Chemistry with Cabbage

Try these experiments at home

In the Chemistry with Cabbage workshop you saw how much fun you could have experimenting with the chemicals that you have in your kitchen.

This booklet shows you how to do experiments at home.

Show your parents what you are doing. They will be amazed how much chemistry you know.

Equipment

Do your experiments in old yoghurt pots, jam jars or bottle tops. Don't use cups or glasses in case someone thinks it's a drink.

You can make pipettes from drinking straws cut into pieces about 10 cms long. To avoid contamination use a new straw for each chemical or wash it in between.

If you want to buy special equipment, the most useful things are:

- A small plastic artist palette, from an art or craft shop, will make a good spot-test kit.

- Chemists sell small glass bottles with droppers.

Chemicals

You can do all these experiments with household chemicals. There is no need to buy special chemicals or a chemistry set. The only chemical that you may not have at home is bicarbonate of soda. You can buy small cartons of this at the supermarket, chemists sell larger boxes.

Only use chemicals that you know your parents would be happy for you to eat or to clean with. DON'T experiment with bleach, oven cleaner or chemicals in the garage or shed.

When you have finished your experiments, throw the chemicals away. Don't eat anything that you have been experimenting with.

Keep your science equipment away from food and drink.

Wash your hands when you've finished.

Make an indicator

Purple plants like red cabbage have a dye in them which turns red in acids and green in alkalis.

To get the juice out, you need to break the cell walls of the cabbage. You can do this by boiling the cabbage in water, or by breaking the cells on a rough surface.

Boil the cabbage (ask your parents to help)

Put a piece of red cabbage leaf into a pyrex jug. Add cold water to cover the cabbage and boil it in the microwave for about 5 minutes. Alternatively put it in a saucepan and boil on the cooker for 5 minutes.

Add cold water to cool the liquid before you use it.

Or break the cells on a rough surface

Rub a small piece of red cabbage on something rough like a nail file, an emery board (ask first!), a piece of sandpaper or a grater. Alternatively you could cut it very finely, or pound it with something gritty like sand in a pestle and mortar. Then put the bits of cabbage and juice into cold water.

This indicator doesn't keep. Throw it away at the end of the day.

Test some household chemicals
only use things you know are safe to touch

Colourless chemicals are best as the colour change is obvious.

Many of the things that we eat are weak acids. Vinegar, fruit juices, sauces, sour sweets, fizzy drinks, TCP, vitamin C are likely to be acid. If you haven't got distilled (white) vinegar at home you may have onions or gherkins pickled in vinegar. Ask your mum if you can pour a bit off.

Cleaning products are usually alkali. Try washing up liquid, washing powder, washing soda, soap, bath salts, bath bombs, bicarbonate of soda, indigestion remedies. Only use cleaning things that you know your parents are happy for you to handle.

Water is neutral, so is sugar dissolved in water.
Salt is neutral, but manufacturers put chemicals in table salt to stop it clumping together and these make it alkali.

Test your chemicals by putting a little of your indicator into a jar or lid and adding the chemical.

Acids turn red cabbage juice red
Neutrals stay the same colour
Alkalis turn red cabbage juice green.

It's a good idea to keep some of your original indicator as a 'control' to compare your experiments with.

Do a neutralisation

An acid is the opposite of an alkali.
So if you add an acid to an alkali you get neutral.

When you've found an acid and an alkali, add some indicator to one of them and neutralise it with the other. When your indicator goes back to the original blue/purple colour you have neutralised it. Compare it with your original indicator as a 'control'.

Both acids and alkalis are corrosive and neutralisation is used to make them safe. A wasp sting hurts because wasps inject an alkali. Vinegar, an acid, neutralises the sting and makes it less painful. Bees inject an acid with their sting, so you need an alkali such as bicarbonate of soda to make a bee sting better.

Test the strength of different acids and alkalis

When you have found several acids or alkalis, you can use neutralisation to find out which is strongest.

For example to test whether lemon or orange juice is the stronger acid, put the same amount of soap solution into two small jars. Add the same amount of indicator to each. Then add drops of lemon juice to one jar and count how many drops are needed to neutralise it. In the second jar add orange juice and count the drops to get to the same neutral colour. If you found for example that ten drops of orange juice were needed, but only five drops of lemon juice then lemon is twice as strong an acid.

Acids have some interesting properties.

Denaturing protein

Proteins are long molecules which fold themselves up into a ball. Acids will denature the protein, so that it unrolls into long strands. This is what happens when milk curdles.

Add some milk to acids, neutrals and alkalis. It will denature (curdle) only in the acids. Denaturing is the first stage in digesting protein and one of the reasons why you have acid in your stomach.

Clean a coin in acid

Copper coins like a 2p piece will go shiny in any acid. Put a coin into a jam jar and cover it with an acid such as vinegar. Leave it for an hour.

If you want a good way to see how much it has cleaned it, stick a small piece of label onto the coin. The acid can't attack the bit under the label so that area will stay dull and show the difference very clearly.

Sticky tape doesn't work because it comes off when it gets wet.

Reaction with sodium bicarbonate

Put some acid in a jar with a little red cabbage indicator. Then add a teaspoonful of sodium bicarbonate. You will see fizzing and the red acid will turn purple.

The sodium bicarbonate is an alkali, so it neutralises the acid. The reaction produces carbon dioxide gas which is why it fizzes and bubbles.

Sodium bicarbonate makes cakes rise because it gives off carbon dioxide when you mix it in. The bubbles of gas expand in the hot oven, making the mixture rise. You can see the holes left by the bubbles of carbon dioxide when you cut a cake.

Bicarbonate of soda makes indigestion (heartburn) better because it neutralises the excess acid in the stomach. It has the side effect of causing burping because of the gas given off.

You can make a volcano effect by adding some red food colouring and doing the reaction under a cone shape so that the liquid bubbles out looking like lava. Whenever you do this reaction, be sure to leave a hole for the gas to escape.

Make a fire extinguisher

The carbon dioxide that you make when you add an acid to bicarbonate of soda will put out a flame. Fire needs oxygen to burn. Carbon dioxide is heavier than oxygen, so if you pour it onto a flame it pushes all the oxygen out of the way and the flame goes out.

You need to do this in a jug with a spout so that you can direct the carbon dioxide at the flame. Put a spoonful of bicarbonate of soda in the jug and add some vinegar. Leave the jug still until the fizzing stops. Carbon dioxide is heavier than the other gases in air, so it will stay in the jug.

Put a small candle or nightlight on a plate and light it. Gently pour the gas in the jug onto the flame. (You need to do this carefully so as not to pour the vinegar out as well) The flame will go out as if by magic because you can’t see the carbon dioxide gas.

Dissolving things

You are used to water dissolving things, so it no longer surprises you that you can't see sugar when it's dissolved in water. The sugar has been broken down into individual molecules which are much too small to see. Molecules are unbelievably small. A mug of water contains approximately 8,300,000,000,000,000,000,000,000 molecules of water.

Dissolving is very impressive when you see it for the first time. Try dissolving polystyrene in nail varnish remover. Ask your parents for some expanded polystyrene, they might have a cup or often it's used as packaging round things like computers. Put the polystyrene on an old plate or saucer and pour on some nail varnish remover.

Nail varnish remover is acetone, but manufacturers put conditioners into it to make it kinder to your nails. Boots' nail varnish works, some other makes don't.

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