

# Coloured Chemistry



*Make a coloured dye and discover the underlying chemistry*

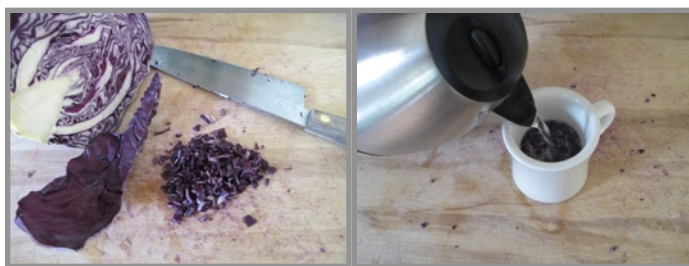
You will need:

- piece of red cabbage (included in kit)
- sharp knife and chopping board
- heat resistant small mug or bowl
- teaspoon
- white ice cube tray, or paint tray, or a white plate will suffice if you don't have these
- vinegar and baking soda (included in kit)
- other kitchen liquids and powders to test

Chop a red cabbage leaf into small pieces, and put in the mug/bowl.

Pour boiling water over the cabbage pieces.

Let the cabbage pieces soak in the hot water for half an hour or more - the longer it soaks, the darker the dye will become. Overnight will give the darkest dye.



Strain off the juice if you have a strainer, or carefully pour the juice out without the cabbage pieces.

This red cabbage juice dye can be stored in the fridge for at least a week.

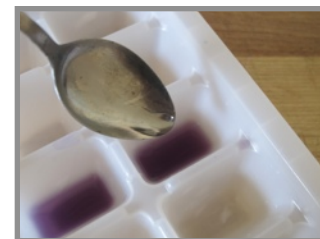
(Or you can leave it in the fridge with the cabbage pieces still in it, and the dye will get darker.)

Use the spoon to put a little red cabbage juice dye in each of a few wells of an ice cube/paint tray. If you don't have a tray, make separate puddles on a white plate (White is best for seeing dye colour.)

You will now add different substances to the different wells of the dye.

Start by adding a drop of water to the dye using this method:

Add a little water to the teaspoon then pour off the excess. The liquid that remains clinging to the spoon will be a drop - shake this off into one well of the dye.



Add a drop of vinegar to a new well of dye.

The dye will turn pink (top left in the photo).

Now add a pinch of baking soda to another well of the dye. The dye will turn blue or even green (bottom left in the photo).

Water will leave the dye purple (top right in the photo).

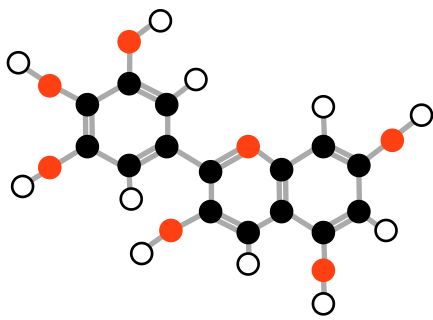
Try adding other household materials to the dye and watch for colour changes, and so find out if the materials turns the dye pink, blue or leave it purple.

## What's going on?

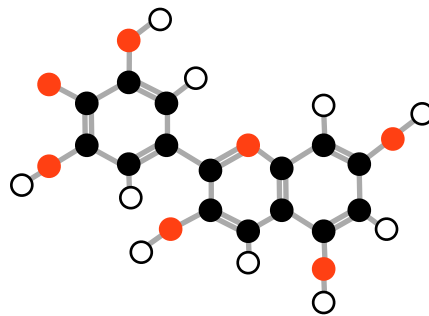
The coloured molecules in red cabbage dye are anthocyanin molecules.

(Molecules are the tiny particles that make up everything around us. They are too small to see individually, but when there are enough of them, we can see the material that they make up. Atoms are smaller particles that join together to make molecules.)

The structure of the anthocyanin molecules in red cabbage dye can take two forms:



*pink anthocyanin molecule*



*blue anthocyanin molecule*

Key:

- carbon atom
- oxygen atom
- hydrogen atom
- bond

Can you find the difference between the two forms? (hint: look at the white hydrogen atoms)

When vinegar is added to the red cabbage dye, most of the anthocyanin molecules in the dye gain a hydrogen atom (at top left of the pink molecule, if you didn't find it already!), so they are the pink form of the molecule and the dye turns pink.

This extra hydrogen comes from the vinegar, which has a lot of free hydrogen atoms in it.

Any material that has a lot of free hydrogen atoms in it is called an "acid".

Any other household materials that turned your cabbage dye pink must be acids.

When baking soda is added to the red cabbage dye, most of the anthocyanin molecules in the dye lose this same hydrogen atom, and become the blue form of the molecule. Hence they dye turns blue.

The hydrogen atom that is lost from the anthocyanin molecule combines with molecules in the baking soda. Any material that removes hydrogen atoms is called a "base".

Other household materials that turned your cabbage dye blue are bases.

Some materials e.g. water, leave the red cabbage dye purple. The water leaves some of the anthocyanin molecules in their pink form and some in their blue form. The pink and blue forms mixed together make the dye look purple.

When a material is not an acid or a base, and leave a mixture of the two forms of anthocyanin molecules, it is called "neutral" (neither acid or base).