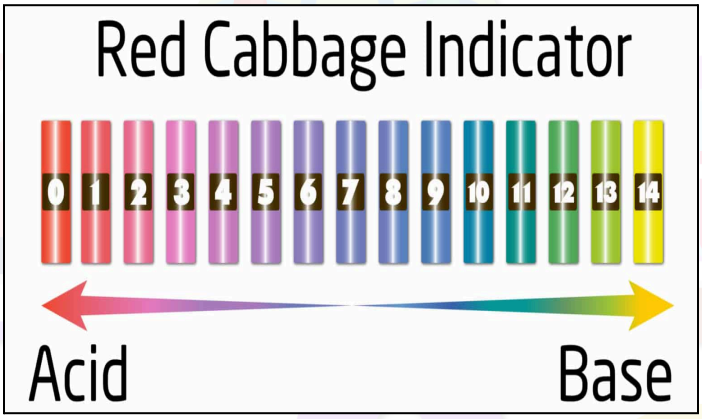
Crazy Cabbage Chemistry

Testing the pH of Household Liquids

INTRODUCTION: In this lab, you will determine the pH of chemical solutions using red cabbage juice as a natural pH indicator. Solutions can be acidic, basic, or neutral, depending on the concentration of hydrogen ions ($H+/H_3O+$) and hydroxide ions ($OH–$). Acids contain more $H+/H_3O+$ ions, while bases have more $OH–$ ions. Neutral solutions have equal amounts of both, with a pH of 7. A pH below 7 is acidic, while a pH above 7 is basic.



Red cabbage juice contains anthocyanin, a pigment that changes color based on pH. In acidic solutions, it turns red or pink, while in basic solutions, it becomes green or yellow. Neutral solutions keep it purple. The color changes because anthocyanin responds to the concentration of hydrogen ions, making it a clear and effective pH indicator.

PRE-LAB QUESTIONS:

1. What is the relationship between the concentration of hydrogen ions ($H+/H_3O+$) and hydroxide ions ($OH–$) in acidic, basic, and neutral solutions?

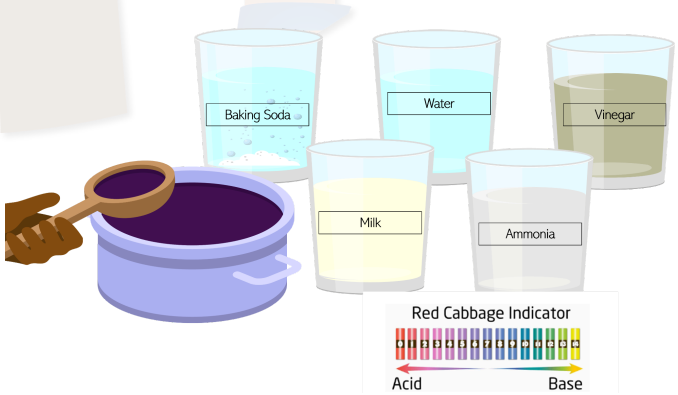
2. How does anthocyanin in red cabbage juice indicate the pH of a solution, and what color changes occur in acidic, basic, and neutral solutions?

3. Why is red cabbage juice an effective natural pH indicator for determining the acidity or basicity of a solution?

MATERIALS RECEIPT:

Red Cabbage	$3.00
White Vinegar	$1.00 (32oz)
Clear Ammonia	$2.00 (64oz)
Sprite	$2.00 (1.25L)
Baking Soda	$1.00 (1lb)
Water	- - -
Cups (5/group)	- - -
Spoon (1/group)	- - -
TOTAL	**$9.00**

EXPERIMENTAL SET-UP:



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PROCEDURE:

1. Prior to performing the lab, chop, boil, and strain a red cabbage to extract the juice. Cool the juice.
2. Pour equal amounts of vinegar, ammonia, milk, Sprite, baking soda solution, and water into labeled cups. *For baking soda, dissolve it into water to create a solution to be tested.
3. Add 3-4 drops of cabbage juice to each cup using a spoon or dropper, without touching the solutions.
4. Gently swirl each cup to mix.
5. Record the color change for each solution in the data table. Then determine each solution's pH value and whether or not it is an acid or base.

DATA:

SOLUTION	COLOR CHANGE	pH VALUE	ACID/BASE?
Water			
Vinegar			
Ammonia			
Milk			
Sprite			
Baking Soda			

CONCLUSION:

1. Order the solutions from most acidic to most basic.

2. Which solution had the highest [H+]/[H3O+]? Which had the highest [OH–]? Explain using the pH and ion concentration relationship. (Hint: Direct or inverse)

3. Which solution's pH surprised you the most? Why? What did you expect its pH to be before the lab?

4. Consider another household item, like lemon juice. What do you think its pH might be based on its taste, touch, and your experiment? Explain your guess.