

CABBAGE PH

| 45 - 60 minutes |



OVERVIEW

Description

Participants will learn about the pH scale using purple cabbage as an indicator to measure how acidic or basic a variety of substances are. This activity is ideal for an older age group, however acts as a very good demonstration for younger participants!

Learning Outcomes

- Learn what the pH scale is
- Learn how acids and bases change the colour of an indicator
- Learn how acids and bases are present in our day to day lives (household chemistry)

Outline

1. Introduction (20 minutes)
2. Preparation of Materials (10 minutes)
3. Experiment (25 minutes)
4. Debrief (10 minutes)

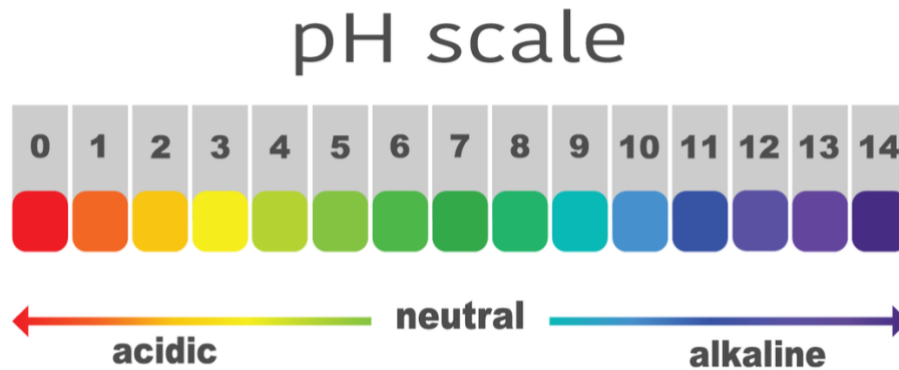
Materials

| Item | Quantity Per Group (groups of 4 recommended) | Quantity Per Class |
|--|---|--|
| <ul style="list-style-type: none">• Purple Cabbage• Glass jug• Kettle• Vinegar• Lemon Juice• Baking Soda• Dish Soap• Plastic Spoons• Glass jars or cups (holds boiling water!)• Small plastic cups• Paper• Pen/pencil• Gloves/goggles/smocks | <ul style="list-style-type: none">• N/A• N/A• N/A• ¼ Cup• ¼ Cup• 2 Tbsp• 2 Tbsp• 4• 4• 3• 1 sheet• 1• N/A | <ul style="list-style-type: none">• ¼ - ½ cabbage head• 1• 1• N/A• N/A• N/A• N/A• N/A• N/A• N/A• N/A• N/A• N/A• N/A• 1 set per child |

KEY INFORMATION

Topic 1: pH Scale

The pH scale ranges from values 0 to 14. A given pH value is the measure of how basic or how acidic something is. Bases have a higher pH (8-14), with strong bases being near 14. Basic can also be referred to as alkaline. and acids have lower pH (0-7) with strong acids being near 0. Neutral substances will have a pH of 7 (such as water). In this experiment, purple cabbage contains a natural ingredient called anthocyanin which acts as an indicator (indicators are chemical compounds that detect acidity in substances and shown visually for simple interpretation). By boiling the cabbage, it will bring out the anthocyanin and create a simple indicator solution, which can then be used to test pH of substances.



Source: USGS: <https://www.usgs.gov/media/images/ph-scale-0>

LESSON PLAN AND PROCEDURE

It can be helpful to prepare the cabbage indicator beforehand - It only takes a few minutes to boil enough for one group using the kettle but can be time consuming with a large class size.

Safety note: If you choose to boil water during the lesson, be very careful when children are around the jars of hot water. Let them know they may not move jars unless they ask a leader to do it for them.

Prior to Lesson (or while doing topic introduction): Make Cabbage Indicator Solution

1. Boil a full kettle of water.
2. Tear or chop cabbage into rough pieces, place into glass jug.
3. Pour boiled water over cabbage, let sit for at least 10 minutes (to ensure solution cools slightly but also so indicator is made properly).

Introduction (10 minutes)

1. Give class an introduction to the pH scale (See Key Information Section)
 - a. Describe that chemicals and household items can be categorized on the pH scale.
 - b. Tell the group that the objective of this experiment is to determine where some recognizable items sit on the pH scale.
 - c. The pH of substances is sometimes important for scientists to know when they are doing experiments. Testing pH is therefore necessary, and the pH scale provides an easy way to classify these substances.
2. Mixing acids and bases
 - a. What happens when you mix an acid and a base together? They often neutralize each other (depending on their concentration) creating salt and water as products.
 - i. For example: mixing vinegar (acid) and baking soda (base) will create a visible reaction (fizzing and bubbling) which is the neutralization of each ingredient! Neutralization means the acidic component is increasing in pH (closer to 0) and the basic component is decreasing in pH (closer to 0).
3. How is pH measured?
 - a. pH is measured by using indicators such as phenolphthalein, phenol red, methyl orange, bromothymol blue (these are non-household chemicals!)
 - b. Cabbage is also an indicator because it contains anthocyanin, which reacts to acids and bases.

Preparation of Materials (5-10 minutes)

1. Divide class into groups of 3-4. Have participants wear goggles, gloves and a smock, if available, to enforce the concept of chemical safety when doing science experiments.
2. Hand out 4 glass jars, plastic spoons, pencil, paper and 3 plastic cups to each group.
3. Pour lemon juice, vinegar, baking soda and dish soap allotments into groups' small plastic cups.
 - a. Encourage the children to guess what the items are and whether the items are acidic or basic, but do not make an conclusions until the experiment has happened!
4. Pour cabbage indicator into groups' glass jars. **Warn the participants that the liquid may still be hot!**

Experimentation (25 minutes)

1. Show the class the pH scale for reference.
2. Have the groups carefully add the different testing substances to the cabbage solution one at a time (there is a separate jar for each substance).
 - a. **Do NOT eat/drink the experiment materials, even though the items are edible!**
3. After each addition, students should record their observations – was there a reaction? What colour did the solution change to? Does the colour change as time goes by?
4. Students should use the pH scale as a reference to determine whether the solutions are acidic or basic.
5. To clean up, mixtures can be poured down the sink, and leftover cabbage can be composted.
6. *The vinegar and lemon juice are acidic substances, while baking soda and dish soap or basic substances.*

Debrief (10 minutes)

- Recap what the pH scale is. If something is basic, what pH value will it have?
- Ask what solutions were the most acidic and which were the most basic.
- Based on the substances used in the experiment, have the students make guesses about the pH of other household items.

REFERENCES & RESOURCES

Acids and Bases

- <https://chem.libretexts.org>
- <https://www.sciencebuddies.org/science-fair-projects/references/acids-bases-the-ph-scale>