Science Museum Learning

KITCHEN SCIENCE

Contents

Introduction

The Science Museum's Outreach team has a range of fantastic science events that can be delivered in a variety of venues, from schools and theatres to community centres and businesses. We work with teachers, children, families and a huge range of community groups. We inspire audiences to engage in the past, present and future of science and technology, through interaction with our unique collections and cultural resources.

Kitchen Science is a collection of activities that people can do at home, with everyday ingredients available from the supermarket or chemist. We want to show that science does not have to be done in a laboratory, by people in white coats. Instead, science is involved in all aspects of people's lives.

Many other free Science Museum resources and experiments can be downloaded from **sciencemuseum.org.uk/educators**.

Blow-Up Balloon

Blow up a balloon without using your own breath

Grab this stuff:

- **A** Small plastic bottle
- **B** Vinegar
- **C** Water
- **D** Baking soda/bicarbonate of soda
- **E** Balloon
- **F** Teaspoon
- **G** Funnel

Blow-up Balloon

Put a small amount of water in the bottom of the bottle, and then add the same amount of vinegar.

Using a funnel, half fill the balloon with baking soda (between ½ and 1 teaspoonful should be enough).

Carefully place the balloon over the neck of the bottle and allow it to droop over to the side, making sure none of the baking soda falls into the bottle.

Now lift the end of the balloon and pour all the baking soda into the bottle. Shake well and place the bottle on a table. Watch the balloon inflate all by itself.

Blow-Up Balloon notes

Aims

- Predictions – learn how to make predictions about mixing materials to create a particular result.
- Investigation – learn about carbon dioxide (CO_2), the expansion of gases and how gases differ from solids.
- Materials – learn the difference between an acid and a base, and explore the reaction that happens when an acid is mixed with a base.
- Fair testing – have the opportunity to repeat the experiment, to develop an understanding of fair testing.

Practicalities and preparation

- Attaching the balloon to the bottleneck can prove tricky. Here are some tips on how to accomplish this effectively... Place four fingers inside the neck of the balloon and open it gently without splitting it. Invert the neck of the balloon over the top of the bottle whilst keeping the body of the balloon vertical. Ensure the baking soda remains in the body of the balloon until it is completely attached.
- Ensure that all the materials you require are available and within their expiry date.
- This is not a messy experiment, but spillages can occur if bottles are knocked over. You may choose to use aprons.
- Ensure all bottles are clean to prevent contamination, which could alter the result of the experiment.

Safety information

Check latex allergies. If there are any ensure these children do not touch the balloon.

The science – an introduction

This is a reaction between a base (baking soda) and an acid (vinegar). It produces a gas called CO_2, one of the gases we breathe out. The gas produced by the reaction cannot escape and therefore fills the balloon.

Discussion

- What is making the balloon inflate?
- What happens if you dilute the vinegar even more?
- What happens if you make the water/vinegar solution strong?
- What can CO_2 be used for? See links to real life.
- Why do we do fair testing?

Extensions

- You can experiment with different-sized balloons. See if the amounts of materials used earlier will be sufficient to inflate a larger balloon.
- Instead of using a balloon, you can use other objects such as a disposable glove.
- Food colouring can be added to the water.

Links to real life

- CO_2 is used by the food, oil and chemical industries. It is used in many consumer products that require pressurised gas because it is inexpensive and non-flammable.
- Beverages – CO_2 is used to produce carbonated soft drinks and soda water. Traditionally, the carbonation in beer and sparkling wine came about through natural fermentation, but many manufacturers carbonate these drinks artificially.
- Foods – a type of sweet called Pop Rocks is pressurised with CO_2 gas. When it is placed in the mouth, it dissolves and releases the gas bubbles with an audible pop.
- Leavening agents produce CO_2 to cause dough to rise. Baker's yeast produces CO_2 by fermentation of sugars within the dough, while chemical leaveners such as baking soda release CO_2 when heated or if exposed to acids.
- Fire extinguisher – CO_2 extinguishes flames, and some fire extinguishers, especially those designed for electrical fires, contain liquid CO_2 under pressure. CO_2 extinguishers work well on small flammable liquid and electrical fires, but not on ordinary combustible fires because it is so dry.

Links to the Science Museum

Galleries:

- Challenge of Materials
- atmosphere ...exploring climate science

Further information

- Lava Lunacy
- Alka-Seltzer Rocket
- Fizzy Fountain

Alka-Seltzer Rocket

Create your own mini rocket

Grab this stuff:

- **A** Empty film canister
- **B** Alka-Seltzer tablet
- **C** Teaspoon
- **D** Water

Alka-Seltzer Rocket

Remove the film canister's lid. Break off a quarter of one tablet and place it on the inside of the canister lid. Put 2–3 teaspoons of water into the empty canister.

Tip the quarter tablet into the canister and snap the lid shut. It is important to have a tight seal. Shake the canister for a few seconds.

Place the film canister on a flat surface, lid down. Step back and wait!

Alka-Seltzer Rocket notes

Aims

- Predictions – learn how to make predictions about mixing materials to create a particular result.
- Investigation – learn about carbon dioxide (CO_2), forces and chemical reactions.
- Materials – learn about the reaction between Alka-Seltzer and water.

Practicalities and preparation

You can get film canisters free from photo developing shops. The best film canisters to use are the opaque ones where the lid fits inside the canister.

Safety information

- Please remember Alka-Seltzer contains aspirin, therefore we recommend that children are not left alone with the tablets.
- Treat the rocket as you would treat fireworks. Never stand over the film canister once it has been turned into a rocket.

The science – an introduction

The Alka-Seltzer tablet reacts with the water and produces a gas called CO_2. Pressure builds up in the canister as more gas is released, and the lid is eventually forced off. Sir Isaac Newton's third law of motion states, 'For every action there is an equal and opposite reaction,' and this activity demonstrates it clearly: the lid pushes down against the surface, and the canister pushes upwards in the opposite direction, shooting off into the sky!

Discussion

- What happens when you are swimming?
- How is this the same as what happens in your rocket? (Newton's third law of motion – every action has an equal and opposite reaction.)
- What happens when Alka-Seltzer is added to water in a glass?
- Will the temperature of water affect the reaction time?
- How high can you get your rocket to go?
- Will the amount of Alka-Seltzer used change the outcome of the reaction?

- Who was Sir Isaac Newton? Sir Isaac Newton (1642–1727) was an English scientist.

  He admired a scientist who died shortly before he was born called Galileo Galilei. He believed (like Galileo) that the world was similar to a machine and that a few mathematical laws could explain how it worked.

  Newton is famous for discovering the theory of gravity after watching an apple fall in an orchard (it never really fell on his head!).

Extensions

- Create your own rocket covering. Be as creative as you like.
- Can you go bigger?
- What else can be used instead of a film canister?
- Measure how far the rocket goes. This will require additional materials: empty paper towel roll (the cardboard tube) or a similar size plastic tube, plus duct tape.

  Seal the end of the cardboard tube with several pieces of duct tape or use a plastic tube with one end sealed. Prepare the Alka-Seltzer rocket as normal, but instead of placing the rocket down on the table, slide it (lid first) down the tube. Point the open end of the tube away from yourself and others and wait for the pop. You can now measure how far the rocket went across the room.

Links to real life

- Real rockets behave in the same way; they just use a different fuel (oxygen and hydrogen).
- When swimming breaststroke you push the water backwards and you go forwards in the opposite direction with just as much force.

Links to the Science Museum

Galleries:

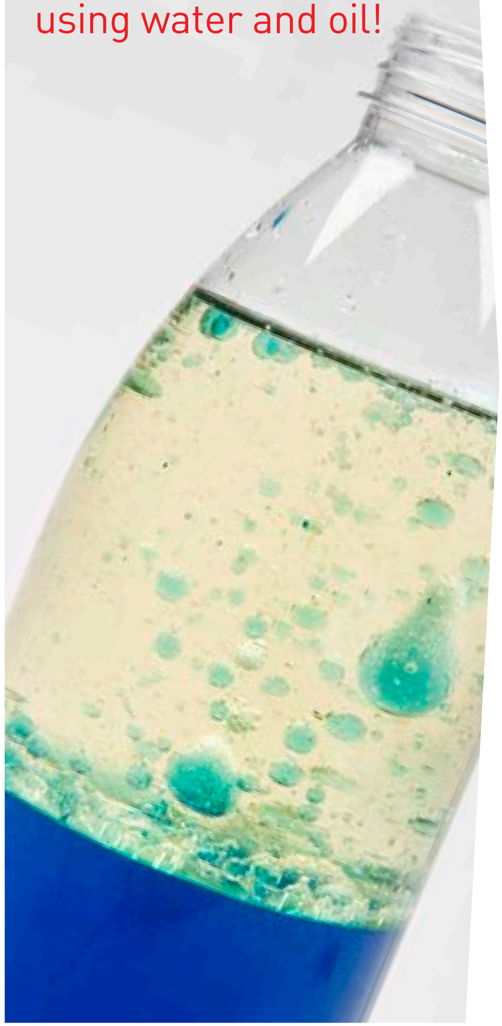
- Exploring Space
- Making the Modern World
- atmosphere ...exploring climate science

Further information

- Lava Lunacy
- Blow-Up Balloon

Lava Lunacy

Create a vigorous reaction inside a bottle using water and oil!

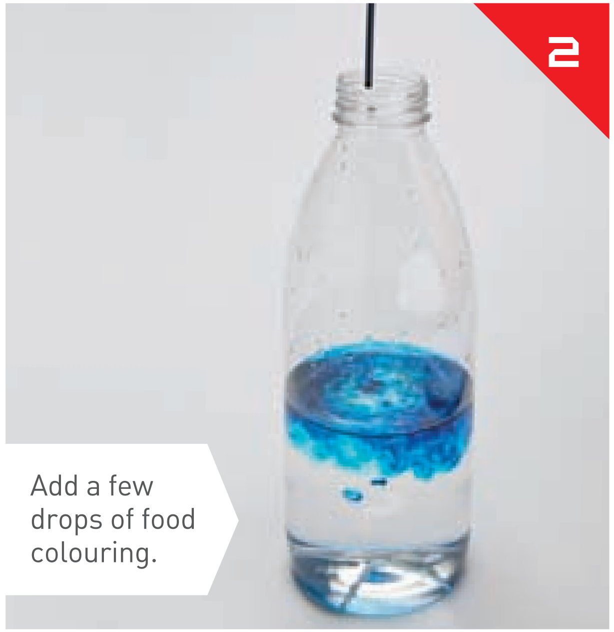


Grab this stuff:

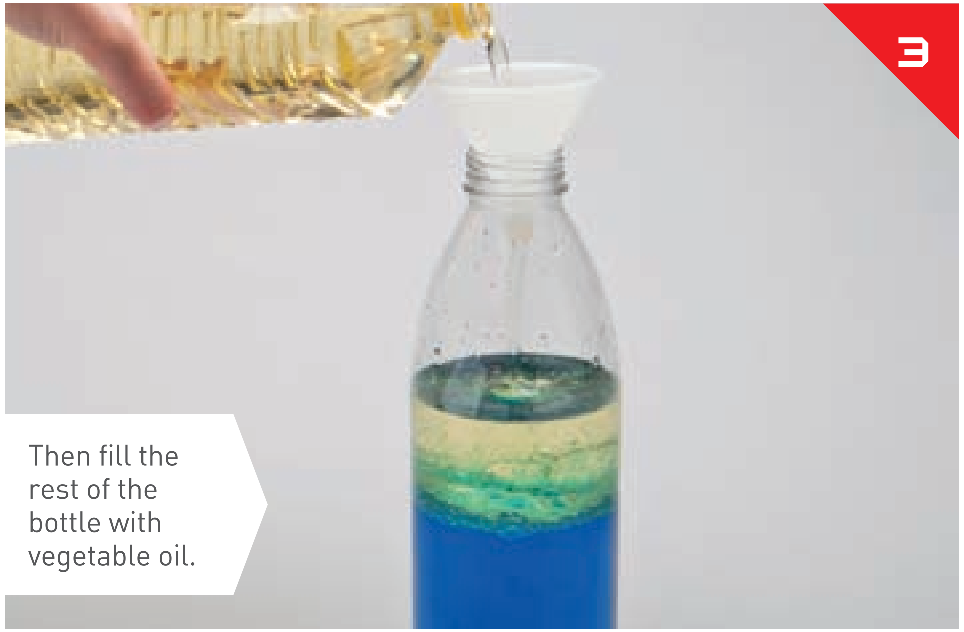
- A Plastic bottle
- B Funnel
- C Vegetable oil
- D Water
- E Food colouring
- F Alka-Seltzer tablet

Lava Lunacy

Pour water into a clean bottle until it is one-third full.



Add a few drops of food colouring.



Then fill the rest of the bottle with vegetable oil.

Break the Alka-Seltzer tablet in half and add it to the bottle. Watch the lava blobs!

Lava Lunacy notes

Aims

- Predictions – pose questions and try to investigate the answers.
- Investigation – learn about carbon dioxide (CO_2) and discover that not all liquids can be mixed together.
- Materials – an introduction to acids and bases.
- Materials – an introduction to molecules.
- Materials – an introduction to density.

Practicalities and preparation

- Do not use yellow food colouring, as it will not show up against the oil!
- If the bottle is knocked over, mopping up may be problematic because of the oil.

Safety information

Alka-Seltzer tablets contain aspirin, so students should not be left unsupervised with them.

The science – an introduction

Water and oil do not mix, as you probably know! This is because water is denser than oil, and sinks to the bottom. The food colouring mixes only with the water, which is why the oil stays its normal colour. The Alka-Seltzer tablet falls through the oil and when it reacts with the water it creates tiny bubbles of CO_2. This gas floats to the surface because it is much lighter (less dense) than both the water and the oil, carrying drops of coloured water with it. When the bubbles pop and the gas is released, the denser water sinks back down again.

Discussion

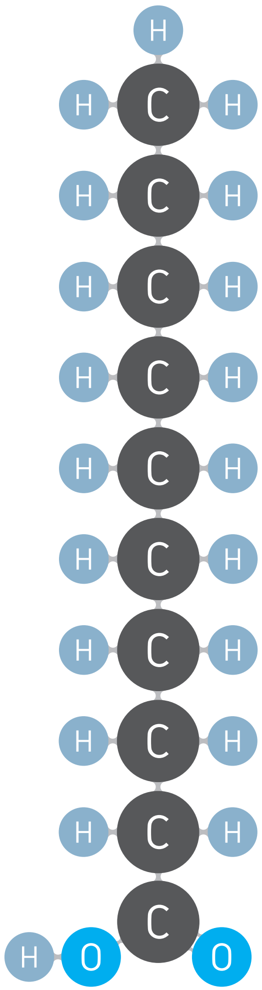
- Why does the food colouring not mix with the oil?

  Food colouring has water in it, so it goes into the water layer and does not mix with the oil.
- Why do oil and water not mix?

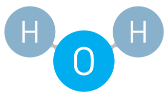
  Water is denser than oil – in other words, for a given volume, water is heavier than oil, so in the bottle it sinks to the bottom.
- What is CO_2?
- What do we use CO_2 for?
- What makes oil different from water? Introduce molecules to the children.

  Oils of all kinds – cooking oil, motor oil, light machine oil – are all long molecules made up of chains of carbon atoms with hydrogen atoms attached to them.

  Water is made up of two atoms of hydrogen attached to one oxygen atom.



An oil molecule



A water molecule

Extensions

- Instead of using Alka-Seltzer, you can put a straw in the bottle and blow bubbles into the water.
- Add crayon shavings to the oil. Will the crayon shavings mix with the oil or with the water? The crayon shavings are more like the oil, so they stay in the oil layer.

Links to real life

Real lava lamps use heat rather than CO_2 to create the effect, but the principle is the same. At the base is an electric light bulb that heats a flask filled with water. The flask also contains a blob of a waxy material which when cold is slightly denser than the water, so it sits at the bottom. As the wax warms up it expands until eventually it becomes less dense than the water and rises to the top of the flask. At the top, away from the heat of the lamp, the temperature is much lower, so the wax cools and begins to shrink. This makes it denser than the water again, so it sinks to the bottom of the flask and the process starts again. This is called convection.

Links to the Science Museum

Galleries:

- Challenge of Materials
- atmosphere... exploring climate science

Further information

- Alka-Seltzer Rocket
- Blow-Up Balloon
- Fizzy Fountain
- Milk Magic

Cornflour Slime

Solid or liquid? You be the judge!

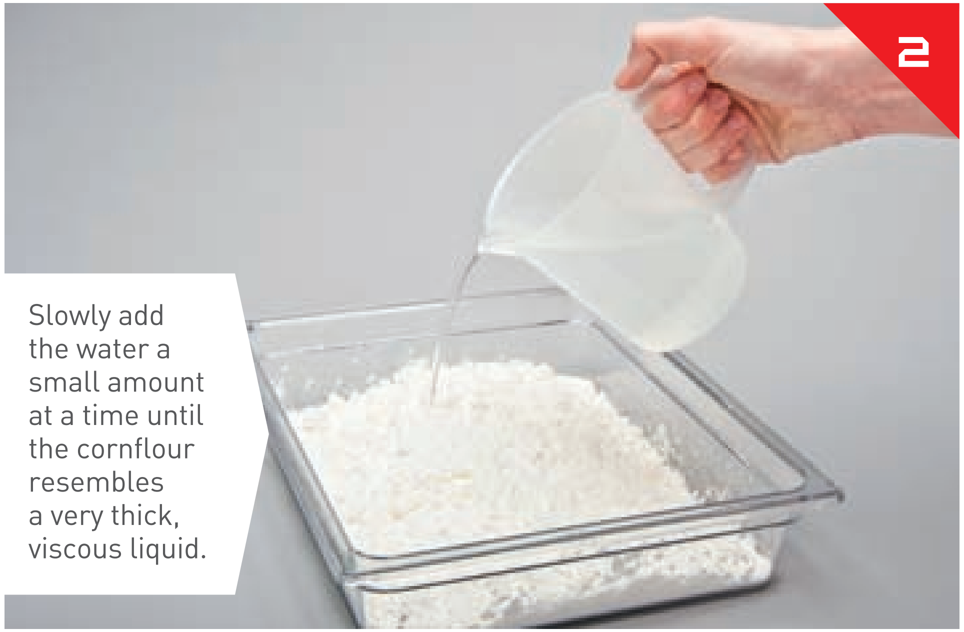
Grab this stuff:

- A Cornflour
- B Water
- C Plastic tray
- D Tablespoon

Cornflour Slime

1

Put 4 tablespoons of cornflour in a bowl.



2

Slowly add the water a small amount at a time until the cornflour resembles a very thick, viscous liquid.

3

Now you can play with the cornflour – try stirring it in a bowl with a spoon. Is it a liquid or a solid?

4

Roll the cornflour into a ball in your hand and see what happens when you stop.

Cornflour Slime notes

Aims

- Predictions – pose questions and try to investigate the answers.
- Properties of materials – discover there are materials that can behave like both a solid and a liquid depending on what you do to them.

Practicalities and preparation

- To mix the cornflour slime, start by placing the cornflour in the bowl, and then add the water a little at a time. If you start with the water and then add the cornflour you run the risk of creating a very watery slime that will not work. If this happens you may find you do not have enough cornflour to create the consistency required.
- Ensure your cornflour is in date.
- Cornflour slime can make a great deal of mess, although once it has dried it can be easily swept or vacuumed up. You may want to wear an apron. If cornflour does get onto your clothes, it will wash out with no problems.
- Having access to a sink will help with washing of hands after the activity is finished. If a sink is not available, a bucket of water will be sufficient.

Safety information

Cornflour is non-toxic, but we do not recommend the consumption of the cornflour slime.

The science – an introduction

The cornflour does not dissolve in the water – it creates a suspension called a non-Newtonian fluid. Cornflour consists of billions of tiny irregularly shaped particles of starch. When water is added, the liquid flows around each starch grain and acts like a lubricant, making the mixture runny by helping the particles to slip over each other.

When a sudden large force is applied, the starch grains jam together, squeezing some of the water out from between them. Without the lubricating effect of the liquid, the particles cannot slide past each other and so the mixture starts to behave like a solid. However these effects are only temporary. As soon as the force is removed and the mixture is allowed to 'relax', the water surrounds each of the particles again and the mixture becomes runny once more.

Discussion

- What happens if I just let my fingers gently run though the cornflour?
- What happens if I apply a force to the cornflour, such as tapping it with my fingers or punching it?
- If you let your hand sink into the cornflour, can you pull your hand out quickly?
- How hard is it to remove objects from the bottom of the bowl?

Extensions

- Instead of cornflour, you can use custard powder. Custard powder has sugar in it, so your slime will be sticky as well.
- If you have an inflatable pool (and enough slime!), you could run across the surface of cornflour slime. It is advisable to do this activity outdoors. Get the children to remove their shoes and socks before they run across the slime. Have large bowls of water ready for the children to wash their feet in.
- You can add food colouring to the water and create different colours of slime. But bear in mind that some food colourings can stain hands and clothes.

Links to real life

Engineers are now exploring using non-Newtonian fluids in body armour, such as bulletproof vests.

Links to the Science Museum

Galleries:

- Challenge of Materials

Milk Magic

Create your own rainbow patterns in milk!

Grab this stuff:

- **A** Whole milk
- **B** Flat plastic tray
- **C** Food colouring (red, yellow, blue and green)
- **D** Washing-up liquid
- **E** Cotton buds
- **F** Pipettes

Milk Magic

Pour milk into a tray.

Use a pipette to put drops of food colouring in a circle near the middle of the tray.

Dip a cotton bud in washing-up liquid and then in the centre of the milk. Watch the colours swirl!

Milk Magic notes

Aims

- Predictions – think and pose questions such as, what happens when red and blue food colouring are mixed together?
- Observation skills – experiment and watch what happens.
- Scientific inquiry – exploring what happens when different materials are mixed together.
- Properties of materials – learn about surface tension.

Practicalities and preparation

- Test your food colouring beforehand. It should sit on top of the milk and not sink to the bottom.
- When repeating the experiment, ensure that all the food colouring and washing-up liquid have been completely removed, or the next experiment will be contaminated.
- Try putting cotton buds at different places in the milk.
- Don't stir the milk – just touch it with the tip of the cotton bud.

The science – an introduction

Milk is made up of water, vitamins, minerals, proteins and fats. When the washing-up liquid is added two things happen. First, the washing-up liquid lowers the surface tension of the milk so that the food colouring is free to flow throughout the milk. Second, the washing-up liquid makes the fats and proteins in the milk spread out. This happens very quickly, causing the liquid to swirl. The food colouring molecules bump together, letting us see the activity of the milk.

Discussion

- What colour do you think you will see when the red food colouring mixes with blue food colouring?
- Why do we see swirls in the food colouring? What is making the food colouring move?
- What happens if you use different types of milk, for example semi-skimmed, low fat or soya milk?
- What happens if you use water instead of milk? Will you get the same reaction?
- What would happen if you repeated the experiment but with washing-up liquid in place of the milk, and then dropped milk in afterwards? Would anything happen?

Extensions

Gently lay plain white paper on the surface and make a print of your colour swirls.

Links to real life

The human body's digestive system:

The bile salts found in the small intestine can be thought of as 'detergents'. They rearrange or emulsify the fats in our food, increasing their surface area, which then helps enzymes to break them down.

Links to the Science Museum

Galleries:

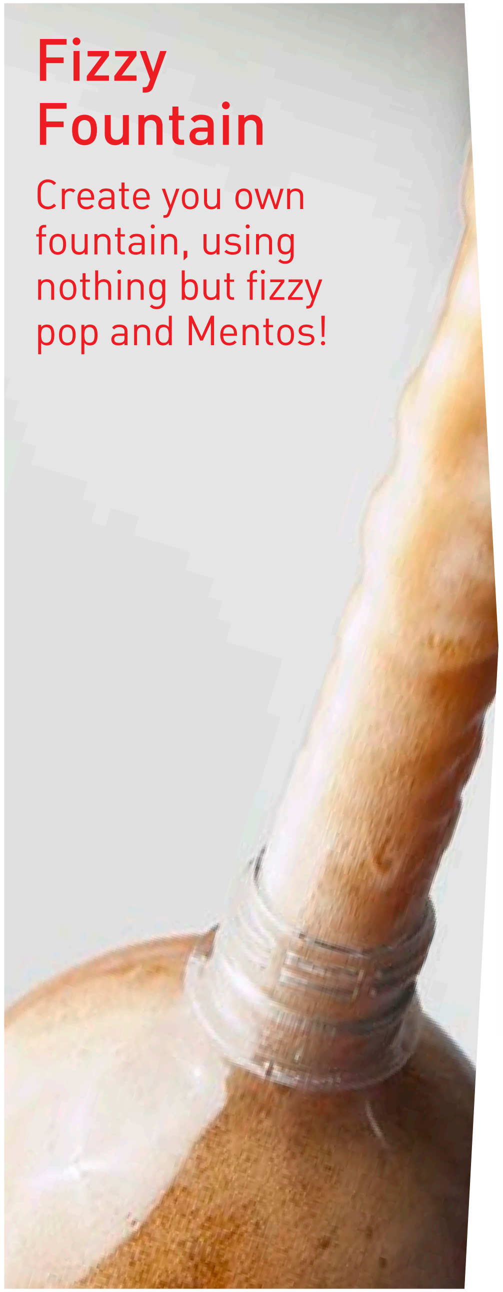
- Challenge of Materials

Further information

- Lava Lunacy
- Bubble Trouble
- Gravity-Defying Water

Fizzy Fountain

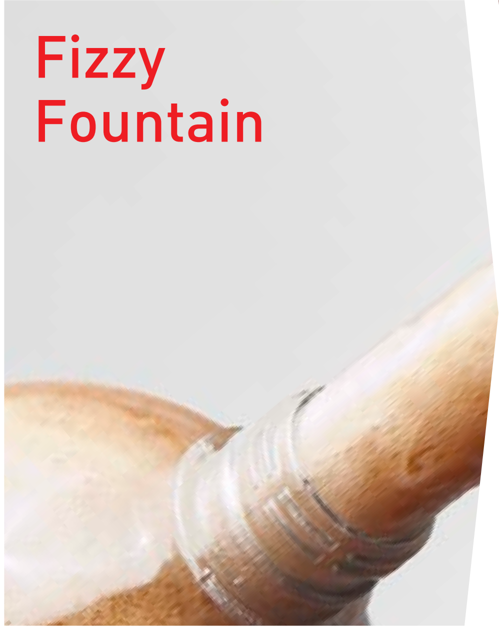
Create you own fountain, using nothing but fizzy pop and Mentos!



Grab this stuff:

- **A** Roll of Mentos (mint sweets)
- **B** 2 litre bottle of fizzy pop
- **C** Plastic tray
- **D** Tube

Fizzy Fountain



Open the bottle of fizzy pop and stand it in the tray. Open the packet of Mentos and put them into the tube.

Put the tube into the top of the bottle and pour all the sweets in at the same time. Stand back and watch!

Fizzy Fountain notes

Aims

- Predictions – pose questions and try to investigate the answers.
- Investigation – learn about carbon dioxide (CO_2).
- Observation skills – you will experiment, watch what happens and make appropriate notes.
- Scientific inquiry – you will explore how different materials react together.

Practicalities and preparation

- Do not shake the bottle of fizzy pop.
- If you are using a piece of paper as your Mentos dispenser, roll it up so it can comfortably hold the Mentos one on top of another. Once you have removed the bottle cap, carefully but quickly tip the Mentos into the bottle and stand back.
- If you are using an empty tube, such as an empty vitamin C tube, place the Mentos in the tube, remove the bottle cap and carefully but quickly tip the Mentos into the bottle and stand back.
- If you are using a Geyser Tube, follow the manufacturer's instructions. It is important to bear in mind that once you have used a Geyser Tube it needs to be completely dry before you use it again. If it is still damp the Mentos may get stuck in the tube.
- Use diet fizzy pop where available – it seems to work better than the ordinary sugary kind. Some scientists speculate this has something to do with the artificial sweetener, although diet fizzy pop's chief benefit here is that it does not leave behind a sticky mess you would have to clean up.
- This demonstration is best done outdoors because of the height of the eruption and the mess it creates. If you are going to be doing the experiment indoors, we recommend using a plastic mat. The mat should be quite a bit bigger than your plastic container because of the unpredictability of the eruption and the splatter radius.
- Different types of fizzy pop may require more or fewer Mentos.

Safety information

- Do not stand over the pop bottle once the Mentos have been added, or you will get covered in pop!
- If any pop does get in your or a child's eye, wash it out with warm water.

The science – an introduction

Fizzy pop is basically sugar (or diet sweetener), flavouring, water and preservatives. Invisible CO_2 is what makes fizzy pop bubbly. It is pumped into bottles at the bottling factory under high pressure in a process known as nucleation. Until you open the bottle the pressure inside the bottle prevents the gas from turning back into bubbles, so the liquid remains fizzy.

When you open the bottle (without adding Mentos) the pressure drops, bubbles find it easier to form and some will trickle to the surface. But water is a sticky molecule, and to form a bubble inside the liquid the gas has to overcome the stickiness and push the water molecules apart. Small bubbles therefore find it difficult to form in the first place.

However, trapped within the rough surface of the Mentos are millions of tiny pockets of air. When the Mentos are submerged in the fizzy drink, these air pockets become tiny bubbles that then 'seed' the formation of large bubbles filled with CO_2 taken from the drink.

Because the Mentos sink to the bottom of the bottle, large numbers of bubbles, which take up large amounts of space, form underneath the liquid. This pushes everything upwards and out through the neck of the bottle. Since the neck is narrower than the body of the bottle, the liquid has to speed up as it passes through, which is what sends it shooting up into the air.

Discussion

- Does the temperature of the fizzy pop make a difference to the reaction?
- What is a molecule?
- What is surface tension?
- In what other ways can you make the gas in the fizzy pop escape?

  Just drop something into a glass of fizzy pop and notice how bubbles immediately form on the surface of the object. For example, adding salt to fizzy pop causes it to foam up because thousands of little bubbles form on the surface of each grain of salt.

Extensions

- Can you create the tallest eruption? Experiment with different fizzy pops and with different-flavoured Mentos.
- How many eruptions can you set off at one time? A Guinness World Record of 2433 simultaneous eruptions was set in August 2010 in Mexico City.

Links to real life

Volcanoes are powered by accumulations of molten rock, know as magma, which build up beneath the Earth's surface. The magma is under enormous pressure, which forces any gases that are present – including CO_2, sulphur dioxide and water vapour – to dissolve in liquid rock. If the pressure suddenly drops, for instance at the onset of an eruption, the dissolved gases form bubbles thousands of times larger than the original volume of magma. This blasts molten rock, pumice, dust and ash for kilometres in all directions and blows the volcano itself to pieces.

Links to the Science Museum

Galleries:

- Challenge of Materials

Further information

- Bubble Trouble
- Gravity-Defying Water
- Alka-Seltzer Rocket
- Blow-Up Balloon

Bubble Trouble

Bubbles!

Grab this stuff:

- A 7 litres of water
- B 500 ml of washing-up liquid
- C 500 ml of glycerol
- D Tennis racket with strings
- E Tennis racket without strings

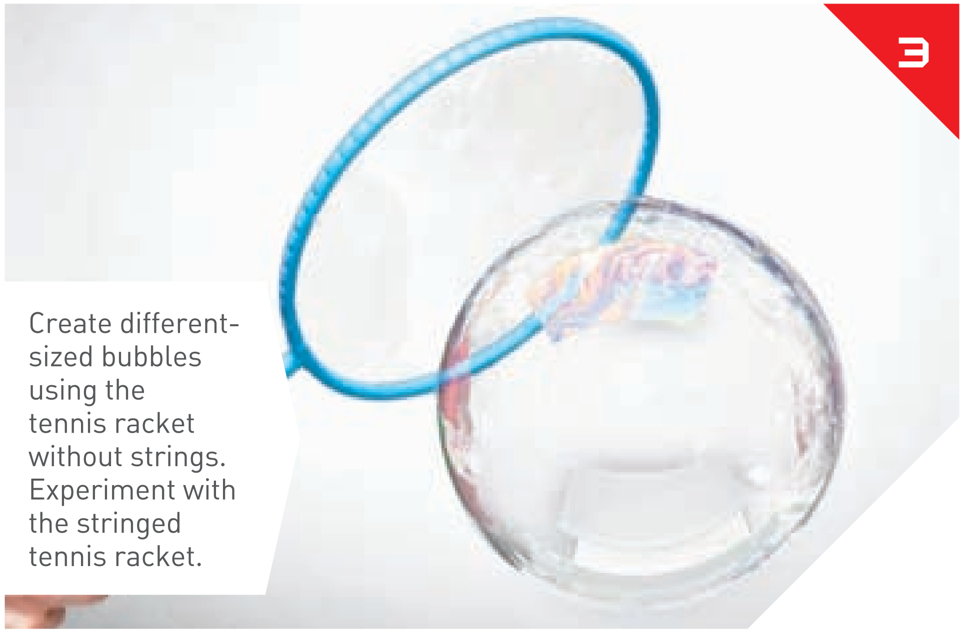
Bubble Trouble

1

Fill the bucket up with warm water.

2

Add the glycerol to the water and mix well. Add the washing-up liquid to the water and stir gently, trying not to create froth.



3

Create different-sized bubbles using the tennis racket without strings. Experiment with the stringed tennis racket.

Bubble Trouble notes

Aims

- Predictions – pose questions and try to investigate the answers.
- Observation skills – learning that observation skills and evidence are important in reaching conclusions in science.
- Materials – describing and exploring the properties of water and the changes in the properties of water in bubble mix.

Practicalities and preparation

- This investigation is messy, so have cleaning materials available including absorbent cloths, towels and aprons.
- Using glycerine in your bubble mix will help the bubbles to last longer and be stronger, potentially allowing more investigation. Do not add too much, though, as the bubbles will become too heavy.
- Bubble mix is very dependent on the outside environment (temperature, humidity, etc.).
- Although it is always tempting to run messy bubble activities outside, remember that bubbles do not like air that is too dry, or too much wind. On hot days mist the air with a plant water mister to help the bubbles last longer. In winter try placing a couple of bowls of water near radiators for an hour before you start the activity. And never attempt to blow bubbles in an air-conditioned room.

The science – an introduction

A water molecule is made up of hydrogen and oxygen atoms that are attracted to each other. This attraction also causes surface tension, an attractive force that occurs on the surface of liquids. This means that if you try and blow a bubble using just water it will not work. When soap molecules (from washing-up liquid) are added to water this reduces the surface tension and enables you to blow bubbles.

Bubbles will always form a sphere because this shape has the smallest surface area for the volume of air in the bubble, and so takes the least energy to form.

Discussion

- Which blower makes the best bubble?
- Which mixture makes this bubble the best?
- Can you make bubbles from just water?
- Do you think you could make the bubbles even better? How?
- Did you change anything that you were doing along the way? Why?
- Do you think there are other ingredients that you would want to try?
- What else could you use to blow a bubble?

Extensions

- Run a challenge – for example, to make the largest bubble, the bubble that lasts the longest or the strongest bubble (e.g. bubble foam that can hold a polystyrene bowl with five marbles in it).
- Look at the shapes that bubbles make and learn about other 3D shapes and whether it is possible to get a bubble to make that shape. For example, does a square bubble-blower make a cube-shaped bubble?
- Blow paint bubbles onto paper by adding paint to your bubble mix and using a straw to blow them. This is a good way to record how large the bubbles were.
- Use the bubble activity to look at other things that float in the air and the similarities and differences between them (e.g. seeds or balloons).
- Shine a light under the bubbles so that you can look at the rainbow colours and talk about why this happens.
- Can you blow your own bubbles using your own hands?

Links to real life

We can see and experiment with bubbles in everyday life. When you are doing the washing up you can often see lots of bubbles. They are made by mixing the water you are washing up with and the washing-up liquid. You may be able to see a difference in the bubbles depending on what washing-up liquid you use and the temperature of the water.

Bath time is also a great time to explore bubbles. These bubbles are made from the bubble bath, shampoo or shower gel that you are using.

Bubbles also have a very practical use in your toolbox. A spirit level is a glass tube filled with ethanol and a single bubble. It indicates that a surface is level when the bubble is positioned exactly between two lines on the tube. You can see a modern spirit level in the *Making the Modern World* gallery in the Science Museum.

Links to the Science Museum

Galleries:

- Making the Modern World
- Launchpad
- Challenge of Materials

Further information

- Fizzy Fountain
- Milk Magic

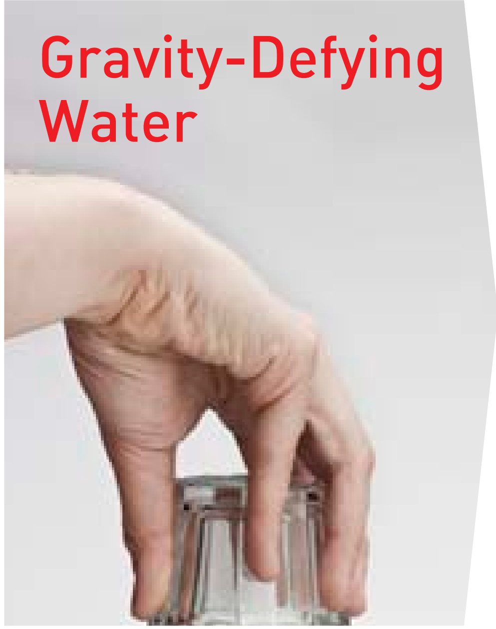
Gravity-Defying Water

Can water defy gravity? Find out for yourself!

Grab this stuff:

- A Water
- B A glass
- C Thick laminated card
- D Plastic tray

Gravity-Defying Water



1

Fill the glass with water.

2

Place the card on top and turn the glass over, while holding onto the card and making sure the card always stays flat. Do this over the plastic tray.

3

When the glass is upside down let go of the card... and it should stay where it is!

Gravity-Defying Water notes

Aims

- Predictions – make predictions and then investigate whether they are correct.
- Observation skills – experiment, watch what happens and make appropriate notes.
- Scientific inquiry – explore gravity and air pressure.

Practicalities and preparation

- When turning the glass over, always keep the card flat.
- Because the activity will more than likely be repeated a few times we recommend laminating the cards as this will make it last longer. Thick card on its own will work, but after a few attempts the card will become saturated and create a mess.

The science – an introduction

In order for the water to fall out of the glass, air has to replace it. This cannot happen when the water at the rim of the glass has formed a seal with the card and with the air pressure in the room pushing up on the card. Air pressure is caused by molecules of air pushing against things, and is one of the main factors that affects the weather. Although the water seal on the glass is relatively sticky, it will not last for ever. In time gravity will break the seal by pulling the card and the water down.

Discussion

- Will the seal hold for ever?
- What is stopping the water from coming out?

Extensions

- Do the experiment again using a plastic or polystyrene cup, but this time poke a hole near the bottom of the cup. Cover it tightly with your thumb until the cup is upside down, with the card suspended. Then release your thumb and watch what happens.

  When you move your thumb, air rushes in the hole, raising the pressure of the air inside to match the pressure outside. This means there is no net force pushing the card up, so gravity wins.
- You can also create gravity-defying cups. Blow a balloon up to one-third of full size, then wet the rims of two plastic or polystyrene cups and hold them against the sides of the balloon while you finish blowing it up. How many cups can you attach?

  The inflating balloon creates suction by getting bigger, so less of the balloon is actually in the cup. This lowers the air pressure, so the suction is really the pressure of the air outside the cup 'pushing' the cup into the balloon and making it stick there.
- Place a glass upside down in a bowl of water. Why does the air remain inside the glass?

- Put a straw into a glass full of water. Suck some water up the straw and then put your thumb over the end that is in your mouth. Now, keeping your thumb over the straw, take the straw out of the water. What happens?

When the straw is just sitting in the glass there is nothing separating the air in the atmosphere from the air in the straw. This means that the air in the atmosphere and the air in the straw are pushing down on the water in the glass with the same force. When you suck on the straw you make the water move up the straw. If you put your thumb over the end it traps the water in the straw, and your thumb separates the water in the straw from the air pressure of the atmosphere. If you pull the straw out of the water and keep your thumb over the end, the water stays in the straw. This is because there is no air pushing the water down from the top of the straw where your thumb is, but the air in the atmosphere is still pushing up at the open end at the bottom, keeping the water in the straw. The force from the air in the atmosphere pushing up is stronger than the force of gravity pulling down!

Links to real life

Car tyres, also know as pneumatic tyres, have an airtight inner core filled with pressurised air. The pressure of the air inside the tyre is greater than air pressure, so the tyre remains inflated even with the weight of a vehicle resting on it.

Links to the Science Museum

Galleries:

- Challenge of Materials
- atmosphere ...exploring climate science

Further information

- Lava Lunacy
- Blow-Up Balloon
- Fizzy Fountain

Stupid Egg Trick

Is it magic or is it science?

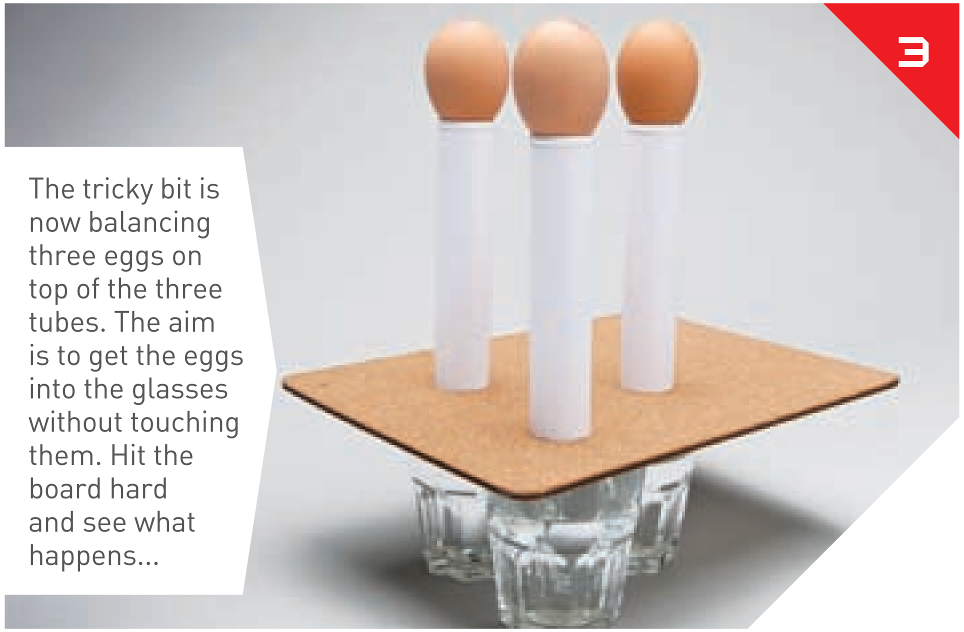
Grab this stuff:

- A 3 eggs (or juggling balls)
- B 3 hollow tubes
- C 3 glasses
- D Cork-backed place mat
- E Water

Stupid Egg Trick

Arrange the glasses in a triangle formation, then half fill them with water.

Balance the board on the glasses with the cork side facing upwards. Next balance the plastic tubes on the board, open end up and directly over the glasses. You can check you have done this correctly by looking at the board at eye level from the front and the side.



The tricky bit is now balancing three eggs on top of the three tubes. The aim is to get the eggs into the glasses without touching them. Hit the board hard and see what happens...

Stupid Egg Trick notes

Aims

- Predictions – think and pose questions. Can you get all three eggs into the glasses?
- Observation skills – discover the importance of friction.
- Investigation – learn how friction can change the outcome of an experiment.

Practicalities and preparation

- If you are using juggling balls, do not put water in the glasses. Most juggling-ball fillings are made with millet, birdseed or other material designed to give the ball bulk, so if they become wet they may start to germinate. The reason water is added to the glasses is to give them weight, so if the plastic tumblers you are using are light in weight we recommend adding a little sand to make them heavier.
- Hit the board quite hard! If you do not use enough force the board will not have enough momentum to clear the glasses. On the other hand, if you use too much you run the risk of knocking the glasses over.
- If you are right-handed make the board hang more over the right-hand side of the glasses, but if you are left-handed do the opposite. Remember the reason for the overhang is to give your hand enough space to stop before hitting the glasses.

Safety information

Using juggling balls and plastic tumblers will save money on eggs, and reduces potential risks from salmonella and broken glass.

The science – an introduction

The place mat has a smooth side and a rough side. The smooth side is face down on the glasses and slides over them with little friction. The cork side is face up and grips the tubes, dragging them along, as there is more friction between the surfaces. The eggs are heavy and gravity pulls them down into the glasses. The water stops the eggs breaking the glasses. This demonstrates the first part of Newton's first law of motion (objects remain at rest or travelling at constant speed unless a force acts on them to change their motion) and helps us understand inertia. Inertia is the tendency for an object at rest to remain at rest until a force acts on it. In terms of the Stupid Egg Trick, inertia is important because, according to the law, the objects (the eggs) will not move unless an outside force (gravity) moves them.

Discussion

- What is friction?
- Which part of the board has the most friction?
- Why do you need there to be friction between the place mat and the tubes?
- Where don't you want friction?
- What other forces are in play to allow this experiment to work?

Extensions

- Use a variety of different-weighted balls.
- Use a variety of boards with different surfaces.
- Can you go bigger?

Links to real life

Inertia can be experienced in lots of everyday situations. When you are standing in a moving bus you lean forward when the brakes are applied suddenly. This is because your body is in motion along with the bus. When the bus stops quickly, the lower part of your body comes to rest along with the bus, whereas the upper part of your body continues to move forwards.

Links to the Science Museum

Galleries:

- Launchpad

Further information

- Gravity-Defying Water
- Tablecloth Trick
- Alka-Seltzer Rocket

Tablecloth Trick

You can be a magician too!

Grab this stuff:

- **A** Shiny tablecloth
- **B** 2 cups
- **C** Teapot
- **D** Smooth table

Tablecloth Trick

Place the shiny tablecloth on the table, leaving half of the cloth hanging over the side (make sure the table has no rough edges). Put the cups and teapot on the tablecloth at the end opposite the overhanging part of the cloth.

Grasp the overhanging tablecloth in your hands tightly, but make sure you do not pull the cloth into the middle or create air bubbles under it.

Pull the tablecloth towards you and down in one fast movement. The cups and teapot should stay where they are!

Tablecloth Trick notes

Aims

- Predictions – think and pose questions. Can you remove the tablecloth without breaking the teapot and mugs?
- Observation skills – discover the importance of friction.
- Investigation – learn how friction can change the outcome of an experiment.

Practicalities and preparation

- Ensure that the cups and teapot have a smooth base. We recommend using fine sandpaper on the bases to remove any rough edges. This will reduce friction and stop the cloth catching on the base of the cups and teapot.
- Make sure the table you are using has no rough edges. If it does the cloth is likely to snag, causing damage to the cloth. Once the cloth has been damaged the experiment will be hard to do.
- Put the teapot and cups in a triangular formation on the tablecloth, near the far end of the table and close to the tablecloth edge. This means you will have to pull less of the tablecloth out from underneath the cups and teapot.
- Make sure the edge of the tablecloth that is near the cups and teapot has no hem or is the selvage edge of the cloth. If this edge has a hem on it, it will not slip easily under the cups and teapot, and most likely knock them over.
- Before you pull the tablecloth, make sure it has no wrinkles or air pockets under it, which will tend to disturb and knock over the cups and teapot when you pull the cloth.
- If the cups and teapot you use are too light, they will not exert enough force on the table to remain in place. You can overcome this problem by weighting the cups and teapot with sand.
- The trick is to grab the ends of the tablecloth with both hands and quickly pull it straight down and away from the table. The key is the quick, downward motion – almost like whipping or yanking the cloth away. Also make sure your pull is perpendicular to the table and not at an inclined angle.

Safety information

Make sure when performing the trick you have plenty of room around you so you do not knock into anything.

The science – an introduction

The tablecloth and the table are both smooth. There is not much friction between the two, and when you pull the tablecloth away it can slide out from under the crockery. The only force acting on the cups and teapot is gravity, pulling them down. As there was no force from you, pushing or pulling on the cups and teapot, they stayed where they were.

This demonstrates the first part of Newton's first law of motion (objects remain at rest or travelling at constant speed unless a force acts on them to change their motion) and helps us understand inertia. Inertia is the tendency for an object at rest to remain at rest until a force acts on it. In terms of the Tablecloth Trick, inertia is important because, according to the law, the objects (the cups and teapot) will not move unless an outside force moves them.

Discussion

- Why do the cups and teapot not move?
- What is friction?
- Is there any friction taking place in this experiment?
- What happens if you use a rough tablecloth?
- What happens if you use heavier or lighter objects? Is it easier or harder to whip off the tablecloth?
- Who was Sir Isaac Newton?

  Sir Isaac Newton (1642–1727) was an English scientist.

  He admired a scientist who died shortly before he was born called Galileo Galilei. He believed (like Galileo) that the world was similar to a machine and that a few mathematical laws could explain how it worked.

  We all know Newton for discovering the theory of gravity after watching an apple fall in an orchard (it never really fell on his head!).

Extensions

- Can you do the trick with a piece of paper?

  Place a piece of paper under a heavy object on the table. The object should sit at one end of the paper, with the rest of the paper sticking out over the edge of the table. Hold the edge of the paper in one hand, and with a quick downward motion (think karate chop!), use your other hand to 'chop' the paper and pull it out from under the object.
- Can you go bigger?

Links to real life

Inertia can be experienced in lots of everyday situations. When you are standing in a moving bus you lean forward when the brakes are applied suddenly. This is because your body is in motion along with the bus. When the bus stops quickly, the lower part of your body comes to rest along with the bus, whereas the upper part of your body continues to move forwards.

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Further information

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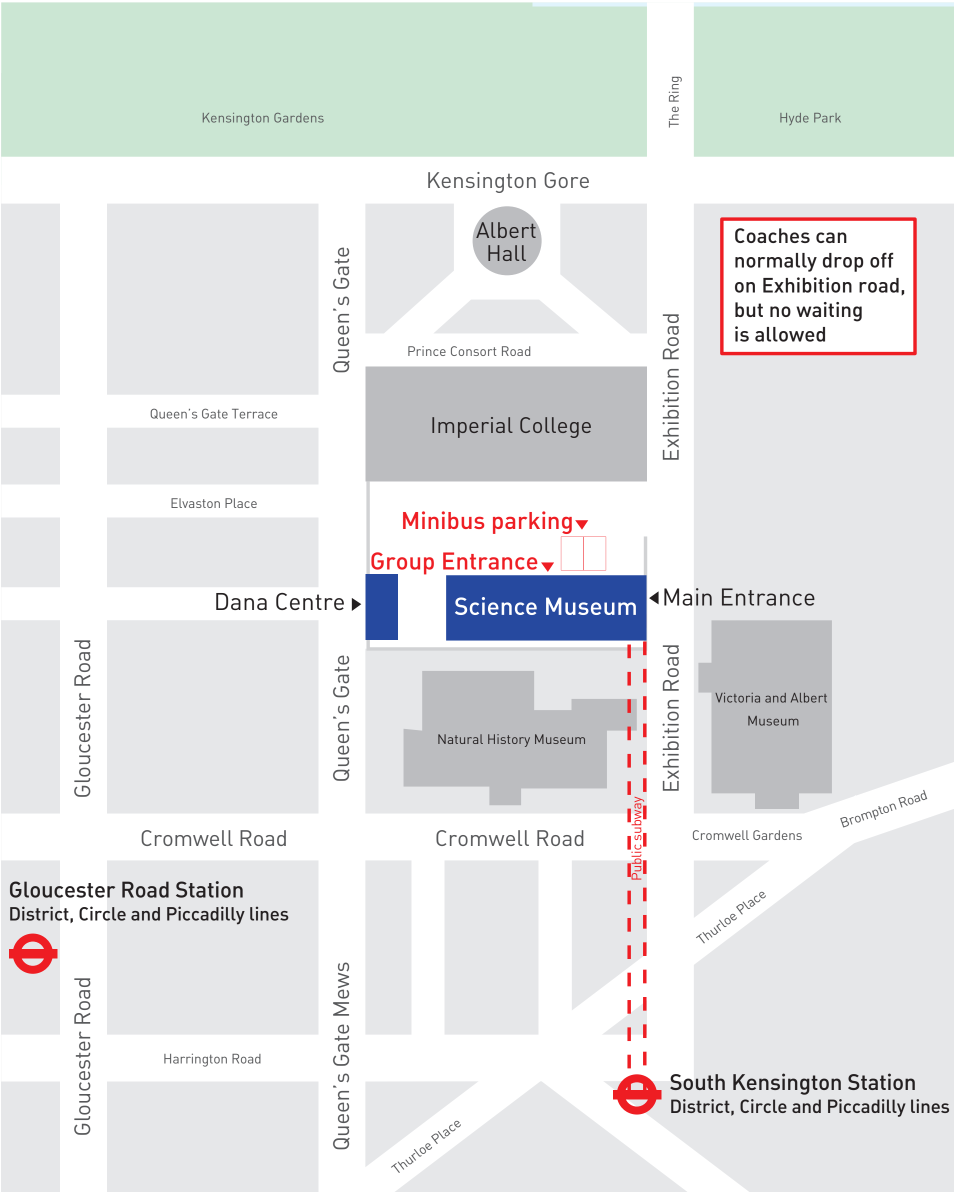
- Stupid Egg Trick

How to get to the Museum



The Museum is free

Open 7 days a week
10.00–18.00

Closed 24–26 December

Science Museum
Exhibition Road
South Kensington
London SW7 2DD

Nearest Tube station
South Kensington

How to contact us

For further details about outreach at the Science Museum:

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call
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SCIENCE MUSEUM

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