That AMAZING CHEMISTRY

IN YOUR HOUSE

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PERIODIC TABLE OF THE ELEMENTS

63 — number of protons
chemical symbol — **Eu** — Europium — name of element

1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium		72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium		104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

I'm a gas, so what am I doing among the metals?

Do you want to be friends with us metals?

We're a friendly bunch of metals. We're real softies...

Apparently, we silver-coloured metals all look alike...

...but not me!

We are the brains of your mobile phone!

We are your brains... and your body too!

Watch out! You don't want to mess with us.

Leave us alone! We don't want to be friends with anyone.

We're radioactive. We break down before you even notice us.

We're the most expensive of all metals.

We can poison your whole life!

Nobody knows us...

Nobody knows us...and we're radioactive!

Uranium!

There's more information about the periodic table in the introduction.

3 THE DINING ROOM

Time for something nice to eat! The food's ready and the house is filled with a delicious smell – all that's left to do is eat it. But what with? And what from? Get your favourite spoon, bowl and glass and...come and find out why they're much more interesting than it might at first appear!

MATERIALS

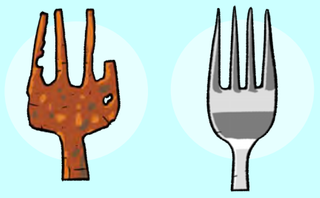
Polystyrene for lunch?

When you buy takeaway food, there's a good chance it'll come in a disposable plastic container. They are usually made of foamed polystyrene. This is a white, airy foam that is also used to make cups, packaging for appliances and home insulation. And just as polystyrene keeps the heat inside a house, it also keeps your food warm.

MATERIALS

The Steel Age

When you want to eat some food, it's normally better to use cutlery. For instance, it's not that easy to eat soup by hand. The cutlery you have at home is usually made of stainless steel. This is mostly iron. However, iron on its own would start to rust the first time it was washed, and after several washes you wouldn't have anything to eat with. That's why other metals are added to steel so that it doesn't rust and you don't have to buy a new set of cutlery every week.



iron steel

PRODUCTION

Water in sand?!

No doubt you've got a favourite glass at home that you prefer to drink out of. And no doubt it's made of sand. Or rather it used to be sand, or silica, which is the basis of all glass.

MATERIALS

Let's wrap it up

If your parents make you a snack for school, they might wrap it in tinfoil. This is a silver-coloured foil made from aluminium, the same material fizzy drinks cans are made from. It's also used when roasting food because it can withstand very high temperatures.

Flexible wood

Snacks can also be wrapped in transparent, flexible cellophane. This is made from cellulose, which is obtained from wood. So it's made from the same material as the paper of this book. Glycerine, which has a sweet taste, is also added to cellophane. That's why cellophane might seem sweet if you lick it.

MATERIALS

Corn cutlery

How do you make a spoon more environmentally friendly? By making it out of something natural! Disposable utensils are now being made from corn. Or, more precisely, from polylactic acid, PLA for short, which is a hard plastic made from corn starch. And that's great because fewer chemicals are used to make it. But do you know what kind of cutlery is best? The metal stuff that can be used over and over again.

MATERIALS

What to use on pans

Have you ever wondered why spatulas and spoons for cooking are usually made of plastic or wood? On the surface of the pan is a special coating that stops food sticking to it. It's called Teflon and it's so thin that if you used metal utensils it would get scraped off and the food would burn onto the pan more easily.

Utensils, food's best friend

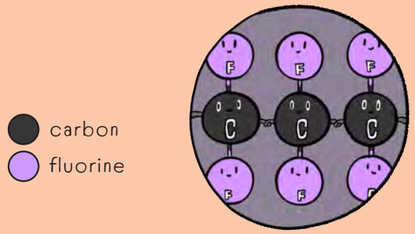
A king and his cabbage

If you want to dine the way kings did in the olden days, get yourself some silver cutlery. But be aware that it's incredibly expensive and gets damaged quickly because silver is soft. But it does have one advantage: silver can kill bacteria and then you have less chance of catching germs.

In the mid-20th century, cheap utensils made of pure aluminium were all the rage. At first it seemed like a good idea, but then it turned out that they started to dissolve if they came into contact with anything acidic. So anyone who ate sour cabbage from an aluminium dish using aluminium cutlery ended up eating a lot of unhealthy aluminium as well. That's why you shouldn't wrap sour snacks – even, say, an apple – in tinfoil.

How come nothing sticks to Teflon?

What is Teflon? A chemist would say it's a polymer. So it's made up of lots of little molecules that are linked together into one big network. Teflon contains lots of carbon and fluorine atoms. They like being together and hold on to each other so tightly they don't let anyone else in. Not even food can latch onto them. Teflon is not only used to make pots and pans but also sealing and piping.



Teflon

The non-stick gecko

Do you know how to confuse a gecko? Put it on a frying pan (but don't put it on the stove!). Geckos have amazingly sticky toes that allow them to climb up anything. Except the Teflon on a frying pan. It's so non-stick that the gecko slides over it the way we do wearing boots on ice.

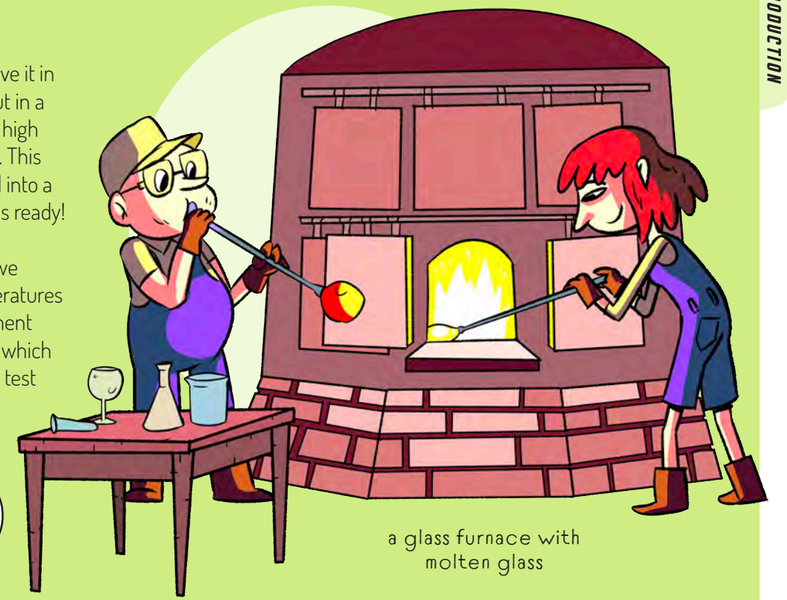
Even Teflon has its flaws

Never leave a pan unattended on a hot stove! Not only can you burn the house down, but you can also harm animals, especially birds. When the Teflon on a pan heats up to a very high temperature, it begins to break down, releasing poisons into the air. They don't affect people much, but birds are very sensitive and can be poisoned.

How to make a glass

First you need some sand and other substances to colour the glass or improve it in other ways. All of the ingredients are put in a furnace, where they are melted at very high temperatures, even as high as 2000 °C. This produces molten glass, which is poured into a mould, left to cool and ta-da, the glass is ready!

And how can we improve the glass? If we want the glass to withstand high temperatures without cracking, then we add the element boron. This produces borosilicate glass, which is used to make things like oven dishes, test tubes, flasks and beakers.



a glass furnace with molten glass

Although most metals are silver-coloured, when they're mixed into glass, they produce all the colours of the rainbow. You need iron for green glass, manganese for purple, cobalt for blue and gold for red glass. In the past, radioactive uranium was also used to colour glass, giving it a beautiful green glow. Strangely enough, no-one wants to drink out of those glasses anymore...

Where do bowls come from?

Bowls, plates and cups are all made of porcelain. But this isn't a modern material: the first porcelain dishes were made in China more than two thousand years ago! If you want to make a porcelain dish, you need to get hold of a special rock: kaolin. Form it into a ceramic dough and shape the bowl. Then find someone with a really hot kiln to fire the bowl for you. At high temperatures the dough starts to transform and the molecules in it join together into a giant solid network. Then the finished porcelain bowl is taken out of the kiln – just be sure not to drop it!

What are you having for breakfast?!

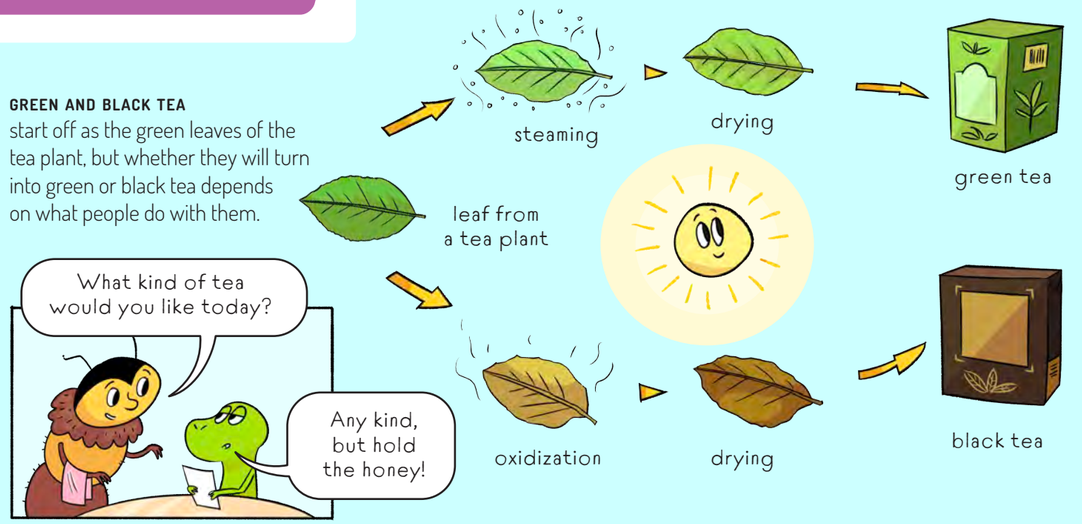
PRODUCTION

All teas are not alike

What kind of tea will you have – black, green or fruit tea? And what kind of fruit – strawberry, cherry or perhaps forest fruits? There are so many to choose from! But what's the difference between them all?

FRUIT TEA
doesn't contain any tea leaves. It's full of dried fruit, berries and herbs. That means it has no caffeine in it and can be drunk by anyone, anytime.

GREEN AND BLACK TEA
start off as the green leaves of the tea plant, but whether they will turn into green or black tea depends on what people do with them.



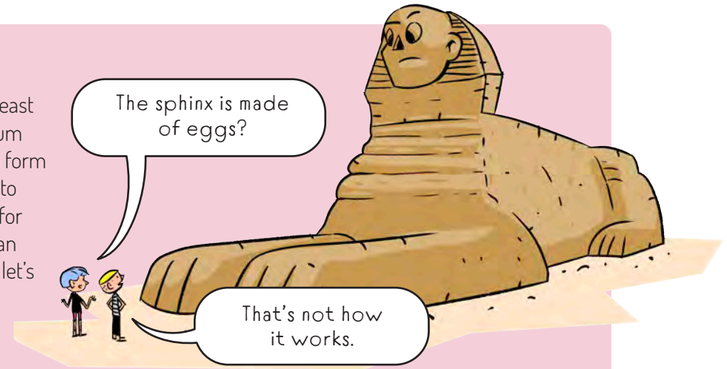
GREEN TEA
is quite simple to make: fresh tea leaves are steamed so they stay green and don't smell bad. Then they're dried and crushed. Each part of the world has its own way of making tea, which is why you'll find so many different packets in the shops.

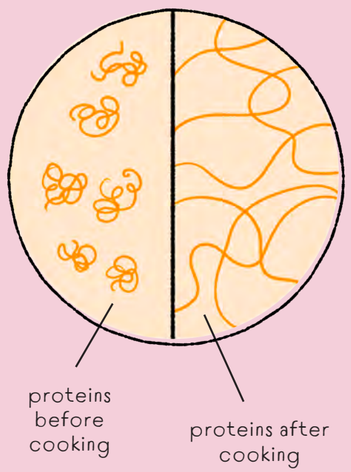
BLACK TEA
is made in a different way: the tea leaves are left to dry in the air till they turn brown. It's like when an old banana goes brown and it's called oxidization. Then the leaves are dried, so they get even darker, which is why we call this tea black.

FOOD

The egg

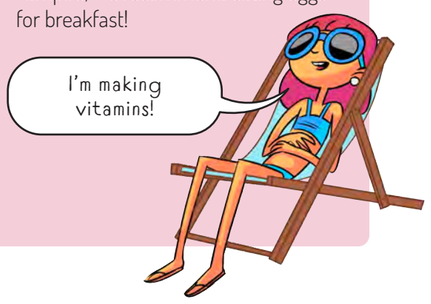
An egg has a shell to make it strong and tough – well, at least a little bit. That's why it's made up of tiny crystals of calcium carbonate. This is found in nature as limestone and it can form whole mountains and mountain ranges. It was also used to make the Great Sphinx of Giza, which has been standing for a few thousand years, so we have proof that limestone can withstand a lot. Unless you drop the egg, that is. But now let's look at the parts of the egg that taste a lot better.





Egg white is runny and transparent, but if you heat it up properly, it'll be solid, white and delicious. But why does it change colour when it's cooked? It's because it contains a lot of proteins, which start to transform when heated, gradually forming a stiff network. This is called denaturation and it happens at a lower temperature in the white than in the yolk. This means that your breakfast egg can have a solid white and a lovely soft yolk at the same time.

Eggs are one of the few foods that contain vitamin D. This vitamin is normally produced by our bodies when we're out in the sun and it gives us strong bones. So if you're a vampire, we recommend eating eggs for breakfast!



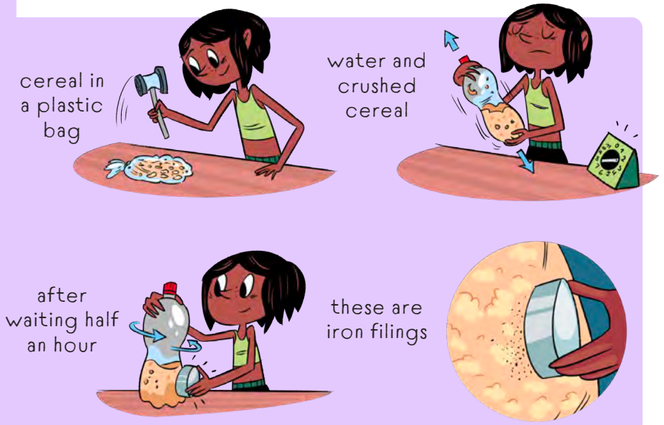
Cereal iron

You can find iron in meat and pulses, but also in cereal, which it's added to. What does it look like then?

You will need:

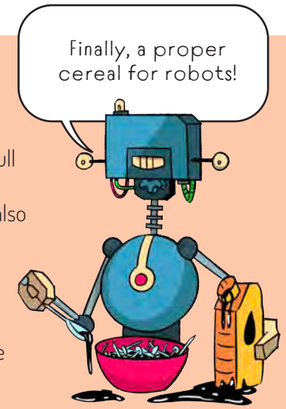
- cereal containing iron, ideally with no chocolate in it
- a powerful magnet
- a plastic bottle with water
- a plastic bag

First crush a handful of cereal into small pieces, preferably in a plastic bag, and then pour these into a plastic bottle about a third full of water. Put the top on the bottle, give it a good shake for at least two minutes and leave it to stand for about half an hour. Then take the magnet, put it against the outside of the bottle where the cereal is and slowly turn the bottle so the magnet attracts as much iron as possible. Now slowly lay the bottle on its side and you'll see that little bits of iron filings have been picked up by the magnet. This is exactly the form iron takes in cereal – although it may look a bit strange at first, our bodies can easily process these iron filings to top up the iron in our bodies.

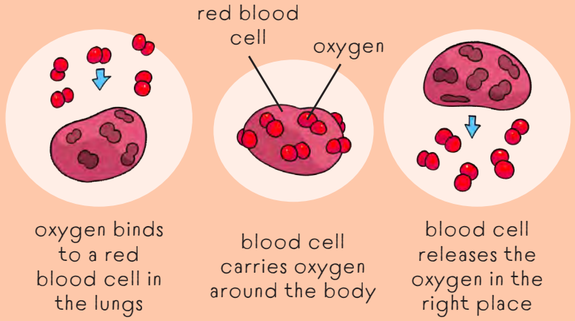


HUMAN BODY

Metal cereals



You can also start the day with cereal and milk or yoghurt. It's full of health-giving substances like protein, fibre and vitamins, but also unhealthy ones – in particular, lots of sugar. But you can also find substances in it that you might not expect, such as iron. What's it doing there? We're not robots who need to eat iron, are we?



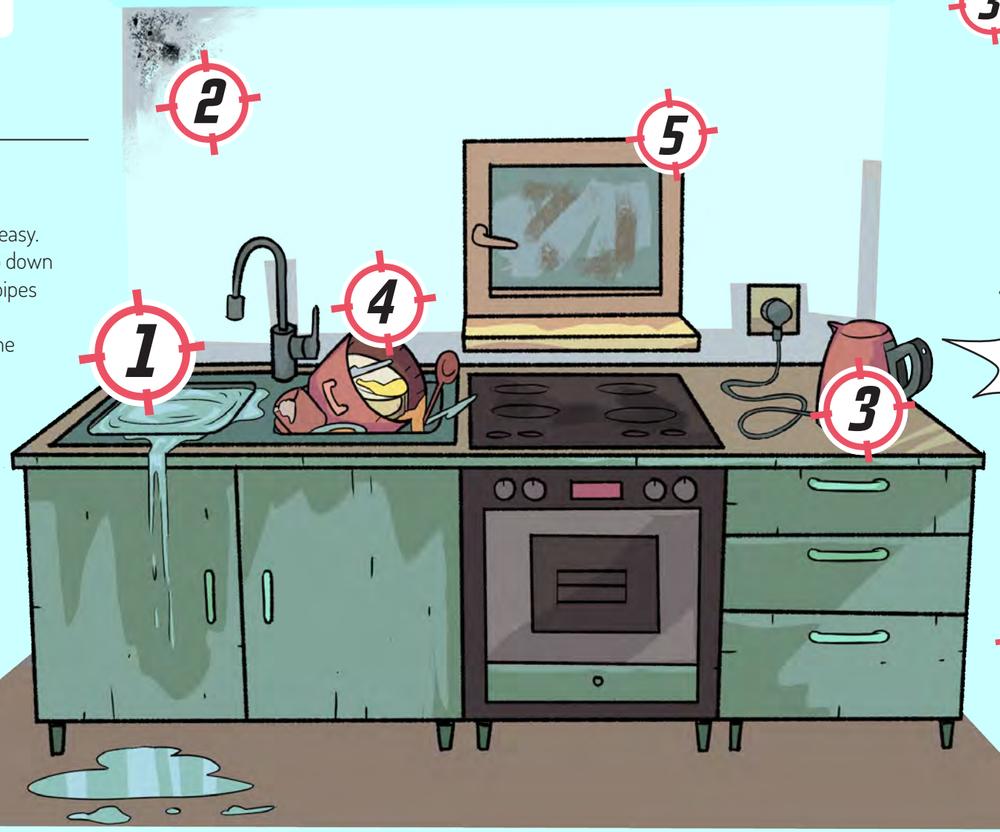
Well, yes and no. We're not robots, but we humans, and especially our blood, need iron too. In blood there are lots and lots of red blood cells. These red blood cells capture the oxygen in the lungs and deliver it to the rest of the body. Red blood cells contain a lot of a substance called haemoglobin, and it contains iron. If people don't have enough iron, they don't have enough oxygen, and then they feel really tired.

What a mess!

There's a solution to every problem and a cleaning product for every type of dirt.

1 A blocked sink

Sinks, basins and baths don't have it easy. Loads of food scraps, dirt and hair go down the plughole. You need to clean the pipes out from time to time to stop them getting blocked. To do this, we use one of the most extreme and horrible chemicals you'll find at home. It's called lye or caustic soda. It'll happily gobble up the dirt in the waste pipe – but be careful, it'll happily eat the skin on your fingers too...



2 Mould

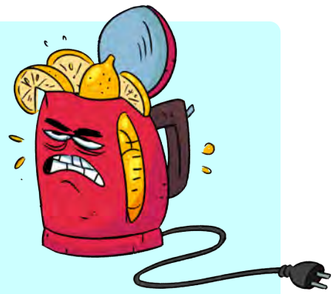
Moulds are fungi which can look like black spots or even greenish-white clumps. They thrive in warm, damp places, so they absolutely adore bathrooms. The nasty thing about moulds is that they release spores and if there are a lot of them, people find it hard to breathe. So it's best to crack down on mould. Bleach will do the trick as it simply gobbles it up.

!

The main chemical in bleach is sodium hypochlorite. Hypochlorite attacks mould, bacteria, pigments, your skin... basically, anything it comes across. It produces stinky chemicals which aren't dangerous, but there's usually such a stench that you have to open a window.

3 The electric kettle

Acidic things are good at fighting against limescale because it dissolves readily in them. So you can clean your kettle or tap with vinegar or citric acid, which is found in lemons or sour sweets. That's why acids are the most powerful ingredient in cleaning products designed to tackle limescale.



4 Dishes

Detergents are used for greasy things like dishes. They're the superheroes of the soap world!

5 The window

The most important thing when cleaning windows is that there are no smudges left on them! That's why glass cleaners contain a lot of alcohol, which quickly evaporates so you can see in the mirror without any smears.

PRODUCTION

Toilet paper

Not all toilet paper is the same. Some of it's white and lovely and soft, while some of it's grey and could probably be used to sand wood. The rough grey stuff has been paper many times before – it's made from old paper. All you have to do is shred this, boil it in water, clean it, and then use this mixture to make new paper. It might not be as nice, but at least they don't have to keep cutting down trees to make it.

PRODUCTION

Nothing but cellulose

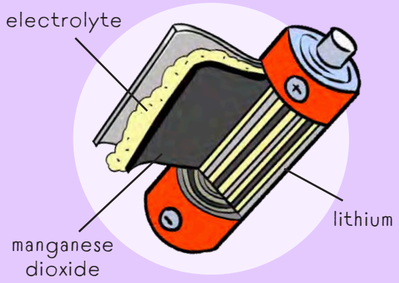
Both cotton wool and paper are mostly made of cellulose, but what's the difference between them? Each of them comes from a different source! Cotton wool is made from cotton, the downy white tufts on the flowers of the cotton plant. Paper, on the other hand, is made from trees, potatoes and rocks. Honestly! Cellulose comes from wood, which is ground up, boiled in chemicals and pressed. Starch (for instance, from potatoes) is added to the paper to make it stronger, and limestone to make it less see-through.

9 THE WORKSHOP

Do you need to fix a bike, put up a shelf or make a lamp? A workshop will help you with all that and more. From screwdrivers to diamonds, you'll find lots of tools you can use to get the job done!

MATERIALS

Diagram of a lithium battery



Batteries all around us

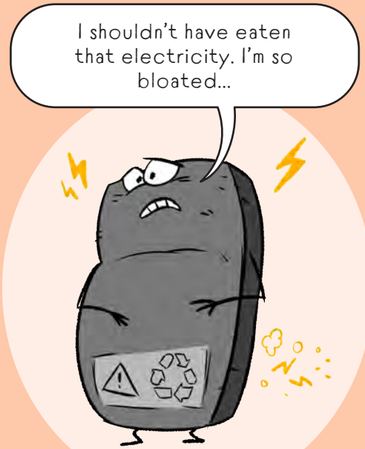
Everywhere you look, there are batteries. In your mobile phone, the TV remote control, the car... This book might be the only thing that doesn't run on batteries. On top of that, all these batteries are different. The ordinary pencil battery you find in a remote control is very light and small as it's made of thin layers of lithium metal and a chemical called manganese dioxide. Between them there's cotton wool soaked in electrolyte, a liquid that's good at conducting electricity. There's just one drawback to this kind of battery: it can't be recharged.

TEMPERATURE

A spaghetti printer

A printer can only print using ink on paper, right? Wrong! 3D printers can print using plastic and you can make just about anything with them. They mostly use long plastic spaghetti – filaments. This is heated up by the printer until it melts. Then all you have to do is apply it somewhere, let it cool and harden, repeat this about a thousand times, and your model of a gecko is complete. However, 3D printers don't just have to use boring old plastic; there are even some that can print using metal or concrete. On one you can print an artificial knee and on the other a whole house!

REACTIONS



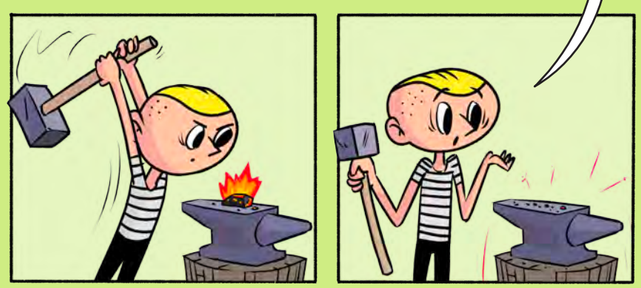
Red-hot batteries

It would be a pain if we had to change the batteries in our mobile phones every day. It's just as well we have rechargeable ones. But these need looking after, just like a pet. What happens if you regularly leave the battery in your phone completely dead, or plugged into the charger after it's fully charged? If you're lucky, the battery will drain more quickly. If you're unlucky, it'll swell up. That's because other chemical reactions start happening inside it which produce lots of gases – oxygen and carbon dioxide. Then it's only a matter of time before this swollen battery explodes and the highly flammable lithium inside sets fire to everything around it.

PRODUCTION

How to make a diamond

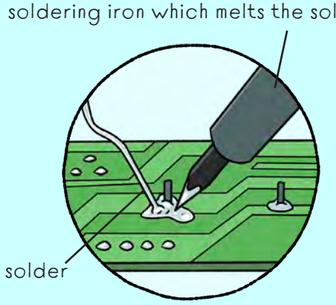
Diamonds – they're beautiful, shiny, expensive and surrounded by many myths and legends. But how is it possible that carbon – which people regularly burn as coal for heating – can form diamonds? The key is high temperature and some serious pressure. However, that doesn't mean that if you hit burning coal with a hammer it'll turn into a diamond. You'd need a lot more pressure than that – in fact, over 1000 times more than you could manage with a hammer. Luckily, people can produce that kind of pressure using machines and almost anyone can buy a synthetic diamond – for example, in the drill bit for a drill.

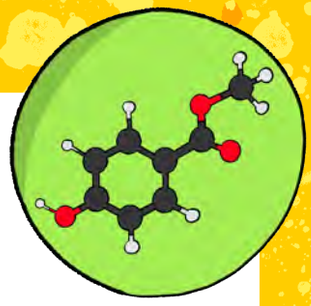


Let's conduct!

How are all those parts and wires connected in your mobile phone, fridge or smart cheese knife? Glue wouldn't work because it doesn't conduct electricity. You need solder: a mixture of tin, copper, silver and other metals that will melt at quite a low temperature and join all the parts together properly and conductively. As well as metals, there's one other special thing in it: pine. You won't find any branches or needles, but solder contains a little pine resin, which acts as an acid and gobbles up dirt wherever you're soldering, so the solder sticks better.

MATERIALS





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Illustrated by ***TOMÁŠ KOPECKÝ***

Does the word chemistry make your hair stand on end? Come and check out the chemistry around us and you'll see that it's not so scary! This book will guide you around the whole house and show you that there's loads of fascinating chemistry in ordinary things. Do you know why geckos hate frying pans? How many stinky chemicals can you find in a kitchen? And why do batteries explode?

Together we'll investigate each room in the house and you'll soon discover that there's chemistry at every turn – whether it's a tasty breakfast or the horrible chemicals in a utility room. Thanks to some excellent experiments, you'll experience chemistry first-hand and find out how far this fascinating world extends. Spoiler: absolutely everywhere!

LOOK
SCIENCE IS ALL AROUND US!

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