaking filter papers in a very concentrated red cabbage juice and then hanging the papers to dry.



What's Going On:

Red cabbage contains a pigment molecule called flavin. This is a water-soluble pigment that is also found in some fruits and flowers. Very acidic solutions will turn the solution a red color. Neutral solutions result in a purplish color. Basic solutions appear in greenish-yellow. Different types of indicators will have different pH color scales.

The color of the juice changes in response to changes in its hydrogen ion concentration. pH is the $-\log[H^+]$. Acids will donate hydrogen ions in an aqueous solution and have a low pH ($pH < 7$). Bases accept hydrogen ions and have a high pH ($pH > 7$).

A neutralization experiment could be performed using cabbage juice indicator. First add an acidic solution such as vinegar or lemon juice until a reddish color is obtained. Then add washing soda or vinegar until the solution neutralizes turning a bluish color. The color change that you see is a physical change but the loss or addition of Hydrogen ions is a chemical change.



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