

The Red Cabbage Indicator



Make a liquid that changes colour as if by magic! And use it to test if a substance is an acid or a base.

You will need



Fresh red cabbage shredded or chopped into small pieces, about a cupful will do.

- Water. Although ordinary tap water will do, distilled or de-ionised water is better.
- Jug or large jar
- A sieve (or coffee filter funnel and filter paper)
- Three small glasses or clear plastic containers
- Teaspoons
- Vinegar
- Sodium Bicarbonate (also called Bicarbonate of Soda or Sodium Hydrogen Carbonate).

You will need help from an adult to cut and heat the cabbage

1 Heat about a cupful of water in a saucepan. Add the red cabbage and simmer gently for about 5-10 minutes. The water should turn a purple colour. Allow to cool for about 30 minutes

2 Strain the mixture by carefully pouring through the sieve. The purple liquid is your indicator so keep it safe in the jug. Throw away the mushy (and smelly!) cabbage.

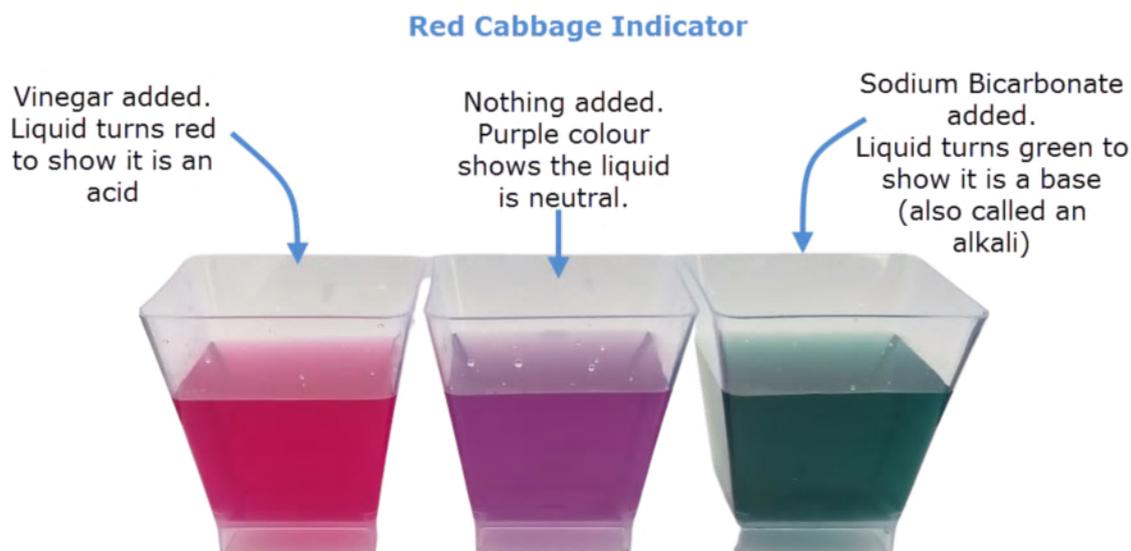
3 Pour a little of your purple indicator liquid into each glass. Then add some of the water so that each glass is about 2/3rds full.



4 Add about half a teaspoon of vinegar to one of your glasses and stir the mixture. Vinegar is an acid and it will turn the liquid red.

5 Using a clean teaspoon add about half a teaspoonful of sodium bicarbonate to a second of your three glasses and give it a stir. Sodium Bicarbonate is a base and it will turn the liquid green.

6 Do nothing to your third glass. This is your 'reference' so you know what the liquid looks like without anything added except water.



Explore some more

7 Try slowly adding drops of vinegar to the green coloured liquid (the glass to which you added the sodium bicarbonate) and stir the liquid. You should find that the liquid starts to turn purple (neutral) and then red to show it has become acidic. The colour will keep changing to show if there is more acid or more base present.

8 Using a clean glass, add some of your cabbage indicator liquid and some water and then test some other substances to see if they are an acid, a base or neither (neutral). Some things you could try are:

- Lemon juice
- Washing up liquid
- Cream of Tartar (which contains the chemical potassium tartrate)
- Washing powder or liquid for clothes washing.
- Tap water. If you live in an area where the water is 'hard' it contains minerals like chalk (calcium carbonate) which are bases and may turn the indicator blue.



Essential Science

Acids

There are lots of different acids. Some are very strong and dangerous (like the acid in a car battery) which can burn your skin and damage metal and even glass. But some acids are much weaker and we find them in the foods that we eat like citric acid in lemons, acetic acid in vinegar and even tannic acid in a cup of tea. These weak acids often have a sour or tangy taste.

Bases

Bases are substances that react with acids and neutralise them.

We find some weak bases in the things that we eat, for example sodium bicarbonate is used in baking and in some medicines for an upset stomach. They are also used in soaps and washing Powder. But some bases are very strong and dangerous, for example sodium hydroxide is used in oven cleaner and can burn your skin.

Alkali

A base that dissolves in water is known as an alkali.

Indicators

An indicator is something that will change colour depending on whether an acid or an alkali is added.

The colour in red cabbage makes a good indicator as it changes colour to red or pink when it is mixed with an acid and goes blue-green when mixed with an alkali (or base).

Taking the science further

An acid is a substance which, when dissolved in water produces positively charged particles which are hydrogen ions . The more hydrogen ions an acid produces the stronger it is.

A base is the chemical opposite of an acid. Bases produce negatively charged hydroxyl ions which are made of hydrogen and oxygen. The more hydroxyl ions a base produces the stronger it is.

When an acid and a base are mixed together in water the hydrogen ions and the hydroxyl ions quickly join together and form water. If there are the same number of hydrogen ions and hydroxyl ions then the mixture is neither acidic or alkaline – it is neutral.

What is an indicator?

Indicators are chemical compounds that will change colour depending on whether an acid or an alkali is added.

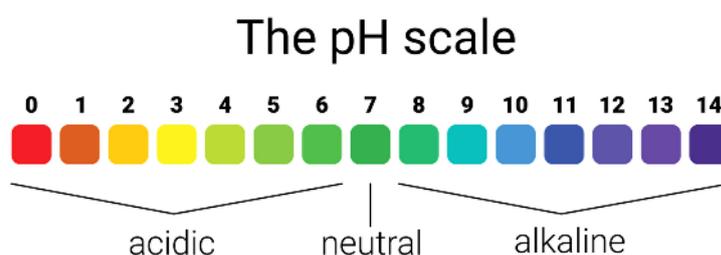
Red cabbage contains a chemical called an anthocyanin and it is the anthocyanin which changes colour depending on whether it is in an acid or an alkali.

Probably the best known indicator is Litmus which is made from lichens which are small plants that grow on walls and trees. When we use litmus we usually use it in the form of small paper strips known as litmus paper. The paper is dipped into the chemical you want to test and goes red if it is an acid and blue if it is an alkali.

What is pH

With all these acids and bases, scientists need a way to measure how strong they are and they use the pH scale to do this.

The pH scale looks a bit like a ruler and goes from 0 to 14. Something that is highly acidic has a pH of 0 and something that is highly basic (or alkaline) has a pH of 14. Pure water is neutral, meaning it is neither an acid or a base, and has a pH of 7.



Why this matters

Water is a vital part of our environment. Pure water has a pH of 7, exactly midway between acidic and alkaline. However sometimes, because of pollution in the air and in the soil, water becomes acidic because lots of chemicals are dissolved in it. This creates real problems for many of the plants and creatures that live in our streams, rivers and lakes.

Scientists and engineers are constantly checking the pH of water in our environment and carrying out work to try and make it safe for wildlife.