



University of
Nottingham
Biodiscovery Institute

A large, detailed image of the Earth as seen from space, showing the Western Hemisphere with North and South America. The Earth is framed by a thin white rectangular border.

Stay-at-home science!

Fun, hands-on experiments for
children of any age, brought to you
by the University of Nottingham's
Biodiscovery Institute



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Welcome

Welcome to the Biodiscovery Institute's stay-at-home science pack - a collection of the Biodiscovery Institute's favourite at-home science experiments!

With schools closed for the next few weeks and home-schooling the new normal, keeping children engaged and interested in science can be tough. To help with this, we wanted to make a resource that makes it fun and easy to do science at home with children.

All the experiments included in this pack are designed to be easy to do using only common household objects. The activities are interactive, fun and encourage children to ask questions and begin to understand the concept that science is all around us.

You do not need any existing science knowledge to do these experiments. Alongside each experiment is a clear description of why it works and the science behind it. Please be aware that some of the activities include scissors/sharp objects and heating up liquids and for this reason the pack is not designed for children to do independently.

We hope that this pack will not only encourage learning and curiosity, but will also provide parents with a resource to help teach their children over the coming weeks. Enjoy!

Stuck with an experiment? Something not working? Please email louisa.taylor1@nottingham.ac.uk or michaela.griffin@nottingham.ac.uk and we will do our best to get back to you with some advice!



Health and Safety



Supervision by an adult is needed.

Always wear correct safety equipment and wash your hands after experiments.

Find safe spaces to conduct experiments and avoid accidents.

Experiment instructions and warnings should be followed correctly to keep safe and get the best results.



**Careful!
Scissors/
Sharp Edges**



**Careful!
Hot Water**



**Wear eye
protection!**



Top Tips

Make sure you have everything you need before starting the experiment!

Read all of the instructions before you begin and make sure you understand what you will be doing.

Identify any health and safety hazards before starting. Look out for hazard triangles in the instructions signifying hot water, sharp edges and eye protection.

Make sure to read the “Things to think about” and “How it works” sections after each experiment!

Think about the planet! Only print the pages from the guide that you need!

Most importantly, enjoy the pack and have fun!



The Science of Sound

Make your own blaster gun!

Background

Did you know that lots of the sound effects from the original Star Wars films were made from everyday materials?

Fun fact! The noise of the blaster guns actually came from hitting the thick metal cables holding up a radio mast! The vibration of the cables made the amazing “pe-ow” sound which we now associate with sci-fi films.

Now, most of us don’t have a radio mast in our garden BUT you can recreate this noise using just a slinky and a cup!

You will need

- A slinky (metal, plastic will not work)
- A cup (any paper or plastic cup will work fine, a re-usable coffee cup or large yogurt pot would be perfect)

Try it at home

1. Attach your slinky to the bottom of your cup! Depending on the size of your slinky and cup, either:



a) press the pointy end of the slinky through the bottom of the paper/plastic cup, pushing the top few coils through the hole to hold the slinky in place (please help children with this – slinkys can be sharp!)

b) **OR** use strong tape to tape the top few coils of the slinky around the bottom of the cup

2. Pick up the slinky and cup and stand up with your arm outstretched.
3. Let go of the bottom of the slinky so that it reaches the ground. What can you hear?!



The Science of Sound

Make your own blaster gun!

How it works

The sound effect is made by the vibration of the metal slinky when it hits the ground.

When you drop the slinky on its own, it stretches towards the ground and vibrates.

This makes the air around the slinky vibrate as well.

As the vibration (or sound wave) travels outwards through the air it reaches our ears and we hear a noise.

How is the noise so loud?

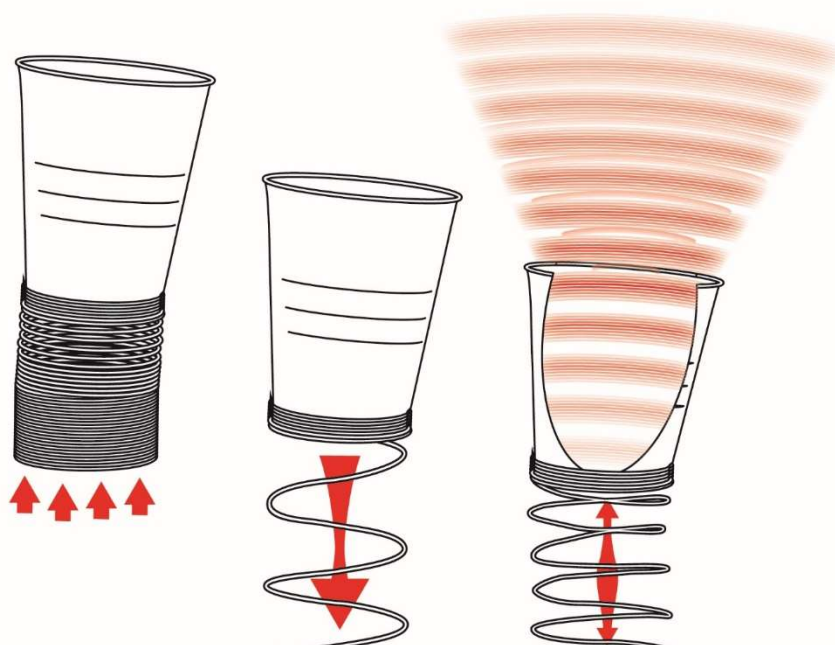
The cup!

The cup holds a large amount of air.

When the slinky is dropped with the cup attached, the coil vibrates the cup, which vibrates the air inside the cup.

More air to vibrate = more powerful sound waves travelling towards your ears.

So, the sound is much louder! The cup basically acts as an amplifier!





The Science of Us

Extract DNA from fruit!

Background

DNA stands for **d**eoxyribon**n**ucleic **a**cid. Have a go at saying it! It's a very complicated word so scientists tend to use DNA instead.

DNA is found in all living things from you, to your dog – even fruit!

Fun fact! Did you know that we share 60% of our DNA with a banana?!

DNA is the material that carries all the information about how a living thing will look or function. For example, DNA in humans determines things like our eye colour, our height and even whether you can roll your tongue!

In this experiment we are going to extract DNA from fruit. We suggest using banana, kiwi or strawberries. The best thing is, you don't need much, sample – so you can eat the leftover fruit after!

You will need

- Fruit (banana, strawberry, kiwi, etc.)
- Water
- Rubbing alcohol (70% or higher) that is **ice** cold (pop it in the freezer)
- Table salt
- Plastic bag (ziplock)
- Coffee filter
- Chopstick, toothpick or paperclip
- Clear glasses (or test tubes)
- Washing up liquid



The Science of Us

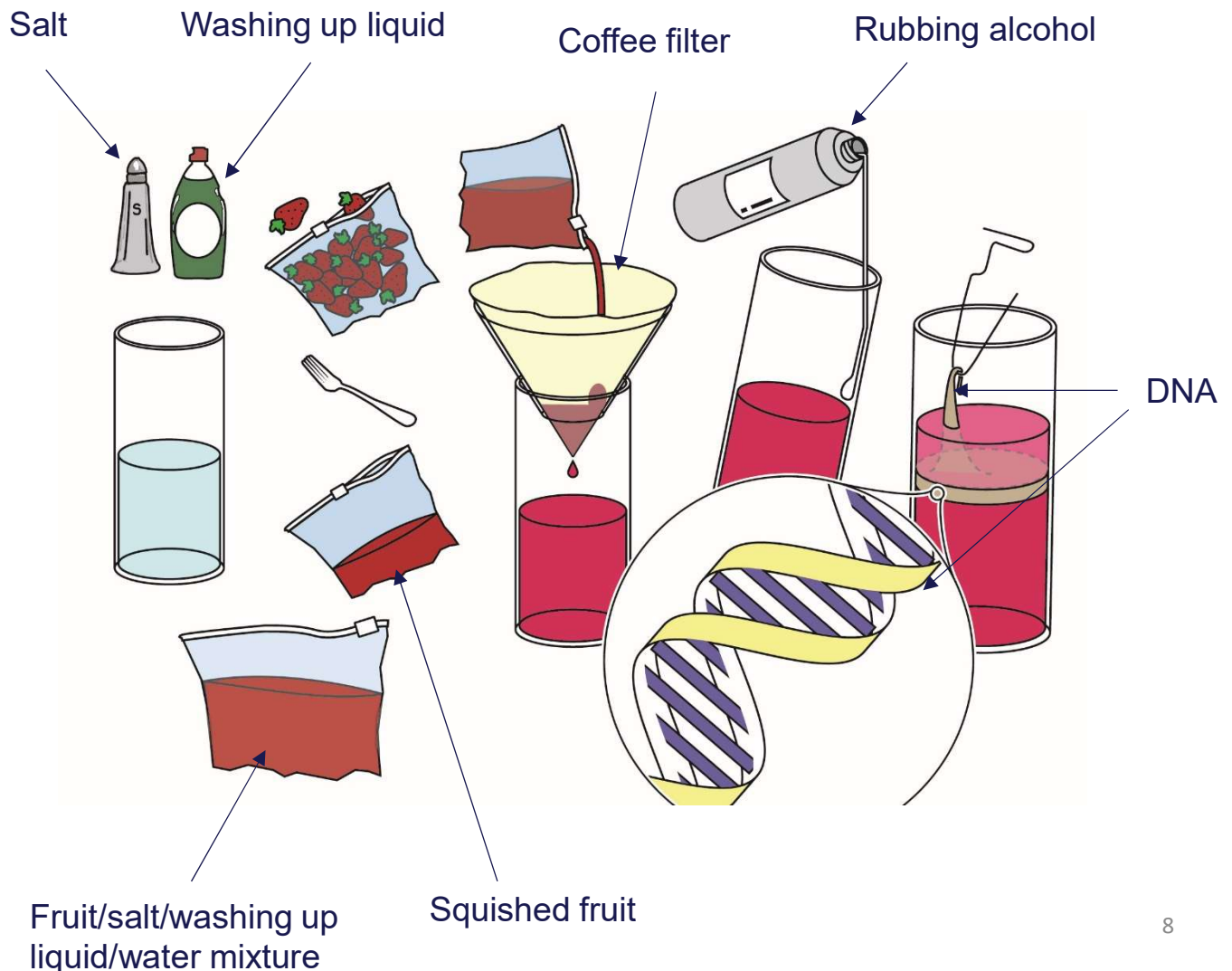
Extract DNA from fruit!

Try it at home

1. Add about 1/3 of a cup of fruit to a clear plastic bag.
2. Break apart the fruit to get to the DNA. This can be done with a spoon or a fork! Keep going until it turns into a paste.

Fun fact! DNA is held inside the nucleus (the cell's control centre) . This means to get to our DNA we need to break apart the membranes of the cell and the nucleus inside!

3. Fill half a clear glass with water. Slowly mix in 2 teaspoons of washing up liquid and half a teaspoon of table salt. Gently mix (without making bubbles!)





The Science of Us

Extract DNA from fruit!

Try it at home (continued)

4. Add the salt, water and soap mixture to your clear plastic bag, don't add too much! Add just enough so that you have a nice mixture that you cannot see through (around $\frac{1}{4}$ of a cup).
5. Flatten out your bag to remove most of the air and then seal it up. Gently squish the liquid around. If you have the time, let this mixture sit for 10-20 minutes to release as much DNA as possible.
6. Place coffee filter on top of a glass and pour mixture onto it and let the liquid move through – this contains your DNA!
7. Remove the filter and very carefully pour alcohol down the side of your glass – try to create a layer of alcohol that sits on top of your mixture.
8. You should begin to see strands of what looks like cotton appearing in the glass – that is DNA! You can collect using a paper clip or toothpick. You have just collected DNA from fruit! AWESOME!

Fun fact! Did you know that a human cell contains almost 6 feet of DNA?

Fun fact! Your DNA could stretch from the earth to the sun and back almost 600 times!

Fun fact! Humans are all 99.9% alike. It is just that 0.1% that makes us unique.



The Science of Us

Extract DNA from fruit!

How it works

Each component of this experiment has a very important role!

Washing up liquid

Washing up liquid acts as a detergent, which means it can break down the fats in the membrane of the cell and the nucleus, helping us to break open the cells to get the DNA!

Salt

DNA has a negative charge. This means that when we release it from the cell it breaks apart into tiny fragments. Salt has a positive charge so can interact with the DNA and neutralise it, allowing it to form big clumps.

Alcohol

DNA dissolves in water which stops us being able to see it at the start of this experiment. BUT, DNA does not dissolve in alcohol, so adding rubbing alcohol to our experiment causes the DNA to collect as a white mass at the top of the tube.

Wait, how can we see DNA? Isn't it really tiny?

You're right, DNA is tiny. In fact, it is only 0.0000000002 metres wide, that's a lot of zeros!

But each cell contains a huge amount of DNA, it is just so tightly packaged that we cannot see it. Forcing it to unravel like we do in this experiment allows us to see it!



The Science of our Planet

Make your own ecosystem in a jar!

Background

Would you like to create your own living planet? It sounds complicated, but creating your own ecosystem is actually very simple!

Ecosystems are a community of living organisms and non-living things in an area, which work together to stay alive. They include plants and animals as well as materials such as rocks, soil, water and sand. A swamp, a forest, an ocean and a desert are all examples of ecosystems.

The health of an ecosystem depends on a delicate balance of all of its members and the environment. If something disturbs this balance, the ecosystem might suffer. Natural things that can disturb ecosystems include a changing climate and natural disasters. Human activities can affect ecosystems too, such as pollution and clearing land to build farms and houses.

You will need

- Large jar with lid, preferably with a large opening (makes it easy to put plants and other materials in it)
- Pebbles
- Moss e.g. sphagnum moss
- Soil
- Your selection of small plants
- Decorative material: tree bark, colourful stones, seashells





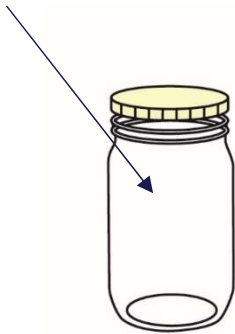
The Science of our Planet

Make your own ecosystem in a jar!

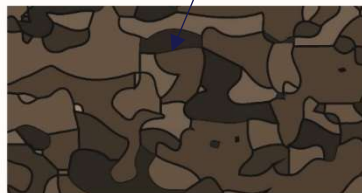
Try it at home

1. Cover the bottom of the jar with a layer of pebbles
2. Add a layer of moss.
3. Add a thick layer of soil (should be twice as thick as the pebbles and moss)
4. Poke small holes into the soil and add your selection of plants.

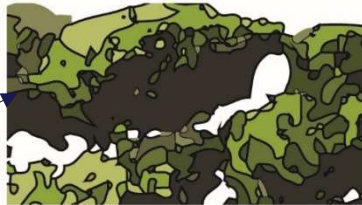
Large jar with lid



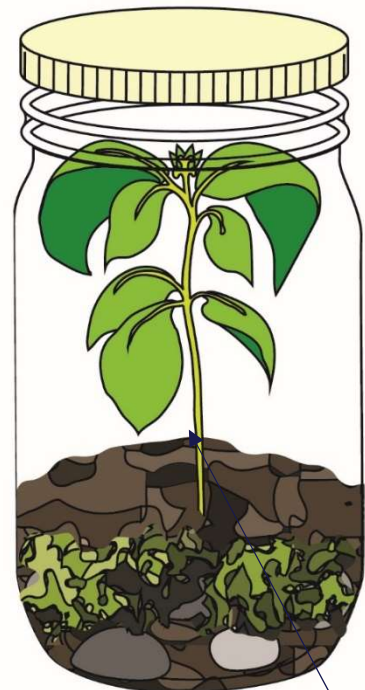
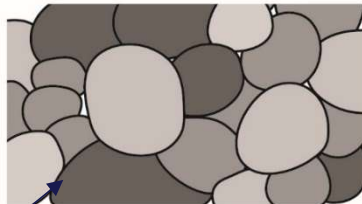
Stage 3. Soil



Stage 2. Moss



Stage 1. Pebbles



Plant



The Science of our Planet

Make your own ecosystem in a jar!

Try it at home (continued)

5. Place your stones, figurines or any other material in your jar.

Get creative! What would you like to put in your mini world?

6. Water your ecosystem and cover with the lid

7. Place the jar where it could receive morning or evening sun.

Top tip! Don't leave your jar in front of the direct sunlight – it could dry out your plants.

8. Monitor the water levels of your ecosystem over the next few days.

If the soil is too dry – add water, if it's too wet leave the jar open for a couple of days so the water can evaporate.

If soil is moist and no heavy water droplets form on jar walls, the level of water is good and you can keep your jar closed all the time.

You have created your own ecosystem!

This is our mini-world!

What do you think?

How is your mini-world different?





The Science of our Planet

Make your own ecosystem in a jar!

Things to think about

Sun

The main source of energy in almost all ecosystems is the sun. Plants take this energy and use something called photosynthesis to produce food for the plant to survive. The sun also makes an ecosystem a suitable temperature and evaporates water from the soil.

Water

Water hydrates the environment. What's really cool is that your ecosystem will form its own water cycle! The water cycle begins in your jar with evaporation from the soil. Water droplets then form on the lid of the jar through condensation (like clouds!). After they become too heavy they will fall to the ground like rain and be absorbed into the soil and the roots of your plants!

Soil

The soil at the bottom of your jar contains important bacteria which decompose old leaves which fall to the ground. These bacteria produce important nutrients which will be later recycled by the plants in your ecosystem.

Carbon dioxide

Carbon dioxide is a very important gas molecule for photosynthesis. Without it, plants could not make the food they need to survive. It is released into the air by bacteria which live in the soil.

Oxygen

As well as making food, plants also make oxygen when they photosynthesise. Humans need oxygen to breathe so plants are very important in our ecosystems!



The Science of Acids + Alkalis

Make a red cabbage indicator!

Background

Some liquids are classified as acids and some liquids are classified as alkalis. Water is described as "neutral" which means it is in the middle. Knowing if things are acidic or alkaline is very important. For example, swimming pools have to be the perfect balance of acid and alkali so they are safe to swim in!

Luckily, you can test the acidity of liquids by using something called an indicator. Indicators are very important in chemistry. They are clever solutions that reveal useful chemical information about different substances by changing colour.

In this experiment you will make your own indicator out of cabbage juice and use it to test the acidity or alkalinity of different liquids.

You will need

- A quarter of a red cabbage
- A blender **or** hot water and a heatproof beaker
- A sieve
- Several clear glasses and a large jug/beaker
- Different liquids to test! You could try: water, vinegar, fruit juice, washing up liquid, milk, soap, egg, baking soda (dissolved in water), lemon juice etc...



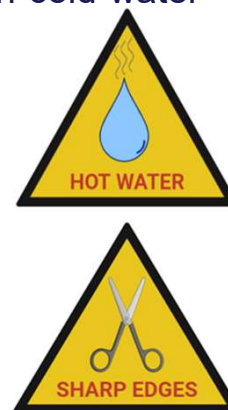
The Science of Acids + Alkalis

Make a red cabbage indicator!

Try it at home

1. Place a handful of torn cabbage leaves into a blender with cold water and blend until the water is dark purple.

Top tip! No blender, no problem! Simply add your cabbage leaves to a large beaker of hot water. Leave until the water is dark purple, stirring occasionally. You need the liquid to be as dark as possible so be patient!



2. Whether your blend or soak your cabbage, you should now have dark purple water. Sieve your purple solution to remove any cabbage pieces.

Add an equal amount of water to your purple liquid so you are left with lots of cabbage indicator.

You are now ready to experiment!

4. To test the acidity of different household items, simply fill a glass a quarter full with red cabbage indicator solution and add your first test liquid.

What happens to your indicator?

It is a good idea to start with vinegar or baking soda. Add a small amount and if you see no obvious colour change add more!

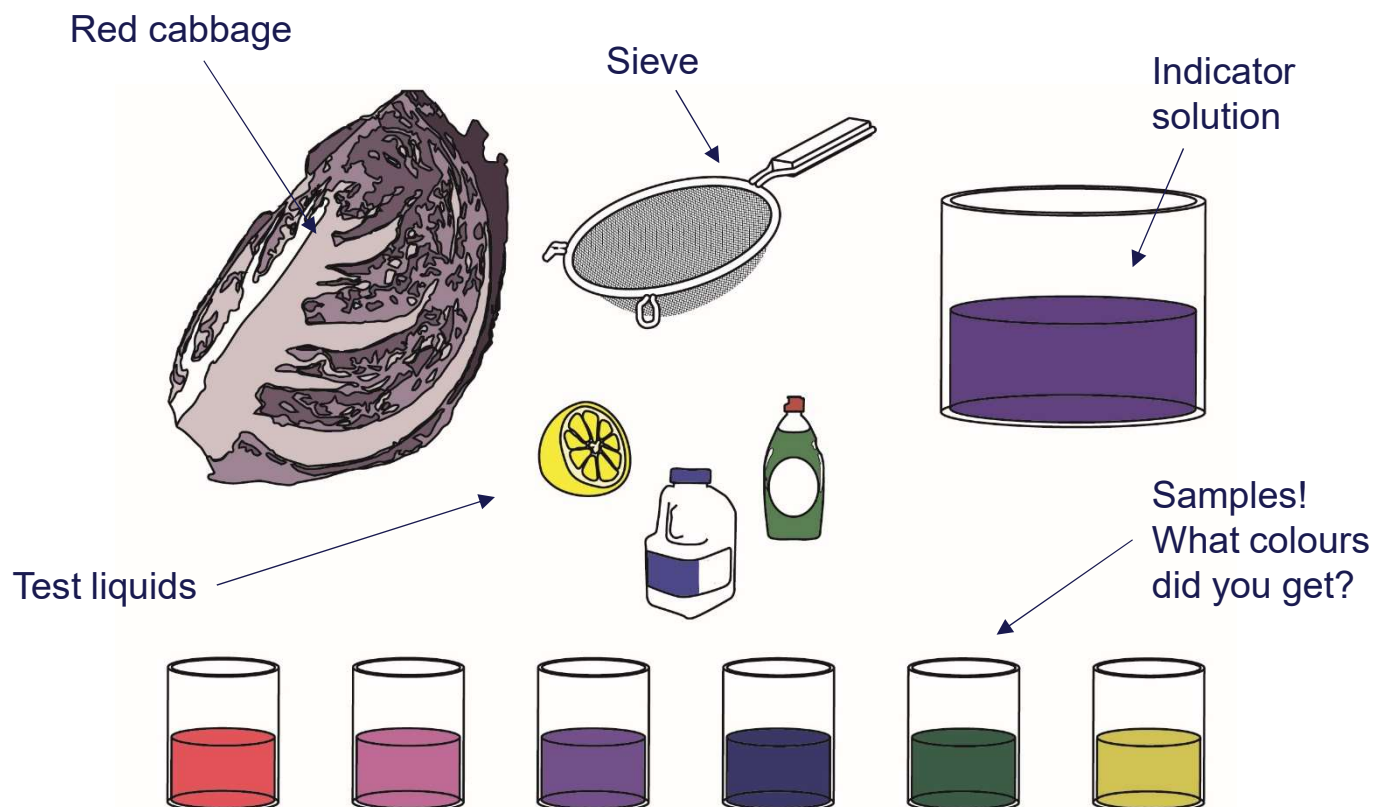
5. Repeat this with the other liquids (in fresh glasses), testing to see what colour the indicator changes when you add them!

Make a note of all the colour changes you see with different liquids.



The Science of Acids + Alkalis

Make a red cabbage indicator!



Things to think about

Look at the notes you made throughout the experiment.

What do you notice about the liquids that make the cabbage indicator turn red? Do they have anything in common?

What do you notice about the liquids that make the cabbage indicator turn blue/green? Do they have anything in common?

How it works

Red cabbage contains a chemical called anthocyanin which makes it red.

Anthocyanin is a pigment which changes colour when mixed with an acid or an alkali.

It turns more red when mixed with an acid (e.g. lemon juice or vinegar) and more blue/green when mixed with an alkali (e.g. baking soda)!



The Science of Crystallization

Edible rock candy!

Background

Crystals are amazing to look at, but they are also really interesting too. We are going to take a look at how crystals form in this fun and edible activity!

Crystals are a special material where the molecules fit together in a repeating pattern. This pattern causes the material to form all sorts of unique shapes.

Crystals form through a process called crystallization. Crystals often form in nature when liquids cool and start to harden. Certain molecules in the liquid gather together as they attempt to become stable. They do this in a uniform and repeating pattern that forms the crystal. Many valuable crystals such as diamonds, rubies and emeralds form this way.

Another way crystals form is when water evaporates from a mixture. For example, salt crystals often form as salt water (sea water) evaporates.

You will need

- 1 cup of water
- 2 cups of granulated sugar (plus extra to coat cocktail sticks/skewers in)
- Mason jars
- Cocktail stick/skewer
- Food coloring
- Laundry peg
- Food flavor (optional)



The Science of Crystallization

Edible rock candy!

Try it at home

1. Soak some cocktail sticks/skewers in water for 10 minutes.
2. Coat the food stick with granulated sugar and leave to one side.
Attention! The next part will involve heating sugar and will need adult help!
3. Add 1 cup of water into a saucepan.
4. Gradually add 2 cups sugar and keep stirring with a wooden spoon until dissolved.
5. Bring the liquid sugar to the boil and then quickly remove from the heat.
6. Add 1 teaspoon of food colouring.
7. Add 1 teaspoon of food flavouring (optional).
8. Mix the solution with the wooden spoon.
9. Leave the saucepan for 1 hour to cool down.
10. Add the cold sugar liquid into a mason jar.
11. Carefully add your sugar-coated cocktail stick/skewer into the jar, securing it with a peg so it does not fall over in the jar.
12. Leave the jar in a safe place where it won't be moved or knocked for at least one week.
Keep checking your sticks during this time. Can you see sugar crystals growing?
13. After a week, carefully remove your crystal-coated sticks from the sugar solution and lay on a plate to dry (this takes a couple of hours).
14. When the crystals are dry inspect them, use a magnifying glass if you have one.

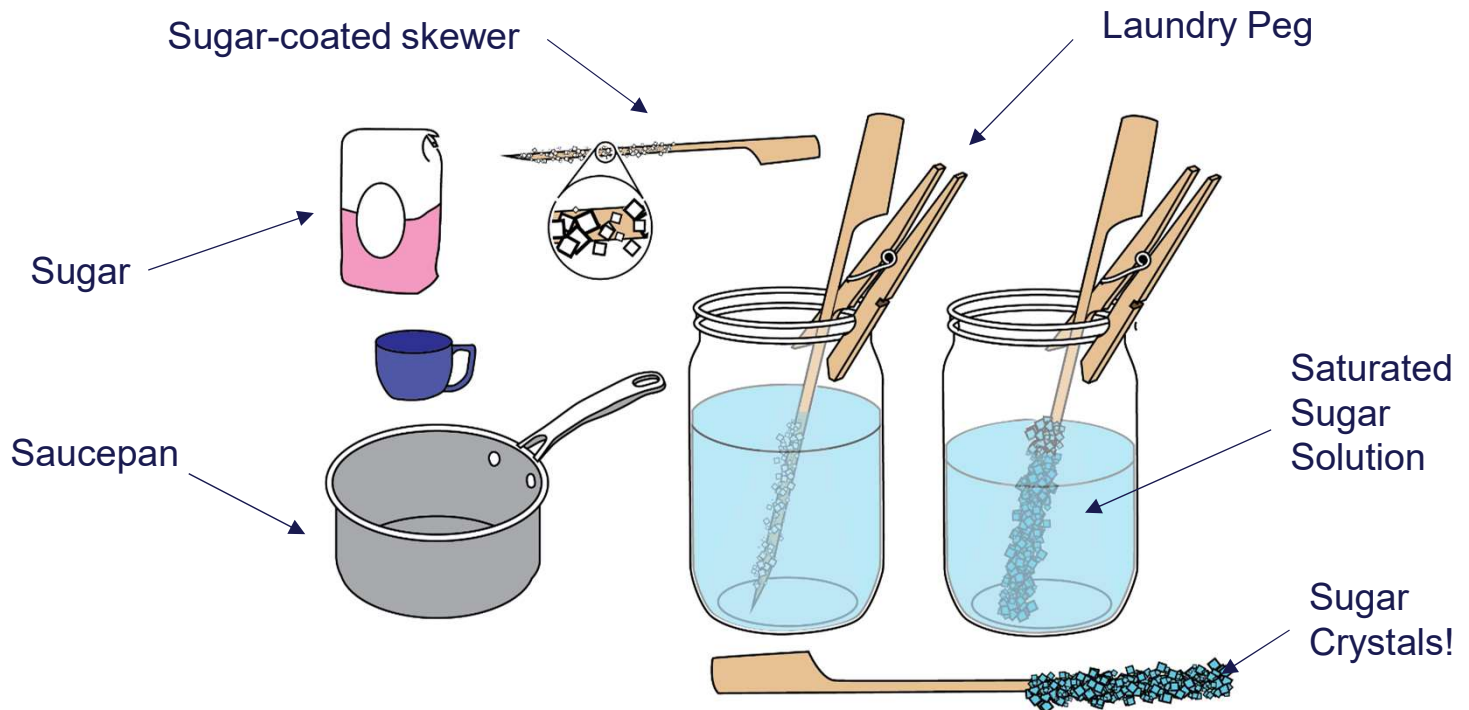


How are the crystals similar? How are they different?



The Science of Crystallization

Edible rock candy!



How it works

In this experiment you used heat to dissolve lots of sugar in a small amount of water.

This makes what is known as a saturated solution. In this saturated solution, the sugar molecules have a higher chance of bumping into one another because there is less space to move around. When this happens, the sugar molecules stick together and form crystals.

When you give the sugar molecules something to cling to like a cocktail stick/skewer, they form crystals faster. The more molecules bump into each other, the bigger the sugar crystals get. The bigger the crystals are, the more they pull other sugar molecules toward them, making even bigger crystals.

Fun fact! Snowflakes are six-sided ice crystals that are formed high in the clouds when water freezes. Amazingly, every single snowflake is completely unique!



The Science of Electricity

The fluttering butterfly

Background

Electricity is essential for many of our daily activities. Without electricity there would be no computers to do our work on, no lights for our houses and schools, no ovens and microwaves to cook our food in and no televisions to watch our favourite films on!

Everything in the universe is made of tiny objects called atoms. Each atom has even tinier particles called protons and electrons. Electricity is simply the flow of electrons and protons.

Most of our electricity comes from power stations. Power stations produce powerful electric currents which are just lots of moving electrons. Electricity also occurs in nature as lightning bolts. Lightning is nothing but a large number of electrons flowing through air all at once, releasing a huge amount of energy!

In this experiment you will learn all about the wonders of static electricity!

You will need

- Cardboard
- Tissue paper
- Pencil
- Scissors
- Googly eyes/ pipe cleaners(optional)
- Balloon
- String
- Glue stick



The Science of Electricity

The fluttering butterfly

Try it at home

1. Cut a 20 cm x 20 cm square of cardboard. Colour it in if you wish! This will be your background.
2. Draw a large outline of a butterfly using a pencil on your tissue paper and carefully cut out. Make sure your butterfly is not larger than the background!



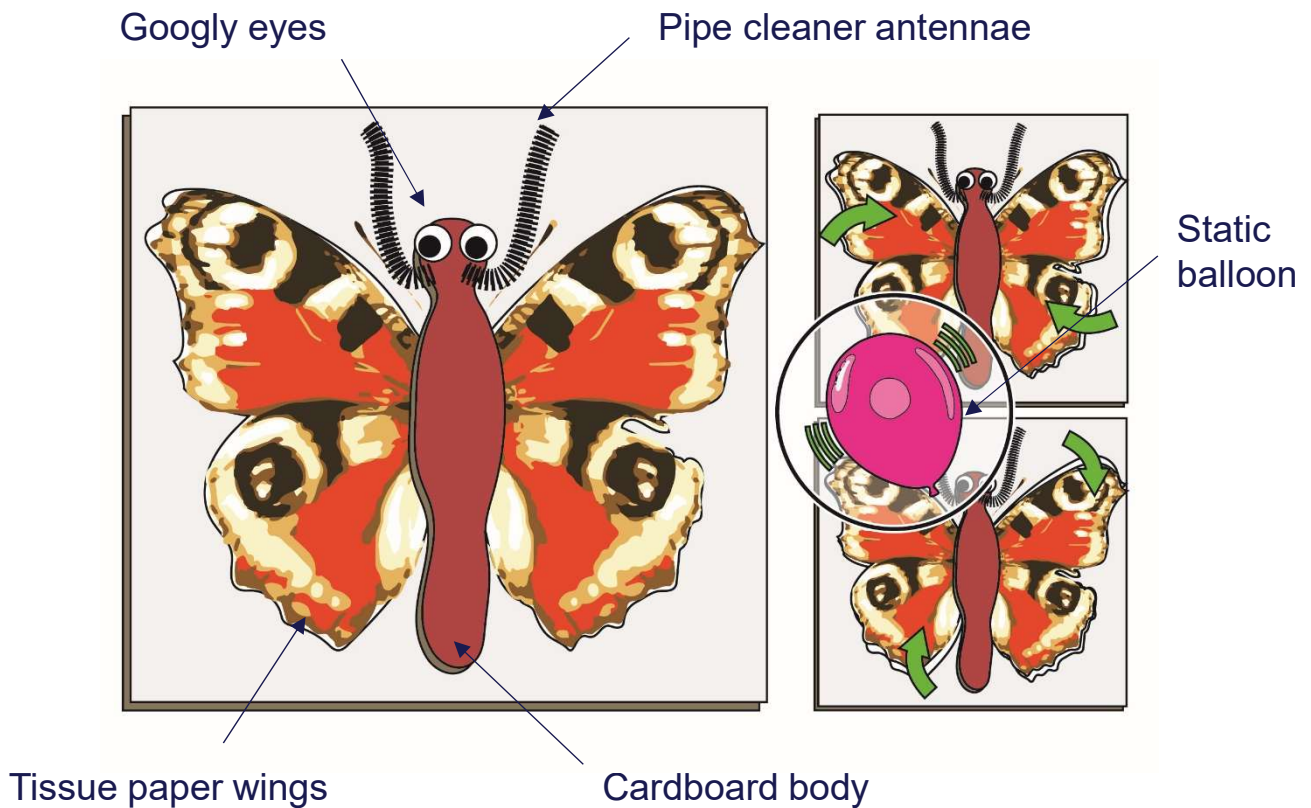
Careful! Please supervise children when using scissors.

3. Use another piece of cardboard to draw a body for your butterfly (without wings). This will be placed on top of the wings so make sure it is a sensible size! Cut the body out.
4. Place your cardboard square on the table in front of you and lie the tissue paper butterfly wings on top.
5. Next, glue the body onto tissue paper. The head and some of the body should overlap the tissue paper and stick onto the cardboard underneath to secure the butterfly. DO NOT GLUE the paper wings. These need to be able to flutter!
6. Decorate your butterfly with googly eyes or pipe cleaner antennae (optional)
7. Blow up the balloon and tighten up the end with a string
8. Rub the balloon to your hair to give it an electric charge. What happens to your hair when you do this?
9. Hold the balloon over the butterfly without touching it. You should see the wings move and flutter!



The Science of Electricity

The fluttering butterfly



Things to think about

We discussed earlier that atoms are composed of electrons and protons. Electrons have a negative charge and protons have a positive charge.

When we rubbed the balloon on our hair, electrons moved from our hair onto the balloon. This gives the balloon a static charge!

Then, when the negative charge of the balloon gets close to the positive charge of the tissue paper, the two materials are so attracted to each other that the tissue paper moves toward the balloon.

This is what caused the butterflies wings to flutter!

Fun fact! Static electricity also causes the electric shock you might have experienced when you touch a doorknob, a car-door handle, or a water fountain? Ouch!



The Science of Nucleation

Coca-Cola and Mentos eruption

Background

Have you ever seen the Diet Coke and Mentos experiment and wondered what makes the reaction work? Well now you are going to learn about the amazing science behind the huge eruption that takes place when Mentos and are dropped into Diet Coke!

You will need

- Open outdoor areas with no roof and at least two meters from other buildings
- 2L Diet Coke bottle (much easier to clean than full fat Coke!)
- 1 Mentos roll pack
- Eye protection (safety goggles or glasses)

Top tip! Wear clothes that you don't mind getting a little bit splashed with Diet Coke – this experiment can get messy!

Try it at home

1. Place your Diet Coke bottle in a clear outdoor area. Make sure that there is nothing hanging above the area and no buildings or other people nearby!
2. Carefully remove the cap from the bottle.
3. Put on your eye protection and carefully add 1-2
4. Mentos to the open Diet Coke bottle. Quickly step back away from the reaction.



Attention! As this needs to be done quickly and carefully, we recommend an adult adds the Mentos.

4. Watch what happens next! How quickly did the reaction start? How high did the eruption go? Is there anything left in the bottle?



The Science of Nucleation

Coca-Cola and Mentos eruption

How it works

Diet Coke and many other fizzy drinks are packed full of dissolved carbon dioxide gas, which makes them bubbly.

If you shake a bottle of Diet Coke, some of the gas escapes from the Diet Coke liquid. When you open the bottle, the bubbles quickly rise to the top, pushing the liquid out of the way. In other words, the Diet Coke sprays everywhere!

This bubbling process is called nucleation.

Although Mentos might look smooth, if you looked at them under a microscope you'd see tiny bumps coating their entire surface - like the Moon! The tiny bumps are called nucleation sites.

Once you drop the Mentos into the Diet Coke bottle, carbon dioxide starts to enter these bumps and form bubbles. And as the sweet has lots of bumps... Lots of carbon dioxide enters... Lots of bubbles form... **BOOM!!!** The gas released by the Mentos pushes the liquid up and out of the bottle in an amazing eruption!





Dates for your diary

Stay-at-home Calendar Days

Celebrate the small things and brighten up your days spent at home with our stay-at-home calendar days! Wake up, check the date and plan something exciting!

May



15 May – Endangered Species Day. This is an awareness day for the animals and plants that are at the brink of extinction. Can you find out which animals and plants are endangered and learn all about them?

26 May – Paper Airplane Day. Try learning how to make paper airplanes. How about making them in your family and seeing whose paper plane can travel the furthest. How does the shape of the plane help it fly?

29 May – Biscuit Day. Does anyone need an excuse to eat biscuits?! How about baking some biscuits, flapjacks or brownies with your family?



June

3 June – Running Day. Get some fresh air and go for a walk, jog or run!

5 June – World Environment Day. A day to learn about how human activity is affecting our planet. Learn all about pollution and sustainability and what we can do to help our planet.

8 June – Best Friends Day. Call, text or write a letter to your best friend. If your best friend has four legs dedicate some time to play with them!

8 June – World Oceans Day. Learn about what defines an ocean and find out some interesting facts about them!

12 June – Superman Day. Dress up as your favourite superhero, read some comics or maybe even draw your own!

23 June – Public Service Day. Today we think about and thank the amazing police, doctors, nurses, firefighters, bin men and teachers who work so hard to keep us safe. Draw a big Thank You picture for them!

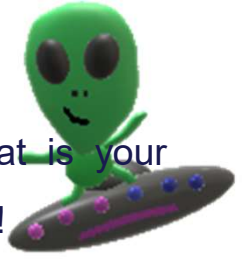




Dates for your diary!

July

1 July – Joke Day. We could all do with laughing more. What is your favourite joke? Tell your family and friends, or even write your own!



2 July – World UFO Day. We are surrounded by stories about aliens and life in space. How about you draw an alien or their spaceship? What do they look like? What is their story?

14 July – Shark Awareness Day. Sharks are often portrayed as monsters, but in actual fact sharks are threatened by human activity and their numbers decrease every year. Find out all about sharks. What species is your favourite? You could even make a poster with some interesting facts to raise awareness.



17 July – World Emoji Day. Draw your favourite emoji or design a new one. You could also play a guessing game with your friends or family members and try to tell them a story/a sentence with emojis only!

20 July – Moon Day. Learn some interesting facts about the moon. Find out why it stays so close to the Earth, when the first man landed on the Moon's surface and what causes different Moon phases.

26 July – Parents' Day. Show your parent's how much you appreciate all of their help and hard work. Maybe make them breakfast or use your creativity to draw/make something nice for them.

The dates were selected specially for you from the 'Days of the Year' website.

DAYS of The **YEAR**



Acknowledgements

This pack was inspired by a number of online resources. Check out their websites below for lots more fun experiments and activities.

<https://www.ignitefutures.org.uk/science-busking>

<https://www.rigb.org/expeRimental>

<https://www.instructables.com/id/Do-It-Yourself-Sustaining-Ecosystem/>

<https://dengarden.com/gardening/How-to-Make-a-Terrarium-in-a-Jar>

<https://www.youtube.com/watch?v=OYpoNLOZHS4>

<http://www.brockscdlab.com/fun-activity-ideas-for-kids/butterfly-static-electricity-experiment>

<https://www.sciencekids.co.nz/experiments/dietcokementos.html>

