

I am a scientist!

! imagine

solutions
create

fun



experiment



$e=mc^2$



H₂O ?

dream



Let's explore science together!



What is science?

Science is an important part of Scotland's heritage and happens all around us. We use its applications every day in our lives, at work, leisure and at home.

Science is central to our economic future and to our health and wellbeing as individuals and as a society.

In a modern and ambitious society like ours, improving accessibility to sciences for all is vital.

Scotland offers many exciting and rewarding careers in the sciences and engineering. Using everyday items in our homes and applying science can be fun for families.

Every day can be a science day for families. If you would like to tell us how you got on or share some fun photos, you can contact us at parentzone@educationscotland.gov.uk

The experiments are split into sections, depending on the age and stage of your child. The exciting thing is, you might find experiments of interest to your family in any of the examples. So look around, find out, ask questions and try things out together and see what happens. Scientists call this experimenting!



What is science?

Hello! We're *Babble* and *Dabble* and we are your scientists. We will take you through this booklet and explain the science behind each experiment.



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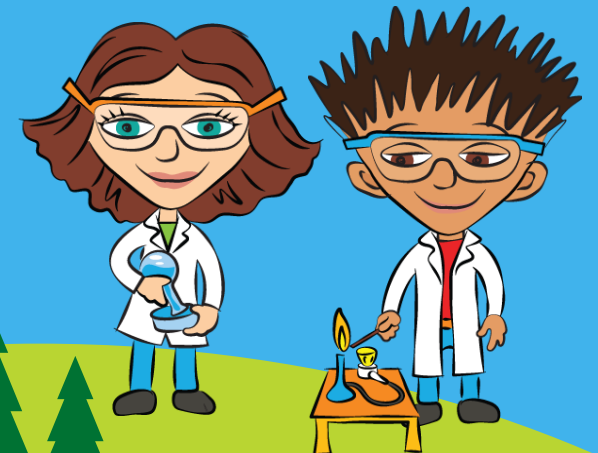
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Fun with Younger Children



Tornado in a bottle

Make your own mini tornado that's a lot safer than one you might see on the television. Follow the instructions and enjoy the cool water vortex you create!



What you'll need:

- Water
- A clear plastic 2 litre bottle with a cap (that won't leak)
- Glitter
- Dish washing liquid



Instructions:

1. Fill the plastic bottle with water until it reaches around three quarters full.
2. Add a few drops of dish washing liquid.
3. Sprinkle in a few pinches of glitter (this will make your tornado easier to see).
4. Put the cap on tightly.
5. Turn the bottle upside down and hold it by the neck. Quickly spin the bottle in a circular motion for a few seconds, stop and look inside to see if you can see a mini tornado forming in the water. You might need to try it a few times before you get it working properly.

Babble and Dabble explain

Spinning the bottle in a circular motion creates a water vortex that looks like a mini tornado. The water is rapidly spinning around the centre of the vortex due to an inward force (centripetal force) directing an object or fluid such as water towards the centre of its circular path.

Vortexes found in nature include tornadoes, hurricanes and waterspouts (a tornado that forms over water). Have a look here for a bit more help if you need it!

https://youtu.be/M9OmmqtoM_k



Make your own rainbow

Learn how to make a rainbow with this fun science experiment.



What you'll need:

- A tall glass of water (about three quarters full)
- White paper
- A sunny day



Instructions:

1. Take the glass of water and paper to a part of the room with sunlight (near a window is good).
2. Hold the glass of water in front of the paper and watch as sunlight passes through the glass of water and bends (refracts) and forms a rainbow of colours on your sheet of paper.
3. Try holding the glass of water at different heights and angles to see if it has a different effect.



Babble and Dabble explain

While you normally see a rainbow as an arc of colour in the sky, they can also form in other situations. You may have seen a rainbow in a water fountain or in the mist of a waterfall. Rainbows form in the sky when sunlight bends (refracts) as it passes through raindrops, it acts in the same way when it passes through your glass of water. The sunlight refracts, separating it into the colours red, orange, yellow, green, blue, indigo and violet.

You will only be able to see a rainbow when the sun is behind you and the sunlight refracts through the water droplets in the sky in front of you. Have a look here for a bit more help if you need it!

<https://youtube.com/watch?v=4ziRXe-w9yg>



Sinkers and floaters

Try this fun family experiment and you will have your own little Archimedes shouting out "Eureka!"



What you'll need:

- Two glasses of water (about three quarters full). You could also use the bath, sink or basin
- Sticky tape that you can write on
- Towel (in case the water spills)
- Objects from around your home, garden or local park (for example cork, sponge, stones)
- Two slices of bread



Instructions:

1. With your child write "water level" on the sticky tape and stick it onto the glasses with an arrow pointing up.
2. Put your objects into the glasses one at a time and take notes (does the water go up? Does the water stay the same? Does the object float or sink?) Talk to your child about what is happening to the water.
3. You will be able to see the water level rise when the objects are put in the water.
4. Put a full slice of bread on the surface of the water and you will see that it floats (until it gets soggy!)
5. Make small balls out of the other slice of bread and watch as they sink.



Babble and Dabble explain

The science behind this experiment is density and displacement. The water in the glass will try to support the solid objects that you put in. Objects that are heavy for their size usually sink, and objects that are light for their size usually float. The exception happens when the shape or volume of the object (its density) controls if it will sink or float.

Displacement happens when an object is put into a liquid, pushing the liquid out of the way and the object takes its place. The volume of the liquid displaced (moved) can then be measured, and from this the volume of the object in the liquid can be worked out by measuring from the first water level to the water level when the object is in the glass. To find out more about Archimedes and displacement have a look here:

<http://www.english-for-students.com/Eureka-Eureka.html>



The ant trail

Use this experiment to talk to your child about how they exist in nature and to find out what foods they like to eat!



What you'll need:

- Ants
- An apple cut into pieces, a biscuit, a plain cracker



Instructions:

1. Go outside and find some ants. Make a game out of it if you have more than one child going on the investigation.
2. When you find the ants, put the food in front of them and leave it for about half an hour.
3. When you go back, see how many ants have arrived and what piece of food they have chosen. Talk about what you see.



Babble and Dabble explain

Ants use their antennae, which are like feelers on their heads, not only for touch, but also for their sense of smell. They live as part of a colony and use great teamwork. When one ant finds food, it won't be long before others come along and join in. Most ants really love sweet things, from sugar to honey or even soft drinks. They will eat almost any fruit or vegetable.

Ants love to eat honeydew—not the melon, but a sweet, sticky substance produced by aphids (greenflies) and other plant-sucking insects. (You'll find it on leaves and other plants, or on your car if you've parked under a tree.) The ants make long trails back to their nest, going back and forward collecting their food. Have a look here for more information if you need it!

<https://youtube.com/watch?v=f4evB1gWK5Y>



Older and bolder



Invisible ink

Making invisible ink is lots of fun. You can pretend you are a secret agent and keep your secret codes and messages hidden from others!



What you'll need:

- Half a lemon
- Water
- Spoon
- Bowl
- Cotton buds
- White paper
- Lamp



Instructions:

1. Squeeze some lemon juice into a bowl and add a few drops of water.
2. Mix the water and lemon juice with a spoon.
3. Dip the cotton bud into the mixture and write a message onto the white paper.
4. Wait for the juice to dry so it becomes completely invisible.
5. When you are ready to read your secret message or show it to someone else, heat the paper by holding it close (but not too close!) to your lamp.



Babble and Dabble explain

Lemon juice is an organic substance that mixes with oxygen (oxidizes) and turns brown when heated. Diluting the lemon juice in water makes it very hard to see when you put it on the paper. No one will know it is there until it is heated and the secret message is revealed.

Other substances that work in the same way are orange juice, honey, milk, onion juice or vinegar. Why not give them a go too! Have a look here for a bit more help if you need it!
<https://www.youtube.com/watch?v=Be-OgewR1M>



Build a balloon rocket

This experiment will have the whole family reaching for the sky!



What you'll need:

- A balloon
- Scotch tape
- 3 metre length of string
- A plastic straw (with flexible ridge removed)
- Scissors
- A clothes peg (optional)



Instructions:

1. Thread one end of the string through the straw.
2. Tie each end of the string to a chair, a table leg, door handle. Make sure it is tied very tight!
3. Blow up the balloon, but leave it untied for now.
4. Hold the balloon closed (you can use the peg here to keep it closed), tape one side to the straw so that it hangs horizontally under the string.
5. Get ready for launch! Release the end of the balloon and watch your rocket go!



Babble and Dabble explain

The balloon is boosted by the energy of the air escaping from the inside.

The air rushing out causes a forward motion force called thrust!

<https://youtube.com/watch?v=N6NIgPIh7HU>



String telephone

Making a string telephone is a fun way to talk to your family and friends. Scotland's own Alexander Graham Bell who was a scientist, inventor, engineer and innovator is credited with inventing the first practical telephone.



What you'll need:

- 2 paper cups or tins
- A long piece of string
- A pencil or something that will pierce the tin (children should be supervised when using sharp objects)
- Friend/family member



Instructions:

1. Poke a small hole just big enough to fit the string through the centre of the base of each paper cup or tin with a sharp object, such as a pencil for cups or a metal skewer for tins.
2. Pull the end of the string through one of the cups/tins and tie a knot in it to keep it in place.
3. The knot should sit inside the base of the cup/tin, repeat these steps with the second cup/tin. Your string telephone is now ready to test.
4. Hold one paper cup/tin up to your mouth and talk loudly into it. Your family member or friend should walk away as far as the string will stretch and keep it tight.
5. Your family member or friend should hold the other cup/tin up to their ear.
6. If the string is tight they should be able to hear your message.



Babble and Dabble explain

A string telephone works because of the vibrations your voice causes along the string. The vibrations travel like waves along the string and when they reach the other end of the string, they hit the second cup and turn back into sound.

This is what your family member or friend can hear. Have a look here for a bit more help if you need it!
https://www.youtube.com/watch?v=LjLiQ_DIFNY



Monster toothpaste

The monster toothpaste science experiment is a fun and messy experiment for the whole family to enjoy!



What you'll need:

- Several sheets of newspaper or an old shower curtain to catch the mess
- 1 empty plastic bottle. Sizes can vary depending on how big you want the experiment to be
- 1 teaspoon of yeast
- 2 tablespoons of warm water
- 1 plastic funnel (to stop spillage)
- 1/2 cup of hydrogen peroxide (at least 6 percent, available at chemists)
- 4-5 drops of food colouring
- A squirt of dishwashing liquid



Instructions:

1. Place the empty bottle in the centre of the sheets of newspaper/shower curtain.
2. In a small jug mix together the yeast and warm water. Shake it until bubbles form (this is to activate the yeast).
3. Use a funnel to pour the 1/2 cup of hydrogen peroxide into the plastic bottle. Add some food colouring and a squirt of dishwashing liquid.
4. Now add the yeast mixture to the bottle.
5. Watch the monster toothpaste rise up and ooze out of the bottle.



Babble and Dabble explain

Hydrogen peroxide naturally breaks down into water and oxygen. The yeast added speeds up the reaction. Dishwashing liquid catches the oxygen particles as they are released by the 'breakdown' process and forms bigger bubbles.

The foam and the bottle feel warm because it releases energy in heat (exothermic reaction). Have a look here for a bit more help if you need it!

<https://www.youtube.com/watch?v=rmBOLiYEF14>



Walking water

This easy colourful science experiment can be done with simple items you have in your kitchen right now. Choose two colours (red, yellow, blue) that will mix to make a different colour. For example mix red and yellow to make orange or mix blue and red to make purple.



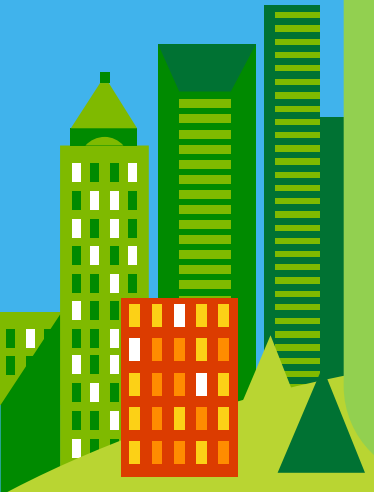
What you'll need:

- 2 x paper towels
- 3 x glasses
- Blue food colouring
- Yellow food colouring



Instructions:

1. Place the three glasses side by side. Starting on the left hand side, fill that glass with water. Squirt a generous amount of blue food colouring into the water.
2. Leave the next glass empty.
3. Now fill the glass on the far right hand side with water and add a generous amount of yellow food colouring.
4. Fold a paper towel in half lengthways and again so that it will fit into the neck of your glass easily. Now place one end of the paper towel into the blue water and bend the paper towel over the edge of the glass so that the other end sits in the empty glass in the middle.
5. Do the same on the other side: place one end of a paper towel into the yellow water, and bend it over so that the other end rests in the empty glass in the middle.
6. Watch and wait.
7. In about 30 minutes or so, the water will start 'walking' up the paper towels and over into the middle glass.
8. After about two hours you will have a mix of the two colours in the centre glass.



Babble and Dabble explain

The process of water moving along the paper towel (conduit) is called capillary action.

This is how flowers and plants move water from the ground beneath them, up through their stems and into their petals and leaves. Have a look here for more information if you need it!

<https://www.youtube.com/watch?v=k8YtroKjVxo>



The science of the cupcake

Everyone loves to eat cakes from time to time and the cupcake is a perfect size for one person to enjoy. What you might not know is that cupcakes are science!



What you'll need (for 15 cupcakes):

- A cooker, preheated by an adult to 200 °C/Gas Mark 6, a muffin tin with case for the cupcakes, 100g margarine or butter, 100g caster sugar, 2 eggs, $\frac{1}{2}$ teaspoon vanilla extract and 100g self-raising flour.
For the buttercream:
- 140g butter room temperature, 280g icing sugar, 1 tsp vanilla extract, 1-2 tbsl of milk, a few drops of food colouring or flavouring and sugar sprinkles to decorate, a medium sized bowl, whisk, spoon and an apron.



Instructions: (young people should be supervised when using anything hot)

1. Mix butter and sugar together until fluffy and add the eggs and vanilla essence.
2. Fold in flour and mix well. Place in 12 cupcake cases.
3. Bake for 15 minutes. Allow to cool before decorating.
4. For the buttercream add butter, icing sugar and vanilla extract to a large mixing bowl, then beat for about 5 minutes with an electric whisk until smooth.
5. Pour the milk gradually if you need to loosen the mixture. Add colouring at this point.
6. To decorate the cupcakes, you can either dollop on some icing and swirl it with a knife or use a piping bag. Either fill a disposable piping bag with the icing and snip off the end or fill a piping bag fitted with a large star nozzle.
7. To pipe on the icing, start at the outside edge piping round the edge of the cupcake in a spiral towards the centre. When you reach the top, pull up quickly to finish the swirl. Decorate with sprinkles.
8. Enjoy the cupcakes!

Amaze
your
friends



Babble and Dabble explain

Cupcakes are a great example of how science works. It is the combination of chemical reactions that creates cupcakes. For example: The melting point of butter is between $32\text{ }^{\circ}\text{C}$ and $35\text{ }^{\circ}\text{C}$. Melting points measure the temperature range at which a solid becomes a liquid. Sugars are a white crystalline group of soluble carbohydrates that are sweet tasting in nature. The most common sugar is sucrose, a crystalline tabletop and industrial sweetener used in foods, drinks and cupcakes!

Fixed oils and fats have the same chemical composition: they consist of glycerides, resulting from a reaction between an alcohol called glycerol and certain members of a group of compounds known as fatty acids. Along with proteins and carbohydrates, the glyceride oils and fats constitute the three main classes of food. Eggs consist of three main parts, the shell, the egg white and the egg yolk. Inside the shell the sticky colourless liquid called the egg white makes up about 58% of the total egg weight!



Mentos volcano

One of the most popular experiments of modern times is the Diet Coke and Mentos Eruption. This experiment is a lot of fun and sure to amaze your family (assuming you do it outside rather than in the living room)!



What you'll need:

- Large bottle of Diet Coke
- About half a pack of Mentos
- Paper plate (optional)



Instructions:

1. Make sure you are doing this experiment in a place where you won't get in trouble for getting Diet Coke everywhere. Outside on some grass is perfect; don't try this one in your family lounge!!
2. Stand the Diet Coke upright and unscrew the lid. Put some sort of funnel or tube on top of it so you can drop the Mentos in at the same time (about half the pack is a good amount). Doing this part can be tricky but just take your time. You could try to make a funnel from a paper plate.
3. Time for the fun part, drop the Mentos into the Diet Coke and run like mad! If you've done it properly a huge geyser of Diet Coke should come flying out of the bottle, it's a very impressive sight. The record is about 9 metres (29 feet) high!



Babble and Dabble explain

Fizzy drinks are bubbly because of the carbon dioxide that is in them. It doesn't get released from the liquid until you pour it into a glass and drink it; some also gets released when you open the lid. This means that there is a whole lot of carbon dioxide gas just waiting to escape the liquid in the form of bubbles.

Dropping something into the Diet Coke speeds up this process by both breaking the surface tension of the liquid and also allowing bubbles to form on the surface area of the Mentos. Mentos sweets are covered in tiny dimples (a bit like craters on the moon), which dramatically increases the surface area and allows a huge amount of bubbles to form.

Have a look here for more information if you need it!

https://youtube.com/watch?v=LjLiQ_DIFNY



Match in a glass

This science experiment is lots of fun and a great way to get the whole family learning!



What you'll need:

- Blu-tack, play dough or even chewing gum will do
- Match
- Plate
- Highball glass
- Water
- Food colouring (optional)



Instructions: (young people should be supervised when using anything hot)

1. Use the blu-tack or play dough to stick the unlit match, upright to the plate.
2. Pour a moat of water around the match (you can colour the water with food colouring to make it more fun if you want!).
3. Light the match. Remember to be safe when working with flammable things!
4. Quickly place the glass over the top of the lit match.
5. Watch as the water is sucked into the glass.



Babble and Dabble explain

The match creates hot air inside the glass. The hotter air in the glass has a higher pressure and so pushes against the glass and water. When the air inside the glass cools, pressure reduces and the water pressure is greater and so more is drawn into the glass.

When the match starts to go out, the air cools and the pressure is released, sucking the water inside the glass. Have a look here for more information if you need it!

<https://youtube.com/watch?v=pwNFnOx5iEg>



Glowing jars

It's fun to create things as a family that will impress your friends and light up your house or garden.



What you'll need:

- As many jars as you want. These can be any size, sometimes it is good to mix the shapes and sizes.
- Glow sticks. Use as many as you want and you can even mix up the colours. Be careful when you crack the glow sticks as there will be tiny pieces of broken glass
- Glitter. You can use as many colours as you like.



Instructions:

1. Wash your jars and let them dry.
2. Crack the glow sticks and cut one end off. Carefully empty the contents into the jar and shake to make sure the paint sticks to the glass. The more glow sticks you use, the more illumination you will create.
3. Add glitter, close the jar and give it a good shake.
4. It may not look like it now but your jar is ready. In daylight it would look like an ordinary jar but its real beauty will be reflected at night or in dark places.
5. Simply charge it with day light or with a lamp and bring it into any dark place.



Babble and Dabble explain

Luminous paint gives off visible light (through fluorescence, phosphorescence, or radioluminescence). Fluorescent 'glows' when exposed to long-wave "ultraviolet" frequencies (UV). These UV frequencies are found in sunlight and some artificial lights. Human eyes perceive the changes as the unusual 'glow' of *fluorescence*.

There are both visible and invisible fluorescent paints. The visible paints appear under white light to be any bright colour, turning peculiarly brilliant under black lights. Invisible fluorescent paints appear transparent or pale under daytime lighting, but will glow under UV light in a limited range of colours. Since these can seem to 'disappear', they can be used to create a variety of clever effects. Have a look here for more information if you need it!
<https://www.youtube.com/watch?v=QDwowoqFILY>



CD hovercraft

Hovercrafts are a lot of fun for the whole family to make. You won't be able to sit on it and ride around but you will be able to have fun watching it glide around your table or floor!



What you'll need:

- Plastic sports bottle top (the type with a valve)
- Adhesive putty
- Balloon
- CD or DVD (an old one that you don't need anymore)



Instructions:

1. Roll the Blue-Tac into a sausage shape and press it down onto the CD, in a circle. Push the bottle top down onto the CD so that it sticks to the CD with no gaps for the air to escape.
2. Blow air into the balloon and then twist the bottom round several times (so the air doesn't all come out while you're attaching it to your hovercraft base!).
3. Let's take your hovercraft for a test drive! Stretch the balloon over the bottle top, untwist the balloon and you're off. Try pushing your hovercraft gently and watch how far it glides!



Babble and Dabble explain

Hovercrafts work by using air to lift a vehicle off the ground. The CD Hovercraft is no exception. As the balloon deflates, it is releasing air through the sports bottle top and beneath the CD.

The shape, smoothness, and weight distribution of the CD and the releasing air creates a cushion of air between the CD and the surface. This cushion of air reduces the friction between the CD and surface and allows your hovercraft to move more freely. Have a look here for more information if you need it!

<https://www.youtube.com/watch?v=Wed12y2ORXA>



Now you are a scientist!

! solutions
imagine create fun experiment
H₂O ?
e=mc²

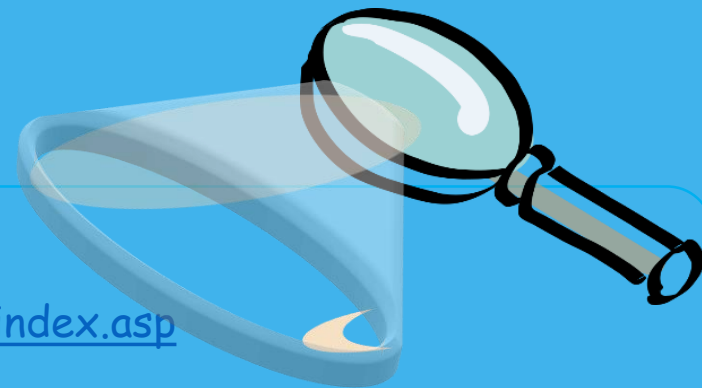
dream
☁



Let's keep exploring science together!



Want
to
learn
more?



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<https://www.madaboutscience.com.au/store/experiments-all-0.html>
<http://www.livescience.com/29447-science-experiments-for-kids.html>



Glossary

Carbon dioxide

a colourless, odourless, incombustible gas, CO_2 , that is in carbonated beverages like fizzy juice.

Carbohydrates

compounds containing carbon, hydrogen, and oxygen. Carbohydrates provide energy and you can find them in foods like pasta and potatoes.

Capillary action

the movement of a liquid along the surface of a solid caused by the greater attraction of the liquid's molecules to the surface of the solid than to each other. having the characteristics or structure of crystals.

**Crystalline
Density**

the quantity of something per unit measure, especially per unit length, area, or volume.

Exothermic

a chemical change that is accompanied by a release of heat.

Fluorescence

light emitted during absorption of radiation of some other (invisible) wavelength.

Friction

the rubbing of one object or surface against another.

Glycerides

formed between one or more fatty acids and glycerol. Glycerides are found in plant oils and animal fats.

Hydrogen peroxide

chemical compound, H_2O_2 , a colorless, syrupy liquid that is a strong oxidizing agent and, in water solution, a weak acid.

Particle

any very small part of matter, such as a molecule, atom, or electron.

Phosphorescence

a fluorescence that persists after the bombarding radiation has ceased.

Protein

any of a large group of nitrogenous compounds of high molecular weight that are essential constituents of all living organisms.

Radioluminescence

luminescence that is induced by radiation from a radioactive material.

Refract

to deflect (light, for example) from a straight path by refraction.

Thrust

to push or drive quickly and forcefully.

Vortex

whirling mass of fluid or air, especially a whirlpool or whirlwind.



Thank you to...

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