THE SCIENCE COOKBOOK

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RECIPES

FORMING FOSSILS

30 min

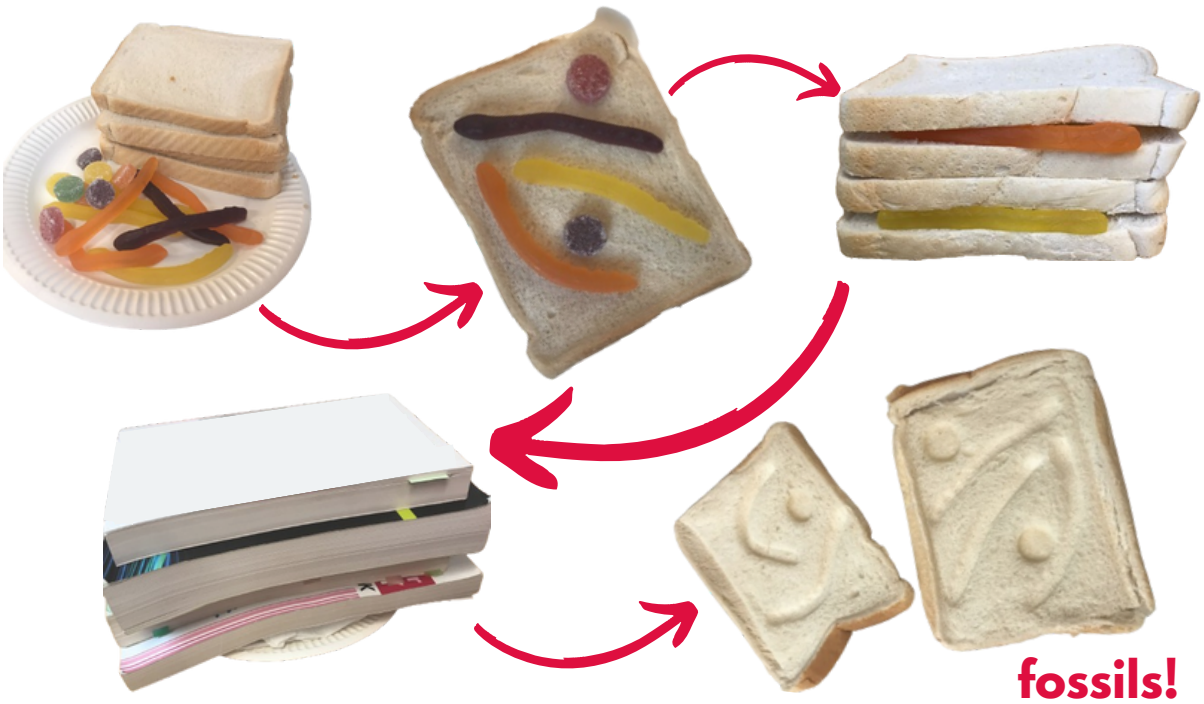
This activity is shows how fossils are made through making fossil imprints in bread using different sweets!

INGREDIENTS

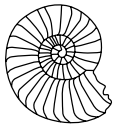
- **Sliced bread** (4 slices per group). You can also use a mixture of bread types if you'd like, e.g., white, brown, seeded.
- **Animal Themed Sweets** e.g., Gummy Bears, Jelly Snakes/Worms/ Frogs
- **Heavy books** (or other heavy flat objects)
- **Cling Film** or **Tea Towels**

RECIPE

1. Place a few animal sweets on a slice of bread and place two slices of bread on top of it.
2. Add another layer of sweets to the top slice of bread and place a final slice of bread on top.
    a. It should look like: bread, gummies, bread, bread, gummies, bread,
3. Wrap the stacked bread in cling film or a tea towel.
4. Place heavy books (or other weights) on top of the wrapped bread and apply additional pressure by pushing down.
5. Leave the weighted bread stack undisturbed for 15 minutes to simulate the pressure required for fossilisation.
6. After 15 minutes, remove the weights and carefully unwrap the cling film.
7. Peel apart the layers of bread, removing the gummy bears.
8. Examine the imprints left by the gummy bears.



fossils!



Science Background

Much of what we know about evolution comes from examining fossil records, a study known as 'palaeontology'. Fossils are created through a process called 'fossilisation':

1. When an animal dies, it often rots (decomposes) or gets eaten by other creatures. Sometimes, however, the dead organism or its traces, like footprints or poo, get buried quickly under layers of mud or sand.

2. The hard parts, such as bones, teeth, and shells, are strong and take much longer to rot after being buried. Under the dirt, minerals from the soil gradually seep these remains or imprints over tens of thousands to even millions of years.

3. Over time, more layers of soil (sediment) pile on top of the fossil, pressing down on the remains and slowly turning the minerals into solid rock.

4. Eventually, natural forces on Earth, such as movements in the Earth's crust and soil erosion, bring the fossils to the surface of the ground. Here they can be discovered by anyone and studied!

We have learned a lot from fossils, such has how different species of animals and plants have evolved, how landscapes have changed over time, and the dates of significant events like mass extinctions.

Discussion Questions

Do the imprints look like the animals that made them?	Observational answer - there's no right/wrong answer!
If the gummies decomposed but the bread didn't, what would happen over time?	The gummies would leave behind imprints on the bread which would mirror fossils!
Did using different types of bread impact the imprints made? E.g., did softer bread create deeper imprints? Did the seeds in seeded bread distort animal shapes?	Observational answers so no right or wrong answers. However, in theory softer bread would create deeper imprints as it's easier to mould and seeds would likely distort the gummy shapes as they are solid and would create imprints on the bread. A similar effect can happen depending on the type of ground in which fossils are formed.

COCOA MOON CRATERS

20 min

Create your own craters with this cocoa moon crater activity!

INGREDIENTS

- **Large baking pan** or shallow cardboard box
- **Icing Sugar** (enough to fill the pan)
- **Cocoa powder** (enough to create a thin layer on top of the icing sugar)
- **Balls or small rocks of various sizes** (it has to be a hard object between 1 to 5 cm, no bouncy objects allowed!)
- **Sieve or sifter**
- **Optional: Ruler and metre stick**

RECIPE

Preparing the surface:

1. Fill the baking pan with half an inch of icing sugar.
2. Use the sieve to put a thin layer of cocoa powder on top of the icing sugar.

Making impact:

3. Try dropping a ball into the pan from about half a metre above it. Don't stand too close to the pan! Optional: Use the metre stick so you can drop from a consistent height).
4. Look at the resulting impact crater. What colour is the surface immediately around the crater? How does that compare to the surface of the rest of the pan? How far did the flour and cocoa powder spread? Optional: Use the ruler to measure these distances.
5. Try dropping the same ball from a different height to a different location in the pan. What does the resulting crater look like?
6. Try dropping balls of different sizes from the same height on other places of the pan, and examine the resulting craters.
7. You can even try throwing a ball sideways so it hits the pan at an angle, instead of coming straight down.
8. How is the resulting impact pattern different from when you dropped the balls straight down? If needed, smooth out the surface of the pan, and sift a fresh layer of cocoa powder on top.

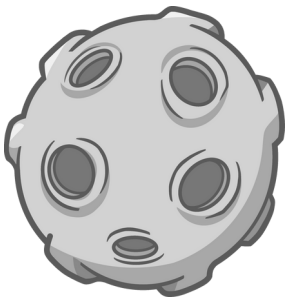
Science Background

Craters are round, bowl-shaped holes on the ground surrounded by an elevated rim. Impact craters are made when a meteorite crashes into a planet or moon (as opposed to volcanic craters, which are created when a volcano erupts).The size and shape of the crater depends on how big the meteorite was and how fast it was going when it hit the ground. A bigger, faster-moving meteorite will create a bigger crater, sometimes throwing material very far away from the impact site.

Some of the craters on the Moon are so big that you can see them with the naked eye! The Earth also has a lot of impact craters, but not all of them are obvious because Earth has an atmosphere with weather that causes erosion that changes landscapes over time. Many meteoroids (they are called meteoroids while they are still in space, and meteorites once they hit the ground) also burn up in Earth's atmosphere, never reaching the ground at all.

Discussion Questions

- What are the lines that form on the crater?
- Does the size and speed of the meteorites have an effect on the crater?
- What are the cocoa powder and icing sugar supposed to represent?
- What happens when you throw the ball sideways?
- Why are the craters on the moon so big and easy to see?



LAYERS OF THE EARTH

45 min

Prep Work

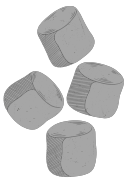
Prepare the mantle layer by mixing together a 1 to 2 ratio of peanut butter to icing sugar to form a dough. If there are peanut allergies, prepare "Rice Krispie Treats" from a pack of melted marshmallows and a box cereal by stirring the two together. For both recipes you may need to add melted butter to get the right consistency.

Ingredients	Recipe
Per Person • **1 Skittle** • **1 Marshmallow** • **Icing** • **Digestives** (crushed) • Optional: **wooden sticks** • **Peanut butter dough** (can be substituted with Rice Krispie treats if allergies)	1. Use a skittle or another hard, dense sweet to represent the Earth's inner core. 2. Squish the skittle inside a marshmallow which represents the outer core of the Earth. 3. Roll the peanut butter and icing sugar dough (or rice krispie treats) into a ball around the cores to represent the first part of the mantle- the Mesosphere. 4. Coat the ball in icing to represent the flowing part of the mantle- the Asthenosphere. (Tip: use a wooden stick or toothpick to help coat the balls) 5. Finally, roll the ball in crushed digestives to represent the Earth's crust. 6. You can now cut the ball in half to reveal all the layers!

Adding the digestives

The Earth

The layers of the Earth



Science Background

The layers of the Earth are arranged by density, which means the most tightly packed pieces of rock are in the centre of the Earth and lighter, less packed rocks are on the outside. The centre layer of the Earth is the densest, hottest part of Earth called the “inner core". It is mostly made of Iron and Nickel and is under extreme pressure which keeps the metal solid even under extreme temperatures. The outer core is under less pressure so it is made of liquid Iron and Nickel. It flows slowly and generates an electric current that makes Earth’s magnetic field. The mesosphere is the thick rigid middle layer. The asthenosphere is a thin, semi-solid layer that slowly moves over time. Finally, the outermost layer is crust which is the coolest layer and includes the tectonic plates.

If you’d like to find out more about how planets are formed:

Planets like Earth form from dust and tiny elements that surround a brand new star. The dust circles the star like a hula-hoop and we call that a “protoplanetary disk” which is a big word for a disk of dust that will eventually condense into a planet or many planets. The dust particles start to collide into each other and gain matter like a snowball rolling down a hill. This is called a “protoplanet” which means a young planet. Once the young planet is large enough, it will condense more so that the heaviest elements like Iron and Nickel are at the centre and lighter elements like Silicon and Aluminum are on the outside.

Discussion Questions

(Answers can be found in the section above)

- Why are there layers of the Earth? What causes them?
- What is density?
- What layer of the Earth do you think the continents are on? What causes continents to move?

Other Activities

Cut a boiled egg with the shell on. This can also represent the layers of the Earth. If the shell crackers, this can represent the tectonic plates.

Show this PBS “Be Smart” video about density and the layers of the Earth.

GUMMY GREENHOUSE GASES

30 min

This activity is a great way to teach young people about greenhouse gases!

INGREDIENTS

- **Gumdrops of four different colours** (per young person):
- **7 Purple Gumdrops:** To represent the oxygen atom.
- **2 Yellow Gumdrops:** To represent the nitrogen atom.
- **2 Green Gumdrops**: To represent the carbon atom.
- **6 Orange Gumdrops**: To represent the hydrogen atom.
- **10 cocktail sticks**

PLEASE NOTE:
The gummies can be of any colour as long as there is a sufficient number of each colour.

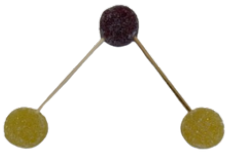
RECIPE

- **Ozone Molecule (3 oxygen atoms - 3 purple gumdrops)**

Attach a red gumdrop to the end of a stick. Repeat with another stick. Then connect both sticks to the sides of another red gumdrop at a slanted angle.

- **Nitrous oxide Molecule (2 nitrogen atoms and 1 oxygen atom - 2 yellow gumdrops and 1 purple gumdrop)**

Take 2 sticks and attach a green gumdrop to one end of each stick. Then connect both to a red gumdrop at a slanted angle.

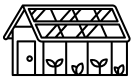


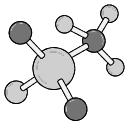
- **Carbon dioxide Molecule (1 carbon and 2 oxygen atoms - 1 green gumdrop and 2 purple gumdrops)**

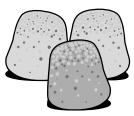
Take 2 sticks and attach a red gumdrop to one end of each stick. Then connect both to a blue gumdrop at a straight angle.

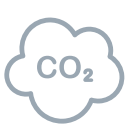
- **Water Molecule (2 hydrogen atoms and 1 oxygen atom- 2 orange gumdrops and 1 purple gumdrop)**

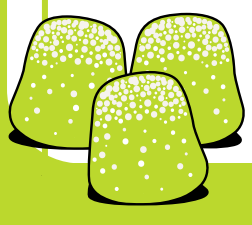
Take 2 sticks and attach a white gumdrop to one end of each stick. Then connect both sticks to the sides of another red gumdrop at a slanted angle.











- **Methane Molecule (1 carbon atom and 4 hydrogen atoms - 1 green gumdrop and 4 orange gumdrops)**

Take one blue gumdrop and stick 3 sticks equal distances pointing down. In the centre of the gumdrop at a stick that is point up. To the end of the sticks, attach 4 white gumdrops.

Science Background

Atoms are the smallest unit of matter. It is also the building blocks of molecules which are formed when atoms are combined.

In this activity, the atoms are represented by the gumdrops and when attached with the lolly sticks, they represent gas molecules which are part of the air and are called greenhouse gases because like the glass walls of a greenhouse, trap heat in the Earth's atmosphere.

When there is an excess of greenhouse gases, they trap too much of the Sun's energy and causes a warming effect known as global warming.

Global warming is a serious problem as it causes a rise in sea leavel which results in the loss of coastal land, causes greater chances of droughts and floods and threatens biodiversity of species.

Discussion Questions

Answers can be found in the section above.

- What are greenhouse gases?
- How does the greenhouse effect work?
- What is global warming?
- Why is global warming a serious problem?

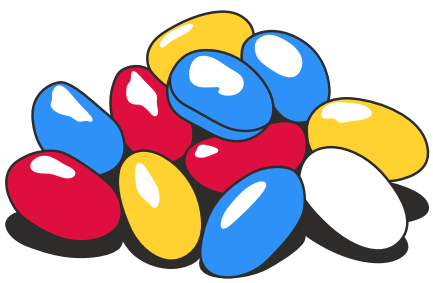
MACHINE LEARNING

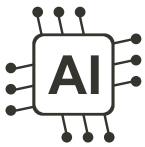
15 min

Prep Work

Count how many jellybeans are in a jar.

Ingredients	Recipe
• **Jellybeans** • **Large clear Jar** • **White board or flipchart with markers** • **Paper for each young person** • **Pencils** • **Calculators**	1. Present the young people with a transparent jar of jelly beans and have a discussion on how they could figure out how many are in the jar. a. For example, they could calculate how many jellybeans are in the circumference and multiply, but it is best if each person has a unique method and number. 2. Ask each young person to write down how many jelly beans they think are in the jar. 3. Ask them to write what things they considered when deciding on their number. Emphasise that it is very important they try to have original ideas. 4. Write each guess down and have young people find the average of all guesses. 5. Reveal how many jelly beans were in the jar. 6. Discussion about machine learning. *Note: this activity works best with the most people guessing. It can be used as an introduction to a coding or AI based day.





Science Background

Machine learning is a part of the Artificial Intelligence field and is focused on training computers/algorithms to learn from input data (the data we enter) and then perform tasks. The larger and more diverse the data set, the more confidence the AI would have in identifying an object or doing a task without needing explicit instructions. The machines do this by averaging up all the input data and finding similarities it can identify in future inputs. In this activity, every guess by an individual is like a data input and the average would be like the AI's identification that is based on input data. With real life AI, more specific data is collected that helps AI predict things even better. young persons will be able to see that they have the skills needed to train AI!

Discussion Questions

(Answers can be found in the section above or are observational)

- What number was closest to the actual number of jelly beans?
- Would you trust any random guess or the average of all the guesses? Why?
- When would averaging guesses not work?
- What were some of the considerations for deciding on the guesses? Are there any patterns to these considerations?
- What is AI?
- How does this activity relate to how we teach AI how to recognize things?

Other Activities

Use Scratch to let young persons practise teaching a machine how to do something by inputting data.

Young people can practise "clustering data" by sorting the beans by colour or size. This can be related to the clustering that is done to teach computers what sorts of things are similar to each other.

Jelly beans can be used to discuss ratios by counting how many of each colour is in the jar compared to the total. You can continue the discussion into random sampling by randomly taking 5 jelly beans out and counting how many of each colour is represented.

ATMOSPHERE DRINK

30 min

Learn about the layers of the atmosphere with this atmosphere drink!

Ingredients

Ingredients per person:

- **5 drinking glasses**
- **4 Lemons**
- **Sugar**
- **Water**
- **Spoon**
- **Small kitchen baster**
- **Optional: Lemon squeezer**
- **Optional: Food colouring in four different colours**

Recipe

Glass 1:

1. Squeeze the juice from 1 lemon into the first glass
2. Add about 3 teaspoons of sugar to start, and then keep adding sugar until you can't dissolve any more.
    a. Make sure each spoon of sugar is fully dissolved or you'll have trouble getting the layers to separate.
3. Make note of how much sugar you added.

Glass 2:

1. Squeeze the juice from half a lemon into the second glass and add the same amount of water. Add half the amount of sugar that you added to the first glass and stir until dissolved.
    a. Each glass should have the same amount of liquid.

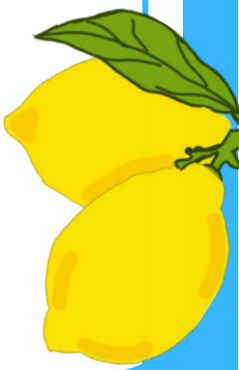
Glass 3:

1. Squeeze the juice from half a lemon into the third glass and add 3 times as much water. Add half the amount of sugar that you added to the second glass and stir until dissolved.

Glass 4:

1. From the remaining half lemon, add 10 drops of juice into the fourth glass and fill it up with water. Don't add any sugar. This will be the least concentrated lemonade.

Optional: Add 2 drops of food colouring to each glass so that each glass of liquid is a different colour.



Assembly:

1. We will use the fifth glass to create the final drink. Using the kitchen baster start by gently pouring the juice from glass 1 into the fifth glass until you reach a 1/4 cup.
    a. You can pour it against the wall of the glass to make sure it falls down gently. This is very important to make sure the layers don't mix.
2. Repeat the process with the juice from glasses 2, 3 and 4, leaving it to settle for a minute after each pour and being careful not to shake it or move it too much.
3. Give it a taste! You should barely taste the lemon and sugar on the top layers, but it should get better as you drink down!

Glass 1

Glass 2

Glass 3

Glass 4

Final drink!

Science Background

Think of an **atmosphere** like a cosy blanket of gases that wraps around a planet. On Earth this blanket is a life saver! The **ozone gas** in it shields us from the sun's harmful rays, **carbon dioxide** and other gases keep things warm enough for us, and **oxygen** is what lets us breathe and live.

Now, every planet has its own unique atmosphere, but there are some things they share. In some of them, differences in temperature and **density** create distinctive **layers** that wrap on top of one another like the layers of an onion. The bottom layers are denser and have most of the gases, while going up, things get lighter and thinner until the top layers have barely anything.

Imagine putting a planet's atmosphere in a drinking glass and tasting it. At the top, it's kind of **plain**, but as you drink down, the flavours get **stronger**. That's like how the density changes as you move through the layers of a planet's atmosphere!

Discussion Questions

(Answers can be found above)

- Why are the layers not mixing?
- Which layer is denser?
- How does this relate to the atmosphere of a planet?
- Where would the humans be in this lemonade?
- Why is density important?
- Where can I find density in action?

OREO MOON PHASES

15 min

Use oreo cookies to learn about the phases of a moon!

Ingredients

- **Oreo Cookies** (4 pieces per young person)
- **Plastic Knife**

Recipe

To begin: Pull the oreo cookies apart to get 8 separate pieces.

Below are instructions to make the different phases of the moon.

New Moon Phase
To represent this phase, use a plain oreo without any cream.

Waxing Crescent Phase
To represent this phase, use a plastic knife to scrape enough the cream to ensure that only the crescent shape is left behind.

Waxing Half (First Quarter) Phase
To represent this phase, take an oreo with cream filling and use a plastic knife to scrap the left half of the filling off.

Waxing Gibbous Phase
To represent this phase, use a plastic knife to scrape off ¼ of the white cream filling from the left side of the biscuit.

OREO MOON PHASES

15 min

Use oreo cookies to learn about the phases of a moon!

INGREDIENTS	RECIPE
	Full Moon Phase To represent this phase, use an oreo with cream filling. **Waning Gibbous Phase** To represent this phase, use a plastic knife to scrape off ¼ of the white cream filling from the right side of the biscuit. **Waning Half (Third Quarter) Phase** To represent this phase use a plastic knife to scrape half of the cream, ensuring only the crescent shape is left behind. **Waning Crescent Phase** To represent this phase, use a plastic knife to scrape off most of cream, ensuring only the crescent shape is left behind.

You could place all the phases of the moon together to represent the full lunar phase cycle!

Science Background

The phase of the moon we see depends on where the Earth is relative to the moon and the Sun. When the moon is between the Earth and Sun, the surface of the moon that is lit up is not facing us, so we can't see the moon at all. This is the new moon. When the Earth is between the moon and Sun, the Sun's light bounces off the surface of the moon and the moon is completely lit up as seen from earth. This is the full moon. When the moon is between those two positions, we see the first and third quarter.

When the surface of the moon facing Earth is completely illuminated, we see a full moon. When none of the surface is illuminated and we can't see the moon at all, the phase is a new moon. When half of the moon is lit up, the phases are called the first and third quarters. When the visible moon appears to be getting bigger, we say it is waxing; when the visible lighted surface seems to be getting smaller, we say the moon is waning. When less than half of the visible moon is lit, it's called a crescent, and when it's more than half, it's called a gibbous.

Discussion Questions

Answers can be found in the section above.

- Are moon phases the same everywhere on Earth?
- Are moon phases caused by shadows from Earth?
- Why do we see moon phases?
- What is the moon really shaped like?
- Why does the moon rise and set?
- Can people in different countries see the moon on the same day?

3D ICING PRINTING

30 min

This activity gives practical experience of creating objects using 3D printing techniques! We use icing, instead of traditional materials like plastic, which makes all your printed creations edible!

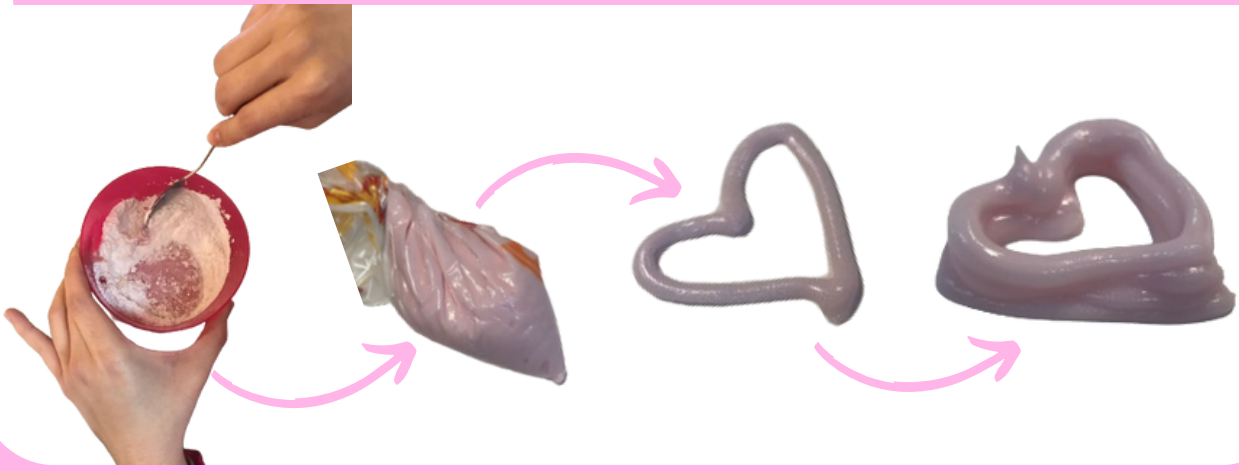
Ingredients

- **Icing Sugar**
- **Mixing Bowls**
- **Spoons**
- **Water**
- **Food Colouring**
- **Piping Bags** alternatively you can use plastic food bags and scissors
- **Hand wipes**
- **Paper towel / plates**

Recipe

This activity is easiest when using just one colour of icing per design, but you're welcome to use multiple colours - just swap colours between icing layers!

1. Make your icing(s) by mixing icing sugar with minimal water and a few drops of food colouring.
    a. This activity requires the thick icing - you can even challenge young people to see how little water they use. The icing should be firm not runny, if in doubt add more icing sugar!
2. Transfer the icing into the piping bags.
    a. TIP: if you don't have piping bags you can make some by cutting a corner off a plastic food bag/s.
3. Squeeze the icing out to outline a shape on a plate or paper towel.
4. Cover the shape with more layers of icing. If you're using multiple icing colours you may wish to layer the different colours on your outline.
5. Repeat to print as many objects as desired!
6. Leave the icing to dry
7. Admire your creations!

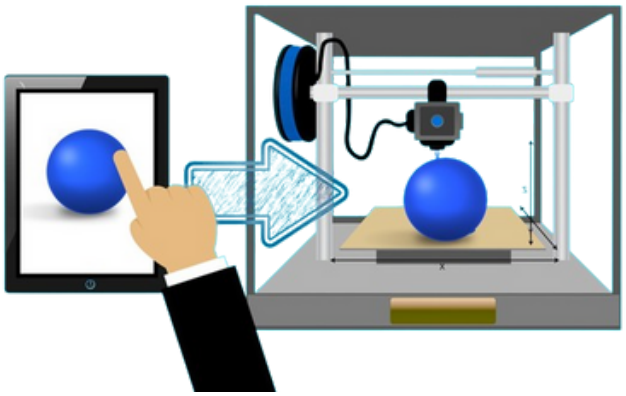


Science Background

3D printing works by building up layers of material to create an object. First, a design is created on a computer using special software called CAD (computer-aided design). This design is then digitally sliced into thin layers, which the program translates into instructions for the 3D printer. The 3D printer then prints all the layers on top of each other to create the designed object!

The printer begins the printing process by heating up the chosen material, such as plastic, to its melting point. Once melted, the printer follows the instructions to precisely deposit the plastic in a pattern for the first sliced layer. After that layer has cooled, the 3D printer prints the next layer directly on top of it. As each layer is deposited, it rapidly cools and solidifies, fusing with the layers beneath it. This process repeats layer by layer until the full object is printed.

In the end, what was once just a design on the computer becomes a physical object through 3D printing, ready to use!



Discussion Questions

Why is it important for the icing to be thick and firm rather than runny?	If it was runny it wouldn't hold its shape when iced!
Why is it necessary to let the icing dry before handling your creations?	It may loose its shape if you pick it up before its dry!
Do you think icing printing is similar to 3D printing?	Yes! The process of creating an object through building layers on each other with icing is the same as with plastic!

ACKNOWLEDGEMENTS

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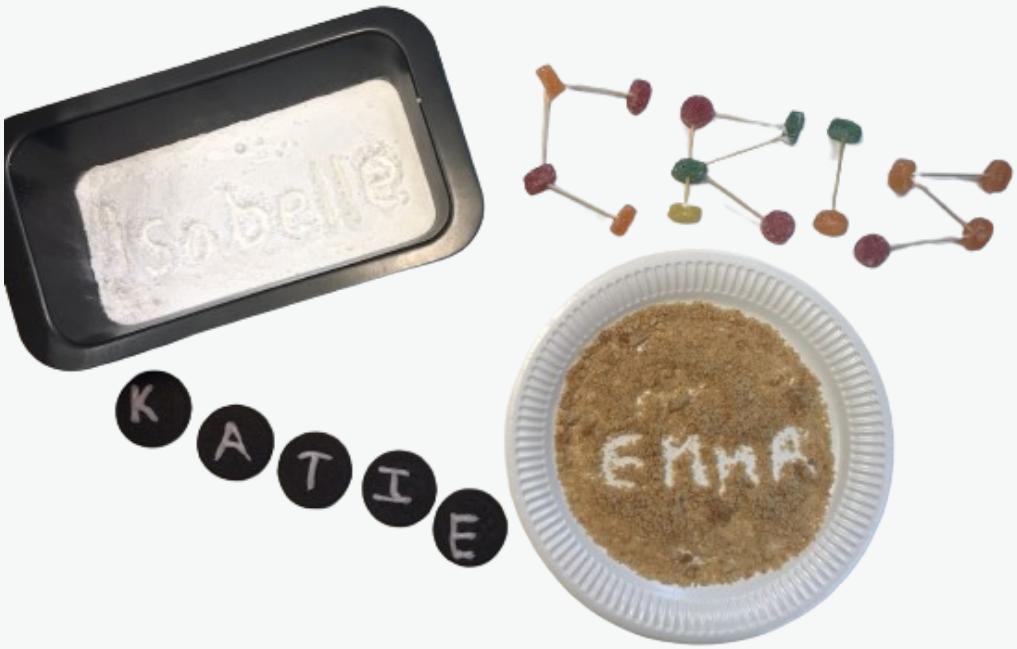

Isabelle, Cris, Katie and Emma