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Seven Smart Science Experiments To Try Out At Home This Summer

1 Balloon hovercraft

Make your own model hovercraft with a few simple bits and pieces

You will need:

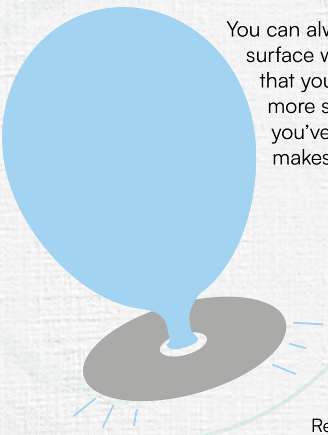
- balloon
- sports drink bottle top (push-up type)
- blu tack or plasticine
- an old cd

What to do:

1. make a ring of blu tack / plasticine and fit it around the hole in the middle of the cd
2. push the (closed) bottle top into the blu tack/plasticine, making a tight seal
3. blow up the balloon and fit it over the bottle top
4. find a smooth, flat surface, open the bottle top, and your hovercraft will float

How does it work?

Hovercrafts work because of a large layer or cushion, of pressurised air underneath the hull between the ground and the craft. The difference in this pressure and the pressure in the air around the craft causes the lift that is needed to make it hover. In this model, the high-pressure air is created by the balloon you blew up, with the bottle top acting as a valve for this high-pressure air. With the craft lifted from the ground, there's no friction to stop it moving on a smooth surface, so you should be able to push it around, watching it glide quite happily.



You can always compare how it moves on the surface with a normal CD. You should find that your hovercraft glides around much more smoothly, and it's the air cushion you've made with your balloon that makes this possible.

2 Magnetic magic in your cereal

Use a strong magnet to show that the iron in your breakfast cereal is actually tiny pieces of iron filings. Don't panic — this is a good thing

You will need:

- strong magnet (neodymium is best if you can get one)
- breakfast cereal that's 'fortified with iron' (just check the box)
- a plain white coloured tray or shallow box with a smooth white surface on the inside
- a large bowl or container for crushing your cereal

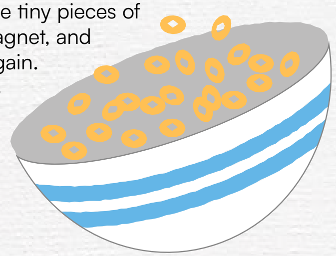
What to do:

1. pour out some cereal into the large bowl
2. get crushing! you want it broken down and almost pulverised into dust
3. sprinkle the crushed cereal over your white surface tray or shallow box
4. move the magnet around underneath the surface
5. you will see tiny dark flecks start to move along with the movement of the magnet. this is your iron!

How does it work?

Breakfast cereals are often 'fortified with vitamins and minerals' which means they are enriched with essential ingredients our bodies need to stay healthy. Iron is one of these minerals, which is important for making haemoglobin – a protein in our blood that moves oxygen around our body. Foods like leafy green vegetables and red meat are naturally high in iron. In this experiment, it's important to really crush the cereal, because the pieces of iron we want to see are so small.

Use the strongest magnet you can find to separate the iron from the crushed cereal. As it's dark, it stands out against the light surface of the tray or box, and as it's magnetic, it will always be attracted to the magnet as you move it. Always have the box or tray between the magnet and the cereal, otherwise the tiny pieces of iron will attach themselves to the magnet, and you'll struggle to see them clearly again. Be sure to keep your mobile phones and bank cards away from the magnet, as it could damage them.



3 The power of soap

Demonstrate the cleaning power of soap and detergent with this simple experiment

You will need:

- a large bowl (white / light coloured / clear is good)
- ground black pepper
- washing up liquid
- water from the tap
- cotton bud or similar (or just your fingertip works too)

What to do:

1. fill the bowl with water from the tap
2. sprinkle some black pepper on the surface of the water
3. put a small amount (a drop) of washing up liquid on the cotton bud or your finger tip
4. dip the cotton bud (or your finger) gently into the surface of the water — the 'dirt' particles will be forced away from the cotton bud very quickly

How does it work?

It's important to understand that simple soaps and detergents, such as washing up liquid, are an incredibly effective way of getting rid of dirt, grime, and viruses. Soaps are actually one type of detergent, and detergents are chemical substances that break up dirt, grease, and grime to make things clean. They do this because they contain surfactants – ingredients that help water spread out more evenly by being active on the surface of the water.

The pepper in the bowl is hydrophobic, which means that the water molecules are not attracted to the bits of pepper, they just sit there as they fall. When we add a drop of detergent, that changes the surface tension of the water, making the water molecules on the surface shoot away from the detergent, looking to clump together with themselves — water molecules like to stick together. They do this so efficiently that they carry whatever else is on the surface with them. In this experiment, that's the bits of pepper we added from the pot.

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4 Goodbye ice cubes — you will be 'mist'

Do some investigations with ice cubes from your freezer with this pair of simple experiments

You will need:

- ice cubes from freezer
- chopping board (plastic is good)
- frying pan

What to do:

Experiment 1:

1. take out two (or more) ice cubes
2. place one on the plastic chopping board
3. place one on the metal frying pan
4. which will melt faster? the one on the colder surface of the frying pan, or the one on the warmer surface of the chopping board?

Experiment 2:

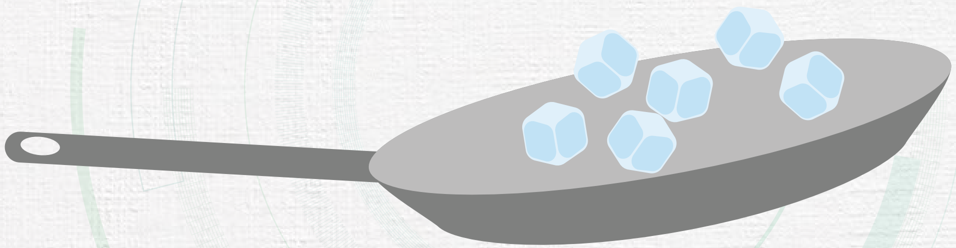
1. switch on a ring on the hob until the frying pan is hot (children to be supervised)
2. pop an ice cube into the pan and watch what it does — it should zoom around the surface of the pan and won't stay still

How does it work?

In the first experiment, you should find that the ice cube melts much faster on the colder surface of the frying pan than it does on the warmer surface of the chopping board. This may come as a surprise, and it's to do with how these materials conduct. The metal in the frying pan is a great conductor of heat, which means all the heat in and around the pan is transferred efficiently into the cube, which is why it actually melts quite quickly.

The plastic in the chopping board is a far less effective conductor, in fact it's an insulator, which means it doesn't transfer heat into the ice cube very quickly at all. Eventually the ice cube will melt, but this will be mostly because of the air temperature around it rather than the chopping board itself. You can try this with any other materials you have — stone, wood, plastic, porcelain, and see what works best as a conductor?

In the second experiment, we use a hot pan to melt the ice cube very quickly. Watching this happen is quite fun, because of how the ice cube melts. The bottom of the cube melts really quickly, turning into water. The water then starts to boil, because it's on a particularly good conductor, on top of a source of heat. Boiled water is called steam, and these little bubbles of steam try to escape from the source of heat. This makes a little cushion between the (diminishing) ice cube and the hot pan, all helped along nicely by melted water coming from the ice cube the whole time. The result is quite chaotic, you get the 3 states of water (solid ice, liquid water, and gaseous steam) all zooming around on the pan together.



5 Top of the class in Topology

Topology is the science of how we look at shapes and structures. Explore the fascinating science of topology with this simple experiments where you can challenge yourself and others to cut a hole in a piece of paper large enough to climb through.

You will need:

- sheet of a4 paper
- pair of scissors
- two lengths (about 60 — 100 cm each) of rope or string

What to do:

1. fold the piece of paper in half lengthways
2. starting at the fold, and about 1 cm in from the top edge, cut towards the edge opposite from the fold, so the cut is parallel to the top edge
3. stop the cut about 1 cm from the edge
4. move another 1 cm down from the top edge, and this time cut towards the folded edge
5. stop the cut about 1 cm from the folded edge
6. keep going until there are cuts all the way down the piece of paper. you will end up with a zig zag of loops in the paper
7. now cut along the folded edge itself, but not the two outermost loops. you should now be able to open up the sheet of paper, making a huge hole that you can climb through!

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6 Ice Ice Baby

Playing with states of matter is good fun but seeing water change from liquid to solid in an instant is a really cool party trick, all down to some pretty simple science!

You will need:

- bottle of pure, still mineral water
- similar size bottle of ordinary tap water
- household freezer
- plate or bowl
- ice cube
- time! this takes around 2 hours to prepare

What to do:

1. put the unopened bottle of water into the freezer. upright is best, but anywhere it won't be disturbed should work
2. put the bottle of tap water in at the same time
3. give the bottles 2 hours in the freezer, without disturbing
4. after 2 hours, check the tap water. if it's frozen solid, your mineral water should be just about supercooled, and ready to use!

Experiment 1:

1. remove the supercooled water from the freezer very carefully, without knocking the bottle (this is important)
2. once you're ready (and everyone is watching!), bang the side of the bottle. you should see it freeze before your eyes

Experiment 2:

1. place the ice cube in the bowl, and very carefully, pour the supercooled water over the ice cube
2. you should see the supercooled water form a slushy ice tower on top of the ice cube. it's turning from liquid to solid right in front of you

How does it work?

As you know, water freezes at 0 degrees Celsius. Household freezers are usually around 0 degrees Fahrenheit, which is around -18 degrees Celsius, so this is more than cold enough to freeze water. But this doesn't just happen as soon as the temperature reaches 0. Water and ice are chemically the same thing, but structurally rather different. Ice is formed out of ice crystals, which form around each other within the water, but only when something kick-starts this reaction. For example, when you make ice cubes in a tray in the freezer, the water you use comes from the tap, and will have absorbed various gases on its way from the tap to the freezer. This means there are lots of tiny, harmless impurities within the trays, and it's these that kick-start the freezing process.

With our supercooled water, the temperature is below freezing, so it's ready to turn to ice, it just needs that kick-start, which you can provide by banging the side of the bottle or pouring it over an ice cube. This experiment might take a couple of attempts to get exactly right. There will be a degree of variation in the type of freezer too, and the variety of bottled water. Have fun experimenting!

7 Say cheese – pinhole camera

Make your own pinhole camera and explore how photography works using simple household materials to develop your understanding

You will need:

- pringle's tube and lid
- sharp knife (e.g. stanley knife)
- ruler
- baking paper/greaseproof paper/tracing paper (white/light coloured works best)
- tin foil
- sticky tape
- needle/pin

What to do:

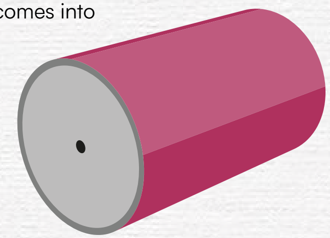
1. wipe out the pringles tube so there are no crisps or crumbs left inside
2. measure about 5 cm from the bottom of the tube, and cut all the way round, to make a small tube with an open end, and the original metal bottom
3. use the needle or pin to make a small hole in the centre of the metal bottom. do this carefully, you want a small, smooth, round hole in the bottom of the tube. this will be your aperture
4. line the inside of your pringles tube lid with a piece of baking paper, it's ok for this to hang out over the outside of the tube. the inside of the lid with the paper attached will be your viewing screen
5. re-attach the larger part of the tube to the smaller part of the tube. this is your viewer, the part you look inside to see your image on the viewing screen, further down the tube.
6. use sticky tape to join these two parts together
7. use tin foil and sticky tape to wrap the whole thing, making sure no light can get into the camera through any gaps where the two parts meet
8. if you look inside the open top of the tube and hold it up to a source of light — a window or a lamp, you should see the image projected onto the viewing screen. let as little light into the tube as you possibly can — you can use your other hand to cup your eye around the camera, holding it like a hand-held telescope or kaleidoscope
9. it's upside down! why's this?

How does it work?

You've just made a pinhole camera, which is a simple camera that uses a tiny aperture (the pinhole) instead of a lens. By letting light into the darkened chamber through only this aperture, you can see whatever the camera is pointing at, projected onto the viewing screen inside the bottom tube. This is the same principle as a 'Camera Obscura', so you can point the tube at moving scenes, such as traffic, and see it projected on to the screen.

All the images you will see are upside down. This is because there is no lens inside this camera to 'fix' the image and make it the right way up. All the images we see every day are made of light which is reflected off the things we look at. This reflected light enters our eyes, which are curved. This bends the light, making the images projected on the back of our eyes (the retinas) upside down. Our brains know this, and 'fix' the images to be the right way up.

The larger the pinhole aperture, the more light gets into the chamber, and the more work you will have to do to get the image into focus. This is why it's important to make a really nice, smooth, small hole with the pin. You can focus the image by simply moving closer or further away from what you're looking at, until it comes into focus.



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