Red Cabbage pH Indicator

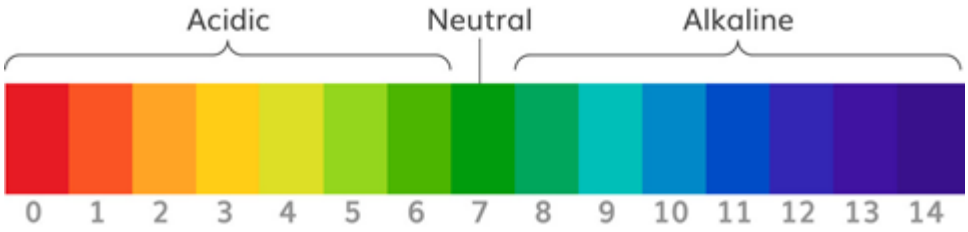
Years 8 & 9

Overview:

Note: Complete this experiment before the *Reacting Sherbet* experiment.

In science, pH is a scale used to measure how acidic or basic/alkaline a substance is. The scale is technically open-ended but, since most substances have a pH somewhere between 0 and 14, that's usually how you'll see the pH scale depicted. A pH of 7 is considered neutral – it is neither acidic nor basic. Pure fresh water has a neutral pH of 7. Anything below a pH of 7 is acidic – the closer to 0, the more acidic it is. Anything above 7 is basic or alkaline – the closer to 14, the more basic it is.

The pH Scale



When measuring pH, what is actually being measured to determine how acidic or basic a substance is? In a very simplified answer, it's a measure of the concentration of hydrogen (H^+) ions in a solution compared to the concentration in pure water. Acidic solutions have a higher concentration of hydrogen (H^+) ions compared to pure water (which causes a lower pH), whereas basic (alkaline) solutions have a lower concentration of hydrogen (H^+) ions (which causes a higher pH).

One way scientists can measure the pH of substances is to use *pH indicator* solutions. These pH indicators will cause a colour change when mixed with a substance that has an acidic or basic pH. The colour change is due to a chemical reaction occurring between the indicator and the tested substance.

In this experiment, you'll create and test your own pH indicator solution using a red cabbage!

Core alignment to Australian Curriculum:

Year 8

Chemical sciences

- Chemical change involves substances reacting to form new substances

Year 9

Chemical sciences

- Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer

Safety:

Not to be eaten!

- Parents/guardians, please check whether any materials are known to cause **allergies or sensitivities** in your child (via skin contact) before proceeding. Gloves can be worn for duration of experiment if you're happy for your child to proceed.
- Parent/guardian **supervision/discretion** is required for this experiment as it involves knives, hotplates and boiling liquid. Parents/guardians may also like to determine exactly **which household substances are tested** with the indicator.
- Thoroughly wash hands before and after activity.

Materials:

- ½ a red cabbage
- Knife and cutting board
- Water
- Medium sized saucepan
- Colander or strainer
- Glass measuring jug
- Empty ice cube tray or several small containers/dishes (same as the number of substances you'll test)
- Paper and pen

Possible household substances to test

Toothpaste
Soda water/soft drink
Liquid soap
Vinegar
Milk
Lemon juice
Egg white
Baking soda (sodium bicarbonate/bicarb soda)
Fruit juice
Airtight container

Procedure:

1. Roughly chop the cabbage into small pieces and put into a saucepan.
2. Add water to the saucepan so it just covers the cabbage.
3. Heat the cabbage and water on the hotplate with the lid on the saucepan. Once water starts to boil, turn the hotplate off and take the saucepan off the heat.
4. Leave the cabbage and water in the saucepan to cool (roughly 20 – 30 minutes).
5. While waiting, discuss with your **parent/guardian** which household substances (from the Materials list or other) they're happy for you to test.
6. Once you've decided which and how many substances you'll test, set out a table similar to the one on the next page in preparation to record your results. Reduce or increase the number of columns depending on how many substances you are going to test.

Results Table:

	Test substance 1 (e.g. toothpaste)	Test substance 2 (e.g. soda water)	Test substance 3 (e.g. liquid soap)	Test substance 4 (e.g. vinegar)	Test substance 5 (e.g. Milk)
Colour result					
pH result					

7. Beneath your results table, record predictions about which substance will be the strongest acid (pH closest to 0), the strongest base (pH closest to 14), the weakest acid (less than, but close to 7) and the weakest base (greater than, but close to 7). Include explanations as to why you have predicted your chosen substances.
8. Place the ice cube tray or small containers onto a sheet of paper and, on the paper, write out the names of each substance you're going to test (one beside each container/section of the ice cube tray).
9. Gather the household substances you're going to test and, for each, put a small amount into the container/ice cube tray section closest to the label for that substance. For any solids (e.g. baking soda) or thick substances like toothpaste, mix in a tiny amount of water (e.g. a few drops).
10. Once the saucepan is cool, drain the cabbage liquid through a sieve into a glass measuring jug. The cabbage pieces can be discarded. It's only the liquid you want. This liquid is your pH indicator solution.
11. Using a spoon, add approximately 2 drops of your indicator solution to each container/section of an ice cube tray containing a test substance.
12. In your results table, record what colour has resulted from the reaction between the indicator and each test substance.
13. Using the following diagram, as best as possible, record the pH of each substance tested.

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14. Once you've finished testing all substances, store the rest of your indicator solution in an airtight container that is well labelled (e.g. "Cabbage pH indicator – do not drink") and store it in the fridge. You will need it for another experiment, *Reacting Sherbet*.

15. Wash up, dry and pack away all equipment. Return tested substances to their normal storage location in your home and clean down your workspace.
16. Thoroughly wash your hands.

Reflection:

Underneath your results table (or on a fresh piece of paper), rule out and label a blank pH scale from 0 to 14. On this scale, mark and label where each of your tested substances fits in relation to their pH.

Record your answers to the following questions beneath your results table.

- Which substance tested was the strongest acid?
- Which substance tested was the strongest base?
- Which substance tested was the weakest acid?
- Which substance tested was the weakest base?
- How did these results compare to the predictions you made before testing?
- Did you get clear results for all tested substances, or were you uncertain about the pH values for any? If so, list which ones.
- Were there any sections of the procedure where error could have been introduced? Could any adjustments be made to minimise any error in your results?