

WOW Science Experiments Workshop

This is a rather long list of "fun" things to do with a science class. Some of them you may never use but others you may see the potential and include them in your practical work. Experience tells me if one teacher is successful with something practical they will tell others to have a go.

Experiments to WOW a class

- 1) tornado in a bottle — this is a cheap fitting that goes onto two soft drink bottles.
- 2) coloured tornado — use large beaker, on a magnetic stirrer with a mid sized stir bar. Fill a 1 L beaker $\frac{3}{4}$ full of water, add universal indicator to give a strong colour and turn on stirrer until a tornado forms in the beaker. Adjust the colour with 0.1 mol L^{-1} alkali or 0.1 mol L^{-1} acid. Should be able to get all rainbow colours. Great starter for "acids and bases" or open day "hands on".
- 3) blue bottle — In a 500 mL clear bottle (preferable with a screw cap) place the 2 solutions. The first solution = 10 g NaOH dissolved in 125 mL tap water, 2nd solution = 10 g glucose dissolved in 125 mL of tap water. Add 2 — 3 drops of methylene blue, shake well and allow to stand until colour fades. Shake bottle and it turns blue, let it stand and the colour fades. Methylene blue shows the presence of O_2 in the liquid i.e. shaking the bottle dissolves oxygen in the liquid, and it diffuses out on standing. Good equilibrium demo
- 4) Pink /purple bottle use same chemicals as above but add a trace of safranin. Bottle turns pink then purple. Safranin is more sensitive to oxygen than the methylene blue so you get a double colour change.
- 5) rainbow tube — pour 2 cm of 1 mol L^{-1} sulfuric acid into a large measuring cylinder (or similar) I like the 2 L. Add tap water to fill cylinder within 7 cm of top. Add enough Universal Indicator to give a strong colour. Stir or invert the cylinder (with your hand over the end) to mix colour through. Drop in about 1 tablespoon of washing soda crystals ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$). Stir or invert cylinder and watch rainbow form. If the rainbow is not convincing stir again. If too purple add more acid gently on top. Can use HCl but watch the fizzing.
- 6) Swirling colours -into a dish of milk, carefully place in a few drops of food colouring -2 different colours is fun. Add a drop of detergent to the centre of the dish and watch.
- 7) Oobleck — mix equal amounts of maize cornflour and water (measured with a spoon) (wheaten cornflour doesn't work). Stir gently with popsicle stick, pick up roll in a ball, let rest on hand and it will run off. Explanation — corn starch does not dissolve in water. When you press it the water is squeezed out from between the particle and it appears to be a solid, release the pressure and the water causes the starch to flow. Is it a solid or liquid?
- 8) PVA slime — add 10 mL of water to 10 mL of PVA glue. Add 1 drop food colour if desired. Mix well then add 5 mL of 6% sodium tetraborate solution

WOW Science Experiments Workshop

- (borax). Lift out resulting slime. Roll it, bounce it, stretch it, let it flow, and when you place it back in a container it takes on the shape of the container—is it a solid or a liquid? Also fits in Polymers
- 9) rockets I (acid and base) — use film canisters, put a small amount of baking soda in a square of tissue and wrap into a tight parcel. Place in bottom of canister, add a little vinegar and place the lid on the canister. Set the canister so it is not pointing at anyone (upwards is good, but not toward light fittings or sprinklers) The lid will blow when the bicarbonate and vinegar react.
 - 10) rockets II (dry ice) — place a small piece of dry ice in a film canister. Add a few drops of water and place the lid on the canister. Above warnings apply
 - 11) Cold boiling water -add a piece of dry ice to a beaker of water - the water appears to boil, and smoke.
 - 12) Put a piece of dry ice into a balloon (which you have previously blown up and let down a couple of times) and tie a knot in the balloon. As the dry ice sublimates the balloon will inflate.
 - 13) Boiling colour change. Add Universal indicator to the beaker of water and dry ice. When the colour changes red add some 1 mol L^{-1} NaOH until it goes purple again, and watch as it changes again through the colour range.
 - 14) ammonia fountain — use a long neck round bottom flask (Pyrex) fitted with a 2-hole bung. One side of the bung has a long thin glass tube which extends about 4 cm above top of the bung, the other side contains a dropper, which is filled with water. Also needed is a pneumatic trough (or similar) $\frac{1}{4}$ filled with water plus 2-3 drops of phenolphthalein. Place about 5 mL concentrated ammonia in the flask and heat to vaporize. Insert bung and invert over trough with end of tube under water. If the fountain does not spout immediately prime with a quick squeeze of the dropper. Ammonia is extremely soluble in water and thus rapidly dissolves causing the pressure in the flask to fall. This sucks water from the trough into the flask, and the colour changes due to the ammonia
 - 15) magic colours — use a cotton bud dipped in a solution of ammonium thiocyanate to write a word on newsprint type paper. Add another word written with potassium ferrocyanate. Allow to dry. To reveal the colours spray with FeCl_3 solution (note FeCl_3 is corrosive, but using a 0.1 mol L^{-1} strength solution is safe enough, however wearing safety glasses is advised)
 - 16) silver growing (1) — under the dissecting microscope place a petri dish of silver nitrate (0.1 mol L^{-1}) drop in a small piece of copper wire. Observe the beautiful crystals of silver, and the blue tint within the petri dish. (Great if you have a video flex or camera to project to TV screen)
 - 17) silver growing (2)— into a 100 mL beaker containing 50 mL of 0.1 mol L^{-1} AgNO_3 suspend a copper shape. Observe the silver being deposited. (It is possible to recover all the silver for future use as quantity and strength are not vital)
 - 18) Mix equal quantities of 0.1 mol L^{-1} KI and 0.1 mol L^{-1} $\text{Pb}(\text{NO}_3)_2$. Colour change colourless to showy yellow. Great demo for Year 9 to show they should never assume a colourless liquid in a beaker is water especially if you start with the 2 solutions in small beakers ie don't initially let the students see the

WOW Science Experiments Workshop

reagent bottles.

- 19) spontaneous SOLID chemical reaction. Place some KI(solid) in a test tube, gently add some Lead nitrate (solid). Mix the 2 white crystals with several sharp taps on the test tube - the crystals change yellow as the compounds spontaneously react.
- 20) large crystals of PbI_2 - these are lovely glittery crystals. Use yellow substance from demo 18 or 19 add 2-3 times the amount of water then heat to boiling. Allow to cool. The PbI_2 will recrystallize into large flat glittery crystals.
- 21) Purple Fire. Place about 1 teaspoon $KMnO_4$ (solid) on an upturned metal tray or the base of a retort stand (reaction gives off lots of heat so DO NOT do it direct on the bench). Drizzle over 1-2 mL ethylene glycol and stand back. Initially reaction will smoke then burst into flame. Residue is HOT! **Warning** it is not advisable to tell the student exactly what chemicals you mixed for this demo, as both are readily available and we don't want to encourage arson attacks.
- 22) "Ejaculation" tube. The name was given to the experiment by past colleagues! ($MnO_2 + H_2O_2 +$ detergent) — a catalyst demonstration given a memorable name. Add a few drops of detergent to H_2O_2 and MnO_2 in a measuring cylinder. The detergent helps the reaction to "ejaculate" from the cylinder.
- 23) electrolysis of water with 2 pencils, a couple of bits of wire and a battery — a fun activity for junior classes. Sharpen 2 pencils at both ends, connect a battery to one end of each of the pencils, and insert the other ends into a glass of water. A few grains of salt may need to be added to start the reaction. Observation will show bubble coming off the pencil tips, one faster than the other. It is possible to trap the bubbles into an inverted, water filled, test tube if you wish. Most batteries will work but a 9 V plus battery clip is probably the easiest. Don't forget your Hoffman voltameter if you have one -show it as the "real" thing.
- 24) $Ba(OH)_2 + NH_4SCN$ or NH_4NO_3 — a very graphic endothermic reaction. Stir together 32 g of $Ba(OH)_2$ with 16 g of NH_4SCN or NH_4NO_3 . Sit the beaker on a wet piece of board. Continue stirring (do not add water). The beaker will get so cold the water on the board will freeze and they **will** stick together. Explanation (include important chemical reaction):- The reaction is as follows:
$$Ba(OH)_2 \cdot 8H_2O + NH_4SCN \longrightarrow Ba(SCN)_2 + NH_3 + 10 H_2O$$

The large increase in the entropy of the system (495J/molK) is a result of the large number of molecules present in the sum of the products. This increase in entropy overcomes the endothermicity (102.2 kJ) of the system, so the reaction is spontaneous. The endothermicity of the reaction takes thermal energy away from its surroundings, so much so that the water around the beaker will freeze as a result.
- 25) The magic drink: (Kiwi Integrated Science Series 3 Book 1) — you may have tried this and written it off because it doesn't work — there is an error in some of the teacher's guides. Solution 2 should be sodium sulfite. The 5 beakers (plastic tumblers?) should contain (in this order):
1. acidified potassium permanganate (wine), 2. sodium sulfite solution (water), 3. silver nitrate solution (milk), 4. concentrated ammonia solution

WOW Science Experiments Workshop

- (lemonade?? – water), 5. phenolphthalein solution (raspberry).
- 26) collapsing coke can — boil about 1 cm of water in an empty coke can. Once boiling quickly invert the can into a trough of cold water. The hot water vapour rapidly cools and air pressure on the outside of the can causes the can to collapse with a bang.
 - 27) paper beaker and candle — make a paper cup, fill it with water and set it over a candle. Expectation is that the paper will burn through and the candle will be extinguished. What actually happens is the water gets hot and the paper cup stays whole. The heat is transferred to the water and as long as there is water in the cup it will not burn. It is possible to boil the water.
 - 28) magnet in tube (eddy currents) — you need an aluminium tube (I used an old mop handle) and a very powerful cylinder magnet (I use 2 Crescendo neodimium magnets together). Make up a similar sized cylinder from lead, wood, what ever. Drop the made up cylinder through the tube and it falls straight out. Drop in the magnet and it hangs around in the tube for some time. Eddy currents are the explanation for these phenomena but it isn't always necessary to explain fully especially to juniors.
 - 29) Revolutions — purchase this "toy" from a supply company. - Magnets / perpetual motion / engines?
 - 30) whirling pipe — we have this in our energy circus — mine was purchased from the \$2 store but they are available from a supply company.
 - 31) giggle stick — another for the energy circus purchase form \$2 store
 - 32) whizmo wheel on rack - \$2 store — lots of physics in this toy. Some years ago my daughter had one, which had a light in the wheel and a music box in the handle. It played music and the light lit up when the wheel was on the track.
 - 33) yoyo- another toy with lots of physics — try the \$2 shop
 - 34) dynamo / hand operated torch — have spotted these in the Warehouse for \$9.95, but the clear view ones come for a supply company.
 - 35) mirage — check with the supply companies — useful for light or just as a fun demo. I found one, called Illusion disk in a Devonport (Auckland) shop called "House of Toys" \$14 -its smaller than the ones the supply companies have but will do the trick, and about 1/6 the price.
 - 36) major magnet /paper clip — to prove magnetic fields pass through paper etc. —Tie a paper clip onto a piece of cotton and fasten it to the desk with a piece of BlueTac. Mount the major magnet or other very strong magnet in a clamp stand about 3 cm above the height of the paper clip when held up from the desk. Adjust to maximise the gap between the paper clip and the magnet but still having the attraction strong enough to hold when a sheet of paper is held between the two.
 - 37) Doppler effect: Mount a electronic buzzer on the base of a grey film canister and push the wires to the inside. Use a cork borer to make 2 holes in cap (to fit contacts of 9V battery. Put battery clip on outside of cap (becomes the switch), push wires through and wire the buzzer to the battery clip. Place a 9V battery in film canister, put on cap (making sure battery contacts stick out holes). Push a strong cord through the film canister about 1 cm from bottom

WOW Science Experiments Workshop

and out the other side. Join the cord in a loop about 1 metre long (ie use 2 metres of cord). Clip on battery contact and swing overhead parallel to ground. Observing student will hear the Doppler effect. Disconnect battery clip to kill the noise.

- 38) TITANIUM DIOXIDE — type the words titanium dioxide in CAPITALS and if possible each word in a different colour. View the words through a perspex rod or a test tube filled with water. Titanium will appear back to front, dioxide the right way round. Why? Is it the colour? No, it is to do with the fact that the letters in dioxide are symmetrical along their horizontal line and titanium is not. Note not all fonts will produce this effect — a quick way to check is view the print from the back of the sheet of paper held to the light. If dioxide looks OK then you will be right, if not try another font. (Both Arial and Times New Roman work on my Mac computer)
- 39) Make the world's simplest motor - a block of wood, 2 paperclips, a small coil of wire, a magnet, and a battery and holder. Make sure the wire for the coil is insulated, but strip off the 2 straight ends. Instructions for this "toy" can be found at <http://fly.hiwaay.net/~palmer/motor.html> (it's not quite the same as mine).
- 40) lighting the Bunsen with the van der Graff. You need a brave student or teacher for this. Have person stand on a polystyrene block, and place one hand on the van der Graff. Point a finger towards an earthed Bunsen which another person turns on at the right moment. (suggest you "pre heat" the Bunsen by lighting it with a match and allowing it to burn for a minute or so before you start the attempt). The spark jumps from the pointed finger to the Bunsen tube and causes the gas to light.
- 41) Place 5- 6 inverted pie plates on the van der Graff — turn it on and watch as they fly off one after another
- 42) Balance a plastic container hold 8 -10 pieces of polystyrene packaging material on the top of the van der Graff. Turn on and watch the fleas fly.
- 43) Purchase a "pony tail" (hair extension) from the \$2 shop or similar. Adjust to fit on your van der Graff — mine doesn't have a hole at the top so I added some lead around the base to weight it. It does need to be "placed" around the ball to ensure it doesn't fall off. (hair dressing skills)
- 44) magnets on friction free surface. I scavenged some round magnets from 3 inch speakers (Surplustronics at \$2 each). Lots of fun - watching the magnets repel each other. Since first writing this I have purchased a "block" of 10 round, plastic covered magnets from the \$2 shop -they are sold as a child's maths game.
- 45) happy and sad balls - buy these from the supply company. One bounces the other flops and if you freeze them the opposite happens (at least that's what I was told by a physics teacher who tried it).
- 46) Total internal reflection -Put a single hole bung into a Buchner flask, and attach a hose to the side arm. Attach hose to tap and put flask in clamp with base at right angles to bench. Position so when the tap is turned on the water jet runs into the sink. Manipulate flask until filled with water. Shine a laser (recently I used a \$2 laser) through the base of the flask and out the hole in

WOW Science Experiments Workshop

the bung. The beam will totally internally reflect within the stream of water and bend with the water.

47) paper helicopter— a great activity for forces, an investigation / graph exercise for Year 9, or with a bit of lateral thinking it will fit into "seed dispersal"

If your school allows "food" experiments -

48) make popcorn -science is all around - good chemical change -student love to eat the remains of their experiment. (I use a pop corn maker)

49) make hokey pokey. I use small aluminium dishes and ice block sticks (new ones naturally). Recipe: 2 tablespoons sugar, 1 teaspoon golden syrup. Heat gently over blue flame until boils. Boil gently about 4 min. Test with a drop of mixture in beaker of water. If drop goes snap remove from heat, add 1 teaspoon baking soda and stir. Reactions of carbonates, also rocks (igneous)

50) making sherbet - 1 cup icing sugar, 2 tsp citric acid, 1 tsp baking soda, 2 tsp tartaric acid, 4 tbsp fruit drink powder (adjust to taste some mixes are quite strong). Mix in clean bowl (or ice cream container) and serve in small paper bags or cup cake papers. Great for to "acids and bases"

51) making ice-cream - in a small ziplock bag put $\frac{1}{2}$ cup milk, 1 tablespoon sugar and $\frac{1}{4}$ tsp vanilla essences. Seal tightly. Place bag into larger ziplock bag which contains 1 cup crushed ice and 2 tablespoon salt. Shake and move the contents of small bag until it freezes -takes about 5 -10 mins. Also do this when you have dry ice in the school. Replace ice and salt with dry ice in ice cream container. Freezes much quicker, but warn students about the dangers of touching dry ice.

Toys that can be added to a science classroom:

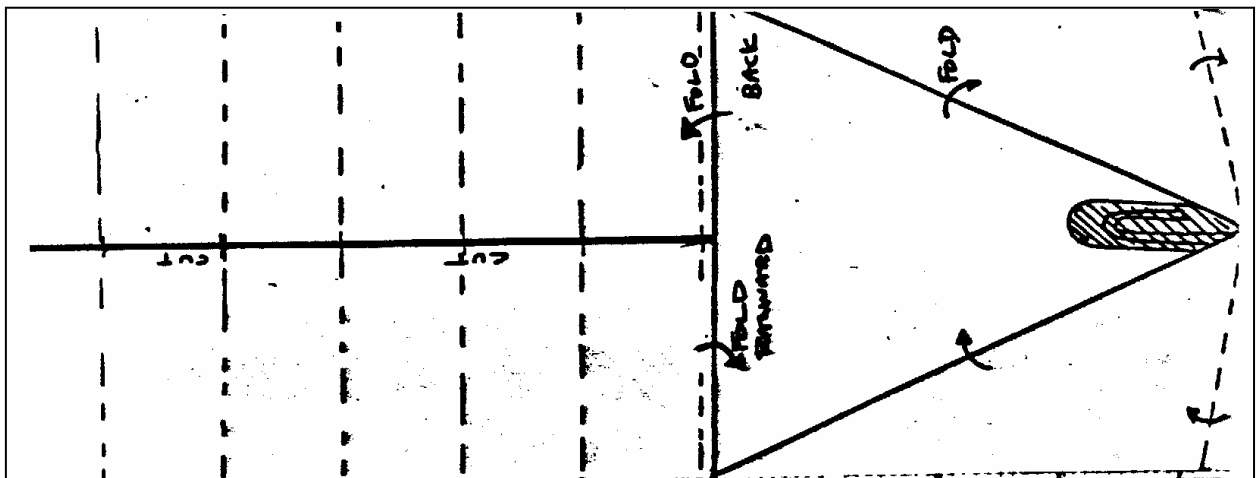
- Submerging submarine (baking powder powered) -Nature's Window (\$6). Smaller versions of mine are available at Foodtown \$5 for pack of 2.
- Pocket volcano -\$5 at Foodtown (fits in geology (volcanoes) and also acids and bases.
- Fibre optic torch -\$2 Shop
- Astro blaster -shows transmission of energy -Nature's Window (\$11)
- Gyroscope -\$2 shop
- Whizmo -\$2 shop
- Yoyo -\$2 shop
- Giggle stick -\$2 Shop
- Light stick -\$2 Shop
- Glow stick -\$2 Shop
- Expanding animals -\$2 Shop
- Foam Gliders -\$2 Shop - have used class set of these in forces expt
- Magnetic cogs - mall Xmas promotion \$6
- Expanding ball -\$2 Shop
- Vibrating Egg - \$2 Shop
- Earth ball (also called UFO ball, flashing ball)- Nature's window (\$7)
- Whirling pipe - \$2 Shop (if you are lucky) or Science Supplier. Check out

WOW Science Experiments Workshop

- Delta's price (\$4 at time of writing)
- Musical Toy - \$2 Shop
- Remote control cars - "constant velocity machines". Attach ticker tape and run through ticker timer. - \$2 Shop has a good selection find one you like then buy a class set.
- Toy cars and "finger" skate boards. NCEA 1.1 in Science or Physics. Have made ramps from PVC down pipe, and more recently the trays the stationery shop gets rulers in. Use a hot wire to cut off one end. Text books make OK height adjusters for ramps. The Warehouse usually has cheap sets of cars even if you have to get a new set every year. Finger boards buy them where you see them -I have seen them in Foodtown at 3 boards for \$2.
- Mood Ring -\$2 Shop -equilibrium
- Stress Card - Dick Smith \$3
- Jumping beans - \$2 shop.
- Kaleidoscope -can often get these at \$2 shop
- Wind up toy \$2 shop - energy circus
- Jacobs Ladder - have found these in Toy shop -paid \$11 for the last one I bought. Makes them think.
- Solar powered toys -today's students don't seem to have seen these. Electronic supply companies or science suppliers stock these.
- Steam engines - keep it maintained. Students are fascinated by these. - Hobby shops, science supply company -may be expensive.
- golf balls and ping pong balls -both about the same size but different weights. Roll down ramp, note different distance travelled.

With the \$2 shop you need to buy when you see them, stock changes and you might not be able to get the item again.

helicopter



WOW Science Experiments Workshop

Paper cup

