Gloucestershire Leading Science Teachers group

Short

Engaging

Practical

Demonstrations

Gloucestershire COUNTY COUNCIL

Short engaging practical demonstrations

This collection of ideas has been gathered together by a group of Gloucestershire science teachers who were looking for attention grabbing ideas to use as starter activities or to re-engage pupils during a lesson.

Each example is linked to a science curriculum area with details of equipment requirements and some suggestions for questions to ask pupils to think about.

We hope that you will find this to be a useful resource and that it inspires you to share more of your own. If you have any comments, suggestions or ideas for activities please contact the science team through sylvia.odell@gloucestershire.gov.uk

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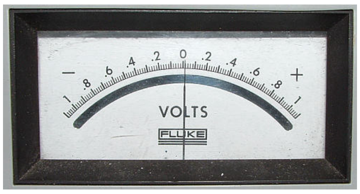
Contents by topic



Amorous meter

Introduction

This experiment fits in well to KS3 Electricity and Energy (9I). It is useful for discussing voltage and conductivity of people, but it is also a fun way of introducing electrochemical potentials at KS4.

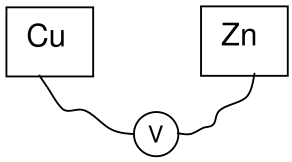
Risk assessment   Risk of cuts if plate edges are not smoothed

Apparatus

Plate of copper and plate of zinc
(both should be hand-sized and have smooth edges to reduce risk of cuts)
Voltmeter to read between +1V and -1V (eg large demo meter)
Leads to connect metal plates to voltmeter

Method

1. Pupils place 1 hand on each metal plate.
2. Voltmeter should read between 0.5V and 1.0V

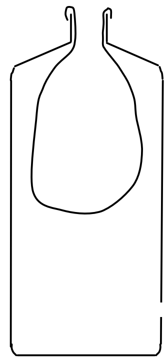


Explanation

The electrochemical potential between copper and zinc causes the reading on the voltmeter. The pupils' bodies act as the conductor. Pupils producing the highest reading have the sweatiest palms (most amorous?).

Questions to ask

1. What is the reading on the voltmeter (for analogue meters)
2. What do you notice about the reading for different pupils?
3. Why do you think this is?
   How could you test your idea?
4. Why is the reading always positive/negative?
   How could you change its polarity?
5. How is the voltage produced?
6. What will happen if we use different metals?



Balloon in a bottle

Introduction

This experiment is useful for demonstrating air pressure and that 'air is real', but it is a useful 'teaser' for any age.

Risk assessment

Very low. Only one person should blow up the balloon to avoid infection.

Apparatus

Empty water bottle of any size up to about 1 L
Make a small hole (2 to 4mm diameter) near the bottom.
Place a balloon inside and wrap its open end around the top of the bottle.

Method

1. Discretely hold your finger over the hole and try to blow up the balloon (it won't blow up).
2. Remove your finger and repeat - now it blows up.
3. With the balloon inflated, replace your finger over the hole and remove the bottle from your mouth - the balloon stays inflated.
4. Pretend to pour the air out of the bottle: tip it and move your finger slightly so that the balloon deflates slowly.
5. Repeat these in any order to prove that you have an obedient balloon!

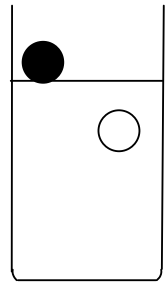
Explanation

The air in the bottle can only move in and out if the hole is open. If the hole is closed, the balloon cannot change shape as the air in the bottle is exerting a pressure on it.

Questions to ask

1. Why won't the balloon inflate?
2. When the balloon is inflated, why doesn't it go down when the person takes it away from their mouth?
3. How can the air be poured slowly out of the balloon?

Balls in rice



Introduction

This experiment is useful for demonstrating floating and sinking (Forces and their effects, 7K) and for discussing solids and liquids (7G), but it is a useful 'teaser' for any age.

Risk assessment   Very low.

Apparatus
Empty transparent bottle or other container with a wide neck.
Fill bottle with long-grain rice.
Place a steel ball on the top of the rice and a polystyrene ball a few cm below the surface. Both balls should be roughly the same size, between 1cm and 2cm diameter.

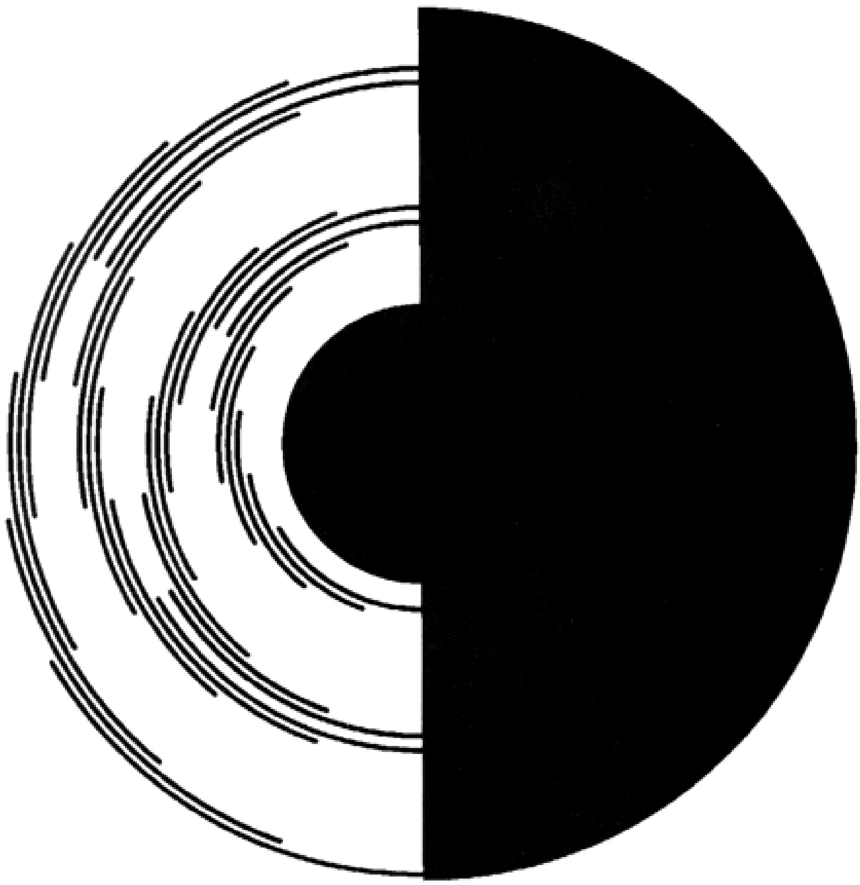
Method
Shake the bottle quite vigorously so that the steel ball sinks and appears to be replaced by the polystyrene ball as it rises to the top.

Explanation
The rice behaves as a fluidised bed (liquid). The steel ball sinks because it is more dense than the rice and the polystyrene ball rises as it is less dense.

Questions to ask

1. How has the steel ball turned into a polystyrene ball?
2. How can these balls move through the solid rice?
3. Why does the steel ball sink and the polystyrene ball rise?

Benham's Disc



Introduction
This experiment is useful for discussing light, sight and perception at any age.

Risk assessment   Very low.

Apparatus

- Copy of this pattern stuck onto card
- Device to allow rotation of the pattern eg drill, turntable, toy spinner, electric screwdriver etc
- incandescent light (fluorescent light does not produce such a good effect)

Method

1. Attach the disc to the rotating device and spin it
2. View the disc under incandescent light

Explanation
Coloured bands will appear. Different people see different intensities of colours on this spinning disk. There are three types of cones, sensitive to red, green and blue light. Each type of cone has a different latency time (the time it takes to respond to a colour) and a different persistence of response time (the time it keeps responding after the stimulus has been removed). When you gaze at one place on the spinning disk, you are looking at alternating flashes of black and white. When a white flash goes by, all three types of cones respond. But your eyes and brain see the colour white only when all three types of cones are responding equally. The difference between the latency and response times leads to an imbalance that partly explains why you see colours.

Questions to ask

1. What can you see? Does everyone see this?
2. What does this demonstrate about light?
3. What variables could you investigate?

Biscuit paper/teabag

Introduction

This demonstration fits in well to Heating and Cooling (8I) and KS4 Energy transfer (convection) - but it is great fun at any time!
It promotes discussion of how convection currents are caused and how the mass of an object changes as it burns.

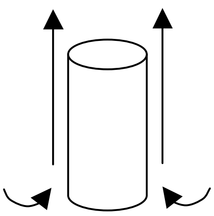
Risk assessment Do this in a room with a high, fire-resistant ceiling.
Prevent pupils from blowing the burning paper.

Apparatus Wrapper from Amaretti biscuit or empty tubular tea bag

Method

1. Smooth the paper, roll it into a cylinder (biscuit paper only) and stand upright onto a heatproof mat.
2. Light the top of the cylinder all the way round.
3. When the flame reaches the bottom, the cylinder (ash) will rise dramatically (up to the ceiling if you are lucky).

Explanation

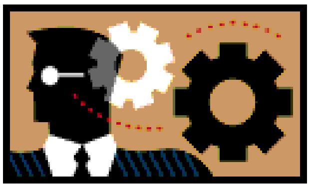


The flame creates a convection current in the air around the paper cylinder (see diagram). As the paper burns, its ash weighs less than the original paper. Eventually, the weight of the ash becomes so small that the convection current lifts it upwards.

Questions to ask

1. What causes the ash to rise?
2. Why doesn't the paper start rising near the beginning of the experiment?
3. What would happen if the paper was (a) smaller or (b) larger?
   (this would make a good investigation - there seems to be an optimum size which is a compromise between creating an adequate convection current and the weight of the paper)

Brain Teaser



Introduction
Suitable for Sc1.

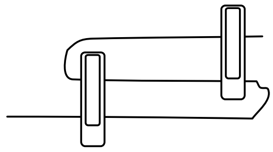
Risk assessment   Low risk

Apparatus

- A strip of paper, approx. 15 cm by 3cm
- 2 paper clips

Method

1. Fold the paper so that it makes an 'S' shape and attach the paper clips as shown
2. Pull the ends of the paper to pull apart the S



Results

The paper clips fly off and end up stuck together.

Questions

1. What do you think is going to happen?
2. What happened?
3. Why did it happen?
4. How could we make this into an investigation?
5. Are there any variables that you need to consider?

Bunsen flame

Introduction
This demonstration can be used in Year 7 to introduce pupils to the Bunsen burner. It would also be useful later on with any fuel /combustion or chemical reactions related topic.

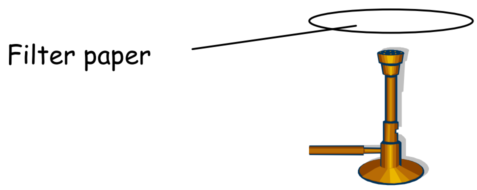
Risk assessment: Low

Apparatus

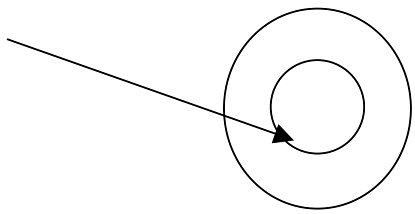
- Bunsen burner
- Matches
- Filter paper

Method

1. Secure an unused match in the top of a Bunsen burner (with the tip upright) and show that it doesn't light when the flame is roaring (air- hole is open).
2. Briefly hold a piece of filter paper over the roaring flame for a very short time. You will be able to tell which is the hottest by where the paper has burnt. This can also be done with the air-hole closed and half open to compare.



When the air hole is open there should be a ring to show where the paper has burnt indicating the hottest part of the flame.



Questions

1. Why do we always light the Bunsen burner when the air hole is closed?
2. Why can't you use a thermometer to test which is the hottest part of the flame?
3. How could you find out which flame is the hottest?
4. What are the reactants and products of this chemical reaction?

Burning tenner

Introduction

This demonstration could be linked to a Fuel/Combustion or Energy topic.

ethanol + oxygen --> carbon dioxide + water

C_2H_5OH (l) + $3O_2$ (g) --> $2CO_2$ (g) + 3H20(l)

Risk assessment (Medium: refer to CLEAPPS guidance)

Ethanol is highly flammable. Don't get the beakers mixed up.

Are you prepared to risk one of your own tenners?

Apparatus

- 3 beakers
- Bunsen burner
- Tongs
- 2 pieces of banknote sized paper
- One ten pound note
- Ethanol
- Water

Method

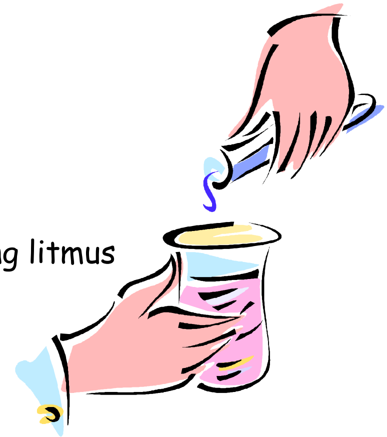
1. Dip a banknote- sized piece of paper into a beaker containing $100cm^3$ of water.
2. Using tongs, place the piece of paper into the flame of a Bunsen burner. It should not burn.
3. Dip the other piece of paper into $100cm^3$ of ethanol.
4. Using tongs, place the paper into the Bunsen flame. It should burn.
5. Put $50cm^3$ of ethanol and $50cm^3$ of water into a beaker to produce a 50:50 mixture.
6. Dip your ten pound note into the solution.
7. Using tongs, place the ten pound note into the flame.

Results

Hopefully your tenner shouldn't go up in flames. The ethanol burns away but the water keeps the paper under its ignition temperature so it doesn't burn. It works along the same principle as a flaming Christmas pudding.

Questions

1. What happens to the particles of the liquids on the outside of the tenner?
2. How and why is the heat energy transferred?
3. Why do you think the note in water does not burn?
4. How can you make this a fair test?



Cabbage Paper

Introduction
This can be linked to Acids and Alkalis (7E). While pupils are using litmus and universal indicator paper, they can make their own indicator paper. This can be done over two lessons where the indicator paper is made one lesson and used in the next lesson.

Risk assessment
Wear safety goggles when using acids and alkalis.
Use low concentrations
Refer to CLEAPSS guidance

Apparatus
- Red cabbage
- Pestle and mortar
- Filter paper
- Samples of acids and alkalis –dilute solutions
- Pipettes

Method
1. Chop up some red cabbage and use pestle and mortar to crush, adding a small amount of water
2. Drain of red cabbage juice. More water can be added if needed to dilute the solution
3. Soak some filter paper in the 'jus de red cabbage' and leave to dry
4. Once dry, 'paint' on some acids and alkalis, writing their initials or making a drawing with it.

Results
Red cabbage is a wonderful natural indicator. 'Stomach acid' turns it pink, and oven cleaner turns it green. It will get them thinking about the facts that the colour of an indicator can tell us if something is an acid or an alkali.

Questions
1. What colour does the red cabbage turn is the substance is acidic?
2. Can you pick the substance which is the most acidic?
3. Why do you have to crush the cabbage?

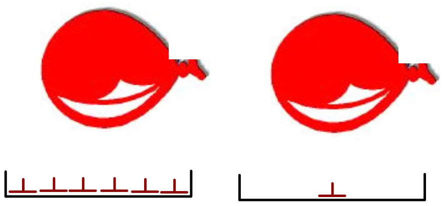
Can you take the pressure?

Introduction
This demonstration could be linked to pressure and moments (9L).

Risk assessment
Warn pupils about the loud pop! Care should be taken with any individuals of a nervous disposition

Apparatus

- 2 pre-prepared Petri dishes; the first with a single drawing pin stuck down, point up; the second filled with pins, stuck down, points up (make sure they are all the same level)
- A couple of balloons



Method

1. Get the pupils to predict what will happen
2. Press the balloon against the full Petri dish. It shouldn't pop
3. Press the balloon against the Petri dish containing the single pin. It should pop.

Results
The pupils should be able to explain in terms of pressure, force and area, why the balloon didn't burst with lots of pins.

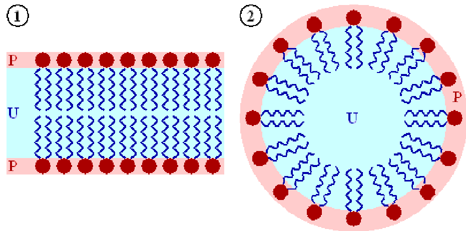
Questions

1. Why did the balloon burst with only one pin?
2. Why didn't the balloon burst when there were lots of pins?
3. How many pins do you think you would need before the balloon no longer burst?
4. How can you relate this to a bed of nails?

Cell Membranes

Introduction

This nice little demo shows that the cell membrane is not a rigid structure, and shows how some substances pass through the membrane. To model the cell membrane, this can be used in Cells (7A), and at A-level to show pinocytosis and phagocytosis, and to help students understand the idea that lipids form micelles in water.



Risk assessment Very low

Apparatus

- Measuring cylinder
- Water + food colouring (just to make it look pretty)
- Cooking oil
- Salt

Method

1. Fill the measuring cylinder (any size) 3/4 full of water. Colour the water with the food colouring
2. Add a layer of oil to the top surface of the water
3. Sprinkle salt on the top

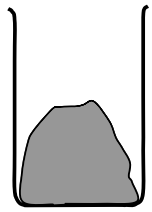
Results

The salt floats on the top of the oil and gradually sinks down to the boundary between the water and the oil. Once there is enough of it, it begins to sink down into the water in the shape of a sphere – the lipids appear to form a micelle-type structure around the salt. This can be compared to the structure of the lipid membrane.

Questions

1. What does this model tell us about the structure of the cell membrane? Does anything about it surprise you? (trying to get them to think about the fluidity of the membrane rather than it being a solid structure)
2. How does the formation of micelles compare to the structure of the cell membrane?
3. Can you relate the structure of a lipid to the formation of a lipid bilayer or a micelle?
4. How does this model inform us about pinocytosis and phagocytosis?

Cornflour



Introduction

This experiment is useful for discussing the differences between solids and liquids in 'Particle model of solids, liquids and gases', 7G, and for describing forces in 'Forces and their effects', 7K. The experiment is great fun for pupils to do (can be very messy!); it could be used with the 'Brainiac' episode in which a man walks across a swimming pool filled with custard (available on DVD).

Risk assessment — Little safety risk but pupils do like to get their hands in the mixture and the lab may need cleaning.

Apparatus

Several heaped tea spoons of Cornflour in a medium beaker.
Strong spoon to stir.
If pupils are doing the experiment, cover bench with newspaper and provide trays for the beakers to stand in.

Method

1. Add water a little at a time and stir into the Cornflour.
2. If stirred slowly, the mixture behaves as a runny liquid; if stirred violently, it behaves more like a solid. If treated roughly, it can even be formed into a ball which bounces - but don't let go of it for long!

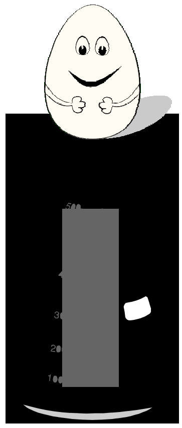
Explanation

The mixture is said to be thixotropic; the long polymer chains of the Cornflour can move easily past each other when the applied force is low. When the applied shear force is large, they cannot slide over each other fast enough and get tangled up.

Questions to ask

1. What do you notice when you stir the mixture slowly and then fast?
2. Is this mixture a solid or a liquid?
3. Do you know any other materials that behave like this?
4. Can you think of any uses for a thixotropic material?
5. The molecules of Cornflour are very long and thin; use this to explain your observations.

Egg and Conical Flask



Introduction

This can be used to demonstrate gas pressure in the particle model of solids, liquids and gases (7G)

Risk assessment Very low

Apparatus

- A hard boiled egg, shell removed
- A conical flask
- Bunsen burner, tripod, gauze, heat proof mat

Method

1. Place a small amount of water in the bottom of the conical flask, and heat using the Bunsen. The water needs to begin to boil
2. Take the flask off the heat, and once the steam seems to stop coming out of the flask place the egg on top of the flask
3. As the water cools, the water vapour inside condense back into water and the egg gets sucked into the flask
4. If the egg does not break up on the way in, you get it back out by tipping the flask on its side so that the egg is in the neck of the flask and heat the water again. The egg should be pushed out.

Results

As the water vapour in the flask cools and condenses, the pressure inside the flask drops and the egg will get pulled into the flask. The reverse happens when you re-heat the water. It evaporates and increases the pressure in the flask, pushing the egg out.

Questions

1. How can I get this egg into this flask without breaking it up?
2. What is happening to the water as I am heating it? Think about it in terms of particles and energy.
3. Why is the egg being pulled into the flask? Think about the particles of gas.
4. How could I get the egg back out?

Exploding Canister

Introduction

This can be used to demonstrate simple Chemical Reactions, Rates of Reactions, for Pressure experiments and Building rockets.

Risk assessment (Medium)

Wear goggles and stand well back.
Don't shake the contents or it could go off in your hand.
If making rockets sit them on a flat surface e.g. a plate and set them off outside!

Apparatus

- Empty black camera film canister and lid
- Alka-Seltzer, blu-tac and water
- Vinegar and sodium hydrogen carbonate can be used as an alternative
- Card if you want to make a rocket (to make a front cone and the body of the rocket, these can be decorated in a funky style!)

Method

1. Fill 2/3 of a film canister with water.
2. Attach a piece of Alka-Seltzer to the inside of the lid using blu-tac,
3. Replace the lid and turn the canister upside down.

Results

When in contact the water and Alka-Seltzer will react. One of the products of the reaction is carbon dioxide gas. After a short while the pressure should build up enough to force the lid off the canister.

See this useful website for other teaching ideas with Alka-Seltzer
http://www.alka-seltzer.com/as/experiment/student_experiment.htm

Questions

1. What do you see happening when the Alka-Seltzer drops in the water?
2. What is being produced?
3. How can we vary the time it takes to 'pop'?
4. Why does the lid blow off (particles)?

Exploding Crisp Tube

Introduction
This demonstration is an alternative version of the exploding can. It shows the explosive properties of gas at a particular concentration but can also be used to demonstrate the rocket principle (Newton's 3rd law).

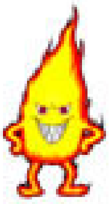
Risk assessment
Ensure there are no naked flames nearby while filling the tube with gas.
Make sure that the tube is completely full of gas.
After lighting the flame at the top of the tube, stand well back behind a safety screen.

Apparatus
Tall tube with plastic lid (eg Pringles)
Make a 1cm diameter hole in the metal base.
Make a 1cm diameter hole in the cardboard side, near to the plastic lid

Method
1. Place the tube upside down (metal base at top) on a heatproof mat. Have the plastic lid ready next to the tube.
2. Closing the 2 holes with your fingers, fill the tube with gas for 15 seconds (until you can smell the gas escaping). Quickly seal it onto the plastic lid.
3. Light the gas escaping from the hole at the top of the tube.
4. After a few minutes, the tube will jump up and leave the plastic lid behind. This always takes longer than expected so keep waiting!

Explanation
As the gas in the tube burns, air flows in through the larger hole to replace it. The flame moves down inside the tube until the mixture reaches the explosive proportions. The explosion lifts the tube out of its plastic base.

Questions to ask
1. Why is the first flame yellow?
2. Where does the flame go?
3. What causes the explosion?
4. Why does the tube lift off the plastic lid?



Fire ball

Introduction
This can be used for topics relating to Combustion or Chemical Reactions but is spectacular at any time!

$$CH_4 (g) + 2O_2(g) \rightarrow CO_2 (g) + 2H_2O (l)$$

Risk assessment (Medium: refer to CLEAPSS guidance)
This is best carried out by 2 people - it is essential to practice first.
Keep the lit candle away from the funnel where the gas bubbles are formed as the gas is highly flammable. Make sure that the clip is closed and that the bubbles have moved away from the apparatus before lighting them with the candle.

Apparatus
- Bubble mixture (25% washing-up liquid; 25% glycerol; 50% water)
- Rubber tube connected to gas tap with a clip to close it near the free end
- Medium filter funnel (clamped vertically with the large end at the top)
- Metre rule with candle or wooden splint attached to one end
- Heatproof mat

Method
1. Attach the free end of the rubber tube to the bottom of the funnel
2. Flush the tube and funnel through with gas; close the clip
3. Place some bubble solution into the funnel
4. Open the clip and allow gas to rise slowly through the bubble mixture to form a column about 25cm high
5. **Close the clip**
6. Scoop some of the bubbles onto a heatproof mat (or damp hands if you are brave!) or use the mat to scoop them off and allow them to float away.
7. The other person lights the bubbles using the candle on the ruler.

For more details, see 21st Century Science,
Combustion demonstrations AC1.11, Teacher and Technician Guide, OUP

Results
When the bubbles are lit they should catch light and produce a magnificent fireball.

Questions
1. Why do the bubbles rise?
2. What might happen if you used a different gas?
3. What might happen if the bubbles were bigger or smaller?

Floating Egg

Introduction
This can be linked to Forces and their effects (7K), floating and sinking.

Risk assessment Very low

Apparatus
- A raw egg
- A large measuring cylinder
- Salt water
- Fresh water (tap water is fine)

Method
1. Half fill the measuring cylinder with salt water
2. Fill the rest of the cylinder with fresh water
3. Place the egg in the cylinder

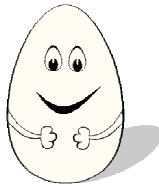
Results
The egg will float in the boundary between the salt water and the fresh water. This will allow to the pupil explain why in terms of density.

http://www.york.ac.uk/res/sots/activities/eggs.htm

This website suggests some other fun things with eggs!

Questions
1. Would the same thing happen with a boiled egg?
2. Can you describe the forces acting on the egg?

Floating and Sinking Egg



Introduction

This can be linked to Forces and their effects (7K), floating and sinking, Simple Chemical Reactions (7F), Rocks and Weathering (8G – the shell reacts to the acid in the same way that acid rain attacks limestone).

Risk assessment

Safety goggles required when using hydrochloric acid.

Apparatus

- A raw egg
- Tap water
- A large measuring cylinder
- Hydrochloric acid

Method

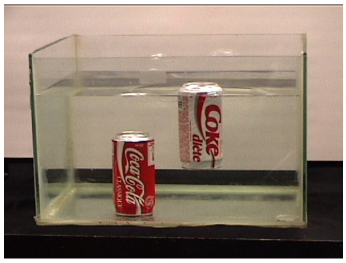
1. Fill the measuring cylinder about 2/3 full of water
2. Place the egg in the cylinder and it will sink to the bottom
3. Pour in some 0.5M hydrochloric acid
4. The egg will start to form bubbles of carbon dioxide on the surface and will float to the top

Results

The acid reacts with the carbonates in the egg shell, producing bubbles of carbon dioxide. These bubbles stick to the egg shell and enable it to float up towards to the surface. If you leave it for a while the egg will sink back down, and you can make it float again by adding more acid.
Vinegar can also be used to remove the egg shell. See http://www.york.ac.uk/res/sots/activities/eggs.htm

Questions

1. Write a word/symbol equation.
2. Can you describe the forces acting on the egg?
3. What do you think will happen after 1 hour?
4. Would the same thing happen in a boiled egg?



Floating and sinking cans

Introduction
This can be used to elicit ideas about density in the topic Forces in KS3 and KS4 and is very useful for making predictions, conclusions and fair testing.

Risk assessment: Low

Apparatus
- 1 tank or large bucket of water
- 1 x 330 ml can of Diet coke
- 1 x 330 ml can of Coke
- 39 g sugar in a beaker (to show amount in 1 can of Coke)

Method
1) Get pupils to think about similarities and differences between the cans then get them to predict what will happen to each can as you put it in the tank.
2) Place each unopened can into the tank in turn and observe what happens.
3) You could extend this activity by getting pupils to find the density of the coke and diet coke, measuring their mass and then their volume by displacement. You could also show them the mass of sugar added to the Coke and link this to healthy diets.

Results
Even though both have the same volume the can of 'Coke' should sink and the 'Diet coke' should float. The amount of low calorie sweetener (aspartame) that is added to Diet Coke is less than the amount of sugar added to regular Coke. The low calorie sweetener is sweeter than sugar so less is required. This means the mass of the Diet Coke can is less than the regular Coke.

Questions
1) What happened to each can?
2) Describe the forces that were acting on the cans. (What are they?/are they balanced or unbalanced?)
3) Was this a fair test?
4) What made the can of Coke sink? (Density of water = $1g/cm^3$)
5) What is density? How could you work out the density of each can? (M/V)
6) How could you extend this investigation? (test other brands of diet and regular carbonated drinks)

King Kong's hand

Introduction

This demonstration can be used as a fun introduction to Chemical Reactions.

Risk assessment   Low

Apparatus

- Latex glove
- Sodium hydrogen carbonate (Bicarbonate of soda)
- Vinegar

Method

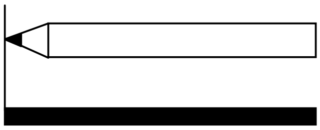
- Put some sodium hydrogen carbonate into the fingers of the latex glove.
- Add some vinegar.
- Quickly tie up the glove around the wrist.
- Wait for King Kong's hand to grow!

Results

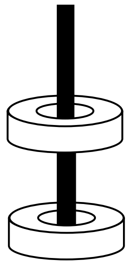
The vinegar and bicarbonate of soda react to release carbon dioxide gas. This inflates the rubber glove.

Questions

1) What chemical do you think is present in the vinegar?
2) What is happening in the reaction? Can you think of an equation for the reaction?
3) What is happening in terms of particles?
4) How is pressure changing inside the glove?



Magnetic pen



Introduction
This demonstration fits in well to Forces and their effects (7K), Magnets and Electromagnets (8J) and KS4 Forces or Magnetism.
It provides an opportunity to practise drawing force arrows, discussing balanced forces and non-contact forces.

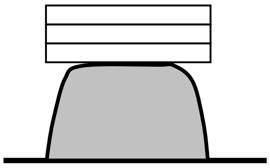
Risk assessment Very low.

Apparatus Magnetic floating pen or magnetic rings
(several versions available from toy and gadget shops)

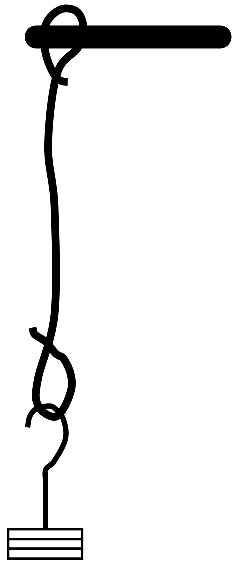
Method
1. Demonstrate the pen floating (with great drama ofcourse)
2. Ask pupils to draw the forces (as arrows) acting on the pen only.

Explanation
Both the pen and its holder contain magnets that are arranged so that they repel. The only 2 relevant forces acting on the pen are the force of gravity (downwards from the centre of the pen) and the magnetic repulsion (upwards, easiest to draw from the centre of the pen).

Questions to ask
1. What are the forces acting on the pen?
(restrict this to vertical forces to avoid complicated discussion about any sideways movement)
2. Why does the pen remain stationary?
(forces are balanced ie equal in size and opposite in direction)
3. What have the 2 forces (gravity and magnetism) in common?
(they are both non-contact forces)
4. How can forces affect an object without touching it?
(simple answer about fields but if they can answer this in full, apply for a Noble prize! Could promote discussion about how we are attracted to the Earth)



Marshmallows and laces



Introduction

These experiments fit in well to Forces and their effects (7K).
They make a pleasant change to the usual springs and elastic bands.

Risk assessment Very low. Pupils should not eat in a laboratory.

Apparatus Marshmallows and strawberry laces
Clamp stands, mats, 30cm and metre rules

Method

1. Place the marshmallow onto a mat, add 100g masses and measure its height at each stage.
2. Tie loops in both ends of the strawberry lace, hang it on a clamp stand. Add 10g masses and measure the length of the lace at each stage.
3. Pupils should work out the compression or extension, as appropriate, for each mass and plot a graph of compression/extension against number of masses/total mass/total force as appropriate to the group.

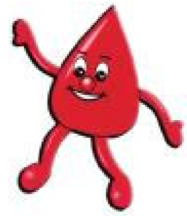
Explanation

The graphs are both non-linear, unlike that for a spring. The lace extends a great deal even for these small forces, and starts to 'creep' at very low forces.

Questions to ask

1. Describe how the height of the marshmallow changes as you increase the force on it. What is this called?
2. Describe how the length of the lace changes as you increase the force on it.
3. Compare the stretching of a lace to the stretching of a spring.

Model of blood



Introduction
This model is useful for demonstrating the constituents of blood. This can be used in KS3 for topics such as 'Respiration' or 'Fit and Healthy' or as a useful recap at KS4.

Risk assessment: Low

Model of blood

- Giant glass measuring cylinder
- Cold tea without milk to represent plasma
- Salt/sugar to demonstrate dissolved nutrients
- Red lentils to act as red blood cells
- Small marshmallows to be white blood cells
- Porridge oats to represent platelets

The different ingredients are added to the measuring cylinder to show the main constituents of blood.

Questions

1) Why do we need blood?
2) Why are the lentils a good representation of red blood cells in this model?
3) Why do we use black tea rather than water as the plasma?
4) Having looked at this model would you still classify blood as a liquid?
5) What does each part of the model represent?

Model digestive system

Introduction
This model is a great visual aid to help demonstrate how the digestive system works. This can be used in KS3 as a fun introduction to digestion or a useful recap at KS4.

Risk assessment: Low

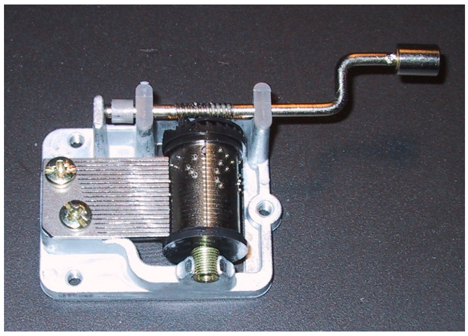
Parts of the model

- Food – leftovers from the day before e.g. cereal and milk, brown toast and baked beans etc.
- Mouth- flat container and potato masher (to grind and mash food up like teeth would). Bottle of water labeled 'Saliva' to be added to the food as it is being mashed.
- Gullet - Large Filter funnel attached to long balloon to allow food to move through into stomach.
- Stomach – Plastic bag or container to collect food. Bottle of water labeled 'Stomach acid' and another labeled 'digestive juices' to be added as the food gets churned up in the stomach.
- Small and large intestines- One leg of a pair of tights. A bottle of water coloured green and labeled 'bile' added to neutralise the stomach acid. Another bottle of water labeled 'digestive juices'. The bile and juices are added then the contents of the tight are squeezed. This leaves the solid remains (faeces).
- An elastic band can be used to represent the sphincter muscle or a hole can be made at the end of the stocking and the solid remains pushed out!!

Questions

1) Why do we need a digestive system?
2) Why does the gullet have muscular walls?
3) Why does the stomach have acid?
4) Why is bile added to the small intestine?
5) Why is the balloon used to represent the gullet and tights (which are permeable) for the intestines?

Musical Box



Introduction

This demonstration fits in well to Sound and Hearing (8L) and KS4 Sound.
It promotes discussion of how sound is caused by vibrations and how these travel through different materials.

Risk assessment Very low

Apparatus Musical box as shown in picture
(Available from Science Museum shop and various gadget shops)

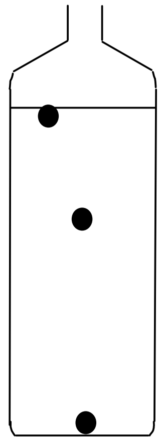
Method
1. Holding the musical box in your hand, turn the handle and ask the pupils what tune is being played (they won't be able to hear it!)
2. Hold the box gently onto the bench and turn handle again.
(It will be much, much louder - plenty of wow!)

Explanation

As the box is played in air, the vibrations of the metal strips generate a sound wave travelling through the air in all directions. The energy is spread out and only a very small proportion reaches our ears. The sound energy is transferred to the air by heating (random movement of the air molecules). When the box is on the bench, the vibration of its frame causes the whole bench to vibrate (sound travels faster and more efficiently through solids than gases). The bench vibrations now cause larger amplitude sound waves through the air.

Questions to ask

1. How does the musical box produce sound?
2. How are the sounds of different pitch produced?
3. Why is the sound much louder when the box is on the bench?
4. What other objects could be used to make a louder sound?
(it sounds quite good when placed on a pupil's head!)



Raisins

Introduction
This experiment is useful for discussing floating and sinking (Forces and their effects, 7K). It could also be used for measuring the speed of the raisins (Speeding up, 9K).

Risk assessment Very low.

Apparatus

1. Measuring cylinder or other tall transparent container full of fizzy mineral water or lemonade.
2. A few raisins or peanuts to add to the liquid

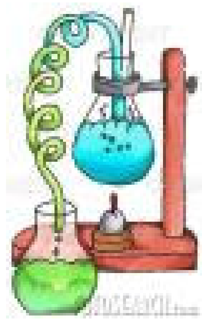
Results

The raisins will travel up and down the container. The effect sometimes takes a while to get going so it is best to set it up at the beginning of the lesson.

Explanation
Bubbles of CO_2 begin to form on the raisin (nucleation). As the bubbles grow, the density of the raisin/bubble falls and it rises to the top. Here the bubbles burst and the raisins sink again.

Questions to ask

1. Why do the raisins sink initially?
2. What causes the raisins to rise?
3. How could you measure the speed of the raisins?
4. How do the bubbles form?
5. Find out some other examples of nucleation.
   (sugar grains in cola, bubbles in a beer glass, clouds, vapour trails)



Rates of reaction

Introduction
This can be used to help teach the topic Rates of Reaction in KS4 or Metal Reactions in KS3 or KS4.

Risk assessment (Medium: refer to CLEAPPS guidance)
Acid is corrosive and harmful.
Remember that hydrogen is explosive. Before lighting the hydrogen remove the balloon from the glass bottle.

Apparatus

- 2 small empty glass coke bottles (or equivalent)
- 25cm^3 2M ethanoic acid
- 25 cm^3 2M hydrochloric acid
- 2 x 5cm length strips of magnesium ribbon
- 2 balloons

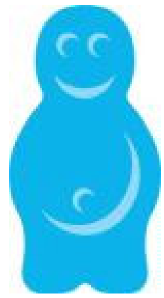
Method

1) Put 25 cm^3 of ethanoic acid in one of the bottles and 25cm^3 of hydrochloric acid in the other.
2) Put 1 piece of magnesium into each bottle and place a balloon over the top to trap any hydrogen gas produced.
3) Leave the balloons till the reaction has ended in both bottles.
4) As an extra you can set fire to the gas to demonstrate that it is hydrogen.

Results
Both balloons should inflate to the same size. Showing that different strength acids of the same Molarity, produce the same volume of product.

Questions

1) What is the word and symbol equation for the reaction?
2) Which reaction produces the most gas?
3) Why does the reaction stop?
4) What happens in terms of particles?
5) How could you calculate the rate of reaction?
6) How else could you change the rate of reaction?



Screaming jelly babies

Introduction

This is a classic Chemistry demonstration and nicely shows just how much energy there is in a "jelly baby". It could be also be used as an introduction to Chemical Reactions or in KS4 as an example of an oxidation reaction.

Risk assessment

(High: See following pages for detailed safety advice)

Apparatus

- Jelly babies
- Potassium chlorate
- Boiling tubes
- Clamp Stand
- Tongs
- Goggles
- Bunsen burner
- Heat-proof mat
- Access to a fume cupboard

Method

1. Put 1-2cm depth of potassium chlorate in a boiling test tube.
2. Clamp the tube in a clamp stand at approx. 60° (just off the vertical) then melt the powder in a fume cupboard with a bunsen burner.
3. Turn the bunsen off, then, using tongs and wearing heat resistant gloves, drop in the jelly baby.

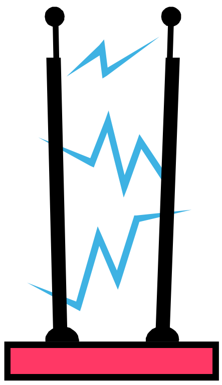
Results

If all goes well the jelly baby will burst into flames and make a very nice screaming sound as it burns to death! A smell of candy floss will also steal its way around the room. Potassium chlorate is a very strong oxidising agent that oxidises the sugar in the jelly baby all at once.

Questions

1) What happens?
2) How do you know it is a chemical reaction?
3) Why does it make a noise?
4) Where has the jelly baby gone?
5) Why does it burn so rapidly (link to the fire triangle)?

Semolina Saucer and The Salt and Pepper Spoon



Introduction
These demonstrate static electricity (KS4).

Risk assessment Very low

Apparatus

- A pre-prepared saucer with semolina in it and a piece of cling film stretched over the top
- A mixture of salt and pepper and a plastic spoon

Method

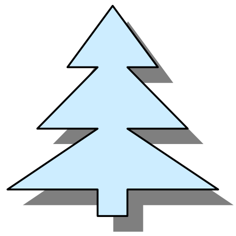
1. Wipe finger over the top of the cling film and the semolina will jump up to it and back down again. Can even write name on the cling film
2. Rub the plastic spoon with a piece of cloth and the spoon will pick up the pepper but not the salt.

Results
Pupils will be amazed at the force of static electricity

Questions

1. What happens to the semolina?
2. Why does it jump up?
3. How has the cling film become charged?
4. Why does the semolina jump back down sometimes? (Not gravity!)
5. Why does the pepper 'stick' to the spoon but not the salt?
6. How could you test your theory?

Silver Trees



Introduction
This can be linked to displacement reactions in Patterns of Reactivity (9F)

Risk assessment   Low (refer to CLEAPPS advice)

Apparatus

- A piece of copper sheet in the shape of a Christmas tree.
- Plenty of silver nitrate solution (0.5M)

Method

1. Place your copper Christmas tree in an empty beaker
2. Fill the beaker with the silver nitrate solution so that it covers the top of the tree
3. Leave for a few minutes

Results
The silver nitrate is reduced on the copper to form silver crystals. The more reactive copper displaces the less reactive silver from solution. Pupils can write a word equation to explain the reaction.

Questions

1. Why happens?
2. What is the feathery coating?
3. Where is it coming from?
4. What colour is silver nitrate solution before and after?
5. What other metals could you use instead of copper?

Swinging Buzzer

Introduction

This demonstration of the Doppler effect can be used to introduce redshift and the evidence for the Big Bang theory of the beginning of the Universe (KS4).

Risk assessment Risk of buzzer hitting pupils. This experiment should only be performed by the teacher and only in a space large enough so that pupils can be arranged in a ring of radius larger than the length of the string.

Apparatus Small buzzer and appropriate battery attached to small block of wood. String attached to block.

Method

1. Turn on the buzzer, swing the block over your head (start with short string and gradually let it out).
2. Alternative method: hold the buzzer and run across the room.

Explanation

The pitch of the buzzer will rise and fall as it moves towards and away from the pupils respectively. This is know as the Doppler effect; if the source of sound is moving away, the wave fronts are further apart and reach the observer less frequently. This is similar to redshift; the light emitted by distant stars has a lower frequency (it looks redder) than expected, demonstrating that they are travelling away from Earth.
(Note: strictly, redshift is caused by space expanding rather than the star moving through space, but the effect is the same).

Questions to ask

1. Describe what you hear as the buzzer moves.
2. Where else have you heard this effect?

Bill and Ben's thermite reaction

Introduction

This is a safe and predictable way of carrying out a large thermite reaction with flowing molten metal being produced.

Risk assessment (High: See following pages for detailed safety advice)

Apparatus

- Iron (III) oxide powder 30g (dry)
- Aluminium powder 10g (dry)
- Large evaporating basin or similar for mixing
- Terracotta flower pot 3 1/2" (9cm) diameter
- Two sparklers
- Thick aluminium foil sufficient to cover the flowerpot top as a lid
- Fire cement
- Old knife and teaspoon
- Tripod
- Tin box filled with dry sand to depth of at least 3 cm
- Electricians tape
- Metre ruler, broom shank, retort stand rod or similar.

Method

1. Completely line a 3½" (9cm) terracotta flower pot with fire cement using an old table knife and a teaspoon for rounding out the base. Cover all around the hole but finally clear it out.
2. Mix thoroughly 30g Iron (III) oxide with 10g fine aluminium powder to make the thermite mixture.
3. Cover the hole in the bottom of the pot from the outside with a piece of electrical tape.
4. Pour in the thermite mixture into the pot and tamp it down firmly using a blunt object such as the back of a board pen wrapped in paper for cleanliness.
5. Push a sparkler blunt end first into the centre and bury it full depth then firm around it to make good contact.
6. Pierce a piece of thick aluminium foil with the pointed handle end of the sparkler and slide it down, folding it over the pot to form a spark-proof lid.
7. In an appropriate fireproof place outside set up a large biscuit or sweet tin with at least 5cm depth dry sand in the bottom.

8. Place a tripod in the centre. (If required a shallow indentation can be made in the sand directly below the centre of the tripod and two clean iron nails can be placed head to head in it for welding together.)
9. Place the prepared pot in the tripod.
10. Stick another sparkler onto the end of a rod or metre rule using tape.
11. Wearing appropriate safety kit, light the sparker on the stick.
12. With the observers well back (10m), use the lit sparkler to light the upside down sparkler sticking out from the pot.

Results

The sparker acting as a fuse will burn through the lid, down to the charge and a large vigorous exothermic reaction with much flame sparks and smoke will ensue, culminating in a run of white hot molten iron metal falling from the hole in the bottom of the flowerpot.

Iron oxide (Fe_2O_3 = rust) and aluminium metal powder undergo a redox (reduction-oxidation) reaction to form iron metal and aluminium oxide (Al_2O_3 = alumina):

$$Fe_2O_3(s) + 2\ Al(s) \longrightarrow Al_2O_3(s) + 2\ Fe(l).$$

Pupils can then be brought in to closer range (2-3 m) to observe the molten metal. The iron will look a bit like an egg lying in a nest of aluminium oxide. Do not move it until it is cold. Do not quench it with water or poke it. When cold check with a magnet to see if it is iron. The lined pot can be reused many times. Check for cracks before use and if cracked discard and make a new one.

Questions

1. What happens?
2. How do you know it is a chemical reaction?
3. What has happened to the fire cement (if using fresh stuff)?
4. Where has the iron come from?
5. Why was there fire and smoke?
6. What could it be used for?

Risk assessment for thermite reaction

- This is a very vigorous exothermic reaction. Do not carry out on or near anything that you don't want burned! Always outside on a non-combustible surface.

- Do not exceed the stated amount of thermite powder.

- Don't try it without using the foil lid over the pot – sparks from the sparkler can fall onto the mixture and light it early while your hand is above it.

- Always use a stick or rod to hold the igniting sparkler – again to keep yourself out of range of any possible early reaction.

- Don't let the molten metal fall into water or into wet sand – explosions can ensue.

- Try it out first before showing a class.

- Wear face shield, lab coat and leather gloves when lighting it and during the reaction. Stand well back.

- Don't carry out if it is raining or is windy.

- The sparkler acting as a fuse should not go out as it burns under the lid. I have never known one do so. However it takes some considerable time to burn down to the mixture. Do not go back to the pot once it has been lit. If nothing has happened after ten minutes douse the pot with water from a hose from distance.

- Keep observers at least 10m away while the reaction is going on and at least 2.5m away when observing the glowing metal afterwards. Do not allow shoving – do not attempt this demo with a class unless they are under good control and will do what you say.

- Don't poke, pick up or interfere with the metal produced until it is cool.

- Check the lined pot before use – if it's cracked from a previous reaction discard it

Tonic water

Introduction

This demonstration can be used when teaching the Electromagnetic Spectrum in KS4. It provides an opportunity to show one property of ultraviolet light, discuss how fluorescent tubes work and tell the story of how the 'gin and tonic' was invented for treatment of malaria!

Risk assessment   Very low.

Apparatus   Bottle of any tonic water containing quinine
Ultraviolet lamp

Method

1. Shine the UV light onto the bottle of tonic water and also onto a bottle of water for comparison (best in a darkened room)
2. Notice the bluish glow from the tonic water
3. Place a sheet of glass between the lamp and tonic water to show that glass absorbs UV (also try other transparent materials)

Explanation

Quinine is a fluorescent material; its molecules absorb UV light, are excited to a higher energy state and then emit visible light as they return to their ground state.

Questions to ask

1. What difference do you notice between the tonic water and tap water when they are illuminated by UV light?
2. Tonic water contains a drug called quinine; what is the drug used for?
3. What happens when glass is placed in between?
4. What is the glass doing to the UV light?
5. Can you think of any other evidence to show that glass absorbs UV light? (or Can you get a sun tan if you sit behind a window?)
6. Find out why the drink 'gin and tonic' was invented.

Woodpecker

Introduction
This demonstration fits in well to Forces and their effects (7K) and KS4 Forces. Can also be used for measuring speed in Speeding up (9K).
It promotes discussion of balanced and unbalanced forces, and friction.

Risk assessment Very low

Apparatus Woodpecker on a pole as shown in picture
(Available from toy and gadget shops)

Method
1. Arrange the woodpecker so that it is stationary on the pole.
2. Lift the woodpecker up slightly and let go so that it falls slowly down the pole, bobbing up and down as it does so.

Explanation
The physics is very complicated; you could limit the discussion to balanced forces but some pupils will want to know why the woodpecker lurches down in this crazy fashion!

When stationary, the forces on the woodpecker are balanced (gravity down and friction at the pole up). When travelling down at constant speed, the forces are still balanced on average but it stops and starts alternately. The woodpecker only falls when its fixing on the pole is exactly vertical; in this position, there is no friction. As soon as the woodpecker tilts, the fixture once again rubs against the pole and stops the woodpecker. The spring enables this to keep on happening as the woodpecker keeps vibrating backwards and forwards.

Questions to ask
1. Draw labelled arrows to represent the forces on the woodpecker when it is stationary.
2. Why doesn't the woodpecker fall? (1st part of demonstration)
3. Measure the average speed of the woodpecker when it is falling.
4. How could you make your measurement of speed more accurate?
5. Why does the woodpecker fall? (2nd part of demonstration)
6. Why does it fall in a jerky motion?

Useful resources of more short engaging practical demonstrations

http://www.physics.org/funsites/funsites.asp	Marvin and Milo Physics to go
http://teachingphysics.iop.org	Resources: Physics on Stage 2 & 3
http://www.salters.co.uk/club/publications.htm	Free CDrom of handbook
http://www.creative-chemistry.org.uk/index.htm	Fun practical activities
http://www.teachers.tv/home.do	From video library: Demonstrating Chemistry Chemistry with CLEAPSS Periodic table: Ferocious elements Demonstrating Physics (x2) Physics for non-physicists (x2)