

Cabbage Chemistry Experiment

A **solution** is a mixture of a soluble **chemical** dissolved in water. Think about the difference between saltwater and tap water. The salt in the salt water has dissolved and the solution looks clear, but the salt is still there and will taste salty if you taste it. Because solutions are made with water, which is made of hydrogen and water, the hydrogen in the water can make a solution into an **acid** or a **base**.

You might think about an acid as something that an evil villain uses to trap a superhero, but actually some very common household solutions are acids. Acids are solutions that will donate hydrogen ions in a solution, and usually taste sour. Some common acids are citrus fruit juices and household vinegar. Bases are solutions that accept hydrogen ions in solution, and usually feel slippery. Bases have many practical uses. "Antacids" like TUMS or Roloids are used to reduce the acidity in your stomach. Other bases make useful household cleaning products.

How do you tell if something is an acid or a base? You use a chemical called an **indicator**, which changes in color depending on whether a solution is acidic or basic. (Specifically, an indicator works by responding to the levels of *hydrogen ions* in a solution.) There are many different types of indicators, some are liquids and some are concentrated on little strips of "litmus" paper. Indicators can be extracted from many different sources, including the pigment of many plants.

Red cabbage contains an indicator **pigment** molecule called *flavin*, which is one type of molecule called an *anthocyanin*. This water-soluble pigment is also found in apple skin, red onion skin, plums, poppies, blueberries, cornflowers, and grapes. Very acidic solutions will turn anthocyanin a red color. Neutral solutions result in a purplish color. Basic solutions make a greenish-yellow or yellow color. Because red cabbage has this indicator pigment, it is possible to determine the **pH** of a solution based on the color it turns the red cabbage juice. The pH of a solution is a numerical measure of how basic or acidic it is. A solution with a pH between 5 and 7 is neutral, 8 or higher is a base, and 4 or lower is an acid.

pH	Color
2	Red
4	Purple
6	Violet
8	Blue
10	Blue-green
12	Greenish-yellow

Directions:

1. Pick out your testing solutions and hypothesize in the table below whether you think they will be acidic, basic or neutral based on the color scale.
2. Grate a small red cabbage and place the pieces into a large bowl or pot.
3. Pour boiling water into the bowl or pot to just cover the cabbage. Use caution when handling the boiling water.
4. Leave the cabbage mixture steeping, stirring occasionally, until the liquid is room temperature (may take up to half an hour). The liquid should be a reddish purple color.
5. Place a strainer over a second large bowl or pot and pour the mixture through the strainer to remove the cabbage pulp. Press down on the pulp in the strainer with a spoon or hand to squeeze more liquid out of the pulp. This is your indicator solution and will be used to test other liquids and solutions.
6. Set up your Dixie cups and pour an even amount of the indicator solution into each one. You should have the same amount of cups as you do household liquids and solutions to test.
7. Using your pipette, add a few drops of a liquid into the solution. Gently swirl the cup and see the color change.
8. Observe the color difference compared to the indicator solution and record the pH and color of each solution in the data table below.

Household solution or liquid	Hypothesis (Predict base, acid, or neutral.)	Color (Record color of solution after indicator is applied)	pH (Record the pH of solution according to table 1)
Tap Water			
Vinegar			

Questions:

1. Were your hypotheses correct?
2. How do the pH of the different household solutions you tested compare to each other?
3. How are indicators considered a chemical change?
4. Were you surprised by the results of household cleaning products versus common sodas or drinks?
5. What do you think happens when an acid and a base come in contact with each other?

Source:

https://www.sciencebuddies.org/science-fair-projects/project-ideas/Chem_p013/chemistry/make-cabbage-pH-indicator/#summary