Kitchen chemistry (KS 2)

SUPPORT NOTES

Find out how to be really messy in the kitchen and discover some science at the same time – play with slime; learn how to explode bags with household chemicals; and keep your eyes on that lemonade!

(developed as a Science Live lecture for the *Royal Dublin Society*)

Purpose of these notes

These notes are intended to provide teachers with a brief overview of the main demonstrations and concepts presented in the show, and to suggest some topics for discussion or follow-up after the show. We also hope that the show will encourage teachers to integrate some of the ideas and techniques that they find useful into their own teaching. If you would like any more information about any of these topics please get in touch with us.

safety information
Although each demonstration presented in the show only involves everyday equipment, each activity has been subject to the normal risk assessments. It is important to emphasise that if any of the demonstrations are to be used or adapted for classrooms they should, of course, be thoroughly assessed by each teacher in advance. *Pupils repeating the experiments at home should be encouraged to involve their parents or carers for reasons of both safety and education.*

Format of the show

This interactive demonstration show aims to reveal the exciting "hidden chemistry" that is all around us – especially in the food and equipment that we find in our kitchens.

The intention is to present science in a way that will enthuse the audience and perhaps make them *think differently* about some of their attitudes towards science. It presents science as a way of asking questions about how our world works and then using simple experiments to test out our ideas.

Most of the demonstrations use everyday equipment. The educational philosophy behind the show is a move from showing the familiar (everyday equipment or relevant applications) to the unfamiliar (the underlying science concepts). The familiarity and simplicity of the equipment involved in our shows has several advantages:

- the easy availability of the equipment will hopefully encourage pupils to try to repeat these activities safely in class with their teachers or at home with their families;

- the pupils are less likely to be distracted by the strange or unusual equipment sometimes used in science experiments;
- the familiarity of the objects will help pupils to immediately connect the science concepts discussed with their everyday lives and to see that they use "science" in many places outside school;
- the simplicity of the equipment may help to give teachers the confidence to search for other engaging science activities using equipment from around the home.

A selection of the demonstrations outlined below will be used in the show. The exact activities used in each show will depend on the length of the show, the performing conditions, the age and background of the audience, and any particular topics requested by the teachers.

Curriculum connections

Our shows are designed to support and enrich the science strand of the revised NI curriculum learning area *The World Around Us* for Key Stage 2. The topics covered in the show are concerned with the "change over time" theme.

Density and dissolving

key ideas:

- if an object has more weight than the same volume of water it will sink in water (we say it is more dense than water – more weight for its size);
- if the object has less weight that the same volume of water it will float in water (it is less dense);
- the chemical sweeteners that are added to our food and drink in place of sugar are very strong;
- the "scientific method" – make an hypothesis; devise an experiment; carry out the experiment (many times); observe and record; interpret your results; conclude if your prediction agreed with what happened;
- some liquids mix together (we say they are soluble in each other), and other liquids do not mix but separate into different layers (they are not soluble in each other).

coke can puzzle

We often make a prediction (or hypothesis) in science before we do the experiment so that we can check if we understand how things work correctly. If the experiment doesn't produce the result we expected, then after many repetitions to make sure we carried it out properly, we know that we need to change the way we think about what was happening in the experiment. It doesn't mean that "the experiment didn't work".

Asking pupils at this age whether cans of fizzy drinks will float or sink in water will usually create a spilt in the audience. Both cans are same volume, but one must be heavier than the other, since one sinks and the other floats. The diet drink has artificial sweeteners like aspartame in it in place of sugar. Because the sweeteners are so strong (up to 200 times sweeter than sugar), you need much less of them than the amount of sugar normally added to fizzy drinks. This means that the diet drink can is lighter than the same size of ordinary drink can – we say that the diet can is "lighter for its size" or "less dense" – so it floats in the water.

Adding sugar to the diet can side of the balance until it equals the weight of the sugared can demonstrates visibly just how much sugar is dissolved inside each can of fizzy drink.

"do as I do" game

Although the volunteer followed the presenter's instructions exactly, the result of mixing his/her liquids was very different to that from mixing the presenter's liquids. The presenter was simply using water with three different food colourings added, so they all mixed together. The volunteer, however, was using coloured water, vegetable oil, and lamp oil. The water and vegetable oil are not soluble in each other and the lamp oil and vegetable oil are also insoluble. The water is heaviest for its size (the most dense) so it forms a layer at the bottom of the cylinder, with the next heaviest liquid sitting on top (the vegetable oil), and the least dense liquid rests on top of both (the lamp oil).

acids and bases

key ideas:

- some substances are classified by scientists as either an acid or a base – they are chemically opposite to each other;
- acids usually taste sour and have a strong smell eg vinegar and lemon juice. Some acids, however, are very powerful and they can eat away at substances (like the acid inside car batteries).
- bases usually taste bitter and have a soapy feel. Bases that dissolve in water are called alkalis. Some bases are very powerful and must be used very carefully eg bleach. Other bases are weaker eg bicarbonate of soda used in cooking.
- an indicator is a substance that changes colour when in comes in contact with an acid or a base.

painless blood testing

The colourless liquid sprayed over the presenter's hand is actually dilute household ammonia (used as a cleaning agent). The goldenrod paper is an indicator – it turns red when in comes into contact with a base. The alkali ammonia from the presenter's hand therefore creates dramatic 'blood red' splatters over the paper. If an acid (like vinegar) is sprayed on top of the ammonia on the paper, it can cancel out the effect of the ammonia and turn the paper yellow again – this is called neutralisation.

colour changing cylinder

The liquid in the cylinder has an indicator dissolved in it. Adding milk of magnesia (a base) and then vinegar (an acid) means the indicator will go through a series of beautiful colour changes.

liquids and solids

key ideas:

- materials that we call liquids usually change shape when we give them a push or pull; they also take the shape of their container eg water, milk;
- materials that we call solids do not change shape when we push or pull them eg frozen ice cream, a chair;
- changing a solid into a liquid (i.e. melting) is an example of a physical change – it can usually be reversed;
- some materials fall in between solids and liquids – sometimes they behave like a solid and at other times they seem to be a liquid eg the cornflour slime;
- sometimes when you mix two liquids they react together in a chemical reaction to make a new substance.

cornflour slime!

The cornflour and water mixture is a very unusual substance. You can stir it, poke it, punch it, squeeze it and throw it – as long as you do each of these things quickly the slime will stay solid. The water allows the cornflour grains to flow and move if you do anything to the cornflour slowly. If you push or pull the cornflour mixture quickly, however, the water does not have time to move to let the cornflour grains flow, and the substance turns solid immediately.

gases

key ideas:

- gases take up more space than liquids or solids – they spread out to try to fill all of the container they are in;
- carbon dioxide is a gas that is heavier than air (more dense than air) so it sinks in air;
- any fire needs heat, fuel and oxygen to burn;
- vitamin tablets fizz when they react with water and start to dissolve – they give off bubbles of a gas;
- if you try to contain the gas as it is produced the pressure inside the container will increase (the molecules of the gas keep bouncing off the sides of the container faster and faster), until the lid explodes with great force;

- to have a 'fair test' in an investigation you have to keep all the factors that might affect the investigation the same except for the factor you are testing.

carbon dioxide extinguisher

The baking soda and vinegar react together to give lots of bubbles of carbon dioxide gas. This gas is invisible and because it is denser than air the carbon dioxide sits at the bottom of the bottle. The candle flame needs three things to burn – heat, fuel and oxygen. As the candle is lowered deeper in the bottle it has less oxygen around it and more carbon dioxide, until there is no oxygen at all, and the flame goes out. Carbon dioxide is used inside some fire extinguishers – it smothers the fire by preventing oxygen getting to it.

the exploding bag!

The baking soda and vinegar react as before to give of carbon dioxide gas. The gas takes up more space than the liquid and solid used to make it, and this time because the gas is contained the bag slowly expands until it bursts open along the sealed top of the bag.

film can rocket

When vitamin C tablets are dropped in water they start to dissolve and lots of bubbles of carbon dioxide gas are given off. As this gas is given off from the vitamin tablet inside the film can, it starts to push harder and harder against the sides and top of the can. This is like shaking a can of coke. When this pressure gets too much for the lid to contain, the film can will explode up into the air at great speed as the gas rushes out. The gas moving out in one direction creates an opposite force on the can, pushing it upwards – just like a space rocket. How could you change the experiment so that the cans explode faster?

burning

key ideas:

- any fire needs heat, fuel and oxygen to burn;
- gases take up more space than liquids or solids – they spread out to try to fill all of the container they are in;
- when gases are heated they spread out even more;
- sometimes substances that look safe can catch fire very explosively if you do not treat them correctly.

the exploding can

The finer the grains of any powder the more surface area there is to react with the oxygen in the air when some heat is added. This has led to many explosions in factories where fine dust or powder are used eg grain factories. Blowing the fine cornflour powder over the candle flame in the sealed tin causes the chemical burning reaction (called combustion) with the cornflour to happen more quickly. A lot of heat is generated which causes the air in the can to expand quickly and a gas is produced as the powder burns. Both these changes build up the pressure of the gases inside the can until the lid explodes off.

As explained during the show, **this is the one demonstration that pupils should not try at home.**

fountain of fizz finale

key ideas

- fizzy drinks have a gas dissolved inside them;
- shaking the lemonade bottle causes the gas to come out of solution in the form of lots of bubbles;
- the holes on the surfaces of some sweets encourage bubbles to form very quickly in lemonade;
- the pop-up sports bottle top will only open when the pressure inside the bottle has built up enough;
- the narrow opening in the bottle top means the fountain of lemonade will be higher when it "explodes".

lemonade fountain
Sweets like *Refreshers* fizz when we suck them. When these sweets are added to lemonade they encourage the carbon dioxide dissolved inside the liquid to come of solution very quickly – they fizz producing lots of bubbles. This gas pressure builds up inside the bottle until it forces the pop-up top to open and a spectacular fountain of lemonade is forced out.

follow-up ideas

There are lots of simple kitchen science experiments to try. Most science experiment books for children contain at least a couple. Some useful books devoted to "science cookery" activities are:

- "Kitchen science", Christopher Maynard (Dorling Kindersley);
- "Science magic in the kitchen", Richard Robinson (OUP);
- "Science experiments you can eat", Vicki Cobb (Harper Trophy);
- "Pure slime, Brian Rohrig, www.fizzbangscience.com
- "150 captivating chemistry experiments using household substances", Brian Rohrig, www.fizzbangscience.com

Here are some activities you might like to try with your pupils after the show:

- experiment with different fruits to discover which sink and which ones float in water – try to make a prediction for each fruit before you try it.
- create your own density column with safe liquids from around the home – how many different layers can you make? You can drop small objects into the column to find out at which layer they float.
- make an indicator by boiling shredded red cabbage leaves in a saucepan to create a juice that changes colour in acids and bases of different strengths – can you find colourless liquids around the kitchen that are acids or bases?
- play with cornflour slime – you have to feel this substance yourself to appreciate how amazing it really is. You can even add some food colouring if you wish
- repeat the vitamin C film can experiment - ask the pupils to list as many factors as possible that might change the time it takes the can to explode (size of tablet; amount of water; shaking the can; temperature of the water). Help them to devise a simple investigation to test if each factor speeds up, or slows down the reaction, or has no effect. It is important to supervise this activity carefully so that the explosions only happen under your control - the flying can/lid could cause a serious eye injury if a pupil was looking directly over it when it explodes. If any cans do not explode be careful when you "disarm" them.
- fountain of fizz demonstration - If you're feeling adventurous you could help the pupils to experiment with different brands of lemonade and sweets to see which produce the highest or longest running fountains. Best done outdoors wearing a raincoat! If your pupils would like to see this demonstrations done in a much bigger and more beautiful way, you can show them 100 coke bottle fountains going off to music at: www.eepybird.com - it's well worth watching.