Is all drinking water the same? (pH of drinking water)

Recommended for students in Grade 5 – Year 8, this activity can be adapted for a wider audience. Students observe colour changes when a pH indicator solution is added to tap water and a range of bottled waters. This activity has been inspired by a bottled water segment on ABC's War on Waste. It can be used as a short teacher demonstration or it is a low risk experiment students can conduct themselves.

Curriculum connections

Students use science inquiry skills to collect information to make choices that inform health, environmental and economic decision making.

Economics and Business

Consider the effect that the consumer and financial decisions of individuals may have on themselves, their family, the broader community and the natural, economic and business environment (VCEBC005)

Health and Physical Education

Plan and practise strategies to promote health, safety and wellbeing (VCHPEP108)

Science

Respond to and pose questions, and make predictions about familiar objects and events (VCSIS050)

Identify questions, problems and claims that can be investigated scientifically and make predictions based on scientific knowledge (VCSIS107)

Participate in guided investigations, including making observations using the senses, to explore and answer questions (VCSIS051)

In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task (VCSIS109)

Use informal measurements in the collection and recording of observations (VCSIS052)

Construct and use a range of representations including graphs, keys and models to record and summarise data from students' own investigations and secondary sources, and to represent and analyse patterns and relationships (VCSIS110)

Background notes for teachers

The pH scale describes the acidity or alkalinity (base) of a substance. The pH is the concentration of hydrogen ions in a substance. It is a reverse scale; substances with a low pH have a high concentration of hydrogen ions and high pH substances have a low concentration of ions.

	ACIDIC	NEUTRAL	BASIC/ALKALINE
Concentration of hydrogen ions	high	medium	low
pH	Less than 7	7	Greater than 7
Common substances	Lemon juice, vinegar, soft drinks, stomach acid	Purified water	Bicarbonate soda, bleach
Common properties	Taste sour* and can be corrosive	Tend to be harmless	Slippery feel, bitter taste*

* please don't taste or touch items

There are a range of pH tests used to ensure substances are fit for purpose. For example, pool and aquarium owners and gardeners conduct regular pH checks. A stable pH is important for living things and change causes stress driving biological processes to maintain the pH. The pH is easily managed with addition of certain chemicals. For example,

	TOO ACIDIC	TOO BASIC
soils	Plants get too much or too little of certain nutrients. Add lime.	Plants get too much or too little of certain nutrients. Add crushed sulphur or nitrogen fertiliser.
fish tanks	Fish become stressed. Add calcium.	Fish become stressed. Add peat.

To meet the Australian Drinking Water Guidelines, tap water is regularly tested to ensure the pH is between 6.5 and 8.5. At water treatment plants, the capacity to adjust the water pH level aids the following:

- ensure water is delivered to customers within an acceptable pH range;
- make coagulation more effective;
- make disinfection more effective; and
- reduce the corrosiveness of the water.

The pH can be adjusted by adding acidic or alkaline solutions to the water. Coliban Water currently uses caustic soda, soda ash, hydrated lime, carbon dioxide and sulphuric acid to adjust pH.

Bottled water is not subject to the same standards as tap water. Bottled water is classified as a food and must satisfy the Australian New Zealand Food Stands Code. Sparkling water has a lower pH, due to carbonation.

An indicator can be used to measure pH. An indicator is a liquid or test paper that changes colour when in contact with another substance, to give an indication of pH. Common pH indicators are: litmus paper, liquid kits, pH meter (probe) and red cabbage. Red cabbage (which is actually purple) contains a pigment called anthocyanin that changes colour depending on pH. This experiment uses red cabbage as an indicator as it is inexpensive, readily available at supermarkets, quick and easy to prepare and it is safe for use with students. If you have access to other indicators, please adapt this experiment accordingly.

Materials

- Red cabbage indicator: ½ red cabbage, boiling water, 2 large heat proof jugs, strainer, knife and chopping board
- A weak acid (lemon juice in water or lemonade) and a weak base (mix a teaspoon of bicarbonate soda with water)
- 5 drinking water samples, for example: tap water, bottled water labelled with their cost (this article suggests a range of brands and their pH), tank water.
- For each group: 6 clear cups/jars/beakers, masking tape/markers to label jars, measurement containers

A note on measurement: this experiment is fairly forgiving; approximate amounts of water and indicator will give good results. However, measurements are provided if you would like students to practice measuring liquids and keeping an experiment controlled.

The Activity

On the night before or the morning of the activity prepare some red cabbage indicator solution. Each group will need 250mL (50mL for their 5 samples) plus extra for the demonstration. Adjust the amounts below depending on your group.

Procedure: roughly chop ½ the cabbage and place in a large heat proof jug. Cover with 1 – 1.5 litres of boiling water and **leave to cool**. Strain to remove cabbage. The indicator is now ready and can be placed in cups labelled 'indicator' for groups to use. Leftover cabbage can be eaten or composted. Leftover indicator can be used to water plants.

Prepare the classroom so that group materials are in a prominent place and are easy to access and return. Student instructions and a worksheet are included below, however you may prefer to open this document on your smartboard or distribute for use on devices.

Introduce the activity by comparing and contrasting a range of sources of drinking water based on health, economic and environmental considerations. As a class or in small groups, complete a PMI chart for each sample. List the qualities we look for when choosing our drinking water (taste, cleanliness, cost, convenience). Raise acidity as a potential quality. Acids are chemicals that can break down other substances – can water be acidic? Would we expect there to be much variation in the acidity? Soft drinks are acidic, which means they can break down tooth enamel. We can test the acidity of water and other drinks. Use a known acid and base to demonstrate how to use the red cabbage indicator and pH key to determine acidity. Introduce the experiment, outlined in the procedure, below. Consider how the tested samples can be collected or reused to water plants.

After the experiment, as a class discuss the results and discussion questions. Does this new information change your water drinking habits – or those of someone you know?

Further information

https://www.youtube.com/watch?v=X5zJQtBLJqI

https://www.abc.net.au/btn/classroom/bottled-vs-tap-water/10488572

Is all drinking water the same?

Aim:

To find out the pH of a range of sources of drinking water.

Materials:

- A range of water samples (tap water, tank water, bottled water)
- 5 clear jars/cups/beakers
- Sample labels/marker
- Copies of worksheet (below)
- Indicator solution
- Measuring containers

Safety:

1. Clean up any spills promptly

Procedure:

- Set up your work space: label jars and add 100 mL of each water sample to jar.
- Add 50mL of red cabbage indicator (or follow the directions of your chosen pH kit). Swirl the water while the colour develops.
- Compare the colour of the sample to the key on the worksheet. Use your judgement to find the closest colour match and record the number in the worksheet. Repeat for all samples.
- Carefully move the samples to put them in order from most acidic to most basic. Sketch or take a photograph to add to your experiment report.
- Clean up: samples can be collected to water plants. Rinse and return your containers.

Results:

Refer to attached worksheet.

Discussion Questions:

Refer to attached worksheet.

Aim:

To find out the pH of a range of sources of drinking water.

In this experiment you will be comparing water from a range of sources to find out if they differ. Use a tally to show where your water samples have come from:

Results:

pH	pH less than 7 = acid		pH more than 7 = base			
	2	4	6	8	10	12
Colour						
	Red	Pink	Purple	Blue	Blue/green	Green/yellow
			Tap water 6.5 – 8			

Sample/Brand	pH		Draw or photograph the results here. Make sure the labels are visible.

Discussion

Tap water needs to have a pH of 6.5 – 8.5.
Which samples are outside of this range?

Acids are not good for your teeth as they can damage the tooth enamel.
Are there any samples that should be avoided or consumed rarely?

Conclusion:

I/We found that

This is interesting because