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UK Young Scientists & Engineers Fair

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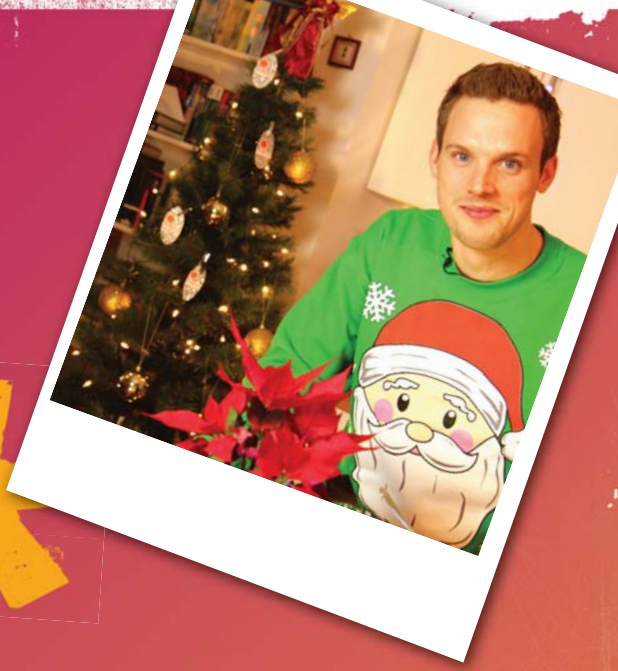

Selection box science

The Big Bang Fair and daredevil science TV presenter, Greg Foot, have put together 12 fantastically festive experiments using everyday items you can find in your cupboards.

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You will need:

- A bucket of clean snow or a large bag of ice cubes
- 10 tbsp of salt
- 1 large resealable freezer bag
- 1 small resealable freezer bag
- 2 tbsp sugar
- 1 tsp vanilla extract
- ½ cup of double cream
- ½ cup of milk
- Gloves

Top tip

Handling snow is cold so put some gloves on!

Blizzard Ice Cream

Instructions:

- Add the milk, double cream, vanilla extract and sugar to the small freezer bag. Squeeze out the excess air and seal the bag.
- Fill the large freezer bag three quarters full with your fresh snow or ice cubes.
- Add the salt to the snow in the large bag and seal. Shake so the salt mixes into the snow.
- Open the large freezer bag of snow and put the sealed bag of ice-cream mixture inside. Re-seal the bag.
- Put on some Christmas music and squeeze, shake, squish, turn and move the snow bag about so the bag of ice cream mixture comes into contact as much as possible with the snow.
- After about five minutes, open up the large bag, remove the bag of ice-cream mixture and rinse off the salt.
- Eat and enjoy!

The Science bit:

Salt is the key to our homemade ice-cream mixture for the same reason we put salt on icy roads. When we mix in salt, the ice melts. We say salt 'lowers the freezing point of water', meaning it now just isn't cold enough for the ice to stay as ice. But the ice won't actually melt until it absorbs heat from somewhere. That heat comes from the warmer ice cream mix. The salt-ice mix is pulling the heat away from the ice cream mix and eventually the temperature drops so much in the ice-cream mix that it can freeze, leaving you with lovely ice cream!

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You will need:

- 300g granulated sugar
- 1 tsp peppermint essence
- 50ml water
- 120ml golden syrup
- ¾ tsp red food colouring
- ¼ tsp cream of tartar
- Medium saucepan
- Wooden spoon
- 2 chopping boards, lightly greased with cooking oil
- 2 spatulas
- Mixing bowl
- 1 small finger bowl of cooking oil

Top tip

Cooked sugar is very hot – ask an adult to help you.

The Big Bang Candy Canes

Instructions:

- Mix sugar, water, golden syrup, peppermint essence and cream of tartar in the mixing bowl. Put one third of this mixture into a saucepan and stir over a medium heat for about 5 minutes until it turns into a clear, thin liquid. Once at this stage stop stirring and simmer on the heat for about 9 minutes.
- Pour half of the mixture onto one oiled chopping board. Add red food colouring to the remaining mixture in the pan. Stir and pour the red mixture onto the other chopping board.
- You'll need a friend to help you with the next bit!
- With one of you working on a candy mix each, push the edges of the mixtures into the middle of the boards with a spatula, keeping them moving until they are cool enough to handle.
- Lightly oil your hands then pick up, pull and twist the candy. Continue to manipulate it until it has a satin-like finish, with an opaque colour and is cool and solid enough to make into a long rope shape.
- When the red and the yellow candy strands are both the same length and shape, hold them against each other and gently twist them together, finally bending the top over into a cane shape.
- Place in the fridge to cool. Once they are set, hang them on the tree for all to see.

The Science bit:

The proper name for sugar is 'sucrose' - a molecule made up of carbon, hydrogen, and oxygen. When you heat up the mixture you get to the point where you can't dissolve any more sugar into the water – a 'saturated solution'. As you keep heating some of the water boils off so that the solution is packed full of more sugar than normally possible – a 'supersaturated solution'. As it cools, it quickly turns into a solid. The cream of tartar and golden syrup stop keep your mix smooth and tasty.

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You will need:

- 15 disposable nappies
- 100ml water
- Mixing bowl
- Spoon

Top tip

The powder is not toxic but don't eat the snow!

Nappy Christmas!

Instructions:

- Tear open the nappies and remove the fibrous, absorbent layer inside.
- Break up the absorbent layer into a mixing bowl. Remove the large chunks of paper fluff so you are left with just the white powder.
- Gradually pour the water on to the powder in the bowl. Stir and watch the powder expand into fake snow!
- You can add more water if it's too dry or take powder from more nappies to make more.
- It doesn't matter what the weatherman says - here's your very own white Christmas!

The Science bit:

Nappies contain a chemical called sodium polyacrylate (that's the small grains you harvested). Sodium polyacrylate is a polymer – this means it's a long chain of identical units (monomers) connected together. Most polymers – like the plastics that make cups and bowls – don't absorb water, but sodium polyacrylate is different. Each of the individual units are brilliant at absorbing water, and that white power can absorb 200 to 300 times its weight in water!

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You will need:

- 4 white light torches
- Red, blue and green transparent sweet wrappers.
- 4 rubber bands
- A dark room with a white wall
- A friend

Top tip

The brighter the torch - the better the effect!

Wrapper's Delight

Instructions:

- Take some chocolates from the tin and remove the chocolate and foil, so you're left with the outer, bright coloured transparent wrapper.
- Attach a different coloured sweet wrapper over the front of each torch, covering the whole bulb end. Use a rubber band to keep the wrapper in place.
- Turn the lights off in the room, turn on the green and red torches and point them at the wall.
- Mix the colours on the wall by overlapping them. What colour do you get?
- You'll need an extra pair of hands here. Ask your friend to point another colour at the wall - what can you see now?

The Science bit:

A primary colour is a colour that can't be made by mixing two other colours together. The primary colours used by artists are red, yellow and blue. You can use the primary colours to make any other colour you like. Light actually has different primary colours. Yellow light can be made from mixing red light and green light. The three colours that cannot be made from mixing any other colours are red, green and blue. Your TV or computer screen is made out of pixels, and each pixel is actually a source of red, green and blue light. It's the combination of those that makes every colour you see on your TV or computer.

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You will need:

- Poinsettia plant
- Small saucepan
- White vinegar or lemon juice
- Scissors
- Plate
- Coffee filter paper
- 200ml water
- Jug
- ½ tsp bicarbonate of soda
- Peg
- Bowl

Top tip

Don't chop up your parents' poinsettia plant without asking first!

Poinsettia pH

Instructions:

- Take five large red poinsettia bracts (the leaves) off the plant and cut into small pieces.
- Put the chopped bracts in a saucepan with enough water to cover them and simmer on a medium heat for four minutes until the red colour has drained from the bracts into the water, leaving them colourless. (Ask an adult to help you before using the hob).
- Use the coffee filter paper to strain the liquid from the bracts into a jug. Cut open another coffee filter paper, lay it flat on a plate and pour the red liquid over until it's saturated. Hang it up with a peg until it's dry.
- Once the paper is dry add a few drops of lemon juice or white vinegar – what colour does it change to?
- Mix the bicarbonate of soda and water together in a bowl and put a few drops onto the poinsettia paper and see how the colour changes.
- Make sure you wash all of the equipment in this experiment after use.

The Science bit:

You know that feeling you get when you screw your face up when you taste lemon juice or vinegar? That's because you're tasting acids. Yuk. Acids have a low 'pH'. The opposite of an acid is an alkali, which has a high pH.

The poinsettia solution is an 'indicator' – it changes a different colour in the presence of an acid or an alkali. It does this thanks to a pigment inside the bracts called anthocyanin.

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You will need:

- Pliers/wire trimmers/dinosaur trimmers
- Christmas tree lights
- Four 9v batteries
- An adult to help you

Top tip

Get an adult to help you because this experiment uses electricity!

Christmas Connections

Instructions:

- Take the Christmas lights out of the box and cut off the plug.
- Connect the 9V batteries together in a series – attach the positive of one to the negative of the next, then the positive of that to the negative of the next, and so on.
- Chop off a string of five lights from the end of the sequence using the pliers. With help from an adult, connect both ends of the wire to the opposing poles of the 9v battery and the lights should turn on.
- Disconnect the battery, take one bulb out of its socket and reconnect the lights to the battery. Do the lights go on? If so, then your bulbs are connected in a "parallel circuit". If all the bulbs don't light up then this means you have a "series circuit"!
- If you have a series circuit you can fix it by disconnecting the battery, cutting the wire either side of the bulb you've removed and twisting those two wires back together again, so the bulb-less socket is no longer in the circuit. Reconnect the wires to the battery and let there be light!

The Science bit:

Electric circuits can come in 2 forms – series or parallel. A series circuit is one loop of wire connecting a 'series' of components. If a bulb blows there isn't a path for the electricity to flow through it, which means the circuit is broken and no lights are lit up - which makes for a rubbish Christmas.
Each component of a parallel circuit is on its own circuit (in 'parallel' with each other) so if it blows it doesn't break the whole circuit and the rest of the lights still light up - which makes for a merry Christmas!

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You will need:

- Five Milkybars
- Empty plastic milk container
- 2 same-sized cups/glasses
- Kettle
- A selection of small weights or objects

Top tip

This involves boiling water – ask an adult to help you and be careful!

Selection Box Structures

Instructions:

Construct a chocolate box-girder bridge:

- Carefully fill half the milk container with water boiled from the kettle and replace the lid. Hold the long edges of the Milkybars on the outside of the milk container to slightly melt them. Join the two melted long edges of the chocolate bars together and hold them in place so the Milkybars are at right angles. Repeat with two more Milkybars.
- Put the two right-angled structures in the fridge to cool. Once hardened, use the heated milk container to join these together to create a rectangular box, then place back in the fridge.

The experiment:

- Balance one Milkybar "plank" across two cups and gradually load on your weights and see how strong the single plank-bridge is.
- Now try the same thing with the chocolate box-girder bridge you've constructed and see how much weight it can take.
- Try experimenting with different shapes and different chocolate bars – which one is the strongest?

The Science bit:

Welding is a process that joins two materials together (normally metals). The bond created is one of the strongest possible, and is behind the engineering of bridges, skyscrapers and cars.

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You will need:

- 1 cup of custard powder
- ½ cup of water
- Mixing bowl
- Spoon

Top tip

You can use cornflour instead of custard powder

Christmas Custard Power!

Instructions:

- Mix the custard powder and water together in a bowl.
- This crazy material (sometimes called 'Oobleck'!) will have different properties depending on how you use it.
- Pick up the mixture and keep pressing it together in your hands – how does it feel?
- Hold your hands still, what happens?
- Hit the surface of the liquid in the bowl – what does it do?
- If you wanted to take this experiment to the next level, you could fill a paddling pool with this solution (ensuring there is double the powder to liquid) and see if you can walk on custard.

The Science bit:

The main ingredient in custard is cornflour. And it's the cornflour that's key in the weird behaviour you've discovered. When you put a force onto the cornflour/water mix it gets thicker (called a 'non-Newtonian-fluid'). The cornflour particles are suspended in just enough water to allow them to glide past each other like they're a liquid. But as soon as a force is applied, the particles lock together and act like a solid.

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You will need:

- 8-10 tbsp of salt flakes
- Empty jam jar
- Heat proof jug
- 300ml boiling water
- 2 pipe cleaners
- 1 pencil
- Blue food colouring

Top tip

This involves boiling water – ask an adult to help you and be careful!

Crystal Constellations

Instructions:

- Cut one pipe cleaner into quarters.
- Take three pieces and wrap them together at the centre. Pull the ends into a six-pointed star shape.
- Wrap one end of the other pipe cleaner around the middle of the star. Twist the other end around the centre of a pencil. Balance the pencil on the edges of the jar so the star hangs in the salt solution - the star must hang freely in the solution, not touching any sides.
- Pour the boiling water into the heat-proof jug.
- Add the salt flakes gradually and stir until dissolved. Repeat until the solution is saturated (this is when no more salt can be dissolved in the water).
- Stir in a couple of drops of blue food colouring.
- Pour carefully into the jar so it covers all of the star.
- Leave it for a couple of days and watch it grow.

The Science bit:

As you stir salt into the hot water it dissolves until you reach the point where no more salt can be dissolved into the solution – called a saturated solution. When the saturated solution starts to evaporate, there's more salt in the solution than it can hold, so the salt starts to come out little by little. It starts to form crystals on the rough surface of the pipe cleaners and the crystals slowly grow and grow.

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You will need:

- Long sturdy cardboard wrapping paper tube
- Uncooked Brussels sprouts
- Vacuum cleaner
- Large ball of plasticine
- Gaffer tape
- Christmas card
- Small food bag
- An adult to help you

Top tip

Be careful where you aim the shooter!

Sprout Shooter

Instructions:

- Cut 10cm off the wrapper paper tube - this smaller tube will become your handle.
- Cut a hole (no bigger than the diameter of the handle) 10cm from the end of the long tube section.
- Take the plasticine and roll into a sausage shape with a diameter just smaller than the tube. Wrap it in a food bag and seal with gaffer tape.
- Cut one end off the bag and stick a Brussels sprout to the end of the plasticine.
- Take the handle and place it over the hole you cut earlier. If it helps cut small curves on the handle to ensure it fits snuggly. Fix handle with an air-tight seal using gaffer tape.
- Insert vacuum cleaner nozzle in to the bottom of your handle and make an air-tight seal with gaffer tape.
- Put the 'shooter' on your shoulder and hold the handle. Turn the vacuum cleaner on.
- Cover the front of the tube with a Christmas card and place the Brussels sprout in the back of the tube. Let go and watch it fly!

The Science bit:

You might not think of air as being heavy, but right now you've got more than 60 miles of air molecules above your head pushing down on you! With both ends of the tube sealed up with the card and sprout projectile, when you turn the vacuum on it sucks about 10% of the air out of the tube. There's now more air pushing the projectile INTO the tube than there is air inside pushing OUT. So the outside air pressure pushes the projectile along the tube knocking off the card as its momentum carries it along.

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You will need:

- Crisp tube (empty!)
- Scissors
- Gaffer tape
- Glue
- Tracing paper
- Drawing pin
- Magnifying glass
- Tin foil
- Pen
- Ruler

Top tip

Ask an adult to help you with the cutting.

Capture Christmas

Instructions:

- Take a clean crisp tube and cut off a section 5cm from the foiled end.
- Make a small hole in the foil end of the tube with a drawing pin.
- Draw around the lid of the crisp tube on to a piece of tracing paper, cut out and glue on to the lid. Attach to the smaller piece of tube.
- Place the long tube on to the lid and secure with gaffer tape.
- Wrap a sheet of tin foil around all of the tube.
- Hold the open end of the tube up to your eye and point the pinhole towards something bright (like a window) – what can you see?
- Place a magnifying glass over the pin hole – what happens to the image?

The Science bit:

Light travels in straight lines. When you look down the tube at the screen you'll only see the light rays that enter in through the small hole at the front and form an image on the screen. If the light bounces off the top of the object, it enters the hole, keeps going, and falls onto the bottom of the screen. And vice versa for a light ray that has bounced off the bottom of the object. So you get a reversed image. The same thing happens on the retina in your eye – light entering it forms an upside down image. Your brain then processes this and flips it back around. You can use the magnifying glass to focus the image on the screen.

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You will need:

- 6 square pieces of paper
- Scissors
- Sellotape
- Stapler
- An adult to help you

Top tip

For best results use clear sellotape.

One in a Million

Instructions:

- Fold one square of paper into a triangle.
- Hold the triangle so fold is nearest you. Draw a line down the middle of the triangle, from top to bottom. On each side, cut three diagonal lines towards the middle of the triangle roughly equal distances apart. Ensure they are the same distances apart and do not meet in the middle.
- Open the paper up and take hold of the sides of the middle square.
- Roll into a tube and secure with sellotape.
- Turn the paper over and secure the next section together with sellotape.
- Turn the paper again and secure the outer sections together with sellotape. You've now got one arm of your snowflake.
- Repeat these steps for the remaining 5 pieces of paper.
- Join 3 completed arms together by stapling at the tip. Repeat with the other 3 pieces.
- Now staple these two parts together in the middle and at the edges to complete your snow flake!

The Science bit:

Everyone's paper snowflake will be slightly different depending on where they cut, folded and stuck. It's the same with real snowflakes – each one grows in a unique way.
Snowflakes are formed when water vapour cools down inside clouds and condenses into ice. They start as a seed crystal which forms on a tiny particle like a speck of dust in the air and grow as cloud droplets and water vapour molecules attach around them. They grow in unpredictable ways, and the temperature and humidity affect how the structures grow too.

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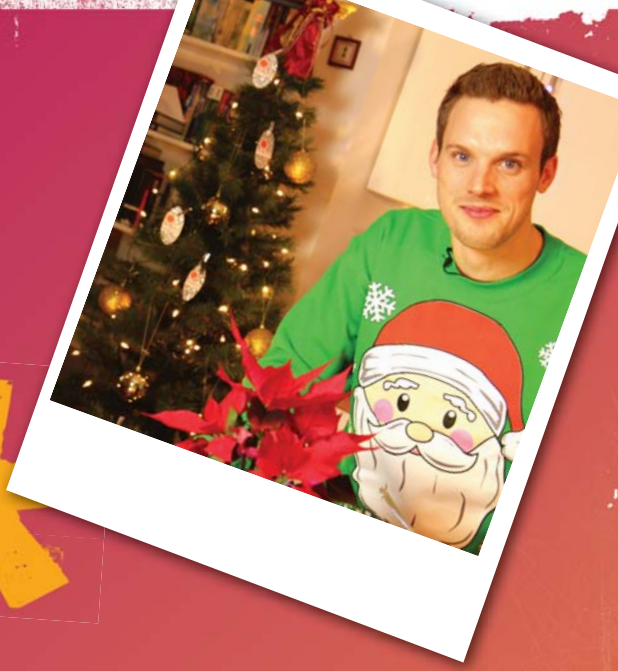

We hope you enjoyed these experiments.

We would love to see your results!
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- 'Science Experiments' by Robert Winston (Dorling Kindersley)
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