



Fun with acids & bases

Objective:

Students will use red cabbage juice as a pH indicator to classify substances as acids or bases and will also use vinegar to dissolve baking soda as an example of neutralization.

Introduction:

Certain molecules change color depending upon the pH of the solution to which they are added. Red cabbage juice contains such a molecule called “Anthocyanin.” Red cabbage juice turns bright pink at low pH values, and yellowish-green at higher pH values. This scale can then be used to test common household foods/chemicals that students are familiar with. They can form hypotheses about the color change they might observe with each substance, test it, and see the outcome and whether their hypotheses were correct. This demonstration can also be used to introduce neutralization of an acid or base, as the color changes are instantaneous and reversible depending upon the pH of the solution.

Materials (pH experiment):

- Head of red cabbage
- Pot for boiling water
- Container to hold red cabbage juice
- Funnel
- Lemon Juice
- Vinegar
- Baking Soda
- Dish Soap/cleaning products (Windex is deal)

Materials (neutralization experiment):

- Baking Soda (sodium bicarbonate)
- White Vinegar (acetic acid)
- Small erasers (optional) to hide in baking soda rocks as a prize for students
- Food coloring (optional)
- Paper towels
- Small containers to do the reactions in (weigh boats work well)
- Containers/mixing bowls to make baking soda paste

Protocol (pH experiment):

Make the red cabbage juice pH indicator

1. Bring a pot of water to boil.
2. Remove the outer leaves from the head of the cabbage.
3. Remove several of the newly exposed leaves from the cabbage, rip into smaller pieces, and place in the boiling water for several minutes. Alternatively, you can shred the cabbage to make a more concentrated extract.
4. Once the water is a purplish-pink color, turn the heat off and remove the cabbage leaves.
5. Allow the red cabbage extract to cool, then pour into a container (here the funnel may be useful). The solution should be a purplish/blue color.
6. This solution can be stored for a few days in the refrigerator prior to use.
7. The student can test the pH of common household food/chemicals by adding a few drops of the pH indicator solution and monitoring color.

Protocol (neutralization experiment):

Make the baking soda rocks

1. Pour baking soda into a large container.
2. Add a drop or two of food coloring.
3. Slowly add water and mix until a paste is formed that holds its shape when rolled into a ball.
4. Allow to dry and harden at least overnight. In a small container, add a small amount of white vinegar to the dried baking soda rock and observe the reaction that occurs.

Expected Results:

Upon immersing the baking soda in the vinegar a couple of chemical reactions occur: 1) The baking soda (base) and the vinegar (acid) react to form water (neutral pH), which is why we

call this a neutralization reaction. 2) The baking soda contains a chemical known as bicarbonate (HCO_3^-) that becomes H_2CO_3 (Carbonic acid) upon reacting with the vinegar. H_2CO_3 is unstable and breaks down to form water and carbon dioxide (CO_2), which is a gas and is also the reason why we observe fizzy bubbles in this reaction.

Supplemental Information: <https://www.sciencebuddies.org/>

This website is a fantastic source of scientific demonstrations to get students interested and to make scientific concepts more sensory, hands-on and accessible.

<https://www.sciencebuddies.org/>

The web address below directs you to the sciencebuddies.org page specifically on red cabbage juice.

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