THE LITTLE BOOK of EXPERIMENTS

31 NEW EXPERIMENTS!

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CONTENTS

A TOWERING SUCCESS

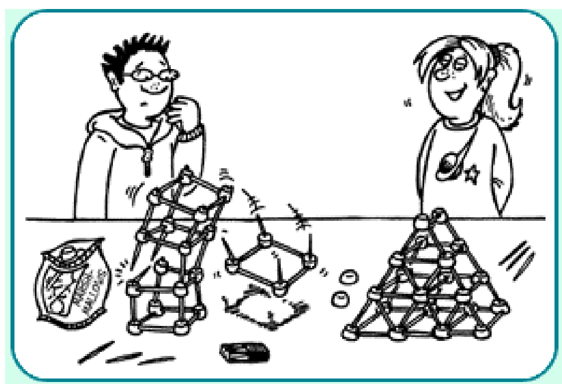
Age Range: 7-14 with adult supervision

You will need

- A box of cocktail sticks
- Cheese cubes or marshmallows or jelly sweets - or a combination

Instructions

The idea is to build a stable structure - but which shapes are best? Here's a quick rundown on the basics:



Squares and Cubes

- Start with 4 cocktail sticks and 4 sweets. Poke the cocktail sticks into the sweets to make a square with a sweet at each corner.
- Poke another cocktail stick into the top of each sweet. Put a sweet on the top of each cocktail stick. Connect the sweets with cocktail sticks to make a cube. (A cube has a square on each side. It takes between 8 sweets and 12 cocktail sticks).

Triangles and Pyramids

- Start with 3 sweets and 3 cocktail sticks. Poke the cocktail sticks into the sweets to make a triangle with a sweet at each point.
- Poke another cocktail stick into the top of each sweet. Bend those 3 cocktail sticks in toward the centre. Poke all 3 cocktail sticks into one sweet to make a 3-sided pyramid. (A 3-sided pyramid has a triangle on each side. It takes 4 sweets and 6 cocktail sticks.)
- For a 4-sided pyramid, you need a square on the bottom and triangles on all 4 sides. Build a square, and then poke a cocktail stick into the top of each corner.

Bend all 4 cocktail sticks into the centre and connect them with one sweet, to make a 4-sided pyramid.

- When you make a structure that uses both triangles and squares, you can make big structures that are less wiggly.

- OK, so now you've got the idea, it's time to set the rules and get creative.

- Set the rules: limit the number of sweets and cocktail sticks available per person and decide on the criteria for winning. It could be a) the tallest structure or b) the structure that can bear the most weight or even c) the one that most resembles a famous building. You can set a time limit if you want to be particularly strict.

Further Information

The inside story:
Even though the sweet structures are standing absolutely still, their parts are always pulling and pushing on each other. Structures remain standing because some parts are being pulled or stretched and other parts are being pushed or squashed. The parts that are being pulled are in tension. The parts that are being squashed are in compression. Some materials, like bricks, don't squash easily; they are strong in compression. Others, like steel cables or rubber bands, don't break when you stretch them; they are strong under tension. Still others like steel bars or wooden cocktail sticks are strong under both compression and tension.

What's the big deal about triangles? Well, squares collapse easily under compression. Four cocktail sticks joined in a square tend to collapse by giving way at their joints, their weakest points. A square can fold into a diamond – but it's different for triangles. The only way to change the angles of the triangle is by shortening one of the sides. So to make the triangle collapse you would have to push hard enough to break one of the cocktail sticks.

Extension Ideas

Display a number of pictures of structures such as bridges illustrating the use of triangles in the structure.

Interactive exercise on the effects of loads on different shapes:
http://www.pbs.org/wgbh/buildingbig/lab/

Skyscrapers:
http://www.pbs.org/wgbh/buildingbig/skyscraper/

Bridges:
http://www.pbs.org/wgbh/buildingbig/bridge/

How Stuff Works: Bridges
http://science.howstuffworks.com/bridge1.htm

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Cocktail sticks are sharp! Take care when handling.

A TROUBLED BUBBLE?

Age Range: 7-14

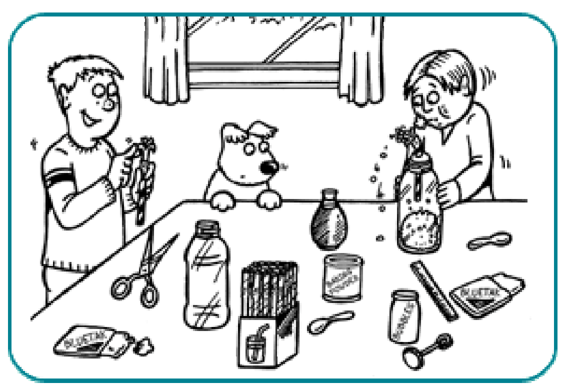
Blow some bubbles using conventional bubble mixture and wands.
Watch what happens.

The bubbles float for a while before eventually falling to the ground. Why is this? Discuss why things float and make references to density. Aren't bubbles supposed to float? The ones in this activity are dropping like stones …

You will need

- A small empty water bottle
- A bendy drinking straw
- Scissors
- Bubble solution
- Blu tack
- Baking powder or Bicarbonate of Soda
- Vinegar
- A teaspoon

Instructions



- Cut the end off the bendy straw so that it measures about 14cm.
- Pull to extend the 'bendy bit', and angle the short end of the straw downwards.
- Using the scissors make several short cuts in the short end of the straw so that it splays slightly.
- Wrap blu tack around the straw and place over the neck of the bottle to ensure a good fit.
- Take the straw and blu tack off the bottle and leave to one side.
- Dip the splayed end of the straw in the bubble solution – ready for action.
- Place two teaspoons of baking powder or Bicarbonate of Soda in the bottle.
- Add a little vinegar and replace the blu tack and straw in the bottle quickly. Make sure there is a good seal.
- A bubble should start to appear from the splayed end of the straw. If not, dip the end in the bubble solution again.
- As the bubble forms, blow gently to cause it to float away from the straw. Instead of wafting about in the air currents it falls downwards instantly.

Further Information

Baking powder and bicarbonate of soda produce carbon dioxide gas when mixed with an acid such as vinegar. This is a chemical reaction between an acid (vinegar) and a base (bicarbonate of soda). The density of carbon dioxide is 1.56 g/mL while that of air is 1.0 g/mL. This means that the carbon dioxide inside your bubble is denser than air and the bubbles of carbon dioxide gas will fall rapidly.

Bubbles formed by blowing through a bubble blower also fall eventually, because our exhaled air contains a higher proportion of carbon dioxide (around 4%) than our inhaled air (0.04%). The bubbles filled with pure carbon dioxide fall much faster. Heavy man!

This experiment came from...

The Planet Science Newsletter.

BALANCING FORKS

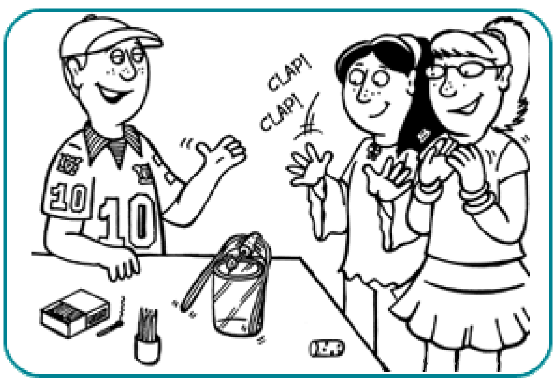
Age Range: 11-14 with adult supervision

Set up the forks-in-cork assembly and challenge the audience to balance it on the edge of a glass. When they maintain it cannot be done, produce the cocktail stick and commence the trick.
NB: This should only be attempted by an adult as it involves flames, glass and potentionally flying forks!

You will need

- One cork
- One cocktail stick
- 2 identical metal forks
- One glass
- Matches

Instructions



- Push the two forks symmetrically and firmly into the side of the cork so that the handles of the forks form about a 90-degree angle.

- Push the cocktail stick carefully into the end cork; take care the cocktail stick does not break at the tip when you push it into the cork.

- Now put the cocktail stick on your finger, and try to balance the above assembly on your finger. If the angle of the forks is suitable, you should find a point on the cocktail stick that you can balance the forks. Mark this point.

- Now try to balance the assembly on the rim of the glass. It should balance at about the marked point on the cocktail stick – even though this seems highly unlikely, being such a top-heavy construction … So, just to clarify, you've got part of the cocktail stick inside the rim of the glass, and everything else balancing on the outside.

- Now for the even crazier bit. Light the cocktail stick at the end that's in the glass and watch it burn away. The burning will stop once it hits the glass rim, but the fork assembly will continue to be balanced at that point.

- Accept the applause from your audience!

Further Information

The ‘centre of gravity’ of any object is the point about which you can balance the object as if all the masses were concentrated or gathered at this point. In other words, the net torque of all the masses of the object about this point is zero, regardless the shape of the object. The centre of gravity does not have to be on the object, it can be in the open space. For instance, the centre of gravity of this fork assembly is in between the forks in the empty space.

How do you make it stable? When you try to balance an object, if the point of support, the pivot point, is not at the centre of gravity then the object will rotate either clockwise or anti-clockwise depending on which side has more torque. However, if the pivot point is on the same vertical line as the centre of gravity, then the object, no matter what shape, is going to balance. It will be stable if the centre of gravity lies below the pivot point. The pivot point is where the cocktail stick rests on the rim of the glass. The actual centre of gravity must lie in the empty space between the two forks and below the pivot point to achieve stability. Consequently we can easily burn away the cocktail stick that extends into the glass because it is playing no part in the balancing act.

As the heat of the flame is absorbed by the glass, the temperature drops below the wood's ignition temperature and the burning of the toothpick stops exactly at the fork or the glass rim.

This experiment came from...

The Planet Science Newsletter.

BALLOON ROCKET

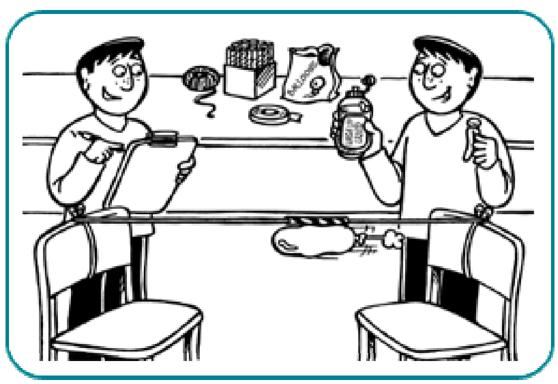
Age Range: 7-14

This activity can lead on from work on pushes and pulls. It is an excellent illustration of Newton's Third Law of Motion – for each action there is an equal and opposite reaction. It can also be used in discussions on the effects of friction and air resistance.

You will need

- A drinking straw
- A long balloon
- About 2m of string
- A clothes peg or bulldog clip
- Washing up liquid
- Sticky tape
- Two chairs about 2m apart

Instructions



- Blow up the balloon, fold the neck and put a peg or clip on it to stop the air coming out. (Warning: don't inflate the balloon yourself if you are under 8 years – ask an adult to do it for you.)
- Thread the string through the drinking straw.
- Tie each end of the string to two chairs placed a distance apart. Make sure the string is at least 30 cm off the ground.
- Pull the straw to one end of the tied string and stick the straw lengthways to the balloon using sticky tape.
- Remove the peg or clip and watch your rocket zoom away!
- Measure how far it goes and then repeat the activity but this time RUB A LITTLE WASHING UP LIQUID ON THE STRING FIRST. Notice any difference?

Further Information

When the air from the balloon rushes out backwards it propels the rocket forwards. If the friction between the string and the straw is high then the rocket will only go a short distance. However, if the friction is low then the rocket will go much further. The washing up liquid acts as a lubricant on the string, which lowers the friction and makes the rocket go further.

Extension Ideas

Try designing a paper rocket to stick to your balloon. Remember to design a shape that will move through the air quickly. For the fastest rocket you will need an aerodynamic shape and very low friction between the straw and the string.

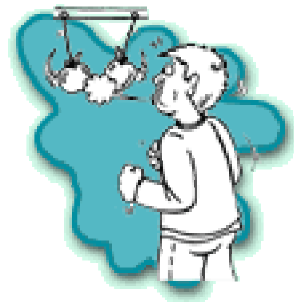
This experiment came from...

The Planet Science Newsletter.

BERNOULII'S APPLES

Age Range: 11-14

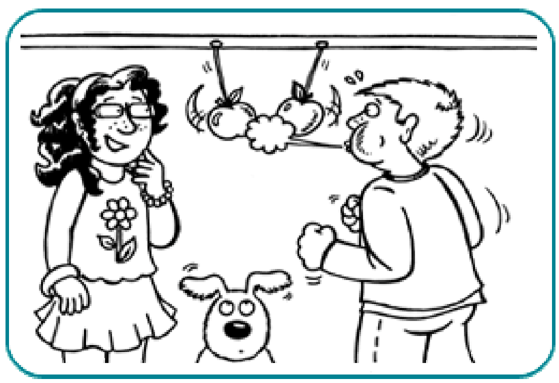
Now for a demonstration of the law of physics that enables sportsmen and women to bend it like Beckham...



You will need

- 2 apples with stalks
- 2 pieces of string about 30cm long
- 2 drawing pins or some tape
- Something horizontal to hang the apples from (using the drawing pins or string so perhaps not anything fragile or valuable).

Instructions



- Tie one end of a piece of string around the stalk of one of the apples. Then do the same with the other piece of string and the other apple.
- Use the drawing pins or tape to hang the two apples up - about 7cm apart.
- Select a volunteer with good lungs to blow between the two apples. But wait a second - before they blow, get everyone else to guess what will happen to the apples? Will the volunteer be able to blow them apart? Will they stay where they are? Or will they move closer (oh surely NOT?)
- Get the volunteer to blow as hard as he/she can... What happens?
- Observe the apples moving closer together. Hmmmmmm - weird. WHY?

Further Information

It's all about air pressure. When someone blows between the apples, the air pressure between them is lowered. The air that's pushing on the outer sides of the apples therefore causes them both to move inwards towards the area of lower pressure. The faster the air, the lower the air pressure, and the greater the movement will be. (You could ask for more volunteers and challenge them to see whether they can get a bigger apple-movement than the first person.)

This effect of air pressure was discovered in 1738 by Daniel Bernoulli, a physicist from Switzerland.

His law can also be used to explain what happens when you put 'spin' on a ball in sport, and it's commonly invoked to explain how the curve of the wings enables planes to fly.

But if it's a spinny tennis serve you want, or a free kick to make the opposition's knees' tremble... there's only one thing that'll do it: practice!

Extension Ideas

The shape of an aeroplane wing is a more complicated story than it seems, and you can read a good overview of the situation on the HOW STUFF WORKS website here: http://travel.howstuffworks.com/airplane2.htm

This experiment came from...

The Planet Science Newsletter.

BOUNCY CUSTARD BALLS

Age Range: 7-14

Plastics and rubbers are made from polymers- long chains of molecules that can be 'zipped' together. The long tangled up polymer chains can be stretched out or squashed up. This makes the material elastic, which is an excellent property for a bouncy ball. We can make a bouncy ball from a simple polymer found in white PVA glue.

You will need

- Custard powder
- White PVA glue
- Borax (available from large branches of Boots)
- Water
- Food colouring (optional)
- A plastic teaspoon
- A tablespoon
- 2 plastic cups

Instructions

- In one plastic cup make up a borax solution by adding a half a teaspoon of borax to two tablespoons of water and stir until dissolved.

- Pour one tablespoon of PVA glue into the other plastic cup. If you want yellow custard balls continue to step 3.

- Otherwise at this point you could add a few drops of food colouring and stir to mix. Remember that the food colouring will change colour when mixed with the yellow custard powder. So red food colouring will produce a wonderful orange ball, blue will make a green ball etc.

- Add 2 teaspoons of custard powder to the PVA glue. Stir everything together.

- Add 1 teaspoon of borax solution to the glue mixture. Stir well until the mixture becomes stiff. Knead the solution until it becomes elastic. This can be a bit messy but keep going - try rubbing the mixture between the hands. It should soon start sticking together and become drier and more pliable.

- Roll the mixture into a ball and bounce it!
- Catch it if you can!
- When you're ready for a rest, put the ball in a sealed plastic bag or it will develop a crust and go mouldy (yuk).
- What if it's...?

  Too brittle? Too much borax.
  Too soft and does not stretch? Not enough borax.
  Too dry? Add more water.
  Too wet? Add more custard powder.

Further Information

The glue is a polymer (long chain molecule) called polyvinyl acetate (PVA), and the custard powder contains cornflour which is a starch. Starch is also a polymer, this time made up from smaller glucose molecules. The borax acts as a crosslinking agent and binds the two polymer chains together. Too much borax gives too many cross-links and hence a brittle substance. Too little borax means not enough cross-links giving a weak substance that's easily pulled apart.

The ball is made of an elastic material. When it bounces the ball gets squashed and the kinetic energy gets converted to elastic potential energy, and some heat, plus a little sound. The ball then unsquashes and bounces back up. So as the ball bounces there are number of energy transfers:

Gravitational energy is transferred to kinetic as it falls. When it hits the ground the ball squashes. The kinetic energy is transferred to elastic strain energy in the ball. As the ball unsquashes the strain energy is converted back to kinetic energy.

Some of the energy is 'lost' as heat, sound, etc, which is why the ball doesn't bounce up to the same height it was dropped from.

Extension Ideas

Use cornflour instead of custard powder and add a drop of colouring to the borax solution to make different coloured balls.

Try a bouncing competition or a stretching competition.

Set up a scientific investigation to explore what happens when you vary the proportions of the ingredients.

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

People with sensitive skin should wear rubber gloves as borax can be a mild irritant.

CRYSTAL HEARTS

Age Range: 7-14 with adult supervision

This is crystal growing with a difference.

You will need

- Borax laundry powder (from old-fashioned style chemists)
- Pipecleaners
- A heavy jar, with a wide neck
- String
- A pencil
- A marker pen
- A glass
- Red food colouring

Instructions

- Shape a pipecleaner into a heart shape.

- Suspend the heart with string from a pencil and hang it in the heavy jar.

- Mark the jar to indicate where the top of the heart is (because you'll want to submerge the entire heart in solution in a minute).

- Remove the heart and fill the jar with hot water up to the mark.

- Add 1/3 glass of borax powder and stir until it is all dissolved. (The water needs to be just off boiling temperature, and borax is a mild irritant - so take care!) You can add red food colour at this point too which will make the heart grow pink crystals instead of white.

- Suspend the heart in the solution making sure the pipecleaner is completely immersed in the solution and isn't touching the sides or bottom of the container.

- As the solution cools, the crystals will begin to form on your pipecleaner.

- Leave overnight. Remove from the solution and allow to dry.

Further Information

The borax powder dissolves in the warm water but as the water cools the molecules of borax crystallise out of the solution onto the pipe cleaner. If you look closely you can see their shapes.

In many solids, the arrangement of the building blocks of the material (ion, atoms and molecules) can be a mixture of different structures. In crystals, however, a single arrangement of atoms is repeated over and over throughout the entire material. For an analogy, you can think of crystals as a big skyscraper, in which all the rooms are built to exactly the same design.

Extension Ideas

Variations:
Overnight soaking will give you very thickly crystallized ornaments. If you want some of the colour of the pipe cleaner to show through, leave in the solution for less time.

The crystals are somewhat fragile, so you might want to spray your finished ornament with acrylic sealer or clear spray paint to keep the crystals from falling off too quickly.

If you're feeling particularly creative, you can try making other shapes - we made an arrow to go with the heart - and you can play about with what food colours you add too. Try flower shapes, or teddy bear shapes – or anything you can bend your pipecleaners into. (Make sure there aren't too many wiggly bits though as the crystals are chunky and not good on detail!)

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Be careful when handling very hot water to avoid scalding injury. Borax can be an irritant to the skin – wear disposable gloves if necessary.

CUPID'S ARROWS

Age Range: 7-14

You will need

- A saucer
- Milk
- Talcum powder
- Strawberry milkshake powder (or cocoa or other coloured powder)
- Washing up liquid
- Cocktail stick
- Cardboard
- A pen
- Scissors

Instructions

- Pour enough milk on a saucer to cover the base.
- On the cardboard draw a heart shape which is smaller than the saucer. This will form a heart shape template.
- Make a hole in the middle of the heart shape and cut it out so that there is a heart shaped hole in the middle of the cardboard.
- Gently sprinkle talcum powder on top of the milk to form a thin layer.
- Make up a small amount of a solution of washing up liquid with a little water.
- Place the cardboard template over the saucer of milk so that the heart shape is in the middle.
- Sprinkle a little milkshake (or other) powder to form a heart on the surface of the talcum powder.
- Quickly take a cocktail stick and dip it into the washing up liquid solution.
- Plunge this ‘Cupid’s Arrow’ into the centre of the heart. He got you!

Further Information

Initially the powders are held up by the surface tension of the milk. Water molecules stick to each other to form a 'skin' on the surface which is strong enough to support the thin layer of powder. When the washing up liquid solution is added it quickly spreads across the surface of milk in a thin layer. This detergent breaks up the closely-packed water molecules and reduces the surface tension allowing the powders to fall. As it spreads across the surface it drives the powders in front of it so the heart shape appears to explode outwards.

Extension Ideas

Use this idea to create a detergent powered boat:
http://chem.ps.uci.edu/

This experiment came from...

The Planet Science Newsletter.

CUTTING THE ICE

Age Range: 7-14

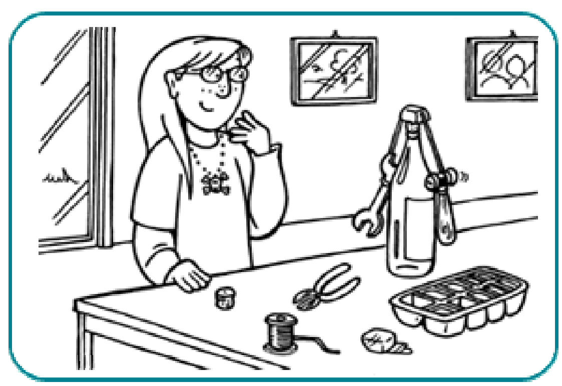
Is it possible to pass a length of wire through an ice cube yet leave the ice cube unscathed?

Try this activity to find out.

You will need

- A thin-necked glass bottle
- A cork
- An ice cube
- A piece of thin wire, 30cm long
- A couple of heavyish objects that can be attached to either end of the wire (eg. a hammer and spanner from your toolbox)
- A cool room

Instructions



- Place the cork on top of the neck of the bottle, and balance the ice cube on top of that.
- Lie the wire over the ice cube, and attach your heavyish objects to either end, so that the wire hangs down either side of the bottle.
- Wait.
- The wire will cut through the ice, and as it does so, the ice will refreeze over the top. Eventually the wire will have passed through the whole ice cube, which will appear unscathed...

Further Information

Water has a peculiar property of taking up more space when it is frozen. The pressure exerted by the wire causes the ice to melt, and once the pressure has been removed the ice refreezes. The process happens continually as the wire passes through the ice.

This was an old favourite experiment from school, and in recent years people have questioned the explanation. It has been suggested that the localised pressure effect is not great enough to cause the ice to melt and that the effect is instead caused by heat being conducted through the wire.

Extension Ideas

If you want to explore this controversy further why not make this part of your exploration. Does it work if the whole experiment is carried out in the fridge, for example?

This experiment came from...

Sophie Duncan.

DNA EXTRACTION IN YOUR KITCHEN

Age Range: 11-14 with adult supervision

If you're under 18 then please do not attempt this experiment without an adult present.

This activity can be used in discussions about DNA and the recent use of DNA analysis in forensic science. It also enriches discussions about the function of cells.

You will need

- A bottle of methylated spirits
- Salt
- Cheap washing-up liquid (concentrated dosen't work as well)
- Kiwi fruit (preferrably ripe)
- Ice cubes
- Hot water
- Sharp knife and chopping board
- Kitchen scales
- Measuring jug
- Two bowls (one small, one large)
- Saucepan
- Fork
- Sieve
- Glass

Instructions

- Put the bottle of methylated spirits into a large bowl of ice so it cools straight away. Do not put methylated spirits into a fridge or freezer as a spark could ignite fumes.

- Mix 25g of salt and 80g of washing-up liquid with 900ml water in a small bowl. Stir carefully to avoid too much froth.

- Peel a kiwi fruit and chop finely. Using a fork, mash the kiwi fruit into a paste.

- Put the kiwi paste into a small bowl and add 100ml of the salt-detergent mix from step 2. Sit this in a saucepan of hot (not boiling) water for 15 minutes.
- Pour the green paste through the sieve into a glass.
- Drizzle the ice cold methylated spirits down the side of the glass so it forms a purple layer on top of the green kiwi paste. You will need an equal amount of methylated spirits and kiwi paste.
- You should see a white string-like layer form in the glass between the green and the purple layers. This is your extracted kiwi fruit DNA!

Further Information

DNA is found within the chromosomes inside the nucleus of the cells that make up every living thing, including your kiwi fruit. To extract this DNA, we have to separate it from all the other cell parts. By chopping and mashing up the kiwi fruit, then leaving it in the salt and detergent mix, we break open the cell walls, called membranes. This lets all the cell contents out, including the DNA. But the DNA is still surrounded by polymers called proteins. Luckily, kiwi fruit contain an enzyme called proteinase – this attacks and breaks up the proteins, freeing the DNA. The green kiwi paste now contains your freed DNA, but also has all the other cell stuff that you have released. Passing it through a sieve removes most of these unwanted bits. Then, when you pour the methylated spirits on top, the DNA turns into a solid, because it can't stay dissolved in the methylated spirits. You might get bubbles in between the purple and green layers. This is because of the different temperatures of the two layers. It makes the air dissolved in the green layer come out as bubbles. This experiment relies on an enzyme in the kiwi fruit to unlock the DNA. Enzymes are powerful polymer machines that help make things work faster. Apples and oranges don't have enough of these enzymes to work with this experiment, as the DNA won't be set free, however as you have seen, a kiwi fruit does!

Extension Ideas

Onion cells are very easy to see using a microscope – particularly if you use a red onion. This can prompt a discussion of how to get the DNA out of the nuclei of the onion cells. DNA from an onion can be extracted in a similar way to kiwi fruit.

This experiment came from…

The Chemistry Department at York University: http://www.york.ac.uk/res/sots/

Remember BE SAFE!

Take care when using sharp knives. Industrial methylated spirit contains 5% methanol and so is harmful as well as being highly flammable.

FANCY A 'SEDIMENTARY SANDWICH'?

Age Range: 7-14 with adult supervision

To really liven up the subject of rocks and the rock cycle, why not create a model?

The Earth’s crust is made up of many different types of rock, including ‘sedimentary’ ones.

These are formed in layers - a bit like a club sandwich.

To find out more about how rocks are formed, take a look at ROCKS FOR KIDS at http://www.rocksforkids.com/, but in the meantime, here’s now to make a culinary version.

You will need

- A plate
- A knife

  ...and any of the following:-
- White bread
- Brown or granary bread
- Butter or margarine
- Salad
- Prawns
- Chicken or turkey
- Marmite
- Salt and vinegar crisps
- Jam
- Peanut butter
- Honey
- Mayonnaise
- Raisins
- Chopped egg
- Cheese

Instructions

- **Before you start:** Check for food allergies, particularly regarding peanut butter. Substitute any fillings if necessary (you can even substitute the bread with lettuce leaves if necessary). And feel free to get creative, it's your sandwich!

- Sedimentary layers are formed with the oldest layer at the bottom and the youngest layer at the top. So first of all we have to 'date' our layers.

- Arrange your sandwich fillings in date order, for example:
  - Chickens and turkeys are birds which are the closest thing to dinosaurs that walked the Earth between 200 and 100 million years ago.
  - Salad represents vegetation that made coal 300 million years ago.
  - Prawns are Arthropods like the trilobites that swam around in the sea 550 million years ago.
  - Marmite is a yeast extract and the first organisms were single-celled like yeast.

- Alternatively, you could assign each of your fillings a different rock name, for example:
  - Jam with seeds, raisins, granary bread = conglomerate rock which contains rounded rocks (pebbles, boulders) cemented together in a matrix.
  - Peanut butter, chopped egg in mayonnaise = porphory rock when jagged bits of rock are cemented together in a matrix.
  - White or brown bread = sandstone, a soft stone that is made when sand grains cement together. Sometimes the sandstone is deposited in layers of different coloured sand.
  - Honey, smooth jam, cheese = shale i.e. clay that has been hardened and turned into rock. It often breaks apart in large flat sections.
  - Prawns, chicken or turkey = limestone, a rock that contains many fossils and is made of calcium carbonate &/or microscopic shells.
  - Salt and vinegar crisps = gypsum, common salt or Epsom salt found where seawater precipitates the salt as the water evaporates.

- Make your sedimentary sandwich by alternating bread and butter with the filling of your choice. Make as many layers as you like – who's counting?

- Eat it! Or if you don't fancy that, try bending it and see what happens to the layers… earthquaaaaaaaake!!

Further Information

The layers in which sedimentary rocks are usually formed are called 'strata'.

These rocks are formed when layers of sand, small bits of rock, clay, plants, bones, and mud are piled on top of each other and eventually get compressed and harden into rock. They're often formed in river bottoms and lakes since the water carries materials from other places that then settle to the bottom in layers. This process takes a long time (hundreds of thousands of years), with the oldest layers being formed first.

Scientists can gain information about how climates and the environment have changed over time by looking at the changes in the rock layers. Some rock types may appear in several different layers – hence the alternate layers of bread and butter.

Extension Ideas

What? Still hungry? If you fancy more geological science snacks try
EDIBLE IGNEOUS ROCKS at
http://www.pages.drexel.edu/~ks73/Ediblerocks.htm

EDIBLE ROCK LAYERS at
http://www.coaleducation.org/lessons/sem/

This experiment came from...

The Planet Science Newsletter

Remember BE SAFE!

Adhere to the guidelines for Food and Hygiene (Be Safe! 3rd edition section 6).

FAST FOOD

Age Range: 11-16 with adult supervision

What have marshmallows got to do with the speed of light? Well, we can use them to measure it. It's true! And we could even do it with chocolate or cheese – fast food indeed.

NB We also need to use a microwave oven, and it must be the sort where you can remove the turntable. Check with the person who owns the microwave BEFORE you attempt this experiment!

You will need

- A microwave oven
- A large microwave-safe plate
- A packet of mini marshmallows (find them in the baking section of the supermarket) otherwise use chocolate buttons or Mily Way Stars
- A ruler
- A calculator

Caution: Never put anything metal in a microwave, and that includes crockery with gilt or any other metallic decoration on it. Always make sure that any plates are cool before handling. And don't keep re-heating for short bursts: if the experiment doesn't worked the first time, leave the plate for a few minutes to cool down before trying again.

Instructions

- First open the marshmallows and place them on the plate, completely covering it with a layer one marshmallow thick. Make sure that the flat side of the marshmallow is facing upwards.

- Take the turntable out of the microwave.

- Next put the plate of marshmallows in the microwave and cook on low heat. The microwave will not cook evenly after the removal of the turntable and the marshmallows will begin to melt at the hottest spots in the microwave.

- Heat the marshmallows until they begin to melt in 4 or 5 different spots. (roughly 30s at Medium setting).

- Remove the plate from the microwave oven and observe the spots. With mini marshmallows you should see that certain areas look like flowers where the central marshmallow has started to swell and the surrounding neighbours also.
- Take the ruler and measure the distance between the melted spots. In the case of the mini marshmallows you can measure between the centres of the 'flowers'. You will soon find that one distance repeats over and over. This distance will correspond to half of the wavelength of the microwave. That should be around 6 centimetres. It may be that your distance corresponds to the full wavelength of the microwave i.e. around 12 cm.
- Now, turn the microwave around or look inside the door and look for a small sign that tells you the frequency of the microwave. Most commercial microwaves operate at 2450 MHz. We need to convert that to Hertz i.e. 2450000000 Hz.
- Now we can do a calculation to find out the speed of light.
- Multiply the distance you measure (it should be around 6 cm) by 2. This is equal to around 12 cm. Convert it to metres i.e. 0.12 m.
- Now multiply this distance by the frequency of your microwave. This is equal to 0.12 times 2450,000000 Hz.
- The answer should be close to the speed of light i.e. 300000000 or 3 x 108 m/s.

Further Information

Both visible light and microwaves are forms of electromagnetic energy and therefore have the same speed since they are both part of the electromagnetic spectrum. When you turn on your microwave oven, electrical circuits inside start generating microwaves. These are electromagnetic waves with frequencies around 2.5 gigahertz (GHz), which is the same as 2500 megahertz (MHz) or 2500000000 Hz. These waves bounce back and forth between the walls of the oven. The size of the oven is chosen so that the peaks and troughs of the reflected waves line up with the incoming waves and form a "standing wave". Microwave ovens cook unevenly because of the pattern of standing waves that form inside the oven chamber. The pattern creates an array of hotspots in a complex 3D pattern throughout the oven's volume. By using a turntable the food is rotated whilst cooking so the hotspots appear in different places within the food and it cooks evenly. Have you noticed how ready meal instructions always ask you to stir the food prior to eating? Microwaves penetrate food and are absorbed by water and fat molecules. These molecules then begin to vibrate rapidly which generates heat and so cooks the food. The full wave is shaped like a "sine function" going from zero to a maximum back through zero to a negative maximum and back to zero again. The distance between the maximum displacements of the wave is one half the wavelength. The electromagnetic field inside the microwave behaves in roughly the same way – except the vibrations are in "the electromagnetic field". Where the vibrations are greatest (the anti nodes), you will see the greatest heating, but at the nodes, the mini marshmallows will only melt slowly as heat diffuses into those areas. Thus, the distance between the melted regions (x) is equal to the distance between the antinodes, and equal to half the wavelength (_)
So, the detailed calculation to find the speed of light (c) is:
c= _ *f
c=2*x*f
And now after all that hard work – the only thing left is to eat them!

Extension Ideas

Try the experiment using chocolate buttons or cheese slices. Is it easier or more difficult to spot the antinodes?

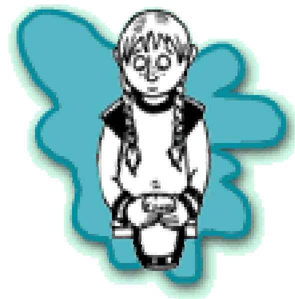
This experiment came from...

The Planet Science Newsletter

Remember BE SAFE!

Caution: Never put anything metal in a microwave – and that includes crockery with gilt or any other metallic decoration on it. Always make sure that any plates are cool before handling. And don't keep re-heating for short bursts – if the experiment doesn't worked the first time, leave the plate for a few minutes to cool down before trying again.

FEELING THE PRESSURE



Age Range: 7-14

Here’s a fun way to learn about the way that air pressure changes around us, and how it relates to those curvy lines that squiggle across the map on TV weather forecasts. It might even enable you to predict a storm before it happens, you never know.

You will need

- A balloon
- A narrow-mouthed jar (or Snapple bottle)
- String or an elastic band
- A straw
- A pin or toothpick
- A piece of card
- Some glue
- Scissors

Instructions

- Cut the balloon carefully to give you a flat-ish piece of rubber.

- Stretch this bit of rubber over the neck of the jar, and fasten it with the string or elastic band.

- Now glue the straw to the centre of the piece of rubber, so that it points out horizontally beyond the edge of the jar.

- Attach the pin or toothpick to the other end of the straw (this is your barometer's pointer).

- Now position your card so that the pointer is just in front of it. You can then draw marks on the card to record the highs and lows of the pointer...

- Over the next few days and weeks, you should see the pointer moving up and down, and this should, in theory, correspond to the weather heading your way. When the pointer's high, look out for nice weather; when the pointer is falling, take an umbrella with you! (If you create your barometer during particularly high or low pressure conditions, you might not get the pointer moving both ways, in which case, try again.)

Further Information

In periods of atmospheric high pressure, the balloon skin will curve into the bottle slightly, as there's more pressure outside the bottle than inside. This will make the pointer point higher. During low pressure, the balloon skin will bulge slightly outwards, with the opposite effect.

Extension Ideas

There are loads more egg experiments around. Here are some of our ideas to get you going.

This experiment came from...

The Planet Science Newsletter

FRUIT FORCE

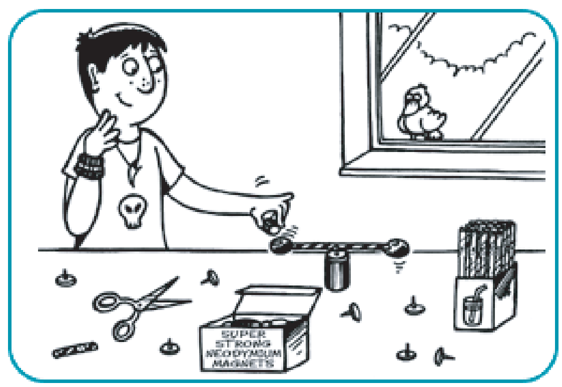
Age Range: 7-14 with adult supervision

Set up the experiment. Challenge the child to move the grapes without touching them.

You will need

- An empty film canister and lid
- A drawing pin
- A drinking straw
- Scissors
- Two large grapes
- A neodymium magnet (a very small but very strong magnet)

Instructions



- Push the drawing pin through the centre of the film canister lid from the back so that when the lid is put on the point of the drawing pin is sticking out.
- Cut the drinking straw so that is about 14 cm long.
- Find the midpoint of the straw and cut a small hole approx. 0.5 cm by 1 cm.
- Push a grape onto each end of the straw.
- Place the straw over the top of the drawing pin so that the point is in the hole and the system is balanced. This is a bit fiddly and you may have to push the grapes further up the straw to balance.
- Check that the system is balanced by giving one of the grapes a gentle push. The straw should spin round freely and easily.
- Now take the neodymium magnet and place it close to one of the grapes (but not touching!) The grape should start gently to move away from the magnet and spin around.
- Remove the magnet and wait for the grape to stop spinning.
- Turn the magnet over and place it close to the grape again. Once again the grape should move away from the magnet.

Further Information

Water is 'diamagnetic'. This means it will be repelled by both north and south poles of a magnet. The diamagnetic force of repulsion is very weak though, so we need a very strong magnet to induce it. One such magnet is the Neodymium-Iron-Boron (NIB) supermagnet, otherwise known as a neodymium magnet.

If a magnet is brought close to a diamagnetic material it will generate orbital electric currents in the atoms and molecules of that material. According to Lenz's Law: when a current is induced by a change in magnetic field (i.e. the orbital currents produced by the magnet approaching the grape) the magnetic field produced by the induced current will oppose the change. Hence the grape is repelled by the magnet because it contains water which is diamagnetic. Other fruits and vegetables that contain a high percentage of water will show this effect too, for the same reason. Fancy a spinning cucumber, anyone? Or a watermelon?

And if you're attracted to the weird world of magnetism, how about the incredible story of the Levitating Frog (including photos!)

Here's where you'll find it: http://www.hfml.ru.nl/phystod.html

Extension Ideas

Other fruits and vegetables that contain a high percentage of water will show this effect too, for the same reason. Try cucumber or watermelon.

Remember BE SAFE!

Avoid using small magnets with young children. (Be Safe!, 3rd Edition, Section 5)

Note: Do not place magnets near TV screens, computers, floppy disks, credit cards, watches etc.

GREEN PENNIES

Age Range: 7-14

Show the class some examples of rusty articles e.g. nails. Ask them what has happened. Ask if they can recall seeing anything similar? Where? What is causing it?

Lead the discussion around to the idea of chemical reactions.

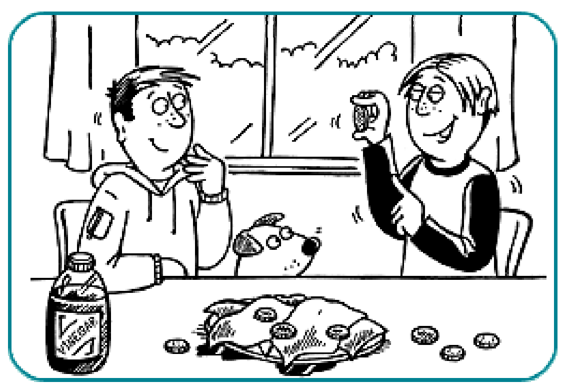
Comment on the appearance of copper roofing e.g. on some church spires. Show pictures if possible. Discuss the green colouring. Lead into this investigation.

You will need

- A sauce
- Some paper towels
- Vinegar
- 3-5 pennies

Instructions

- Arrange the paper towels into a wad on your saucer.
- Pour enough vinegar into the saucer to cover the paper towel.
- Place the pennies on top of the wet paper towel and leave for a few hours.



- Encourage observations; look at both sides of the pennies. The tops of the pennies turn green and the bottoms of the pennies stay copper coloured.

Further Information

Vinegar is an acid that has the chemical name of 'acetic acid'. Part of this acid combines with the copper of the pennies to form a green coating that is composed of copper acetate. Oxygen must be present for this chemical reaction to occur. Oxygen comes from the air, and this is why the tops of the coins turn green but the bottoms do not.

Extension Ideas

Look at other reactions such as the rusting of steel wool in water.

This experiment came from...

The Planet Science Newsletter.

GROW YOUR OWN SALTICLE

Age Range: 7-14 with adult supervision

Teachers:
Ask the class whether they have visited any underground caves. If so, ask what they observed. If stalactites or stalagmites are mentioned then start a discussion about how they may be formed. Lead on to this experiment.

Parents:
Stalactites and stalagmites are formed when small amounts of calcium salts are dissolved as water seeps through rock. When the water evaporates, the calcium salt is left behind. Have a go at forming salticles!

You will need

- Salt
- Two small jars
- Large paper clips
- Wool or string
- A small saucer

Instructions

- Stir plenty of salt into a large glass of very hot water. Keep stirring. If all the salt dissolves, add more until it doesn't. Allow the mixture to cool, and then pour half into each jar.
- Attach a paper clip to each end of a piece of wool about 40 cm long.
- Put one end of the wool in one of the bottles, and the other end of the wool in the other bottle. Make sure the ends of the wool are in the solution.
- Now make sure that the bottom of the loop of wool between the bottles is hanging below the level of the salt solution in the bottles.
- Place a saucer under the bottom of the loop of wool. Leave for a week. And behold a salticle will appear!
- **Tip:** Make sure your wool is good and porous; it's got to act as a passageway for the salty liquid. Also, make sure the wool doesn't dry up during the week or you'll be snookeroo'd.

Further Information

The salt solution travels along the wool by capillary action. This is a physical effect by which water can travel upwards as if to defy gravity! It's due to the interactions between the water molecules and the wool which contains tiny tubes and spaces for the solution to fill. Plants take advantage of capillary action to pull water from the soil into themselves.

As the salt solution travels along the wool it starts to drip from the lowest point in the loop of wool. The water evaporates and salt crystals are left behind. In time more and more salt solution drips down and the crystals of salt grow larger. Eventually it will form a 'salticle' or stalactite.

Stalactites and stalagmites, collectively known as speleothems, form due to water seeping through rock. As the water moves through the rock, it dissolves small amounts of limestone or calcium carbonate. When the water drips from a cave ceiling, small amounts of this limestone are left behind, eventually leaving an icicle-shaped stalactite. Limestone that reaches the cave floor "piles up" and forms 'stalagmites'.

Extension Ideas

Use other salts e.g. baking soda (sodium bicarbonate).

Grow a woolly lamb:
Fold paper such as sugar paper (or other coarse grained paper) in half. Draw a sheep shape on it and cut it out. Make up a strong salt solution and put it into a Petri dish or a coffee jar lid. Place the feet of your sheep into the solution and over the next few days salt crystals will appear over the back and sides.

This experiment came from...

Science on the Shelves (University of York).
Woolly lamb by Mary-Jane Murray, from Saxton Primary School in North Yorkshire.

Remember BE SAFE!

Treat hot water with care to avoid scalding injury.

MAKE YOUR OWN THERMOMETER

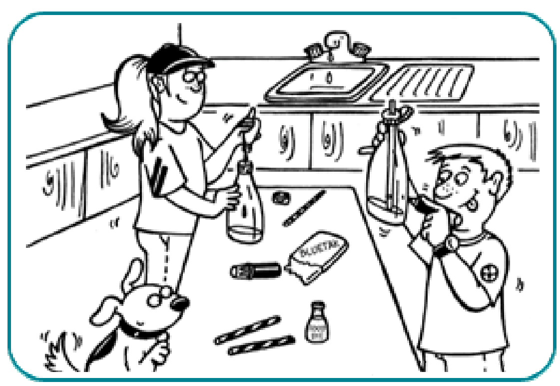
Age Range: 7-14

Want to know how a thermometer works?
Find out by making one.

You will need

- An empty small plastic squeezy mayonnaise or ketcup bottle
- A plastic straw
- Modelling clay or blutack
- Water
- Food colouring
- A marker pen

Instructions



- Fill the empty plastic bottle one quarter full of water.
- Add a few drops of food colouring to the water so you can see it better.
- Push a straw through the hole in the top of the squeezy bottle
- Make sure there is a good seal around the straw by using modelling clay or blutack.
- Blow through the straw so that the water bubbles. If you hear a hissing sound you will know that your seal is not good enough. Re-pinch the clay or blutack around the straw and make sure it is well attached to the bottle top.
- Blow bubbles through the water till it rises half way up the bottle.
- Lift your bottle so that it is at eyelevel and make a mark on the outside of the bottle that shows the level of water in the straw.
- This mark shows the level of water in the straw at room temperature.
- Now place your bottle in the fridge. What happens to the water level in the straw?
- Try placing your bottle in a warm place e.g. near a radiator. What happens to the level in the straw now?

Further Information

The thermometer works because as the temperature rises, the air inside the bottle expands and pushes the water up the straw. At cooler temperatures, the air in the bottle contracts and the water drops.

Bulb thermometers rely on the simple principle that a liquid changes its volume relative to its temperature. Liquids take up less space when they are cold and more space when they are warm. In practice water would not be a good liquid to use, as it would freeze at temperatures below 0oC. Instead other liquids that expand on heating like alcohol and mercury are used. Alcohol has a lower freezing point than water so it can measure temperatures below 0oC. Mercury has a boiling point of 357oC but due to its toxicity alcohol thermometers are usually used for medical purposes.

Digital thermometers contain a thermoresistor (or ‘thermistor’). This device changes its resistance with changes in temperature. A computer or other circuit measures the resistance and converts it to a temperature which is displayed digitally.

Forehead strip thermometers use liquid crystal thermochromic ink which is formulated to change colour at different temperatures.

Extension Ideas

For more info on thermometers, have a look at How Stuff Works at:
http://home.howstuffworks.com/therm.htm

As you probably know, there are three temperature scales: Fahrenheit, Celsius and Kelvin. To find out more about the three scientists who gave their names to these scales, have a look at ENERGY QUEST at:
http://www.evergyquest.ca.gov/

This experiment came from…

The Planet Science Newsletter.

RECYLCING PLASTIC? SORTED!

Age Range: 7-14 with adult supervision

Ever wondered how all those plastic items you chuck away get sorted out for recycling? Read on ... and have a go yourself.

You will need

- A plastic milk bottle
- A yoghurt pot
- A washing up liquid bottle
- A pair of scissors
- A large of bowl of water
- A tablespoon
- Salt

Instructions

- Check the code on the bottom of the containers. There should be a number inside the recycling symbol, for example:

  Plastic milk bottle - code 2 or HDPE
  Yoghurt pot - code 6 or PS
  Washing up liquid bottle - code 1 or PETE

- Carefully cut out three strips from each plastic container. Each strip should be about 1 cm by 4 cm. NB You might need an adult to help with this.

- Fill the bowl with water and place all the strips in it. You may want to use a spoon to make sure all of the strips are fully immersed*.

- One set of strips will float to the surface immediately. Remove these strips.

- Now add a large tablespoon of salt to the bowl and stir it up so that it dissolves.

- Another set of strips should float to the surface. Remove these strips.

- There should be one set of strips still sitting at the bottom of the bowl.

- Congratulations! You have now successfully sorted three different plastics!

- ***PS** If you can't get the PS container strips to sink in water then try adding some washing up liquid to the water. This affects the surface tension of the water and makes it 'wetter' i.e. it will wet the plastic strips better than water alone, if that makes sense...

Further Information

Each plastic container is made of a different plastic, and has its own 'density'. Density is the measure of how heavy something is for its size, in other words its mass per unit volume. Water has a density of 1 g/cm3, and anything with a density greater than this will sink in water; anything with a lower density will float. So if we have a plastic with a density less than 1 (e.g. the milk bottle) it will float in water. But what about the salt? Well, adding the salt to the water makes it more dense. That's why we float more easily in the sea than in the bath. The yoghurt pot has a density slightly greater than 1 g/cm3, so it doesn't float in tap water but it will float in salt water. The washing up liquid bottle however has a higher density still which means that it won't float in either tap or salt water. So now you know how they separate plastics for recycling!

Extension Ideas

Want to know more?
There are many different sorts of plastics and polymers, with different characteristics such as flexibility and transparency. The American Society of the Plastics Industry has produced a marking code to identify the six main types, which you can see at: http://americanplasticscouncil.org
Checking the number on each one before recycling obviously isn't an efficient way of doing things, but because they have different densities, they can be sorted using the type of process you've just tried for yourself.
If you want to know more about the process, and about what plastics are recycled into, check out the Warwickshire Waste Wise website at:
http://www.warwickshire.gov.uk/
For more information on recycling statistics have a look at:
http://www.recoup.org/business/default.asp

This experiment came from...

Katy Hewis of Science Matters.

Remember BE SAFE!

Be careful when using scissors to cut up plastic bottles.

RUSSIAN REACTION ROULETTE

Age Range: 7-14 with adult supervision

As the name suggests, 'Russian Reaction Roulette' is a game of a chance, and one which will test participants' nerves - and knowledge of chemistry - to the max.

As with all of the more explosive events in this competition, it's being conducted outdoors, because past experience has shown that things can get messy.

This is a game for two or more participants.

You will need

- A t least 6 film canisters and lids - professionals prefer the black ones as participants can't see what's inside.
  Tip: your chemist may have spares if you ask nicely.
- Flour
- Talcum powder
- Bicarbonate of soda
- Icing sugar
- Baking powder
- A teaspoon
- An empty washing up liquid bottle
- Vinegar
- A dinner plate
- A food can e.g. beans, soup, catfood
- Several marbles

Instructions

- Into one film canister place two teaspoons of flour, into the next place two teaspoons of talcum powder and so on until all your film canisters are used.
- Put the lids on the film canisters and shuffle them around until nobody knows which is which. Umpire's note: NO CHEATING!
- Pour some vinegar into the empty washing up liquid bottle.

- Place the can in the middle of the circle of participants. Ensure the ring pull end. If there is one, is at the bottom - you want a smooth surface face up.
- Place the marbles on the top of the can.
- Place the dinner plate on top of the marbles so that it spins easily.
- Arrange the film canisters in a circle around the base of the can.
- Place the washing up liquid bottle of vinegar on its side on the dinner plate so that it acts like a pointer.
- Spin the plate.
- When the plate stops, the person at whom the vinegar bottle is pointing must pick a film canister.
- The person must take the lid off the canister and add a squirt of vinegar.
- If they are lucky nothing will happen. Otherwise suddenly a big frothy mass will spurt up and over the top of the film canister and all down the unlucky person's arm. Nice and smelly too!

Further Information

Vinegar contains a weak acid known as acetic or ethanoic acid. It will react with an alkali (or base) such as sodium bicarbonate to give off carbon dioxide gas - hence the froth. This is a chemical reaction between an acid and an alkali (base). Baking powder contains sodium bicarbonate so it too will froth and give off carbon dioxide. The marbles on the can act as ball bearings and reduce the friction between the dinner plate and the can surface - hence the plate spins easily. Try spinning the plate without marbles if you want to see the difference for yourself.

Extension Ideas

Rules for advanced rounds:
Try adding food colouring to the powders for extra yuk-factor
Have more than one 'live' canister - just to spice up the game!

This experiment came from...

Katy Hewis of Science Matters.

Remember BE SAFE!

Vinegar is irritating to the eyes. Wash affected eyes with cool water.

SHRUNKEN HEADS

Age Range: 11-14 with adult supervision

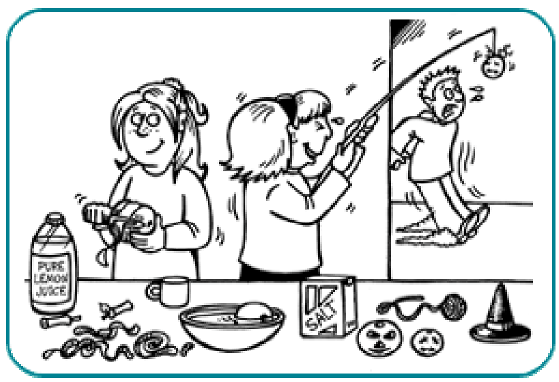
This activity can be used for Halloween fun.

Note: If you are under 16 you will need to ask an adult to supervise.

You will need

- Apple
- Apple corer
- Vegetable peeler
- Cup of lemon juice
- 1 tbsp salt
- Bowl
- Small knife

Instructions



- The first step is to core the apple and remove the skin, which will help the apple to dry quicker.

- Next, mix the lemon juice and salt in a bowl and roll the apple around in the mixture for a minute.

- Now, use the small knife to carve out holes for the eyes, nose and mouth. Remember that apples contain a lot of water so when dry they will shrink to half their size. This means you need to make the facial features big but without too much small detail, as this will be lost.

- Once again dip the apple into the lemon and salt and then place them on a baking tray.

- The quickest way to dry them is to place them inside an oven on its lowest setting and keep checking them until they are dry.

- Decorating Options:
  When the apple is nearly dry you could use a needle and thread to sew the mouth closed, or use grains of rice for teeth or raisins for eyes. Once the apple is dry you could make it a witch's hat or add wool for hair!

Further Information

The apple dries, shrinks and changes shape. Freshly cut apples turn brown when iron-containing chemicals inside apple cells react with oxygen in the air. The chemical reaction is called oxidation, and it is similar to the rusting of iron. When you soaked your apple in lemon juice, the acid in the lemon juice affects this reaction and keeps the apple from browning too much.

Although there were many headhunting cultures throughout the world, only one group was known for ancient practice of shrinking human heads (tsantsa).

They were called the Jivaro clan who lived deep in the Ecuadorian, and neighbouring Peruvian Amazon. The shrunken heads were used as trophies since it was thought the wearers harnessed the power of their hapless victims.

The shrinking process (not for the squeamish!):
After the head was severed, they peeled the skin off the face, turned it inside out and scraped it. Believing that violent death unleashed a soul bent on revenge, they carefully sewed up the lips and eyelids to trap and paralyse the spirit.

The skull and brain were sacrificed to the spirit of the anaconda while the leftovers simmered in a pot of berry-cured water. The plant used is believed to be Œhuito_. After less than 2 hours, the head would shrink to about a third of its size. Then heated pebbles were placed inside the head and shaken to shrink the skin. When the head was too small for pebbles, it was placed between hot rocks (heated by fire) and the cavity of the head filled with hot sand several times. This has the effect of melting a layer of fat inside the head, and causes the skin of the head to shrink and to turn black.

The face was rubbed with charcoal and berries to keep it moisturized, so it wouldn't crack. After one night of smoking over a fire, the hair was carefully trimmed and the head was ready for the celebration.

Much less disgusting to use apples!

For information on the Hobbit-sized human visit the Science Museum, London's website at: http://www.sciencemuseum.org.uk/antenna/flores/

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Be careful when using sharp knives. Ask an adult to help.

SIMPLY NUTS

Age Range: 5-14

Q: What are the chances of picking out a Brazil nut when you plunge your hand into a jar of mixed nuts without looking?

A: Considerably better if you tap the jar on the table a few times first. But why ..?

You will need

- A jar of mixed nuts
- A tabletop
- A hand

Instructions

- Unscrew the lid of the jar and see which nuts are on the surface. There's sure to be at least one Brazil nut.
- Push the Brazil nut(s) down below the surface.
- Screw the lid back on and give it a gentle thump on the table a few times.

- Now look inside again. Aha!! How did that happen?

Further Information

The Brazil nut(s) are larger than the other nuts in the jar. As you tap the jar the Brazils move upwards which allows the other smaller nuts to fall beneath it and take up the space it leaves.

Since the Brazil nut is fairly smooth, the friction between it and the other nuts is low which makes it easier for other nuts to slip beneath it.

As you continue to shake the jar the Brazil nut will gradually move upwards until it is finally sitting on the surface. Cunning eh?

Extension Ideas

You can also try this trick with a jar of rice and a marble or small rubber ball.

This experiment came from...

The Planet Science Newsletter.

SKY IN A JAR

Age Range: 7-14

Why is the sky blue and sunsets red?

Consider possible responses. Introduce the fact that white light is somposed of all the colours of the spectrum.

You will need

- A clear, straight-sided drinking glass, or a clear plastic or glass jar
- Water
- Milk
- Mesauring spoons
- A torch
- A darkened room

Instructions

- Fill the glass or jar about 2/3 full of water, about 250–400ml.
- Add 1/2 to 1 teaspoon of milk and stir.
- Take the glass and torch into a darkened room.
- Hold the torch above the surface of the water and observe the water in the glass from the side. It should have a slight bluish tint.
- Now, hold the torch to the side of the glass and look through the water directly at the light. The water should have a slightly reddish tint.
- Put the torch under the glass and look down into the water from the top. It should have a deeper reddish tint.

Further Information

The small ‘particles’ of milk suspended in the water scatter the light from the torch, in the same way that dust particles and molecules in the air scatter sunlight.

Sunlight is a mixture of all the colours of the rainbow (the spectrum), and different colours of light are scattered by different amounts when they encounter stuff like dust particles. Light at the bluer end of the rainbow has a shorter wavelength; it’s scattered most easily. The red end of the rainbow represents light that’s less easily scattered since it has a longer wavelength.

When the light shines in at the top of the glass, the water looks blue because you see blue light scattered to the side. This is like the midday sky. However, when you look through the water directly at the light, it appears red because more of the blue was sent elsewhere by scattering. In the same way, at sunset light from the sun has to travel through much more atmosphere than when the sun is overhead. Blue light and all the other colours are scattered around (and diluted) so much by all this atmosphere that only red, orange and yellow light remain visible.

This experiment came from...

The Planet Science Newsletter.

SOLAR SYSTEM BISCUITS

Age Range: 7-14 with adult supervision

Tasty snacks with a science theme!

If the Orionoids have left you hungry for more then these biscuits make ideal treats for any sky-gazing nights you might be planning. Of course, you don't have to be into astronomy to enjoy making these biscuits, and what better way to introduce your budding astronomers to the Solar System than to make edible versions of the planets!

You will need

- 175g plain flour
- 100g butter or margarine
- 50g caster sugar
- Four different sized biscuit cutters
- Items to decorate - colouring icing, hundreds & thousands and liquorice.

Instructions

- Pre-heat the oven to 150°C/300°F Gas 2
- Cream the butter or margarine and caster sugar together until they are light and fluffy. Stir in the flour and, once mixed, knead the dough together until it forms a ball. Add a sprinkle of flour if the dough is sticky.
- Roll out the dough on a lightly floured surface until it is about 5mm thick.
- Use the smallest biscuit cutter to cut three biscuits from the dough (Pluto, Mercury and Mars).
- Use the next-size-up biscuit cutter to make two biscuits (Venus and Earth).
- Use the next larger biscuit cutter to make another two biscuits (Neptune and Uranus).
- Use the largest biscuit cutter to cut the last two biscuits (Saturn and Jupiter).
- Place the biscuits on a baking tray and bake in the centre of the oven for 25 minutes or until golden brown.
- Let the biscuits cool before decorating.

  Note: Keep track of the planets as you cut them out so you can decorate them correctly after they are cooked.

Now for the decoration:

- Mercury has a rocky surface and is orange-red in colour, so use coloured icing and hundreds and thousands to decorate this biscuit.
- Venus is covered with thick, yellow clouds so you will need yellow icing.
- Earth is an obvious one! Decorate with green and blue icing and a sprinkle of icing sugar to resemble the clouds.
- Decorate your Mars biscuit with red icing.
- Jupiter is a giant ball of yellow, orange and red gas arranged in stripes. Use stripes of coloured icing decorate with a red sweet in the middle to resemble Jupiter's Great Red Spot.
- Saturn looks yellow because of its foggy atmosphere and is famous for its rings, so use yellow icing and lay a few pieces of liquorice on the biscuit to resemble its rings.
- Uranus looks green so decorate with green icing.
- Neptune is blue with faint stripes so decorate with blue icing and make faint stripes with sprinkles of icing sugar.
- Finally for Pluto, sprinkle a little icing sugar on the top of the biscuit to resemble this icy, rocky planet.
- Now all you have to do is arrange the biscuits in the correct planetary order and serve.

Extension Ideas

Remember the order of the planets by using the mnemonic:

My **V**ery **E**asy **M**ethod **J**ust **S**hows **U**s **N**ine **P**lanets

Mercury-Venus-Earth-Mars-Jupiter-Saturn-Uranus-Neptune-Pluto

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Adhere to the guidelines for Food and Hygiene (Be Safe! 3rd edition section 6). Take care when using cookers and handling hot baking trays.

SPINNING JUICE

Age Range: 7-14 with adult supervision

You will need

- An empty 1 litre fruit juice carton
- A piece of string
- A pair of scissors
- A washing up bowl
- Water

Instructions

- Poke a hole in the bottom left hand corner of each of the four faces of a 1 litre juice carton. (Get an adult to do this, it can be a bit tricky - and stabby)

- Poke an extra hole in the top flap of the carton and tie a string through it.

- Knot the string, so that you can hang the carton from it.

- Pour some water into the washing up bowl so that it's about one quarter full.

- Place the carton into the bowl of water.

- Pour water into the carton until it is full to the top. (The reason you put water in the bowl previously is so that you can fill the carton up with out it shooting straight out of the holes.)

- Now lift the carton out of the water by the string and watch what happens! The carton will be, in the words of Kylie Minogue, "spinning around" …

Further Information

Newton's Third Law states that every action has an equal and opposite reaction. Water shoots out the holes, and pushes back on the carton with equal force. A turbine is formed as the energy of the moving liquid is converted into rotational energy. Consequently the carton spins. This effect was first noted by Hero of Alexandria, although possibly not using a juice carton.

Hero (or Heron) (roughly A.D. 10 to roughly A.D. 70) was a Greek engineer and geometer. His most famous invention was the first documented steam engine, the 'aeolipile'. Steam was generated in a separate boiler and fed into a sphere through a hollow spindle. The steam left the sphere via two narrow, angled nozzles and the reaction to the jets of steam leaving these nozzles made the sphere spin.

Extension Ideas

To see an animation of Hero's Aeolipile, there's a good little animation here: http://www.geocities.com/Athens/Acropolis/

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Be careful when using scissors to puncture holes.

THE AIR POWERED CAR

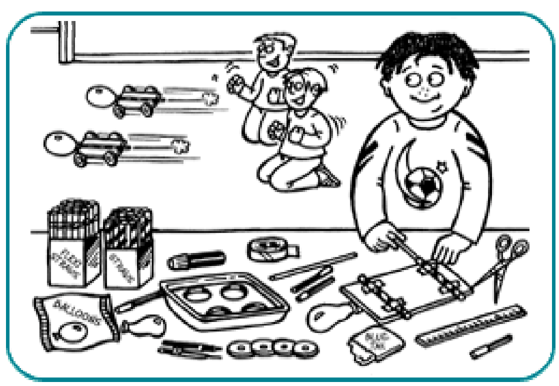
Age Range: 7-14 with adult supervision

Here's an activity which is good fun to try on your own, but can also provide the basis for a Wacky Races style challenge if you have more than one team involved...

You will need

- A piece of strong card - A5 size (approx. 15cm x 21cm)
- Styrofoam trays (1 large or several small)
- A ruler
- A compass
- A maker pen
- A balloon
- Sticky tape
- Scissors
- 1 flexi-straw
- 2 'normal' straws
- 2 thin dowelling rods (approx. 2cm longer than the straws)
- Blutack
- Felt pens etc to decorate - optional

Instructions



- Draw four circles 7.5cm in diameter on the flat surface of the styrofoam tray and cut them out.
- Make a small hole in the centre of each circle. These are your four wheels.
- Inflate the balloon a few times to stretch it. Slip the end of the balloon over the end of the flexi-straw (nearest its bend).
- Secure the end of the balloon to the straw with tape and seal it tight so that the balloon can be inflated by blowing through the straw.
- Tape the straw lengthways along the middle of the A5 piece of card.
- Flip the card upside down and place the two 'normal' straws across the card 5cm from each end. Stick them down.

- Push the dowelling rods through these two straws. The rods should stick out the ends of the straws. Push the wheels onto the end of each dowelling rod. Secure the wheels to the rod with blutack. Flip the car back over. Blow through the flexi-straw to inflate the balloon. When the balloon is full, pinch the straw to hold in the air.

  YOU ARE NOW READY TO RACE!

- Set the car on a smooth surface, with the wheels on the ground (obviously!) and release the straw...

Further Information

The car is propelled along the floor by escaping air. The air travels backwards out of the straw, which causes the car to move in the opposite direction. You can think of this movement as being like what happens when you swim: you push water backwards with your arms but you yourself move forward.

This is a demonstration of Newton's Third Law of Motion, and technologists employ the same principle to launch rockets into space. Gas and fire explode downwards out of the end of the rocket, causing the body of the rocket to take off in the opposite direction, i.e. up, up and away...

Extension Ideas

How far does your car go? Can you think of any design improvements? How about customising the cars?
Now challenge your friends to a race...

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Children under 8 yrs should not inflate balloons as they can be a chocking hazard.
Take care when using scissors.

THE BIG DRIPPER

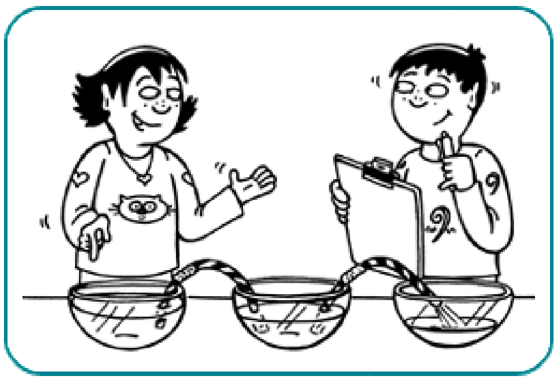
Age Range: 11-14

Challenge the class to move water from one bowl to another without pouring it and without making the bowls higher or lower.

You will need

- Plastic 'bendy' drinking straws
- Small clear bowls or yoghurt pots
- Food colouring
- Water
- Washing-up bowl

Instructions



- In one small bowl add a few drops of food colouring and fill nearly to the brim with water. This is Bowl 1.

- Fill another small bowl a quarter full with water and place it next to the first. This is Bowl 2.

- Half fill the washing-up bowl with water.

- Immerse the straw completely in the washing up bowl so that it fills with water. You may have to jiggle or squash it to force out any air bubbles but take care not to split it.

- Whilst still in the washing up bowl, fold back the two ends of the straw and pinch them tight so that you can take the straw out of the water without letting any air in.

- Put one end of the straw under the surface of the water in Bowl 1. Make sure that it is completely in the water before you release it and no air gets in.

- Arch the straw and place the other end of the straw under the surface of the water in Bowl 2. Make sure that it is completely in the water before you release it and no air gets in.

- Do you see how the coloured water is now draining into Bowl 2? Amazing eh? If not, then you may have air in the straw and you need to repeat steps 4 and 5.

- Once Bowl 1 is draining into Bowl 2, take an empty bowl and add a few drops of a different food colouring and fill it with a small amount of water. This is Bowl 3.

- Connect Bowls 2 and 3 with a water-filled straw as before. Now Bowl 3 should start filling up.

- Continue adding more bowls and straws, as you wish, to make your very own water roller coaster.

Further Information

As you can see, the water has to travel uphill through the straw and down the other side to flow into the next bowl. The fluid is behaving just like the carriages joined together in a roller coaster. This is an effect known as siphoning.

In a conventional siphon a quantity of liquid can be moved from one container to another using a flexible tube. E.g. emptying a fish tank by submerging a length of plastic tubing in it and then sealing one end with a finger and placing it in a bucket on the floor. The bucket is at a lower level than the tank and so the water is siphoned out.

Two things define a siphon:
1. The inlet is higher than the outlet
2. A portion of the siphon tube is higher than the inlet.

Find out more about how siphons work with these two links:
http://www.science-projects.com/WaterCoaster.htm
http://www.pump-flo.com/

But in our water roller coaster all the bowls are on the same level. How does the siphon effect work now? Well the bowls themselves are all on the same level but the levels of water in the bowls are different. In Bowl 1 we have the greatest height of water and this drains into Bowl 2 which has a greater height of water than Bowl 3 and so on. Have you noticed what happens when the levels of liquid equal out? The siphon stops. But it all starts again when you add more water to Bowl 1.

The siphon works because there is a pressure difference at the inlet and outlet ends of the straw. The greater height of water in Bowl 1 means a greater pressure forcing water up the straw towards the lower level water. When it reaches the high point of the straw arch, gravity can then pull the water downwards. Imagine the carriages on the roller coaster as they go over the peaks of the slopes. The combination of these two effects means that the water flows through the straw until both levels of water are equal in the bowls and hence the pressure at the inlet and outlet are the same.

Extension Ideas

Try placing Bowl 2 at a lower level than Bowl 1? Does the water flow faster or slower?

Arrange your bowls in steps with the fullest bowl at the top. Can you move the water from the top bowl to the bottom bowl using straws?

Arrange a colourful water feature by placing different food colourings in different bowls. Remember that the colours will mix!

Scale up and use buckets and washing up bowls with lengths of plastic tubing.

Talk about larging it!

This experiment came from...

Katy Hewis of Science Matters.

THE BLUBBER GLOVE

Age Range: 7-14

Here's an activity that lets you find out for yourself how whales, seals and penguins all manage to stay warm in the cold.

It's gross, but it works...

You will need

- Four waterproof plastic bags, big enough to get your hand in, eg freezer bags
- Parcel tape
- A big bowl of ice and water - good and ch-ch-chilly
- A few packs of solid vegetable fat, at room temperature
- A spoon (unless you really want to get your hands dirty!)

Instructions

- Cut the tops off two of the plastic bags if they have any handles or flaps and place one inside the other.

- Start to fill the gap between the bags with vegetable fat. Mmmmmm - nice!

- Once the gap is filled with about 2cm of fat all around, seal the gap between the bags with parcel tape leaving the inner bag open so you can put your hand in it. You've now made yuor blubber glove.

- Put one hand inside the blubber glove. Sqodge the fat around as necessary as to cover your hand completely.

- Put your other hand inside the the two other plastic bags. Now dip both hands into the icy water. Which one do you have to pull out first? Don't leave either in there too long as they will start to hurt!

Further Information

You should notice that you can keep your blubber-gloved hand in the bowl of ice much longer than the hand protected only by the plastic bags.

This is because the fat acts as an insulator, keeping the heat inside and not letting it pass through to the icy water.

In the wild, many sea animals have a thick layer of blubber to protect them from the cold.

This experiment came from...

The Planet Science Newsletter.

THE STRANGE CASE OF THE WEIGHTY BALLOON

Age Range: 7-14 with adult supervision

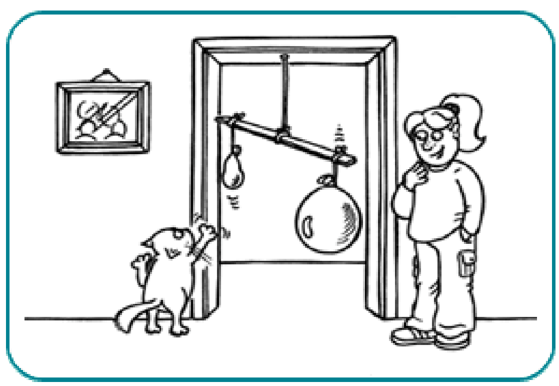
Is it really possible to be as 'light as air'?

Quite a compliment you might think, but is air really that light?
Here's an experiment to help you investigate...

You will need

- A metre rule (or long straight uniform stick)
- String
- Sticky tape / drawing pins
- 2 big balloons

Instructions



- First set up the balance. Tie one end of a piece of string around the centre of the metre rule and attach the other end of the string to the ceiling, or a doorway, with a drawing pin or sticky tape.

- Now move the loop of string until your metre rule balances - this should be around the 50cm mark.

- Once it's balanced, use a bit of tape to stick the string loop in place around the rule.

- Take an uninflated balloon and tie a piece of string firmly around its neck and loop it about 5cm from one end of the metre rule. This will completely unbalance the metre rule, but don't worry about that at this stage.

- Take you second uninflated balloon and tie a piece of string VERY LOOSELY around its neck and make a loop over the other end of the metre rule.

- Move each of these balloons along the rule slightly until it's nicely balanced again. Stick your string loops to the metre rule with sticky tape.

- Carefully untie the second balloon, blow it up and tie it so it stays inflated. Now re-tie it in its place. You will notice that the balance has tipped. After all that work, how come it no longer balances? Any guesses?

Further Information

The inflated balloon actually weighs more than the flat balloon. This is because air has a weight! When we fill the balloon with air it pulls on the balance and tips it over, very, very slightly.

The smaller the balloon the harder it will be to see the change, so make sure you fill the balloon up as much as possible.

Extension Ideas

Read more about this, and why helium balloons float at:
http://science.howstuffworks.com/helium1.htm

Another approach to the experiment would be to balance two inflated balloons on the metre rule. Once balanced, pop one of the balloons with a pin and see what happens.

This experiment came from...

The Planet Science Newsletter.

Remember BE SAFE!

Children under 8yrs should not inflate balloons as they can be a choking hazard.

WARM HEARTS

Age Range: 11-14 with adult supervision

From the Planet Science Diner, here's a science activity that's a dessert as well.

What a top combination!

You will need

- A carton of ice cream (not soft scoop)
- Some of your favourite jam
- A microwave oven
- A freezer or freezer compartment in the fridge
- A knife, and spoons of various sizes

Instructions

- Wash your hands. Then, carve an ice cream ball out of your block a few inches in diameter. With the knife, cut it in half and hollowout the centre. (Be careful not to hurt your fingers by freezing them if you touch the ice cream).

- Place a spoonful of jam in the hollow. Reform the ball by attaching the two halves together again. Make as many balls as you need.

- Place them on a plate and pop them into the freezer for at least half an hour or so. They will need to be rock solid for the next step.

- When you are ready to serve them, remove them from the freezer and microwave each one individually on full power for about 10-15 seconds. You'll be able to see exactly how much time is right in the microwave by trial and error on the first couple of balls. (Do not be tempted to try and microwave them all at once).

- Serve immediately. The ice cream should be deliciously cold - but the jam may become very hot so warn your guests not to burn their tongues.

Further Information

Microwave ovens work by heating (or 'exciting') the water molecules in the food you put in there. But because water in the form of ice is not easily excited by the microwave energy, the ice cream does not melt immediately. However, the jam in the centre of the ice cream is made up of mostly liquid water and sugar molecule. These do absorb the energy quickly, and as the microwaves penetrate through the food to a depth of a few centimetres, the waves can reach the jam and warm it faster than the ice cream can melt. So although it's cold on the outside it has a warm heart. Awwww.

NB: Nothing wrong in using classic vanilla ice cream and raspberry jam, but you might also like to branch out and invent your own combos (eg. chocolate ice cream with black cherry jam centres, mmmm).

Extension Ideas

For loads more fun recipes you can make in the microwave, have a look in our online larder at:
http://www.planet-science.com/outthere/diner/microwave/index.html

And if you want to play with our interactive microwave oven and find out a bit more about how it works (and what you can and can't cook in it) click through to 'Microwhizz Oven' on the following page:
http://www.planet-science.com/outtther/diner/microwave/index.html

This experiment came from...

The Planet Science Diner.

Remember BE SAFE!

Frozen items can cause injury to the skin, take care when handling. Jam can become extremely hot when heated so take care to avoid scalding injuries.

WATCHING THE (WATER) CLOCK

Age Range: 7-14 with adult supervision

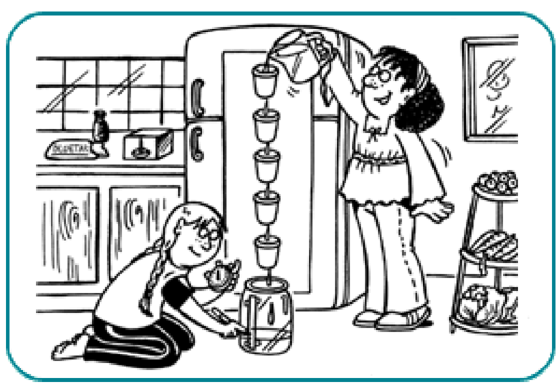
What did we do before mechanical clocks were invented?

Here's a different way to message the passage of time...

You will need

- A large sheet of heavy cardboard (at least 30cm x 75cm)
- A piece of blutack
- 5 paper polystyrene cups
- 5 drawing pins
- A large clear glass jar
- An old tea towel or cloth
- A stopwatch or timer
- Food colouring
- A jug
- A strip of paper
- Sellotape
- A marker pen

Instructions



- Use a drawing pin to punch a hole in the bottom of each cup. Tack the five cups to the cardboard, one underanother at intervals.

- Make sure the piece of cardboard is propped up vertically. You may want to use blutack to fix it against a cupboard or fridge door.

- Tape the strip of paper vertically on the glass jar, and put the jar beneath the bottom cup.

- Put an old tea towel under the jar in case of spillage.

- For a test run, fill the top cup with water from the jug and make sure the water drips smoothly through each cup. Now pour out the water from the test run.

- Add a little food colouring to a jug of water. This will make the water easier to see. Fill the top cup again. Use a timer and, at the end of every five minutes, mark the water level on the paper taped to the jar.

- When all the water has dripped into the jar, you'll be able to use this "clock" to keep track of time.

- For example, start your water clock again and use the five-minute marks to time how long it takes to do your homework, practice playing an instrument, or setting the table.

Further Information

Water clocks were among the earliest time keeping devices. It's believed that the ancient Greeks began using water clocks, called clepsydras ('water thieves') around 325 BC. A clepsydra was made of two containers of water, one higher than the other. Water travelled from the higher container to the lower container through a connecting tube. The containers had marks around their sides showing the water level, which indicated the time.

While these clocks weren't totally reliable, they worked indoors, at night, on cloudy days, so they were much more useful than the sundial, which was the only other clock in use at the time. Water clocks were common across the Middle East, and were still being used in North Africa during the early part of the twentieth century.

Extension Ideas

To find out more about early clocks and water clocks, have a look at The National Institute of Standards and Technology Physics Laboratory at:
http://plysics.nist.gov/GenInt/Time/early.html

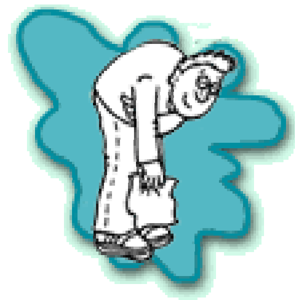
This experiment came from...

This experiment was taken from the National Geographic Kids website at:
http://www.nationalgeographic.com/ngkids/trythis/

Remember BE SAFE!

Be careful when using drawing pins as they are sharp.

WATER GREAT TRICK!



Age Range: 7-14

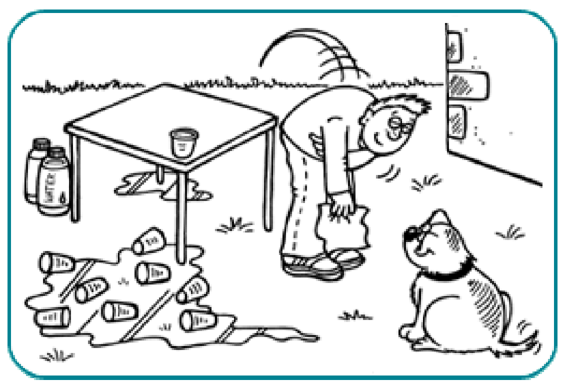
The aim of the game is to take advantage of Newton's First Law of Motion; the one that states that if you have the correct props and have practised sufficiently, you can wow your way into the group memory of both friends and strangers, at very low cost indeed.

You will need

- A paper napkin
- A plastic cup, filled with water
- A table - preferably outside
- Time to practise, practise, practise in private - DEFINITELY outside!

Instructions

- Drape the napkin over the edge of the table.
- Place the cup on one corner of then napkin, only a few cms from the edge.
- Now, focus your mind, calm your nerves, and pull the napkin quickly away from under the cup.



Further Information

What should happen: The cup remains where it is and still full of water, due to inertia. The napkin meanwhile is liberated, and can be waved at the audience.
What may happen: Water goes everywhere - this is why you need to practise alone. The trick is pull the napkin as FAST AS YOU POSSIBLY CAN!
What may also happen: Your one works, but all your little cousins decide to have a try too with less successful results. This is why outdoors is best!

This experiment came from...

The Planet Science Newsletter.