University of Worcester

INSTITUTE OF EDUCATION
SECONDARY ITE & POST- COMPULSORY EDUCATION

WOW Factors in Science Lessons

Science PGCE and GTP Students
2008-9 and 2009-2010

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Introduction to WOW Factors

"In essence, school science's most valuable resource is not its equipment or its laboratories but a cadre of well-qualified, enthusiastic teachers" (Osborne and Collins, 2000)

There are many current issues and challenges surrounding Science education in schools. The supply of well-qualified graduates entering the teaching profession is just one concern. Over the last ten years approximately 30 Chemistry departments have been closed within UK universities, including well-established departments e.g. that of Kings College, London. Closures are occurring not just in Chemistry, but in other key Sciences, such as Physics at the University of Newcastle (RSC, 2010). Though Biology departments are less under threat of closure, the dwindling number of students (set to fall sharply between 2009-2027, BBC News on-line 2007) and the recent announcement of cuts in funding for all UK universities (BBC News on-line 2009) are likely to affect teaching of all Sciences in most universities. There is, therefore, understandable concern about the supply of Science teachers for the future.

Not only is the provision of quality Science teaching in schools likely to become an increasing concern, but so, too, is the quality of learning that takes place by school pupils. One in five secondary schools are not rated 'good' or better on behaviour. The DCSF suggests that there is a strong correlation between achievement in schools and behaviour (DCSF, 2009). "Classrooms need to be environments where pupils engage and are positive about learning, so that they have better attitudes, are respectful of others' views and want to achieve to a high standard," Ed Balls, Schools Secretary, said recently (Maddern, 2009). The new, behaviour initiative, whereby schools rated as 'satisfactory' will no longer be good enough, is partly the result of Sir Alan Steer's report on the behaviour of pupils published last year (Steer, 2009) and looks set to be implemented, whatever government wins the election later on this year.

At Worcester, the training of Science teachers of the future, via the PGCE or GTP route, focuses on producing excellent and inspiring teachers. Our newly-trained teachers, as NQTs, are likely to have to teach any of the Sciences, at least up to the end of Key Stage 3, and often to the end of Key Stage 4. The importance of practical work in engaging pupils should not be underestimated, as this quote from Ofsted suggests:

"Schools that focus clearly on how science works – the practical and investigational aspects rather than only the theoretical elements – are the most successful at teaching the subject." (Ofsted, 2008)

Mindful of the need to engage pupils and to redress the issue of pupils being turned off Science (Bell, 2009), we set our student teachers the task of not only finding a WOW factor, but trialling it and writing it up in detail for others to use. Comments, such the one below, as make these WOW factors individual, personal and enjoyable to read:

"…*extra pupils came in as they heard about it and we had difficulty getting rid of the kids at the end of the tutor time*" (CD Air Glider, Heywood and English)

The character of some of our students certainly shines through some of the accounts. Many of the WOW factors have been borrowed or updated from various sources. Whilst

most of these have been credited, we apologise for any that should have been acknowledged, but have not been.

The original idea of collecting the WOW factors is that of Phil Collins, Science PGCE Tutor and Senior Lecturer at UW. His idea has been taken forward and developed. Particularly, the idea of one group of students (2009-2010 cohort) improving the work of a previous cohort (2008-2009) has been an interesting way forward. This style of research is recognised in the literature e.g. Chang (2008) but is, perhaps, as yet under-valued.

We look forward to developing and creating more WOW factors in the future and hope that you find them not just useful but go on to create more of your own. Please let us have any feedback, whether about any of our existing WOW factors or about any that you have improved.

Sue Howarth, 1st January 2010

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Note 1: some of these WOW factors were presented at the ASE Annual Conference, Sat 9 January 2010, at the University of Nottingham and will be again (though a different selection) at the ASE, West Midlands regional mini-conference at RAF Cosford, near Wolverhampton, on Sat 27 February 2010

Note 2: many thanks are due to Karen Blackmore, Science teacher, who helped with the risk assessments and the preparations for the presentations.

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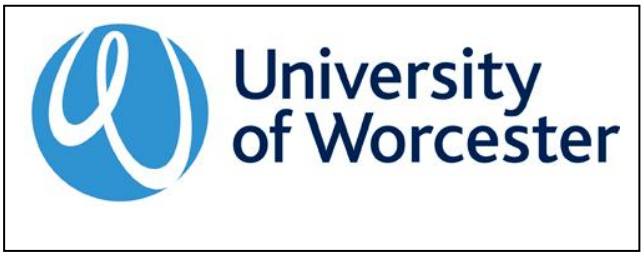
WOW Factors

PGCE and GTP Students

2008-9 and 2009-2010

	Key Stage	Title	Authors
Biology	3	**Microbe Role Play**	Karen Hackman;Jack Chapman; Stuart Dix
Biology	3/4/5	**Sugar Bomb**	Elizabeth Davies
Biology	3/4	**What Was For Dinner?**	Sharon Guest
Chemistry	3	**Balloon on Fire**	Richard Reeve
Chemistry	3	**Carbon Dioxide Fire Extinguisher**	Adam Jennings; Dan Fowler; Carla Hodgetts
Chemistry	3	**Crayon Rock Cycle**	Liz Turner; Becky Hill; Chris Gibson
Chemistry	3/4	**Custard Bouncy Balls Making Slime**	Hilary Lindley-Dore; Laura Lane
Chemistry	3	**Exploding Egg**	James Blount
Chemistry	3	**Fiery Volcano**	Claire Plumpton
Chemistry	3/4/5	**Fireworks**	Andrew Patrick; Sarah Guy; Rachel Reynolds

	Key Stage	Title	Authors
Chemistry	3/4/5	**Fountain of Coke**	Mark Lee
Chemistry	3	**Jelly Fun**	Ed Bamford
Chemistry	3	**Lava Lamps**	Claire Walsh; Jenny Lewis; Sarah Ellis
Chemistry	3/4	**Making Playdough**	Becky Hanna
Chemistry	3	**Onion Skin Weathering**	Teresa King**;** Claire Jordan; Wendy Roberts
Chemistry	3	**Rainbow Fish**	Anita Bush, Laura Carroll; Brenda Hole
Chemistry	3	**Volcano in a Lab**	Becky Hill and Chris Gibson
Chemistry / Physics	3+	**Frankenstein's Hand**	Ann Crompton
Physics	3	**CD Air Glider**	Cathy Heywood; Alison English
Physics	3	**Egg Drop**	Helen Tremayne; Kevin Morris; Laurence Hyett
Physics	3	**Marshmallow Magic**	Katie Salmon
Physics	3	**Paper Planes**	Sally Vyse
Physics	3	**Pressure Fountain**	Sally Vyse
Physics	3/4	**Rice in a Jar**	Rebecca Leighton
Physics	3`	**Running on Custard**	Natalie Cornwell



WOW Factor

Microbe Role Play

Biology Key Stage 3

Described by
Karen Hackman

Modified by
Jack Chapman and Stuart Dix

Equipment / Materials / Resources:

- Sports team bibs/tabards
- Ribbon

Method:

1. Introduce defense mechanisms for KS3 Microbes (tears in eyes, cilia in trachea, stomach acid, skin & platelets) whilst still in classroom
2. Divide class into 4 groups of about 7 pupils and give each group a number (1-4). G&T pupils to be spread across groups
3. Go outside to playground area quietly without disturbing nearby classrooms.
4. Outside, gather class and explain they will be role-playing the defense mechanisms of the body.
5. Assign each group a defense mechanism (e.g. skin) and a corner of the playground to practice.
6. Pupils should take the knowledge learnt earlier on during the lesson and adapt it to role-play.
7. Allow 15 minutes for groups to create a role-play for their specified defense mechanism.
8. Each group to give a 1 minute presentation to the rest of the class
9. Performance should have descriptions of what each member is doing and why.
10. Performance should also include a freeze-frame element to explain the scenario in depth
11. Instruct the audience to consider one good thing about the performance and one that the group could do better next time. Ask 2 people's feedback after each performance.
12. Repeat for each group.
13. Return to classroom quietly.

Safety / Risk Assessment:

- No pushing/running
- Ribbons handed out to act as barriers (e.g. skin) – can cause tripping
- Noise levels in the corridor must be kept low to avoid disturbing ongoing lessons.
- Pupils briefed before going outside to ensure safety instructions are heard/understood by all
- All bibs/tabards to be returned to teacher at end of lesson
- Ensure nominated pupils to carry equipment are careful of tripping whilst carrying

Advice:

- If teaching a higher ability set, allow more creativity in performances whereas lower ability may require some guidance/teacher input.
- Give important instructions to pupils before leaving the classroom. There is a better chance of everyone hearing you inside than outside.

Expected Results / Conclusions:

Groups to think of creative ways to explain a theory. All performances should be different as groups work in separate corners of the playground

By asking for feedback for each role-play, each and every pupil will be required to concentrate and ther learn more

National Curriculum links:

- Year 8 Microbes & Disease
- 1.1a1 – Scientific thinking: Developing explanations using ideas and models – Describe how t use of a particular model or analogy supports an explanation
- 1.2b – Using investigative approaches: assessing risk and working safely
- 2.1 – Life processes – How organs and tissues in animals function to support life processes

Internet links:

http://www.youtube.com/watch?v=1EkehFkhWf4 [accessed 30.12.09]
Microbe song – great fun starter

Giant cuddly microbes (shown in picture) available from http://www.giantmicrobes.com/uk/ [accessed 30.12.09]. Not actually used in this WOW factor, but could be used before or after to continue pupils interest

Lesson Objectives (pupils):

- Understand defense mechanisms of the human body
- Develop group work skills
- Develop speaking and listening skills (speaking in front of an audience)

Differentiation:

- G&T pupils spread evenly for logistical/timing reasons. More able pupils may take on An instructive role within a group, helping those who may be struggling with concepts. It may be the case that pupils who would struggle in the classroom-based tasks will excel in a practical situation so keep an open mind

Assessment:

- Instant questioning of audience pupils regarding their understanding of the performance witnessed. This will also provide instant feedback for the performing group as to the success of their role-play.
- Come back to classroom & pupils to describe each method into their books. Assess understanding

Role of Learning Support Assistant(s):

- As required; perhaps to help with developing and encouraging role play ideas

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Literacy – describing defence mechanisms in their books
- Vocabulary – new words e.g. cilia
- Drama – acting out

Make connections to everyday life by:

- How body defends its self

'How Science Works' and/or 'ideas and evidence'

- The use of models to explain observations; how theories are used to make predictions

WOW Factor

Sugar Bomb (Custard Tin Demo)

Biology Key Stage 3

Described by
Elizabeth Davies

Equipment:

- Custard Tin
- Icing sugar
- Candle
- Washing up bottle
- Tubing
- 2 safety screen
- Safety glasses

Method:

1. Insert a hole into the bottom of the side of a custard tin
2. Secure the tubing from the hole in the custard tin to the washing up bottle (so now if you squeeze the washing up bottle air is forced into the tin)
3. Place a candle / night light into the custard tin, surrounded by a pile of icing sugar
4. Light the candle and then place the custard tin lid firmly on
5. Squeeze the washing up bottle firmly and watch as the custard tin lid is forced off (as the glucose and oxygen react).

Safety / Risk Assessment:

- The custard tin lid is forced off so two safety screens needed – one for pupils and one for demonstrator
- Flames will come out of the tin so pupils must be stood 2 to 3 m behind their screen
- Safety glasses should be worn to protect from flames and lid
- Demo only, not suitable as a pupil activity
- Low risk of burns from candle
- CLEAPSS Hazcard SRA 02 12/15

Advice:

- The lid of the custard tin must be pressed firmly on
- The washing up bottle must be squeezed firmly, ideally leave it on the desk and push down on it with as much force as possible
- Apparently it is advisable to sift the icing sugar first

Expected Results / Conclusions:

The results will show a reaction between glucose (the icing sugar) and oxygen (air from the washing up liquid bottle) – can explain to pupils that the custard tin represents a cell and when oxygen enters the cell it reacts with glucose

National Curriculum links:

- Key stage 3 3.3a life processes are supported by the organization of cells into tissues, organs and body systems
- 1.1a Using scientific ideas and models to explain phenomena and developing them creatively generate and test theories
- Could also be used to remind pupils at KS 4 and 5

Internet link:

http://experiments.magnify.net/video/The-Exploding-Custard-Tin-Exper

A video clip of the practical being done at Arbroath Academy – but you can get the lid to go much higher!

Lesson Objectives (pupils):

- To understand that glucose and oxygen react
- To understand the respiration equation

Differentiation:

- Differentiated questions to discuss the practical
- Differentiated options for writing up the practical (help sheet possible/extension questions possible)

Assessment:

- Questions
- Get pupils to explain what happened after e.g. 'We could say the custard tin represents a cell, in what ways does it represent a cell?'

Role of Learning Support Assistant(s):

- To assist with health and safety
- To support students with follow up work

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Literacy – new key words
- Key skills – evaluation skills

Make connections to everyday life by:

- To consider glucose in our diet
- To consider how oxygen gets to our cells

'How Science Works' and/or 'ideas and evidence'

- The use of a model to explain the idea of respiration

WOW Factor

What Was For Dinner?

Biology Key Stage 3 /4

Described by

Sharon Guest

Equipment / Materials / Resources:

- Owl pellets
- Tweezers
- Mounted needle
- Hand lenses or binocular microscopes
- Bone/skeleton guide
- Disposable gloves

Method:

1. Gently prise apart the pellet with the tweezers and mounted needle and pull out the bones and teeth that you find
2. Identify the bones from the guide. It is possible to whether the bones belonged to birds or rodents & the type of bone e.g. sKull, scapula, pelvis, femur etc.
3. See if you can work out how many different animals the owl has eaten before the pellet was regurgitated!!

Safety / Risk Assessment:

- Care with sharp needles
- Potential biohazard: washing hands afterwards with anti-bacterial soap is important, even if using disposable gloves
- Disposal: steam-sterilize biological material. Dissection equipment can be autoclaved. Laboratory Handbook: CLEAPSS 2009 1441Q

Advice:

- You need to plan this well in advance due to obtaining the pellets. Most Hawk & Owl Trusts or the Barn Owl Trust will provide them for educational use or they can be bought over the internet.

Expected Results / Conclusions:

- Pupils can see real bones and learn to identify them
- Pupils can try to identify the different animals that the owl has in it's diet

National Curriculum links:

- Skeleton
- Food chains and webs

Internet link:

http://www.rspb.org.uk/Images/Owlpellets_tcm9-133500.pdf

Guide from the RSPB on how to identify what is in owl pellets

Lesson Objectives (pupils):

- To recognize bones and be able to identify them
- To know about food chains and put the prey of birds into context
- Think about the variety of animals in the diet or the owl

Differentiation:

- More able pupils will be able to find and identify more bones and teeth
- All pupils should be able to find something

Assessment:

- Draw the bones and teeth

Role of Learning Support Assistant(s):

- Help with the bone identification

Support cross curricular work

- Links with forensic science / archaeology

Make connections to everyday life by:

- Local pellets could be obtained for pupils to relate to known habitats

'How Science Works' and/or 'ideas and evidence'

- The bones and teeth found act as 'evidence' for the owl's diet. Pupils could be asked to consi how reliable this is, especially if it is difficult to identify some of the bones

WOW Factor

Balloon on Fire

(Igniting Hydrogen and Oxygen)

Chemistry Key Stage 3

Described by
Richard Reeve

Equipment / Materials:

- Balloon full of hydrogen and oxygen
- Lighted splint on end of meter stick
- String to tie balloon
- Earmuffs (not essential)

Method:

1. Use string to attach balloon of hydrogen and oxygen to bench so it floats up in the air.
2. Light a splint attached to the end of a meter stick
3. Use the lighted splint to ignite balloon (standing well back)

Safety / Risk Assessment:

- Ensure class are seated well away
- Stand well back when igniting balloon
- Know where the fire extinguishers are!

Advice:

- The more oxygen in the balloon the louder the bang
- Wear earmuffs to particularly frighten class beforehand!
- Warn classes in other nearby rooms first!

Expected Results / Conclusions:

- Balloon explodes in loud bang and flash of flame

National Curriculum links:

- Elements combining to form a compound

Internet link:

http://www.youtube.com/watch?v=TmZ8xXJmx0Q [accessed 31.12.09] Video clip

Lesson Objectives (pupils):

- To see how two elements combine to form a compound
- That the compound cannot easily be turned back into it's constituent elements

Differentiation:

- Worksheets, if used, can be differentiated

Assessment:

- Use of questions such as "what category of substance is hydrogen?"
- Asking pupils to explain what they see/hear

Role of Learning Support Assistant(s):

- Keep an eye on the class during demonstration

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Key terms e.g. combustion, element, compound
- Balancing the equation for higher ability pupils or for KS4

Make connections to everyday life by:

- Making water

'How Science Works' and/or 'ideas and evidence'

- Pupils use observations from demonstration to see how the two elements combine
- And that the compound formed cannot easily be separated out into it's constituent elements

WOW Factor

Carbon dioxide fire extinguisher

Chemistry Key Stage 3

Described by Adam Jennings
Modified by Dan Fowler and Carla Hodgetts

Equipment needed:

- Baking Powder
- Vinegar
- 250 ml conical flask (or beaker)
- Candle or Tealight

Internet links:

http://home.howstuffworks.com/home-improvement/household-safety/fire/question346.htm

Method:

1. Light the candle
2. Add 5 teaspoons of baking powder to the flask,
3. Add 2 cm^3 vinegar to the baking powder in the flask
4. Allow the reaction to occur and any foam to die away.
5. Pour the carbon dioxide onto the flame which should then be extinguished

Risk Assessment:

- Open flame in the lab
- Vinegar and baking powder can be quite a vigorous reaction so flask should be in a spill tray.
- Carbon dioxide is produced so ensure this is done in a well ventilated open space
- '*Safe use of household and other chemicals guide'* L5P CLEAPSS Hazcards, Sept 1999

Advice:

- Try not to add too much of either reagent

Expected results:

- Reacting baking powder and vinegar in the beaker will produce carbon dioxide
- This carbon dioxide can then be poured onto the candle flame

- The flame will be extinguished
- The more chemicals used, the more carbon dioxide produced
-

National Curriculum links:

- Solids, liquids and gases (7G), Simple chemical reactions (7F)
- Atoms and elements (8E), Compounds and mixtures (8F)
- Reactions of metals and metal compounds (9E), Using chemistry (9H)

Lesson Objectives (pupils):

- Chemical trends
- Production of carbon dioxide due to a carbonate reacting with an acid (word and symbol equation)
- Relative densities of oxygen and carbon dioxide / CO_2 is a heavy gas
- Why carbon dioxide can extinguish the flame, fire triangle.

Differentiation:

- Accessible for all students

Assessment:

- Directed and open questions
- Word equation of the reaction between baking powder and vinegar
- Chemical symbol equation
- Pupils could draw diagram to explain what is happening e.g. before and after
-

Role of Learning Support Assistant:

- Circulate the classroom assisting those pupils in need

Support cross curricular work:

- Numeracy – ensuring there are the same number of atoms of each element on both sides of the equation

Make connections to everyday life:

- Example of how carbon dioxide fire extinguishers work and why they are used for some types of fire

'Ideas and evidence'

- Prediction of what will happen and why
- Chemical trends, predictions about what other compounds could be used to produce this reaction

WOW Factor

Crayon Rocks

Physics Key Stage 3

Described by
Liz Turner
Amended by
Becky Hill & Chris Gibson

Equipment / Materials / Resources:

- Several packs of heap wax crayons (12p / pack from Wilkinsons)
- Pencil Sharpeners
- Aluminum foil
- Small yoghurt pot
- Ice cubes
- Tin container or beaker
- Bunsen burner

Method:

- Get pupils to sharpen the crayons and collect the shavings in piles according to colour- they will need quite a lot of sharpenings so get them to do this in groups
- Put double thickness foil into the yoghurt pot
- Layer the different coloured shavings on top of each other in the pot
- Fold the foil to make a tight parcel of the shavings
- Get the pupils to press the parcels firmly with their fingers
- Open the parcels - they have made **sedimentary** rocks with layers of different colours to show the sediment deposits – the layers need to be really think in order to show this effectively
- Fold the parcels back up and get the pupils to take off their shoes – they like this- and stamp firmly on the parcels. This mimics increased pressure and heat
- Open the parcels and they have made **metamorphic** rock
- Get all the 'rock' together in an old tin dish (it makes a mess) and melt the wax over a Bunsen.
- Pour the melted wax over the ice cubes to show how **igneous** rocks form
  (Can discuss intrinsic / extrinsic rocks here and crystal size)
- Take the solidified igneous rock out to show group – making sure it has cooled first

Safety / Risk Assessment:

- Bunsen work can be done as a demo to whole class when all the wax has been collected if there is a worry about the ability of the class to do this themselves
- If pupils are going to do the heating themselves make sure they do not get the wax near the flame and remove it from the heat once it has melted (melted candle wax will make quite a potent smell so have good ventilation and ensure that you are aware of any pupils with breathing problems e.g. asthma
- Take care when sharpening the crayons – especially if pupils try to pick bits of wax out of the sharpeners
- Potential for melted wax to cause burns, so be aware of any messing around with the materials.

Advice:

- You do need quite a lot of pressure at the start to stop the shaving breaking up, and don't make the foil too large – you don't want too much space in the foil package.
- Make sure the tin dish for heating the 'rocks' has no faults because if the wax drips onto the flame it will ignite! (It happened when we tested this!)

Expected Results / Conclusions:

- Explains each step of the rock cycle

National Curriculum links:

8H The Rock Cycle

Internet links:

http://www.exo.net/~emuller/activities/Crayon-Rock-Cycle.pdf [accessed 30.12.09]

Lesson Objectives (pupils):

- Pupils will understand the three rock forming stages of the rock cycle

Differentiation:

- Plenty of opportunity for extension questions, as you can stop at each 'rock' formed
- A higher ability group can perform all three stages, one of lower ability may need certain parts demonstrated or for pupils with manual dexterity issues, ready-made sharpenings of wax crayons could be provided

Assessment:

- Direct questions
- Good to use drag and drop diagram of rock cycle to complete as you go along
- Drawing diagrams of the rock cycle / explaining each process as they complete each stage

Role of Learning Support Assistant(s):

- SEN pupils may need help with practical work.

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Literacy – some new key words, igneous, sedimentary etc.
- Also connections with work they will do in Geography

Make connections to everyday life by:

- Where do rocks come from?
- Why our countryside looks the way it does – different rocks at the seaside to hills etc.

'How Science Works' and/or 'ideas and evidence'

- Models how rocks are made.
- Practical demonstration of processes which they would not be able to readily view in 'real time'

WOW Factor

Custard Bouncy Balls

Making Slime

Chemistry Key Stage 3 / 4

Described by Hilary Lindley-Dore and modified by Laura Lane

Equipment / Materials / Resources:

- Custard powder (or cornflour)
- Various food colourings
- White PVC glue
- Borax (available in chemists' shops)
- Water (warm
- Kettle
- 2 plastic cups or small glass beakers.
- Pipette
- Glass stirrer

Method:

Make a borax solution by adding 1 teaspoon of borax to 2 tablespoons of warm water, stir to dissolve. Leave the solution to cool before adding it to the PVA mixture.

1. In another container mix one tablespoon of PVA glue with 2 teaspoons of custard powder
2. Add a food colouring of your choice
3. Add one teaspoon of your borax solution to the custard/PVA mixture and stir well
4. Keep adding the Borax solution a bit at a time, using a pipette, so that the mixture does not solidify too much (especially if making slime)
5. The mixture will become stiff - tip it out of the cup and knead well with your hands
6. If using as slime, pupils should experiment with the elasticity of the slime and observe what happens if the slime is left on a surface for a few minutes
7. If making a bouncy ball, roll the substance into a ball and cover with cornflour so that the ball does not stick to the table

Safety / Risk Assessment:

- Pupils with sensitive skin may need to wear gloves as borax powder is a mild irritant
- Food colouring may stain clothes; make pupils aware of this
- Beware of glass equipment and boiling water
- Disposal: add just enough 1M sulphuric acid to allow solution to be free-flowing. Dilute and pour down foul water drain
- Hazcard 59; CLEAPPS 2007

Advice:

- Very messy activity, so work on newspaper / plastic cloth

Expected Results / Conclusions:

- PVA glue and custard powder (cornflour) are both long chain molecules (polymers)
- The borax reacts with these long chains, zipping them together with short bridges

National Curriculum links:

- Material – changes in properties Energy and Forces Polymers and their uses

Internet Links

http://www.yummyscience.co.uk/ys_pages/ys_custard.html
Interesting questions about bouncy balls www.van.physics.uiuc.edu

Lesson Objectives (pupils):

- Experimenting with polymers
- Investigating the properties of materials

Differentiation
Use a range of trigger questions increasing in challenge:

- What are the energy transfers involved when the ball is bounced / slime is stretched? (include elastic and gravitational potential for KS4)
- What happens to the slime if it left for a few minutes? (becomes more elastic/stretchy)
- How many kinds of balls do you know?
  (Football, tennis ball, golf ball, basketball, ping pong ball, etc.)
- Do they all look / feel the same? Do they all bounce in the same way?
- Does it make any difference what kind of surface you bounce them on?
- Do balls bounce well on sand? Why do balls form craters in the sand?
- When you squeeze a ball in your hand what do you feel the ball is trying to do?
  (Push back to its original shape).
- What are good materials for making bouncy balls? (Rubber is one.)
- What do you think is inside balls?
  (Some have air, e.g. footballs and tennis balls, some are solid, e.g. golf balls).
- What are some other uses of polymers / why would these properties be useful?

Assessment:

- Use a range of different balls plus custard ball and drop from the same height and measure the bounce / hold a 'bouncing competition'
- Use different surfaces to bounce the balls on as a further investigation
- Investigate the sizes of craters formed from different sized balls

Role of Learning Support Assistant(s):

- Help pupils with balance of ingredients or mixing problems, for example too wet add more custard powder, too soft add more borax solution

Support cross curricular work

- Reading a method sheet and adding the correct weights and volumes of ingredients.
- Knowing the properties of materials and how they can be useful.

Make connections to everyday life by:

- Uses of polymers in the world and everyday life; provide examples
- Using everyday ingredients available from the supermarket and chemists
- Realising the manufacturing process for everyday items (bouncy balls)

'How Science Works' and/or 'ideas and evidence'

Relating science to everyday life / reasons for different types of balls

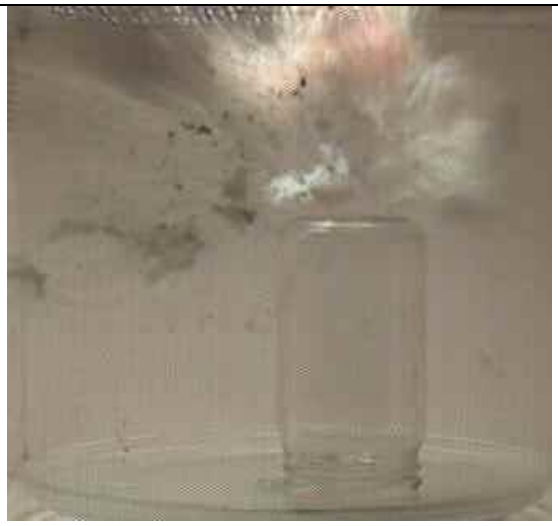
WOW Factor

Exploding Egg

Chemistry Key Stage 3

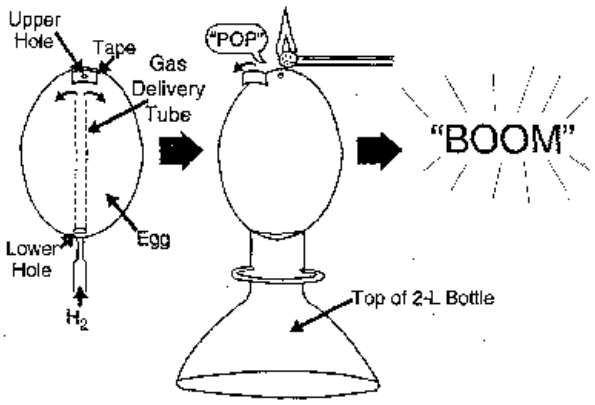
Described by

James Blount



Equipment / Materials / Resources:

- Boiling tube
- Bung with glass tube passing through
- Rubber tubing
- Narrow glass tubing
- 2M HCl
- Magnesium ribbon
- Test tube stand
- Retort stand and clamp
- One 'blown' egg
- Gauze mat with hole in
- Blast screen
- Safety glasses
- Lighted splint on the end of a metre stick



Method:

1. Place the hollowed-out egg on the gauze mat, on top of the tripod, taping the top hole up but leaving the bottom one open, with access to it through the hole in the gauze.
2. Place the boiling tube in the rack and arrange the narrow glass tubing with the rubber tube attached so that its tip is just inside the bottom hole of the egg. Hold in place with retort stand and clamp (or as shown in diagram)
3. Pour $10cm^3$ of the HCl into the boiling tube, add 2x5cm strips of magnesium ribbon, connect the rubber tube to the glass tube passing through the bung and place the bung in the neck of the boiling tube.
4. Wait 5 minutes for the hydrogen produced by the reaction of the magnesium and the acid to fill the hollowed-out egg, displacing the heavier air via the gap between hole and narrow glass tube.
5. Remove glassware from the immediate area, put on safety glasses and erect blast screens.
6. Use lighted splint to reach over/round the screens and ignite the hydrogen-filled egg.

Safety / Risk Assessment:

- Ensure class are at the other side of the room
- Use blast screens and safety glasses

Advice:

- Allow enough time for the egg to fill with hydrogen, to give a really good bang
- Warn other staff of the likelihood of a loud noise

Expected Results / Conclusions:

- The hollowed-out egg explodes with a very loud bang, spraying pieces of eggshell everywhere

National Curriculum links:

- To see how a metal reacts with an acid (to form the hydrogen)
- To see how two elements react to give a compound (the explosion)

Internet link:

http://www.youtube.com/watch?v=IRkK_NfweRA [accessed 30.12.09]
Useful to watch before doing this demo for the first time

Lesson Objectives (pupils):

- To see how a metal reacts with an acid, producing hydrogen and giving out heat (boiling tube gets warm.)
- To see how two elements (hydrogen and oxygen) combine to form a compound, and that such reactions can be dramatic.
- When a lot of energy is given out during the formation of a stable compound such as water, it is not easy to turn them back into the original elements, and takes a lot of energy to do so.

Differentiation:

- Different levels of questioning

Assessment:

- Use of questions such as: 'what category of substance is magnesium?,' 'what gas is produced?,' 'what is the compound that is formed by the explosion?.'

Role of Learning Support Assistant(s):

- Some pupils may need help with any follow-up written work

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Numeracy-consider the mathematics of molarity for higher ability pupils
- Citizenship-if this is how big the bang is from an egg full of hydrogen, imagine the devastation caused when it was first used in armaments/bombs

Make connections to everyday life by:

- Making water
- Hydrogen fuel cells in cars

'How Science Works' and/or 'ideas and evidence'

- Pupils use observations to predict the compounds which result from both reactions.
- They relate the reactions to their ideas on elements and compounds.
- They can incorporate the idea of energy being given out via exothermic reactions, and consider what the opposite is (e.g. if a test tube goes cold during a reaction.)

WOW Factor

Fiery Volcano

Chemistry Key Stage 3

Used by

Claire Plumpton

Equipment / Materials:

- Ammonium dichromate
- Ethanol
- Splint
- Large metal tray
- Safety glasses
- Safety screen

Method:

1. Ensure pupils are away from demo protected behind screen
2. Make a pile of ammonium dichromate on the large metal tray. The pile should be about 2 inches wide and at least 1 inch high
3. Create a wick by dipping a wooden splint in ethanol for a while
4. Break off one inch length of wick and place in centre of ammonium dichromate
5. Light wick and stand back
6. Technician must use gloves to clear up afterwards

Safety / Risk Assessment:

- Must be demonstrated behind protective screen
- Do not handle ammonium dichromate or products without gloves
- Wear safety glasses
- Do not go back to the ammonium dichromate if it doesn't light immediately, it is like a small firework!
- Ethanol is highly flammable – wipe up spills quickly
- Keep the ethanol away from naked flames and only use a small amount
- Although ammonium dichromate is classified as a category 2 carcinogen, hazards are associated with inhalation of the dust. The ASE publication ' Safeguards in the School Laboratory, pages 98-102, states that this compound may be used in schools provided that the dust is not inhaled and that reasonable precautions are taken (as above)

Advice:

- Be prepared to wait a minute or so for experiment to get going

Expected Results / Conclusions:

- Lots of grey 'ash' produced
- Looks like a volcano
- Fiery sparks spew from top

National Curriculum links:

- Rocks and the rock cycle
- Chemical reactions: irreversible / exothermic

Internet link:
http://www.youtube.com/watch?v=Ula2NWi3Q34 [accessed 31.12.09]
Demonstration (without the ethanol wick)

Volcanic eruption song (originally from internet, now as a FLV file.)
Should open from this hyperlink if using the CD

Lesson Objectives (pupils):

- Understand how volcanoes work and appreciate how a volcanic eruption works

Differentiation:

- Explanation will be that this is a simplified example of a volcano
- More able pupils may be able to list similarities / differences

Assessment:

- N/A

Role of Learning Support Assistant(s):

- N/A

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Key words

Make connections to everyday life by:

- What a volcanic eruption looks like (as close as most pupils will get to one)

'How Science Works' and/or 'ideas and evidence'

- Use of a model to simulate an eruption when you cannot see a real eruption
- Pros and cons of the model

WOW Factor

Fireworks

Chemistry
Key Stage 3 / 4/ 5

Described by
Andrew Patrick

Modifications, Details and Photograph
by Sarah Guy and Rachel Reynolds

Equipment / Materials / Resources:

- Fume cupboard
- Small tin dish lined with aluminium foil (for ease of cleaning up)
- Potassium permanganate (VII)
- Glycerol (a small quantity in a beaker with a dropping pipette)
- Spatula

Method:

1. Put 1-2 g of potassium permanganate (VII) in a small pile on the tin lid on a heat proof mat
2. Make a small hollow in the centre of the pile
3. Drip about 0.3cm^3 of glycerol into the hollow in the pile of potassium permanganate (VII)
4. Wait – this reaction takes several seconds to get going

Safety / Risk Assessment:

- This demonstration should be carried out in the fume cupboard.
- Do not return to the experiment once the glycerol solution has been added as there is a varying delay.
- Potassium permanganate(VII) (Oxidising agent, Harmful, Dangerous for the environment) Refer to CLEAPSS Hazcard 81
- Glycerol (propane-1,2,3-triol) (Low hazard) Refer to CLEAPSS Hazcard 37

Advice:

- This is only suitable for a relatively small group demonstration as the pupils need to be able to see what is going on in a fume cupboard
- We would recommend it for a 6th form set to provide some entertainment when studying Hess's law etc.
- Do not return to fume cupboard once glycerol has been added.
- There is a time delay!
- Reaction is violent if done correctly (see video clip, URL given below)

Expected Results / Conclusions:

- Smoke is seen emanating from the pile of potassium permanganate followed by spontaneous combustion
- The lilac flame can be mentioned and related to flame test for potassium ion

National Curriculum links:

- Exothermic reaction – Spontaneous
- Stored energy – chemical energy, relate to energy transfers chemical energy to heat and light energy
- Relate to identification of metal ions through flame tests – lilac for potassium

Internet links:

http://www.youtube.com/watch?v=RWzZoaAOE3Y

Potassium Permanganate + Glycerol = Fire! YouTube video [accessed 30.12.09]

Lesson Objectives (pupils):

- A good one to use on or near Nov.5th as it looks like a small roman candle type of firework
- It gives a good visual link for the pupils in relation to stored chemical energy being released
- It can be related to exothermic reactions
- It clearly demonstrates that a reaction has taken place – heat and light given out, visual change

Differentiation:

- Most able pupils could look at why the reaction is so strongly exothermic – $KMnO_4$ is a strong oxidising agent – good source of oxygen
- Glycerol - an alcohol (propan 1,2,3 tri-ol) and flammable. Link to energy available from drinking alcohol – beer bellies!

Assessment:

- Ask pupils to think about energy transfers / stored energy
- Ask pupils to observe / describe / explain what they see
- Use to follow into identification of metal ions from flame colours

Role of Learning Support Assistant(s):

- Keep control of class around fume cupboard

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Citizenship – danger of alcohols! At least that they contain a lot of stored chemical energy and heavy drinking can lead to obesity.
- Key skills – safety – never return to a lighted firework (good to emphasise if demo is at the beginning of November)

Make connections to everyday life by:

- Never return to a lighted firework!
- High levels of energy contained – glycerol used to make nitro-glycerine
- Could be used as a demonstration of stored chemical energy
- Relate to obesity from drinking excessive alcohol

'How Science Works' and/or 'ideas and evidence'

- This can be related to models for calculating bond energies
- At KS5 it could be related to the model of the arrangement of electron energy levels within the atom and thus the frequency of light emitted by the potassium

WOW Factor

The Fountain of Coke

Chemistry
Key Stage 3 / 4 / 5

Modified by
Mark Lee

Equipment / Materials:

- 5 different types of coke (2 x 2L bottles of coke for each)
  I used Coca Cola, Diet Coca Cola, and Coca Cola Zero, Tesco Brand Cola and Tesco Brand Diet Cola
- Several packets of Mentos mints
- A measuring tape

Method:

1. Identify an appropriate place outside that has good drainage
2. Split the class into groups and put the groups in charge of one particular type of coke
3. Bring the class outside and describe the procedure for the experiment
4. Make sure to keep the number of Mentos used constant (3-4 per bottle works well)
5. Ask pupils to predict which type of Coke will create the highest geyser
6. Using your decided number of Mentos, add to the coke and measure the height of the resulting geyser
7. Ask the pupils to put the results into a table on the interactive white board with a column for the mean value

Safety / Risk Assessment:

- Pupils should be aware to stay back
- Do not eat or drink anything used in the experiment
- Ensure pupils wash hands upon returning to the classroom
- Only on experiment to be run at a time
- Do this on grass outside to reduce the slip hazard
- Safe use of household and other chemicals guide, L5P, CLEAPSS Hazcards, Sept 1999

Advice:

- Use a roll of paper to form a tube. Use this tube to hold the mints in a line ready to drop Into the bottle of coke. The tube containing the mints stands on a small piece of card (credit-card size) above the bottle top. Remove the card to drop the mints in.
- Stay well back
- Try and find somewhere away from other classes – big distraction for other classes
- If you tell the pupils that the experiment never really works that well, they will be pleasantly surprised when it does go well

Expected Results / Conclusions:

- I thought it would work the best with Tesco Diet Cola, but it actually worked best with Diet Coca Cola, next best with Coca Cola Zero, then Tesco Diet Cola, then Coca Cola regular and finally Tesco Cola

National Curriculum links:

- Can be related to Chemistry – surface area of the mints is the key – many small pits allow bubbles to collect

Internet link:

http://revver.com/video/27335/extreme-diet-coke-mentos-experiments/
[accessed 31.12.09]
There are many videos showing crazy demonstrations with Coke and Mentos, but the Eepy Bird ones, of which this is one, are probably the best

Lesson Objectives (pupils):

- Plan and Undergo an experiment to test the effect of Coke with Mentos
- Create appropriate results for the data you have collected
- Produce an experimental write up

Differentiation:

- Groups can be decided before hand to ensure that less able pupils are grouped with other pupils that will be able to assist

Assessment:

- Q&A through out
- Pupils to write up the experiment – peer/teacher assessment can be used to mark these

Role of Learning Support Assistant(s):

- Assistants can assist in controlling class outside
- TA's to walk round and assist pupils with write up

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Numeracy used in tally of results
- Literacy used in experimental write up

Make connections to everyday life by:

- Connections can be related to carbon dioxide in Coke
- Experimental method can be related to the way scientists test ideas

'How Science Works' and/or 'ideas and evidence'

- Pupils are asked to design the experiment
- Results are collected, collated, analysed and interpreted
- Plenty of opportunity to discuss reliability, accuracy and precision

WOW Factor

Jelly Fun

Chemistry Key Stage 3

Described by

Ed Bamford

Equipment / Materials:

- Jelly
- Sand
- Plasticine
- Kitchen sponge
- Cornflower

Method:

1. Try and discover what state of matter each of the first four fit into, relating to the particle theory
2. For a plenary the class play with the cornflower and, relating to everything they have learnt they attempt to classify the state of matter that it fits into and why

Safety / Risk Assessment:

- No eating the jelly
- Wash hands after handling

Advice:

- This is for high ability year 7, as extension to solids, liquids and gases. Try and get the class to think about flow. As they are high ability keep the instructions to a minimum

Expected Results / Conclusions:

- Jelly – Is classed as solid, but has traits of liquid
- Sand – the class may think of sand as a whole and will talk about flow, but should consider each individual particle, which are solids
- Plasticine – Is classed as solid, but has traits of liquid as can show properties of flow and can change shape
- Sponge – Is a solid, but can be compressed and shows characteristics of a gas
- Cornflower – has characteristics of solids and liquids. Can keep shape, yet can be Compressed and show flow

National Curriculum links:

- KS3 States of matter

Internet link:
http://www.youtube.com/watch?v=guoU_cuR8EE [accessed 01.01.10]
Animation of the states of matter

Lesson Objectives (pupils):

- Understand that there are many products that have the characteristics of more than one state of matter

Differentiation:

- Give a picture of a stain- glass window and ask why after 100 years it is thicker at the bottom – but beware of the simpler explanation, now disproven, that glass flows like a liquid

Assessment:

- Class feedback on findings
- Discussion in the plenary activity
- Assessing tabulated results

Role of Learning Support Assistant(s):

- I did not have one, but plan in as see fit

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Citizenship – working as part of team

Make connections to everyday life by:

- Coming up with other products that fit into more than one state.
- This is using products from everyday life

'How Science Works' and/or 'ideas and evidence'

- Practical enquiry investigating what state each substance is in
- Using theories to make predictions.

WOW Factor

Lava Lamps

Chemistry Key Stage 3

Described by
Claire Walsh
Amended by
Jenny Lewis & Sarah Ellis

Equipment / Materials / Resources:

- Vegetable oil
- Water
- Food colouring
- Alka-Seltzer (effervescent) tablets
- Jars/beakers/bottles or other transparent containers

Method:

1. Fill the container about ¼ full with water (food colouring if desired but not essential)
2. Then almost fill the container with vegetable oil, leaving a slight gap at the top
3. Add the effervescent tablet which will sink to the bottom of the jar and then as it effervesces bubbles will rise to the surface pulling up globules of water through the oil which will then fall as the gas is released at the surface. This gives the effect of a lava lamp.

Safety / Risk Assessment:

- Ensure all spillages are cleaned up
- Oil could make the outside of containers slippery if some is spilled
- Alka-seltzers not for consumption
- Allergic reactions to vegetable oil. Do not use any oils which may contain nut oils due to possible allergic reactions
- Safe use of household and other chemicals guide L5P CLEAPPS Hazcards Sept 1999

Advice:

- Take care with oil – can be very messy. Work on newspaper

Expected Results / Conclusions:

- The results can be linked to emulsions or convection as this is the principle behind lava lamps
- Link to discussions about density

National Curriculum links:
Materials and their properties
Classifying materials: solids, liquids and gases

- how materials can be characterised by melting point, boiling point and density
- how the particle theory of matter can be used to explain the properties of solids, liquids and gases, including changes of state, gas pressure and diffusion

Internet link:
http://www.wikihow.com/Make-a-Lava-Lamp-with-Household-Ingredients [accessed 30.12.09]

Lesson Objectives (pupils):

- To observe that water and oil on their own do not mix

Differentiation:

- This was used with an SEN group - could perhaps be extended to using specific measurements and challenging pupils to work out how to make the best lava lamp

Assessment:

- Diagrams; explaining how it works using labels

Role of Learning Support Assistant(s):

- Keep pupils on task, could ask them to do a demo

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Numeracy - if using specific measurements
- Literacy – explaining how it works

Make connections to everyday life by:

- Connections to lava lamps and depending whether focusing on emulsions or convection the use of everyday examples

'How Science Works' and/or 'ideas and evidence'

- Use of models to explain observations;
- How theories are used to make predictions

WOW Factor

Making Playdough

Chemistry Key Stage 3/4

Described by
Becky Hanna

Equipment / Materials / Resources:

- 1 cup plain flour
- 1 cup of water
- ½ cup of salt
- 2 tablespoons cream of tartar
- 2 tablespoons of vegetable oil
- Food Colouring

Method:

1. The above quantities are for if you're making it in a saucepan – to do it in a science lab you need to change the quantities. For example using a really small beaker instead of a cup, and using a spatula/capful instead of tablespoons.
2. Using a small beaker as a measuring cup, measure out the dry ingredients (flour, salt, cream of tartar) and mix together using a spatula. Add the water and mix through until it's smooth, then add the food colouring and lastly, the oil.
3. Place the beaker into a water bath around 60°C and stir continuously with the spatula.
4. When the playdough has gone very sticky and has started to cling to the spatula in bits, it's probably done (if you use red food colouring it looks weirdly like chicken tikka massala when it's ready!), use the spatula to spoon it onto a paper towel.
5. Let it cool for a minute or two, and then begin to put it into shapes. If it is too sticky (bits sticking on hands etc), add a little bit more oil

Safety / Risk Assessment:

- Make sure students are aware that steam is coming off water baths, and also the water baths are heated at 60°C so potentially dangerous / risk of scalding
- All students need to be standing, bags and stools under desk, etc.
- Maybe be aware of allergies to food colourings?
- Warn students that the playdough is REALLY hot when it comes out of the beaker and don't prod until it's cooled down – the consistency means it can cling to your skin and that can be quite painful! So make sure they spoon it onto a paper towel and let it cool down
- Safe use of household and other chemicals guide, L5P CLEAPSS Hazcards Sept 1999

Advice:

- Don't bother trying to do it on a Bunsen burner (I tried!) – it doesn't work as well as the heat is so concentrated on the bottom – also you can't stir it because of the heat coming off it. Also try the quantities out beforehand to check it will work for you.
- If you pre-make a massive batch of red playdough and green playdough, then dish out a lump of each per student, you have traffic light playdough they can wave around in the air instead of traffic light cards for the plenary!
- Check with the class teacher whether or not students are allowed to keep it, and if not maybe suggest students could return to collect their playdough at the end of the day.
- Warn students to be careful of their clothes when using the food colouring!

Expected Results / Conclusions:

- A lovely blob of playdough ☺

National Curriculum links:

- Helps develop safe lab skills (I did this with a medium-ability group who had quite bad lab skills).
- Supports the plant oils section of KS4 Chemistry (because it uses vegetable oil… a bit tenuous!)

Internet link:

http://www.bbc.co.uk/dna/h2g2/A1134073 Recipe adapted from here [accessed 01.01.10]

Lesson Objectives (pupils):

I mostly carried out this practical as I wanted to see how well the students could carry out practicals. I wanted them to:

- Develop safe lab practice, recap the equipment and recap safety rules
- Gain an understanding of the importance of plant oils
- Successfully make some playdough in order to better motivate the group!

Differentiation:

- Less-able students struggle with the quantities, maybe include diagrams on the instruction sheet in case they struggle
- More-able students may benefit from an explanation of why these ingredients turn into playdough when heated

Assessment:

- Using red and green playdough instead of traffic light cards at the end of the lesson

Role of Learning Support Assistant(s):

- If present, I would have TAs maybe overseeing the measuring out of quantities in order to do this as less messily as possible

Support cross curricular work

- Supports numeracy (working out quantities, measuring etc)

Make connections to everyday life by:

- Talking about other uses of vegetable oils
- Making playdough

'How Science Works' and/or 'ideas and evidence'

- Students could suggest why the playdough is formed
- Vary the quantities and make predictions about the outcomes
- Developing practical skills

WOW Factor

Onion Skin Weathering

Chemistry Key Stage 3

Described by Teresa King

Amended by Claire Jordan

and Wendy Roberts

Equipment / Materials / Resources:

- 2 small pieces of granite (select carefully for good results)
- Tongs
- Bunsen burner and heat mat
- 500 ml plastic beaker of cold water (from a tap)
- Safety screen and safety glasses
- Freezer (optional)

Method:

1. Pupils need to wear safety glasses and sit at a safe distance from the heating
2. Pass around the rocks for pupils to examine
3. Use safety screen. Pick up one piece of rock using tongs and heat it until red hot. (This represents the rock being heated in the day)
4. Plunge the rock into the cold water (This represents the rock being cooled in the night)
5. Repeat as necessary (I found 'one week' worked well and made a nice story)
6. Place the weathered rock and unaltered rock next to each other on the desk on a piece of white paper
7. Use the tongs to bash the rocks. You should find that small bits will break off the weathered rock, but not the original rock
8. To develop this further the rock can be put into water and then put directly into a freezer to reflect freeze-thaw damage to rocks

Safety / Risk Assessment:

- All should wear safety glasses and ensure pupils are at a safe distance / use a safety screen
- Beware bits breaking off the rocks
- Use a plastic container for the water to ensure the beaker does not crack when the rock breaks
- Danger of scalding, particularly from steam generated by plunging hot rock into water

Advice:

- We used a piece of rock about 2cm x 1cm x 1cm
- A more angular piece of rock will be easier to break bits off
- Build up a story about the day and night to maintain pupil interest, then if you need to repeat the heating and cooling you can talk about more time needing to pass

Expected Results / Conclusions:

- Successive heating and cooling of rocks weakens their structure
- NB This method makes bits breakoff, rather than whole layers flaking off

National Curriculum links:

- (new) Sc3.4a geological activity is caused by chemical and physical processes
- (old) Sc3.2d how forces generated by expansion, contraction and the freezing of water can lead to the physical weathering of rocks

Internet links:

http://www.bodmincollege.cornwall.sch.uk/Curriculum%20Areas/Geography/New%20GCSE/4%20-%20GCSE%20Geography%20-%20Weathering.pdf
Useful slides from a KS4 lesson (but very suitable for KS3) on weathering (Bodmin College, Cornwall)

Lesson Objectives (pupils):

- DESCRIBE how heating and cooling physically weathers rocks

Differentiation:

- Pitch your explanation at appropriate level of class
- Higher ability/more trusted/mature classes may be able to carry this out themselves
-

Assessment:

- Quiz for identifying different types of weathering as plenary
- Homework following lesson was to write a story of a rock from when it was part of the mountain to ending up in the sea (having covered transportation)

Role of Learning Support Assistant(s):

- Simplify explanations as necessary

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Numeracy: time passing
- Literacy: writing the story as the assessment task

Make connections to everyday life by:

- Explaining landscapes

'How Science Works' and/or 'ideas and evidence'

- Using models

WOW Factor

Rainbow Fish

Chemistry Key Stage 3

Modified from Planet Science

Described by

Anita Bush, Laura Carroll and Brenda Hole

Equipment / Materials / Resources:

- Red cabbage
- Pestle and mortar
- Filtering equipment – filter funnel, conical flask and filter paper.
- Filter paper discs
- Household / kitchen cupboard liquids – e.g. milk, vinegar, lemon juice, indigestion milk of magnesia, washing up liquid
- Giant fish outline

Method:

1. Chop red cabbage and crush with pestle and mortar and add a drop of warm water
2. Filter the red liquid and use to soak filter paper discs - one per pupil plus a few spare
3. Dry – steps 1-3 may have to be done prior to lesson for the pupils or by pupils in one lesson and left to dry ready for the next lesson
4. Use a cotton bud or cocktail stick and spot drop different liquids onto the dyed filter paper. It will change colour instantly depending on pH
5. Draw outline of fish and cut out

Internet links:

http://www.planet-science.com/newsletters/planetscience/issue_305

There is a video of this experiment available at http://video.about.com/chemistry/Cabbage-pH-Indicator.htm. This is a useful resource for visual learners

Safety / Risk Assessment

- Care if using cleaning products – wash off skin immediately
- No eating / drinking and wash hands afterwards
- Care with red cabbage water – risk of staining clothes / skin
- Safety glasses to prevent acid /alkali damage to eyes
- '*Safe use of household and other chemicals guide'* L5P CLEAPPS hazcards Sept 1999

Advice:

- Best to prepare dyed filter paper for pupils
- Careful with finger prints / dirty fingers holding filter paper
- Good to give as homework

Expected Results / Conclusions:

- Nice colourful fish made using kitchen cupboard ingredients.
- If a product is acidic the disc will turn bright pink.
- If a product is neutral the disc should stay the same.
- If a product is alkaline the disc will turn green

National Curriculum links:

- Acids and alkalis - 3.2c Chemical and material behaviour: elements and compounds show characteristic chemical properties and patterns in their behaviour

Lesson Objectives (pupils):

- To recognise that solutions and dyes which show one colour in acids and another in alkalis are called indicators
- To be able to state that indicators can be made from vegetable products

Differentiation:

- Discuss how red cabbage water is a good indicator of whether something is acidic or alkaline.
- It cannot tell how acidic or alkaline something is. Discuss how this can be done using Universal Indicator

Assessment:

- Open questions – e.g. what do the colours indicate?

Role of Learning Support Assistant(s):

- Ensure class follow safety procedures

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Literacy: new vocabulary introduced – provide spellings; add to word bank; include explanations for glossary of terms, using descriptive words for observations and reading new words on products at home

Make connections to everyday life by:

- Examples of every day acids and alkalis in the home and common industry

'How Science Works' and/or 'ideas and evidence'

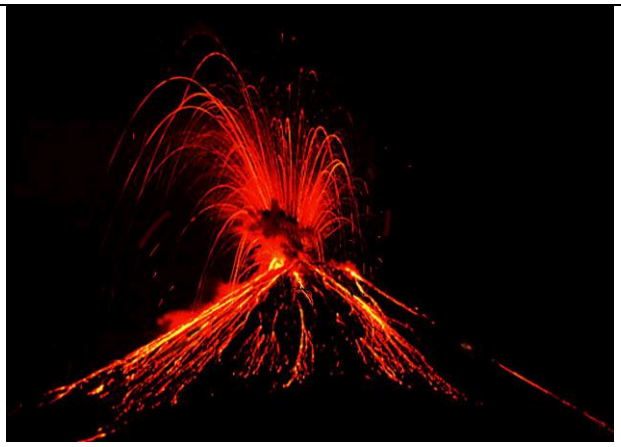
- How theories are used to make predictions - predict colour changes of red cabbage water with acids / alkalis.

WOW Factor

Volcano in a laboratory

Chemistry Key Stage 3

Described by
Becky Hill and Chris Gibson



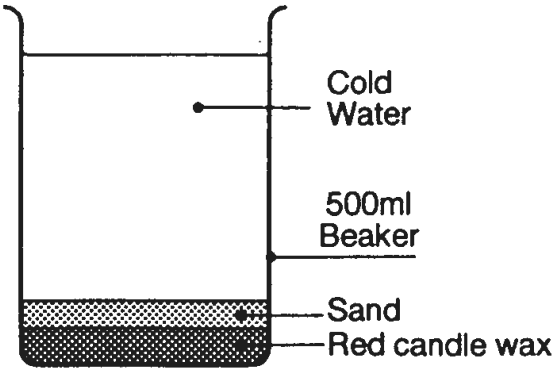
Equipment / Materials / Resources:

- One 500ml glass beaker
- Red candle wax, 1cm deep, melted and poured into the base of the beaker
- Washed sand, 1cm layered on top of the wax
- Cold water to top up the beaker with – about 2/3 full
- Bunsen burner, heat proof mat, tripod, gauze and gas supply

Method:

1) Arrange apparatus as below:

Magma processes simulated by candle wax.



2. Heat the beaker
3. The wax melts and flows through the sand 'erupting' though the water (the water models the
4. crust of the Earth)
5. If the wax moves quickly to the surface this indicates an eruption – it is much more spectacular than it sounds on paper!

Safety / Risk Assessment:

- Safety screen in case of glass cracking
- Usual heating precautions including safety glasses
- ASE publication: 'Safeguards in the School Laboratory' pages 98-102

Advice:

- Stand well back – use a safety screen

Expected Results / Conclusions:

Shows the molten rock in the mantle (wax) and it periodically breaking through the lower crust (sand) and the upper crust (water) and cooling. Where it breaks through quickly and rushes to the surface a 'volcanic eruption' occurs

National Curriculum links:

- 8H the rock cycle

Internet links:

http://www.rsc.org/education/teachers/learnnet/JESEI/volcano/home.htm [accessed 30.12.09]

Lesson Objectives (pupils):

- This is more a demonstration for a plenary after working on igneous rocks and volcanoes

Differentiation:

- The level of explanation is the only real differentiation needed as it is a very visual demonstration

Assessment:

- n/a

Role of Learning Support Assistant(s):

- Help with explanations

Support cross curricular work in literacy, numeracy, key skills and citizenship:

- Geography – volcanoes

Make connections to everyday life by:

- How volcanoes erupt and what goes on below our feet under the Earths crust

'How Science Works' and/or 'ideas and evidence'

- Perhaps relate this back to a diagram of a volcano erupting and then draw it back to what they can see
- Use of models in Science

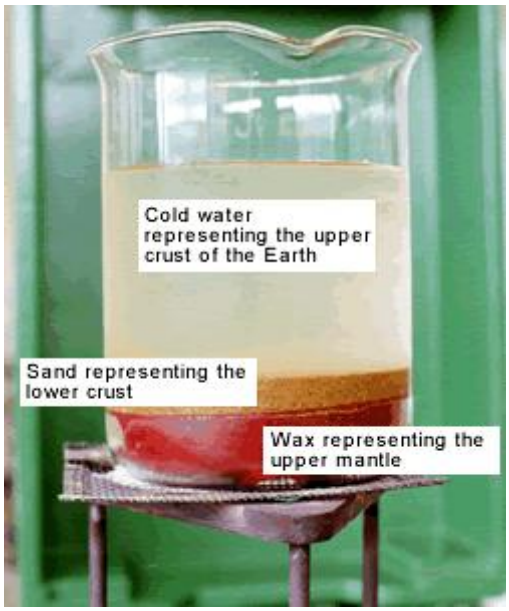


Image from RSC website
http://www.rsc.org/education/teachers/learnnet/JESEI/volcano/home.htm
[accessed 30.12.09]

The original idea for the wax volcano model came from Mike Tuke and is described in M. Tuke *Earth Science Activities and Demonstrations,* London: John Murray, 1991.

WOW Factor

Frankenstein's Hand

Chemistry / Physics
Key Stage 3 +

Described by
Ann Crompton

Equipment / Materials / Resources:

- Rubber Glove (yellow ones are nice and bright)
- Sodium bicarbonate powder
- Vinegar
- 100ml beaker (or glass, or mug)
- Teaspoon / spatula
- Safety glasses

Method:

- Put on safety glasses
- Pour 50ml vinegar into beaker
- Put 2 teaspoons of sodium bicarbonate powder into the glove, and shake into the fingers a bit
- Put the rubber glove over the beaker, making a seal, but keeping the powder in the fingers
- When ready to go (get attention) lift glove to tip powder into beaker and wait for the WOW !

Safety / Risk Assessment:

- May bubble over a bit, so may need to put in a tray, or on a bench which can wiped
- Wear eye protection as vinegar is acidic
- Possible allergic reaction to latex gloves

Advice:

- Make sure the glove seals against the beaker properly, if necessary, use an elastic band or sticky tape (but it worked fine for me last time without this)

Expected Results / Conclusions:

- As the bicarbonate and vinegar react, carbon dioxide is produced
- As the gas builds up, the hand inflates and rises up
- Reaction is $NaHCO_3$ (aq) + $HC_2H_3O_2$ (aq) ------> CO_2 (g) + H_2O (l) + $NaC_2H_3O_2$ (aq) (Sodium acetate is the aqueous solution)

National Curriculum links:

- Mixtures and Compounds (what are 'ingredients' and products?)
- Gases and pressure (inflating hand)

Internet link:

http://www.youtube.com/watch?v=qsRphR4gANo [accessed 30.12.09] Demo

Lesson Objectives (pupils):

- Explain how to identify that a reaction has taken place

Differentiation:

- All students can identify that a gas is produced which inflates the hand
- Most identify the different reactants/products, whether they are solid, liquid, gas, elements, compounds, mixtures, pure impure etc.
- More able students can describe reaction, and suggest products

Assessment:

Works well as a plenary demo with questions (I did at the end of a reaction on mixtures) E.g.

- What do we start with? (mixtures/ pure/ sodium bicarbonate etc.)
- What are the products of the reaction?
- How do you know that there has been a reaction?
- What has inflated the glove?
- Why does the glove deflate again?
- How could we vary this (balloon on lemonade bottle etc)

Role of Learning Support Assistant(s):

- Can be used as a demo, but if done individually, check set up

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Vary mass of bicarbonate added and time how long it takes to raise the 'hand' (numeracy: weighing / timing)
- Describe the reaction using correct terminology (literacy)

Make connections to everyday life by:

- Linking to 'Chemicals in the kitchen' and baking – bubbles in cakes and bread

'How Science Works' and/or 'ideas and evidence'

- The use of models to explain observations
- How theories are used to make predictions
- Link to idea of how to recognise that gas has been produced – can't normally SEE this

WOW Factor

CD Air Glider

Physics Key Stage 3

Friction lesson

Described by Cathy Heywood
Modified by Alison English

Equipment / Materials:

- Plastic bottle + lid
- Balloon/s
- Rubber bands
- Glue gun, plasticine, or blue-tac
- CD
- Push Pin

Internet Links:

http://www.youtube.com/watch?v=a2iCl5zDEoU
(the last minute of this video clip is most useful)

Safety / Risk Assessment:

- Low – latex allergy
- Low – Glue gun may get hot. CLEAPPS: 11.6.4 Hot-melt adhesives (glue guns) . Safety glasses and warn pupils re danger of burns if they assemble this. Low-temperature glue guns can be used by Y7. Hot-melt glue guns by Y9 and above.

Advice:

- Need lots of spare balloons of all sizes as some will get broken as you try to stretch them over the bottle lid.
- Lots of elastic bands needed if attempting hovercraft experiment

Expected Results / Conclusions:

- Fun activity that the kids really engage in. I did it on the Monday of Science Week with 4 pupils as part of a tutor session. I was asked to repeat it in every tutor lesson that week. Extra pupils came as they heard about it and we had difficulty getting rid of the kids at the end of tutor time despite the sessions being 15 mins after school

- Pupils love competition of seeing which glider performs the best

National Curriculum links:

- KS3 Forces – friction

Lesson Objectives (pupils):

- Pupils to consider the effect of friction on the motion of an object

Differentiation:

- Gifted pupils can attempt hovercraft experiment.
  Does adding a rubber ring around the edge have an effect on friction?
- Pupils can experiment with different balloons and also different CDs (with/without labels for example)

Assessment: *bulleted list e.g. directed or open questions /follow-up work such as diagrams*

- Attempts could be video'd or pupils asked to write an account
- A supplied diagram could be handed out and pupils asked to draw arrows to show the forces

Role of Learning Support Assistant(s):

- To help low ability pupils or those with limited manual dexterity with the balloon

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- The gliding could be timed and means calculated
- Volume of balloon could be related to how long the gliding lasts for

Make connections to everyday life by:

- Link to hovercraft, air hockey. Don't mention friction. See below and ask pupils why there is a difference between the movement of the two CD's.

'How Science Works' and/or 'ideas and evidence'

- Helps shows how scientists can model the effects of friction. Best to ask pupils to push the CD along the desk without the balloon etc attached and then ask them to do it again with the air filled balloon attached.
- Pupils can make predictions as to whether the hovercraft idea will work or not and can test heir theories.

WOW Factor

The Great Egg Drop

Physics Key Stage 3

Described by
Helen Tremayne
Kevin Morris
Laurence Hyett

Equipment / Materials / Resources:

- Basic building materials e.g. 5 drinking straws, 2 pieces of card, 2 pieces of paper, 20 cm of double sided paper and 20cm sellotape
- Eggs - hard boiled if you want less mess for you to clean up (one for each group)
- Plus an area for you to drop the finished product

Method:

1. The aim is to build a pod to protect an egg during a fall – set up as a competition they can add a team design to the egg.
2. Pupils have to design and build a carrying pod to protect an egg during a fall using only the materials given to them
3. They have to think about the forces and the problems they will encounter in the fall and the protection needed for the egg.
4. Give them 20mins, after this time show them one you have made using the same equipment (they love the chance to beat the teacher)!
5. Take the class to a suitable drop site – about 10ft is usually enough.
6. Test out their designs – move back to the classroom to see the damage!

Safety / Risk Assessment:

- Sharp objects – for cutting materials
- Movement around the class
- Movement outside the lab
- *Salmonella* – wash hands after handling eggs and disinfect surfaces

Advice:

- Make it a competition with a prize
- If you want only one winner and more than one doesn't break it can go on being able to explain why they designed it in the way they did or the team design

Expected Results / Conclusions:

- Some eggs will break due to not enough protection while other designs will be more effective and protect the egg.

National Curriculum links:

- KS3 3.1a *forces are interactions between objects and can affect their shape and motion*
- (KS4 1.2a *plan to test a scientific idea, answer a scientific question, or solve a scientific problem)*
- It could be used if you have finished a topic and want to challenge pupils
- A team work exercise.

Internet links:

http://wilderdom.com/games/descriptions/GreatEggDrop.html [accessed 30.12.09]

Lesson Objectives (pupils):

- To be able to protect an egg from breaking during a fall
- To be able to explain why they have chosen this method

Differentiation:

- Ensure groups are mixed ability
- Use targeted questioning and offer hints or talk through the problems they face

Assessment:

- Pupils present their design and explain why they have chosen a certain technique

Role of Learning Support Assistant(s):

- To circulate around the room and offer assistance when required

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Numeracy – calculating the drop (height)
- Literacy – being able to present their findings and design idea to their peers

Make connections to everyday life by:

- Crash test dummies and their use in ensuring human protection in cars
- Why parachutes are used.
- Forces – why things fall
- Packaging design

'How Science Works' and/or 'ideas and evidence'

- What forces are going to act upon the pod?
- Why would the egg break if it wasn't protected? – looking at materials
- Design – why would their designs work?
- Why do we use certain types of packaging?

WOW Factor

Marshmallow Magic

Physics Key Stage 3

Described by
Katie Salmon

Equipment / Materials:

- Clear wine bottle
- Wine keeper (vacuum pump & valve)
- Marshmallows
- Safety screen

Method:

1. Push marshmallows into the wine bottle until it's about ⅓ – ½ full
2. Put the wine keeper top on the bottle and use the pump to remove the air from the bottle
3. Give the bottle a shake then pump some more, the marshmallows should expand
4. Depending on the size of the class, it may not be obvious how much the marshmallows have expanded, but when you take the stopper out of the bottle they contract back to normal size immediately, making it a lot easier to see the difference in size.

Safety / Risk Assessment:

- Glass bottle used-careful of broken glass
- Safety screen in case glass breaks (low risk)
- Keep face away from plunger when pumping air
- CLEAPSS 10.6.1 Safety / General Equipment / Vacuum Pumps

Advice:

- Long thin marshmallows are best to use and might need to be rolled in hands to make them fit

Expected Results / Conclusions:

- The marshmallows should expand and then shrink back to original shape when you remove the stopper

National Curriculum link:

- Key stage 3-unit 9L: pressure and moments

Internet link:

http://www.physics.org/interact/physics-to-go/amazing-marshmallows/index.html
Video of the demonstration

Lesson Objectives (pupils):

- To know that air exerts a pressure on everything it touches
- To be able to explain the behaviour of gases under pressure

Differentiation:

- Either ask the pupils simply why they think it's happening or use leading questions eg. what have you taken from the bottle-how could that have made a difference

Assessment:

- Follow-up work-could use ruler under newspaper (rolled up and flat) to demonstrate air pressure

Role of Learning Support Assistant(s):

- Help to monitor practical work

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Ask pupils to think of another way they could demonstrate air pressure and write a description using scientific language

Make connections to everyday life by:

- Look into where air pressure is used in everyday life

'How Science Works' and/or 'ideas and evidence'

- Using model to explain air pressure

WOW Factor

Paper Planes

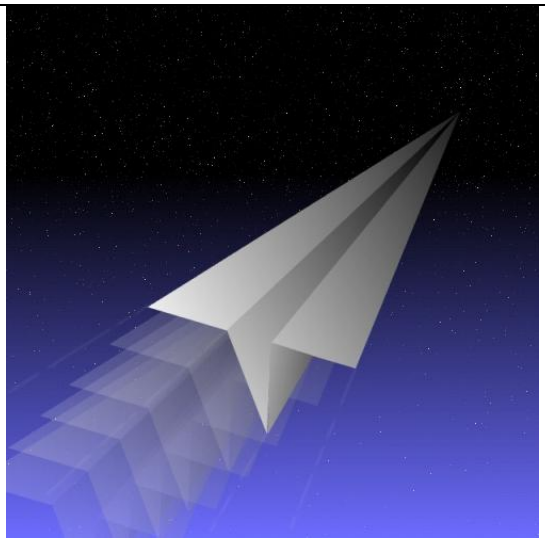
On the Move – investigating air resistance

Physics Key Stage 3

(very low ability)

Modified by

Sally Vyse



Equipment / Materials:

- Sheets of A4 paper, 1 per child
- Ping pong balls (or similar actually better with ones that don't bounce)
- Parachutes (fabric, paper, plastic)
- String/cotton
- Sellotape

Method:

1. As a class, drop a piece of A4 paper and observe
2. Turn the flat paper into a tray shape and observe
3. Describe the differences in movement – why?
4. Hand out balls
5. Drop balls describe what happens
6. Make parachute and attach to ball
7. Leave class go to top of stairs; some people at top, some at bottom
8. All drop together and talk about what we see
9. Whose parachute was the best? Why?
10. Discuss streamlining
11. Make a streamlined object (pupils should know paper airplane)
12. All stand at one end of class and throw
13. The winner (furthest flyer) gets prize.

Safety / Risk Assessment:

- Caution near stairs
- Don't throw planes at each other

Advice:

- Try and avoid balls that bounce
- Collect up all paper airplanes immediately after they have been thrown

Expected Results / Conclusions:

- **To understand that air slows down objects moving through it**

National Curriculum links:

- Air resistance, forces, streamlining

Internet link:

http://hubpages.com/hub/Step-by-Step-Guide-to-Making-Paper-Airplanes [accessed 31.12.09]
One of many guides to making paper airplanes

Lesson Objectives (pupils):

- Describe the effects of air resistance on objects
- Describe the shape of streamlined vehicles

Differentiation:

- All: use practical work to investigate the effects of air resistance on objects.
- Most: describe air resistance as drag
- Some: describe how to reduce drag by changing the shape of an object to become more streamlined

Assessment:

- Targeted Q&A of small groups as working on practical and whole class
- Worksheet with questions
- Creation of suitable streamlined object (paper airplane) – could be photographed or video'd

Role of Learning Support Assistant(s):

- Help with behaviour and finding planes

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- understanding of new keywords, pronunciation

Make connections to everyday life by:

- Design of everyday vehicles and how the children get around

'How Science Works' and/or 'ideas and evidence'

- Why vehicles are shaped as they are

WOW Factor

Pressure Fountain

Physics Key Stage 3

level 5-7

Modified by
Sally Vyse

Equipment / Materials:

- 2 jam jars (1 with lid)
- Screwdriver
- 2 straws
- Blu-tak/plasticine
- Food colouring
- Sinks or buckets

Method:

1. Take 2 jam jars one with a lid
2. Insert straws into (previously made with screwdriver) holes in lid so that 1 pokes through about 2cm and the other about 5, use blu-tak to make airtight
3. Half fill lidless jar with water (coloured for best effect)
4. Add small amount of water to lidded jar(dif colour) screw on lid (tight)
5. Tip lidded jar upside down with longer straw poking into the water in jar 2 and short straw emptying into sink/bucket
6. You get a really cool fountain which the children can then explain to each other

Safety / Risk Assessment:

- Possibility of spills with water, clean up immediately
- Take care with screwdriver, probably best to make holes before lesson

Advice:

- Don't use red food colouring (it looks a bit gruesome!)

Expected Results / Conclusions:

- As water particles leave the top jar pressure decreases; this causes water to be sucked up the straw creating the fountain and returning the pressure to normal

National Curriculum links:

- Scientific investigation
- Pressure

Internet link:
http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/glueing-glasses/
[accessed 31.12.09]
Some ideas for extension work on pressure

Lesson Objectives (pupils):

- Describe what is happening in the pressure fountain in terms of particle movement
- Suggest how to make a higher fountain

Differentiation:

- All: use practical work to investigate the effects of pressure changes.
- Most: describe pressure in terms of particles.
- Some: explain how to increase the pressure and make a higher fountain.

Assessment:

- Targeted Q&A of small groups as working on practical and whole class.
- Diagram showing particle movement in stages.
- Creation of functioning practical.

Role of Learning Support Assistant(s):

- Assisting with fine details e.g. air tight seals

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- understanding of new keywords, pronunciation

Make connections to everyday life by:

- How straws, to drink drinks, work

'How Science Works' and/or 'ideas and evidence'

- Manipulative skills
- Explaining observations

WOW Factor

Rice in a Jar

Physics

Key Stage 3 / 4 / 5

Works with all, although better with KS3 & 4

Described by

Becky Leighton

Equipment / Materials / Resources:

- Rice
- Glass Jar (narrower at neck than body)
- Pencil

Method:

1. Fill up the glass jar with rice.
2. Shake up the jar and add more rice until it is truly full
3. Push a pencil into the middle of the jar. Show the class that the pencil comes out of the jar easily
4. Then ram the pencil in and out of the jar repeatedly
5. After about 40 times the pencil will lift the jar

Safety / Risk Assessment:

- None – unless your kids can do something with grains of rice!

Advice:

- Rice tends to go everywhere so use a tray

Expected Results / Conclusions:

- The friction acting between the pencil and the rice grains overcomes the force of gravity

National Curriculum links:

- 7K Forces
- Yr 9 forces

Internet link:

http://www.csiro.au/helix/sciencemail/activities/LiftingAJarOfRice.html

This Australian site explains this demonstration and is the source of the photo used

Lesson Objectives (pupils):

- To see friction in action and to understand the demonstration work

Differentiation:

- Most should be able to Identify the force that allows the jar to be picked up with the pencil
- Some should be able to explain how this force works

Assessment:

- Can do a diagram, but is good as a plenary

Role of Learning Support Assistant(s):

- Help with explanations

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Introduction / revision of key words e.g. friction, force

Make connections to everyday life by:

- Using everyday materials to demonstrate a scientific concept

'How Science Works' and/or 'ideas and evidence'

- The use of a model to explain observations

WOW Factor

Running on Custard

Physics Key Stage 3

Described by

Natalie Cornwell

Equipment / Materials /:

- A lot of custard powder.
- Corn flour
- A huge tub

Method:

1. Make up a lot of custard in a container that is large enough to stand in
2. Run on it!!!

Safety / Risk Assessment:

- Custard should not be consumed
- It is very messy and students could slip on wet floors

Advice:

- Use lots of newspaper

Expected Results / Conclusions:

- Pupils can see how pressure is linked to area – when running from one foot to the other the pressure is high enough to make custard a solid, but when you stand still on both feet you sink when it turns to liquid again
- Custard is a non-Newtonian fluid which makes it a solid when under high pressure while remaining in its liquid form otherwise

National Curriculum links:

- Any links to pressure.

Internet links:

http://news.bbc.co.uk/cbbcnews/hi/newsid_4470000/newsid_4479100/4479150.stm
[accessed 30.12.09]
Jonathan Edwards running on custard – new item – getting pupils interested in Science

www.youtube.com/watch?v=gUSiwL767dA&feature=PlayList&p=963CD8D07640B1E6&index=1
[accessed 30.12.09]
This becomes more convincing towards the end – pupil running on custard

Lesson Objectives (pupils):

- Understand how pressure is linked to area

Differentiation:

- This may not be a suitable activity for a large class or for anyone with mobility problems

Assessment:

- Pupils could be asked to write a short account for the school magazine, explaining any scientific terms used

Role of Learning Support Assistant(s):

- Can be asked to run on the custard!!!
- Help with pupils and any silliness

Support cross curricular work in literacy, numeracy, key skills and citizenship by:

- Writing an account using key words (literacy)

Make connections to everyday life by:

- Pupils were invited to walk across a pool of custard as part of a drive to convince them tha science is fun (see web link above)
- Linking scientific principles to an everyday item

'How Science Works' and/or 'ideas and evidence'

- Use of repeats to establish reliability
- Observations to establish evidence
- Explanations to suggest what is happening here