HOW TO MAKE A LAVA LAMP

SCIENCE CHALLENGE 19

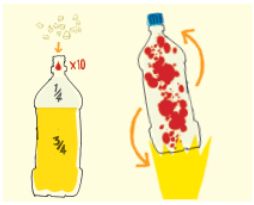
Designed by Gemma, James Dyson Foundation executive

The brief

Make your own lava lamp.

The method

1. Fill the empty bottle ¾ full with vegetable oil.
2. Top it off with water and about 10 drops of food colouring.
3. Break an Alka-Seltzer® tablet into pieces, and add pieces of the tablet to the bottle. The mixture will bubble.
4. Put the cap on and gently tip the bottle back and forth. This will cause the tiny droplets of coloured water moving around inside the oil to join together, making bigger blobs. Do not shake the bottle.
5. Shine a torch into the bottle from underneath, illuminating the bubbles.



Materials

- Empty water bottle
- A large bottle of vegetable oil
- Food colouring
- Alka-Seltzer® tablets (with adult supervision)
- Water
- A torch

How does it work?

Oil is hydrophobic – it will not mix with water – even if you try to really shake the bottle. The Alka-Seltzer® tablet reacts with the water to make tiny bubbles of carbon dioxide which are lighter than water. They attach themselves to the blobs of coloured water, causing them to float to the surface. When the bubbles pop, the coloured blobs sink back to the bottom of the bottle.

These are some brilliant experiments designed by the Dyson team. Full size PDFs are available on the school website.

Each experiment also has a scientific explanation about how it works.

IVORY SOAP

SCIENCE CHALLENGE 20

Designed by Lydia, Global head of the James Dyson Foundation

The brief

Create a big soapy marshmallow out of Ivory soap®.

The method

1. Place the bar of soap in the middle of a plate covered with a paper towel and place in the centre of the microwave oven.
2. Cook the bar of soap on high for two minutes.

3. Watch the bar of soap as it begins to expand and erupt into puffy clouds. Be careful not to overcook it.
4. Allow the soap to cool for a minute. Touch it. Feel it. Look at it.

Materials

- Ivory soap®
- Paper towels
- A microwave (with adult supervision)
- A plate

How does it work?

Ivory soap® floats because it has air pumped into it during manufacturing. When the air inside the soap heats up, the air expands and reacts with the water inside. The expanding gases push on the softened soap, making foam. This effect is a demonstration of Charles' Law. Charles' Law states that as the temperature of a gas increases, so does its volume.

COLOURED CARNATIONS

SCIENCE CHALLENGE 21

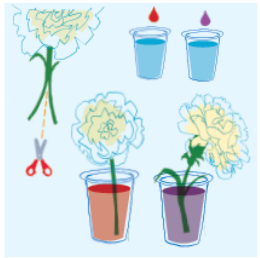
Designed by Adam, Science teacher and former Design engineer at Dyson

The brief

Create multi-coloured flowers.

The method

1. Use the scissors to cut the stem of the carnation in half lengthways.
2. Take two cups and fill them with water. Add a different coloured food dye to each cup.
3. Put the split stems of the carnation into the cups and leave overnight.
4. The next morning you should find that your flower has changed colour.
5. What do you notice about the petals?



Materials

- White carnations
- Two colours of food dye
- Plastic cups
- Water
- Scissors (with adult supervision)

How does it work?

Plants need a transport system to move food, water and minerals around.

There are two things that combine to move water through plants – transpiration and cohesion.

Water evaporating from the leaves (transpiration) draws water up the stem of the plant to replace what is lost. This works in the same way as sucking on a straw. Water that evaporates from the leaves "pulls" (cohesion) other water behind it up to fill the space left by the evaporating water.

This week we are going to explore the world of Science

Sheet 2

INVISIBLE INK

SCIENCE CHALLENGE 22

Designed by Jack, Design engineer at Dyson

The brief

Write your own secret message in an invisible ink solution.

The method

1. Squeeze lemon juice into the bowl and add a few drops of water. Stir with the spoon.
2. Dip the paint brush into the juice mixture and write a message on the paper.
3. Allow the paper to dry completely. Your message should become invisible.
4. Hold the paper very close to the light bulb to heat up the message area (adult supervision required). Watch your message appear.

Materials

- A lemon
- A bowl
- Water
- A spoon
- A paint brush
- A lamp, or other light bulb

How does it work?

The lemon juice is an organic substance which reacts with oxygen in the surrounding air, oxidises and turns brown. By placing the paper right next to the lamp we speed up the oxidisation process. The heat from the lamp causes the chemical bonds to break down.

Did you know?

Oxidisation affects lots of different surfaces, from metal to living tissue. A freshly-cut apple that turns brown, a bicycle that becomes rusty or a copper penny that turns green. Not all oxidisation is bad – but think about choosing the right materials when designing a product for a particular use.

MARBLE RUN

ENGINEERING CHALLENGE 02

Designed by Coco, Design engineer at Dyson

The brief

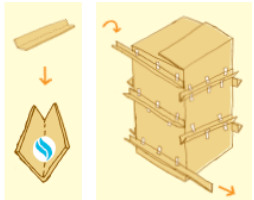
Use a cardboard box and cardboard struts to create a marble run. The marble must run for 60 seconds.

The method

1. Use sticky tape to attach the cardboard struts to the cardboard box, creating a run for the marble.
2. Place the marble at the top of the run and time how long it takes for it to reach the bottom.
3. Keep improving your design until the marble takes exactly 60 seconds to reach the bottom.

Top tip

If you can't find cardboard struts, make your own by folding four inch wide strips of cardboard in half to create a V shape.



Materials

- Large cardboard box
- Cardboard struts
- Sticky tape
- Marbles
- Scissors (with adult supervision)

How does it work?

To help you to control the time your marble takes to run its course you'll need to consider a few factors:

Potential energy – mass x gravity x height

The heavier your marble and higher your slope, the more energy your marble will have.

Friction

The rougher or stickier the surface, the slower your marble will travel.

Angle of the slope

The less steep the angle of the slope, the longer the marble will take to reach the bottom.

SPAGHETTI BRIDGES

ENGINEERING CHALLENGE 03

Designed by Kristian, Design engineer at Dyson

The brief

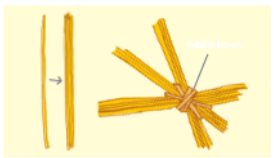
Construct a free standing bridge out of spaghetti, strong enough to support a 250g bag of sugar.

The method

Think about bracing strands together for strength. Some shapes are better at absorbing loads – triangles are particularly strong. Rubber bands make for good junctions.

Top tip

Be patient. Through trial and error, you'll become proficient at working with spaghetti.



Materials

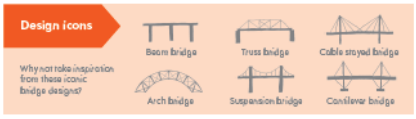
- Spaghetti
- Small rubber bands or bag ties
- Sticky tape
- 250g bag of sugar

How does it work?

Bridges manage two important forces: compression and tension – pushing and pulling. Too much of either and they buckle or snap.

Design icons

Why not take inspiration from these iconic bridge designs?



BOAT POWERED BY A CHEMICAL REACTION

ENGINEERING CHALLENGE 09

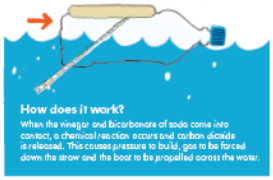
Designed by Rob, Engineering reliability manager at Dyson

The brief

Build a boat powered by a chemical reaction.

The method

1. Tape the cork and ice lolly sticks together to form a triangle.
2. Tape the triangle to the middle of one side of the bottle.
3. Make a hole in the end of the bottle, at the opposite side to the triangle, so it will sit below the water.
4. Push the drinking straw through the hole so the end inside the bottle touches the inside wall.
5. Pour in vinegar and add bicarbonate of soda. Screw the bottle top back on tightly.
6. With a thumb covering the end of the drinking straw, shake the bottle.
7. Once the reaction starts, drop the boat in the water and watch it propel forward.



How does it work?

When the vinegar and bicarbonate of soda come into contact, a chemical reaction occurs and carbon dioxide is released. This causes pressure to build, gas to be forced down the straw and the boat to be propelled across the water.

Materials

- Small plastic bottle
- Sticky tape
- A cork
- Two ice lolly sticks
- Scissors (with adult supervision)
- A drinking straw
- Vinegar
- Bicarbonate of soda
- Somewhere to sail it – such as a bath tub or sink

Design icons

Rockets use a chemical reaction during lift off. Combining fuel and oxygen causes combustion and exhaust gases are released. These gases exit the engine nozzle at high speed and push the rocket skyward.