



Science and Engineering cards 26th February

How many of these
Challenges can
you complete?

Tweet or Upload to Teams and let us know how you
got on.



Good Luck!



CHALLENGE CARDS

40 engineering and science challenges
from the engineers at Dyson.

THE
JAMES
DYSON
FOUNDATION



Please note that the activities contained here in are intended for children
ages seven and above. Adult supervision is recommended for all projects.

LIQUID DENSITIES



LIQUID DENSITIES

Designed by Ben,
Design engineer at Dyson

The brief

Layer different liquids in a tube and discover how and why they settle in a certain order.

The method

1. Start by adding food colouring to the surgical spirit and to the water – using a different shade for each. This will allow you to identify each liquid.
2. Measure out equal quantities of each liquid. Add them to the tube, one by one.

Top tip

Try weighing each liquid before you add it and predict which order the liquids will settle in. The layers may be a little mixed at first. Allow them to settle for a moment and watch the layers start to define.

How does it work?

Different liquids have different densities and therefore, different weights. The heaviest liquids will sink, the lighter liquids will rise to the top. Density is a comparison between an object's mass and volume. Remember the equation:

$$\text{DENSITY} = \frac{\text{MASS}}{\text{VOLUME}}$$

Based on this, if the weight – or mass – of something increases but the volume stays the same, the density has to go up. Lighter liquids, like water, are less dense than heavy liquids, like honey, and so float on top of the more dense layers.

Materials

A test tube

Honey

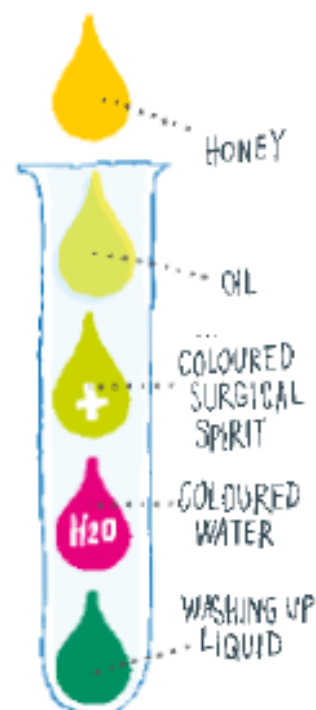
Oil

Surgical spirit

Water

Washing up liquid

Two shades
of food colouring



EXPANDING GASES



EXPANDING GASES

Designed by David,
Senior mechanical engineer
at Dyson

The brief

Find out what happens when gases are heated up or cooled down.

The method

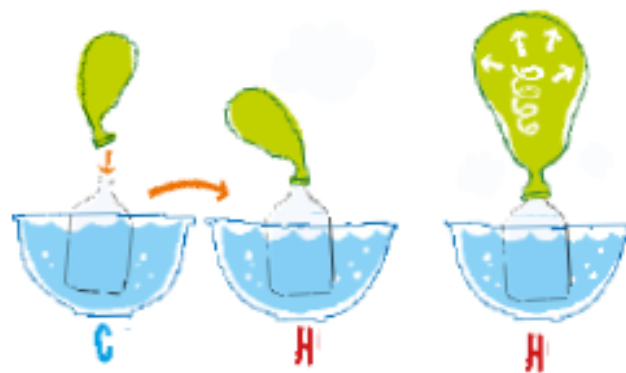
1. Fill two bowls – one with cold water the other with hot water.
2. Put the bottle into cold water.
3. Fit a balloon to the neck of the bottle.
4. Now place the bottle into the hot water.
5. Watch the balloon expand.

Materials

Two bowls
Cold water, hot water
(with adult supervision)
A sturdy plastic bottle
(used clean bottles
are best)
A balloon

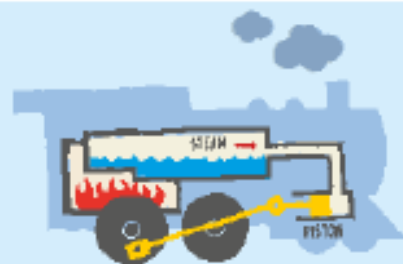
How does it work?

Gas expands when it is heated. The rule is, if the pressure of a gas remains constant, the volume of the gas will increase as the temperature increases. So if the temperature increases, the gas takes up more space. This is known as Charles' Law. The principle was first formulated by the French physicist Jacques Alexandre Cesar Charles in 1787.



Design icons

Steam engines heat up air and allow it to expand in cylinders to drive wheels.



ELECTRIC MOTOR



ELECTRIC MOTOR

Designed by Mike,
Design engineer at Dyson

The brief

Build your own electric motor.

The method

1. Attach the magnet to the head of the screw.
2. Holding the battery in your hand, hang the pointy end of the screw from the positive terminal of the battery. Hold one end of the wire to the negative terminal of the battery.
3. With your other hand, touch the opposite end of the wire to the head of the screw and watch it spin.

Top tip

What happens if you swap the battery terminals?

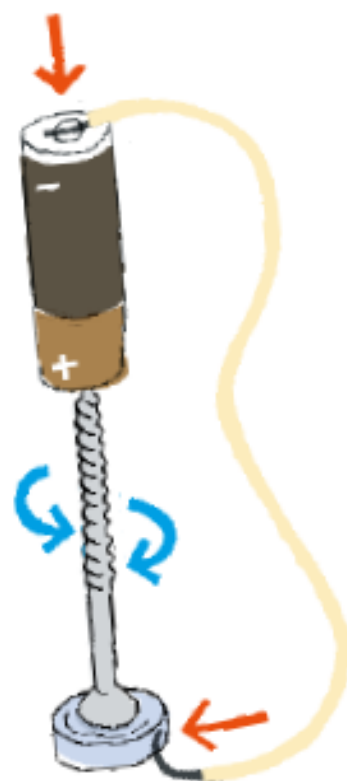
Materials

An AA battery

A screw

A small, round
neodymium magnet
(approx. 6mm diameter)

A wire



How does it work?

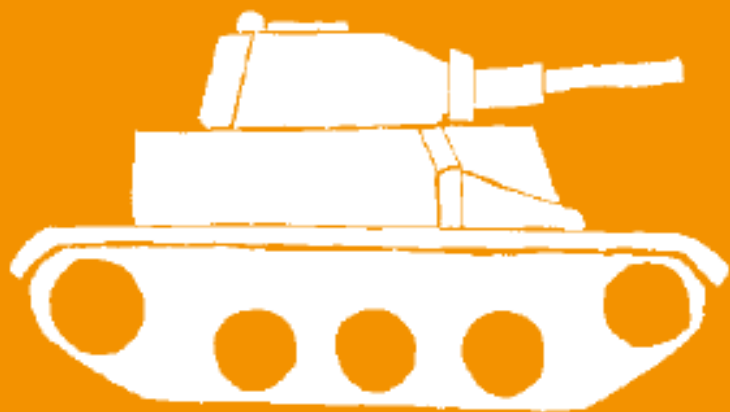
The electric current passing through the screw when the circuit is completed by the wire is subject to the Lorentz force. This force creates torque, which turns the screw.

Design icons



Michael Faraday built
the first electric motor in
1821.

COTTON REEL TANK



COTTON REEL TANK

The brief

Build a tank out of a cotton reel.

The method

1. Thread the rubber band through the cotton reel.
2. Break one matchstick in half. Tie one end of the rubber band around the half matchstick and secure it to the end of the cotton reel using sticky tape.
3. Cut 2cm and use a pencil to make a hole in the middle of it. Thread onto the other end of the rubber band. Place the other match through the loop of the band.
4. Wind up the match to create tension. Place it on the floor and let it go.

Materials

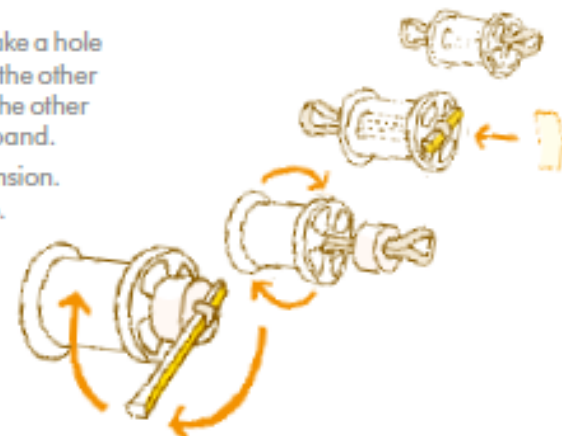
A cotton reel

A long white candle

A rubber band

Sticky tape

Two matchsticks,
with their heads
removed



How does it work?

Winding up the rubber band creates potential energy. When the band is released this stored energy converts into kinetic energy, causing the tank to move.

Design icons



In a car, potential energy exists in the form of liquid gasoline. It is converted into kinetic energy as the fuel is ignited in the engine's combustion chamber.