Edith Cowan University
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Kitchen pH Indicator!

Safety: This experiment involves sharp knives, hot water and household chemicals that might irritate sensitive skin. Adult supervision is needed.

Chop or finely slice a wedge of **red cabbage leaves**. If you like, break them down further by putting them into a blender with a splash of cold tap water and blending for a few seconds at a time until mushy. Put the leaves into a heatproof bowl or jug.
Boil a few cups of tap water in a kettle and **pour some over the leaves**. The more water you use, the more indicator you'll end up with but the fainter the colour will be.
Leave it to cool, then **pour through a strainer** and keep the liquid (you can compost the unwanted solids). While it cools, collect some household products to test. Some ideas:

- Liquids such as **tap water**, **white vinegar** (acetic acid or ethanoic acid), **lemon juice** (citric acid)
- Colourless soft drinks such as **lemonade, tonic water, mineral water, spring water, soda water** – try comparing brands or regular versus diet
- Solids like **bicarb soda** (sodium bicarbonate or sodium hydrogen carbonate), **tartaric acid, laundry powder, baking powder** (an acid and a base mixed together). Add 1 teaspoon to ¼ cup tap water, stir until mostly dissolved
- Different "types" of water: **tap water**, commercial **'distilled' water** (actually *deionised* water in most cases), **rain water, sea water,** water from your **garden pond** or **swimming pool**

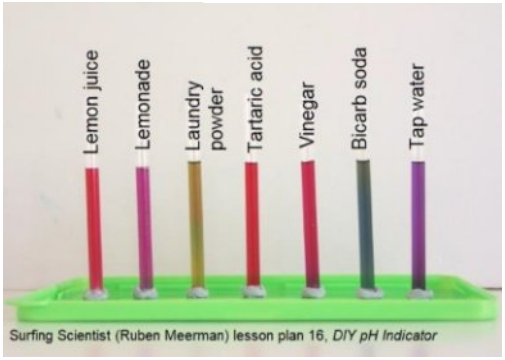
Important: avoid any products with labels saying "caustic" or "corrosive", or warnings to avoid skin/eye contact. These may contain chemicals that could burn!

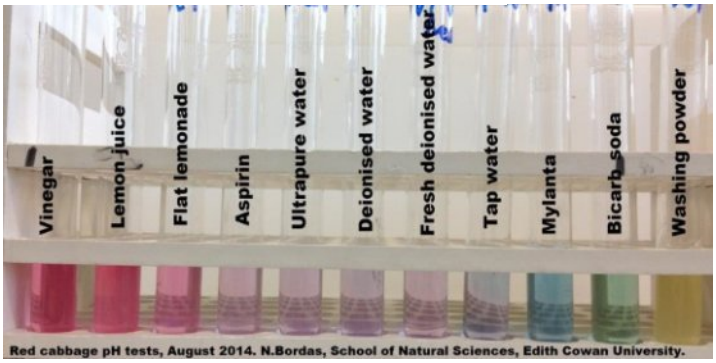
Pour some indicator into a clear plastic cup – this is your **control**. To do the tests, **pour some of each product** into separate clear plastic cups. **Add some of the indicator** and **compare** the colour to that of your control. Or see how to make your own "mini lab" using household items at: http://www.abc.net.au/science/surfingscientist/pdf/lesson_plan16.pdf

Which colours do you see? Do they look like these examples?

Red cabbage indicator pH chart

	Acid (pH less than 7)			Base (pH greater than 7)		
pH	2	4	6	8	10	12
Colour	Pink-red	Pink	Violet	Blue	Blue-green	Green-yellow





Can you add something else to **restore the original colour**? Hint: you'll need the opposite to neutralise it. If you first added an acid, try something basic and *vice versa*.
Try adding a **soluble aspirin**, **vitamin C** or **antacid tablet** to a cup of indicator. What happens to the colour as the tablet dissolves?

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A bit about pH

pH is a measure of how acidic or basic/alkaline something is. What does that mean? Here's a bit of background info.

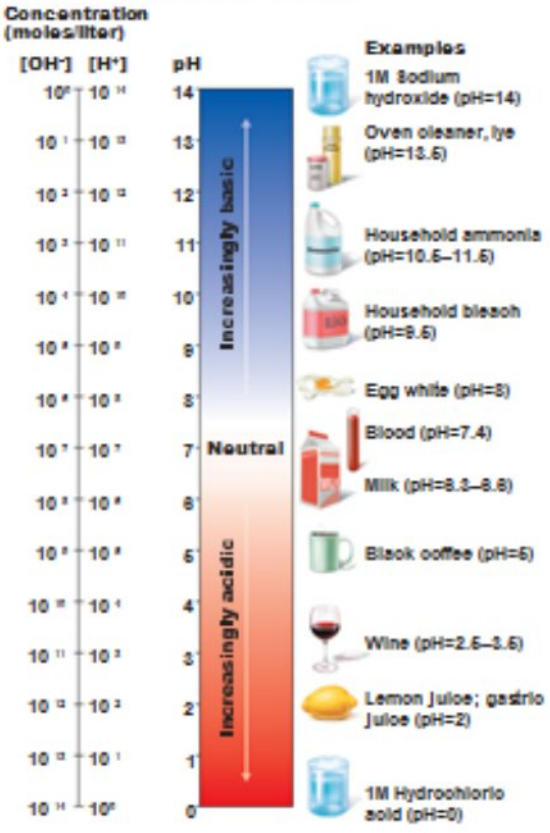
Many chemicals dissolve in water. Some of them, called **electrolytes**, dissolve by breaking into pieces called **ions** which carry positive or negative electrical charges.

One such ion is the **hydrogen ion or H^+**, sometimes called a **proton** because that's all it is – one proton all by itself. It has a positive charge and is the H in pH.

Acids are electrolytes that **release hydrogen ions** when they dissolve in water. Chemists call acids "proton donors" because they 'donate' protons in this way.

Bases are the opposite of acids – they **'accept' hydrogen ions** and chemists call them "proton acceptors". Bases release particular negative ions like hydroxide, carbonate or bicarbonate (also called hydrogen carbonate). Not all bases dissolve well in water; those that do are called **alkalis**.

Figure 2.13 The pH scale and pH values of representative substances.



Chemists measure how many hydrogen ions there are in a given amount of solution (the **concentration**) - but the numbers are small and span a huge range, so we use a logarithmic scale called the **pH scale**. Logarithmic scales increase by powers of ten, like the moment magnitude scale for measuring earthquakes.

The pH scale's midpoint is 7, which is neutral. Acids have pH values lower than 7, bases have pH values higher than 7.

pH indicators are chemicals whose molecules change shape when the pH around them changes. This shape change means they reflect or absorb light differently, which we see as a **change of colour**. Different indicators have different colour changes.

Anthocyanins are plant pigments that can be used as pH indicators. They are red/pink in acids, purple/blue in neutral solutions and blue-green/yellow-green in bases.

Found in red cabbage and many other plants, anthocyanins are also antioxidants and are being studied for possible health benefits.

Adapted from Ruben Meerman by Annette Koenders, Sharon Gough and Nardia Bordas.
References: http://www.abc.net.au/science/articles/2012/04/03/3470205.htm
Marieb, E.N. & Hoehn, K. (2007). Human Anatomy & Physiology. San Francisco, USA: Pearson Benjamin Cummings.