3. REVERSIBLE COLOUR CHANGES

Flowers, fruits and vegetables can contain natural chemicals which give them their distinct colours. Sometimes, these colours change with time (when fruit ripens, for example) and by doing some simple experiments, you can investigate whether changes are due to some new pigment being made, or if some chemistry might be causing the effect.

WHAT YOU NEED

- [ ] A couple of tablespoons of grated beetroot, shredded red cabbage or coloured flowers (reds and purples work best)
- [ ] Mortar and pestle for grinding the vegetable material (optional)
- [ ] Test tube, or other small, clear reaction container
- [ ] 10mL white vinegar (which contains 0.8M acetic acid) with dropper
- [ ] 10mL sodium carbonate solution (0.5M) with dropper

WHAT TO DO

1. Grind or mash the coloured vegetable matter of your choice with a few mL of water to extract the coloured juices.
2. Pour the coloured liquid that results into your reaction container (try to avoid the chunky bits).
3. Add the vinegar a drop at a time, stirring between each addition – you should see the colour change, and then stop changing.
4. Now add the sodium carbonate solution – it will take more drops this time, but the colour should first change back to the original, and then change again as you add more.
5. You can keep alternating adding the two solutions, and the colour will keep changing back and forth.

WHAT IS HAPPENING?

White light (including sunlight) is made up of a mixture of all the colours of the rainbow. A pigment looks coloured because it absorbs only some of the colours present in white light and reflects the others (something that looks red absorbs all the blue light, for example, and reflects the red light into our eyes).

The colour of light which is absorbed by a chemical compound (such as a pigment) is determined by the chemical structure of the pigment molecule, and this structure can change slightly depending on how acidic the surrounding environment is. When you add vinegar, you increase the surrounding acidity, and sodium carbonate has the opposite effect (sodium bicarbonate does the same). Chemists measure acidity on the pH scale, and refer to the opposite of an acid as a base (or an alkali, if it is very soluble).

The effect of dilute acids on pigment molecules is usually reversible, which is why you can keep on changing the colour back and forth.

Now you know what colour your pigment is in different environments, you can use it to test other things from around the home – try toothpaste, lemon juice, soda water or kitchen cleaners (it helps if what you test is a liquid, and preferably not coloured). Is there a pattern?