EDINBURGH SCIENCE

GENERATION SCIENCE

ELECTRIC EXPLORERS

Welcome to Generation Science

Brought to you by Edinburgh Science Learning, *Generation Science* shows and workshops spark pupils' curiosity and bring science to life.

With more than 30 years of experience delivering high quality, engaging shows and workshops, we are leaders in our field.

What we do

Each show or workshop is fully equipped and delivered by trained science communicators. We create fun, interactive environments where everyone gets out of their seats and gets involved. Our inspiring demonstrations and engaging activities are linked to the Curriculum for Excellence, explaining key concepts in a unique and memorable way.

Event Description

Electric Explorers is an interactive workshop that explores electricity; what it is and how it is produced. The class go on a journey as Electric Scientists to discover how we can produce electricity from the movement of our bodies.

Pupils explore the principles of electricity using circuits, flowing electrons, magnets and capacitors. As a final challenge, the children work in small groups to assemble their own generator and produce electricity from their own movement.

Curriculum Links

Electric Explorers complements the following experiences and outcomes:

SCN 1-04a: I am aware of different types of energy around me and can show their importance to everyday life and my survival.

SCN 1-08a: By exploring forces exerted by magnets on other magnets and other magnetic materials, I can contribute to the design of a game.

SCN 2-08a: I have collaborated in investigations to compare magnetic, electrostatic and gravitational forces and have explored their practical applications.

SCN 1-09a: I can describe an electrical circuit as a continuous loop of conducting materials. I can combine simple components in a series circuit to make a game or model.

SCN 2-09a: I have a range of electrical components to help make a variety of circuits for differing purposes. I can represent my circuit using symbols and describe the transfer of energy around the circuit.

TCH 1-14b/2-14b: Having evaluated my work, I can adapt and improve, where appropriate, through trial and error or by using feedback.

Learning Outcomes

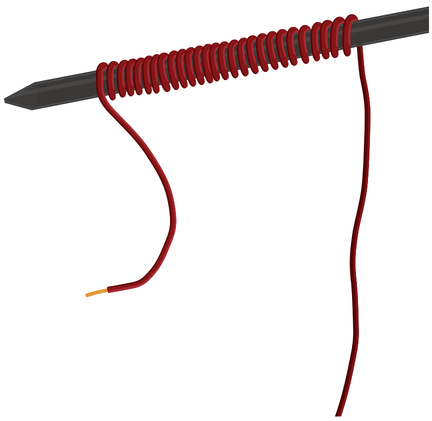
- Recognise that electricity is a form of energy
- Explain that electricity is the flow of electrons around a closed loop known as a circuit
- Recall that moving a magnet past a circuit produces electricity
- Describe how we can use human movement to produce electricity
- Describe how the amount of electricity produced depends on the number of magnets, coils in a wire and speed of movement
- Recall that a capacitor is a device for storing electricity and explain how it works

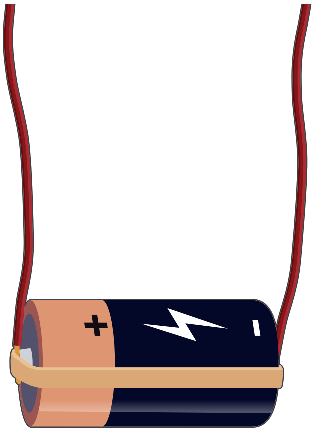
FOLLOW-UP CLASSROOM ACTIVITY 1

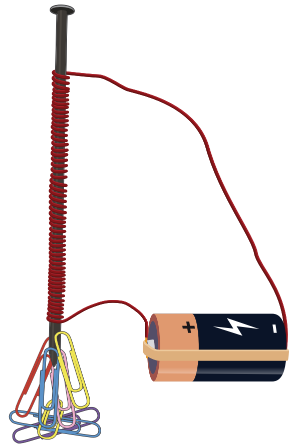
Make your own Electromagnet

You will need:

- A fresh C Battery
- Approximately 36cm of insulated copper wire with around 2cm stripped at each end
- Large iron nail
- Small paperclips or staples
- Masking tape or rubber band







1. Tightly wrap the copper wire around the nail. Leave the two stripped ends plus around 5cm at each end unwrapped. Wrap it as tightly as you can.

2. Tape one end of the wire to each end of the battery (or use and elastic band to hold them both in place).

3. Scatter the paperclips on a table and try to pick them up by holding the nail close to them. Does it work?

Safety: The battery and nail will start to get warm. After five minutes, disconnect the wires from the battery. Allow them to cool before you try again.

Extension

- Wrap more wire around the nail
- Use a bigger nail
- Use a nail made from a different material
- Does it affect how many paperclips you can lift?

Explanation

here are two types of magnets – permanent ones, which are always magnetic and temporary ones, which can be switched on and off.

An electromagnet is an example of a temporary magnet. When an electric current flows through a wire, it creates a magnetic field around it. When the current stops, the magnetic field disappears. The magnetic field can be increased by coiling the wire round upon itself.

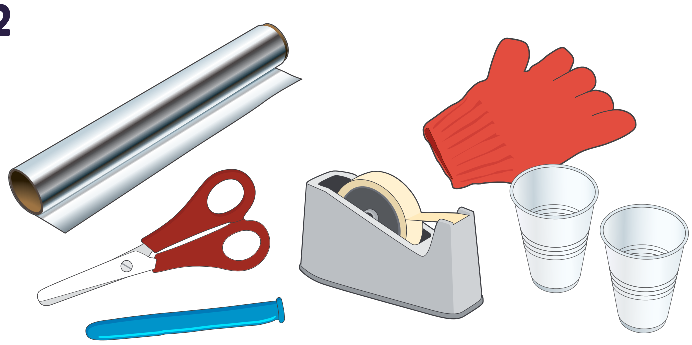
Ferromagnetic metals (e.g. iron, nickel and cobalt) are attracted to magnets and become magnetic when placed in a magnetic field. If the core of coiled wire (i.e the nail) is a ferromagnetic metal it becomes magnetic when the current is switched on, creating a larger magnetic field than one without a ferromagnetic metal core.

FOLLOW-UP CLASSROOM ACTIVITY 2

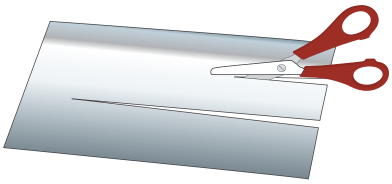
Super Sparker

You will need:

- 2 disposable cups
- Tin foil
- Scissors
- Sellotape
- Balloon (a long balloon is easiest)
- Piece of woollen material (e.g. a glove, scarf or old jumper)

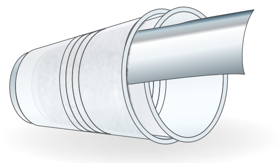


1. Cut a rectangular piece of tin foil large enough to wrap around one of the cups. Wrap it around the outside, leaving 2cm around the top of the cup uncovered.

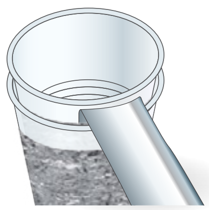


2. Cut another thin rectangle of tin foil approximately 2cm by 15cm.

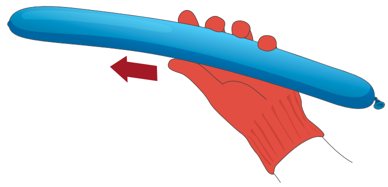
3. Place the thin rectangle of tin foil along the seam of the wrapped tin foil so that at least half of the strip sticks above the cup and secure it with some sellotape.



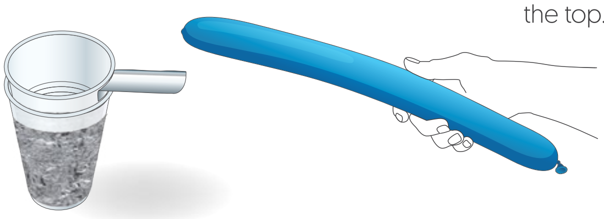
4. Place this covered cup inside the other cup.



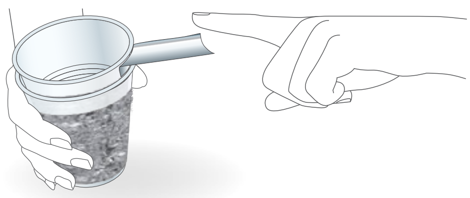
5. Wrap the second cup with tin foil, ensuring this doesn't touch the tin foil on the inside or the strip sticking out the top.



6. Rub the balloon a few times with the piece of wool (rubbing only in one direction works best).



7. Touch the balloon to the strip of tinfoil. Listen carefully. Can you hear anything? Repeat steps six and seven at least five times (the more you repeat the bigger the spark will be) being careful not to touch the strip with anything but the balloon.



8. Pick up the cup with one hand, holding the tinfoil on the outside. With the other hand, carefully touch the end of the tinfoil strip with a finger... what happens? Try it again in the dark. Can you see what happens?

Extension

Instead of using your own finger, hold hands with a friend and get them to touch the strip while you hold the cup. Did you feel anything? How many people does it work with?

Explanation

This piece of equipment is called a a Leyden jar, invented in 1745. It preceded the modern day capacitor – a device used for storing electricity.

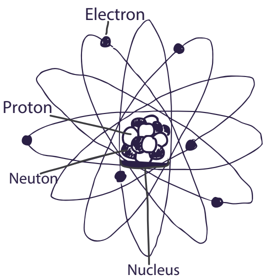
When the balloon is rubbed with the wool, electric charges (electrons) are transferred to the surface of the balloon.

When there is a build-up of charge on an object and it comes into contact with a less charged object, electrons will move towards this object to even out the distribution. So the extra electrons on the balloon transfer to the tin foil, spreading evenly across it. Repeat touches charge up the tin foil with electrons.

When you hold the outer layer of tin foil and bring your finger towards the charged strip, your body completes a circuit and you get a small static shock. In the dark you can sometimes see the movement of charge between your finger and the tin foil as a small blue spark.

THE SCIENCE BEHIND THE SHOW

Electricity is a form of energy and it is produced from the flow of electrons through a material. All matter is made from tiny particles called atoms, and atoms are made from even smaller particles. In the centre of an atom is the nucleus and orbiting the nucleus is electrons.



Not all materials allow electrons to move easily through them. Materials in which electricity can flow easily are known as conductors and they are made from atoms which have lots of free electrons which can easily move through them. Most metals, especially copper and silver, and water are good conductors.

Materials which do not allow electricity to flow through them easily are called insulators. Their atomic structure means the electrons are tightly held to the atoms and cannot move around. Plastic, wood, stone and glass are good insulators.

Why does electricity flow?

Atoms contain positive and negative charges – electrons are negative charges, protons in the nucleus are positive. Like with magnets, opposites attract and like repel.

A flow of electrons needs a voltage pushing them. This can be created by a battery which has a positive and a negative terminal. When a conducting wire connects them, the electrons are pushed from the negative end of the battery around to the positive end.

A closed loop of a conductor connected to an electricity source is known as a circuit. If we put things in this circuit, like light bulbs or fans, as long as the loop has no breaks, electricity will flow and power that appliance.

Voltage measures the amount of energy available to push the electrons around the circuit. The larger the difference in size of positive and negative charges at each terminal of the power source, the more energy there is.

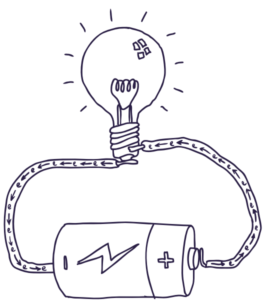
The current is a measure of the flow of electrons through the material. It is measured in amperes and indicates the amount of charge passing through the wire in one second.

How do we generate electricity?

Most electricity for a mains socket is produced by generators in power stations.

When a magnet is passed over a wire, it pushes the electrons in the wire causing them to move. This movement is an electric current. If the magnet can be moved over the wire repeatedly, the current will keep on being produced.
To make this process more efficient, generators have more magnets and coil the wire round on itself many times, increasing the amount of electricity produced each time the magnet passes.

A generator requires power to make magnets move. In traditional power stations something is burned to boil water and produce steam. This turns a turbine which drives the generator. The turbine can also be powered by water, wind and even human movement.



Some Useful Links

explorify.uk/teacher-support/science-teaching-support/electricity-tricky-bits

Scottish Charity Registration Number: SC003790
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