mini scientist

intel

# You're in Charge!

Strand: Energy and Forces

Strand Unit: Magnetism and Electricity

Imagine you could clean your room just with the flick of a switch? You hit the button on the wall and bang and the dirt is gone. Intel does exactly this with its computer chips and in this exploration, you'll learn all about static electricity, magnets and how you can take charge to do the work for you!

## Introduction

In this experiment the children will carry out two sets of experiments; the fist will explore static electricity and the second will explore magnetism. To demonstrate, hold up a dish filled with paperclips all strung together and taped to the dish at one end, now use a strong magnet to make them stand up and follow the magnet as you move it about. Next, pick a few children (make sure to pick at least one child with long hair) and say you are going to try and make their hair stand up just like the paperclips. Try with the magnet first and ask them why it's not working. Then rub a balloon to build up some static charge and hold it above their heads. Their hair will stand up and stick to the balloon as it is attracted by the static! Ask the children what they think is going on? Why did the magnet attract the paperclips but not their hair? Have they ever experienced static electricity? Maybe they got an electric shock when touching a door handle before.

In the first part of the experiment, the children will carry out a series of tests using static electricity. They will add energy to different objects by rubbing them, and test if they repel or attract other objects. Static electricity is the build up of an electrical charge on the surface of an object. When we add energy to an object, like rubbing a balloon, electrons are transferred from one object to another causing an electron imbalance. Therefore giving the object an overall positive or negative charge (if it gains electrons, it will be negative. If it loses electrons it will be positive). This charged object can then be used to repel or attract other objects. This is why balloons with static charge make your hair stand up!

In the second part of the experiment the children will learn about the forces magnetism and electricity and how the two combine to make electromagnetism. Magnets and electromagnets create a magnetic field which allows them to stick to certain 'ferromagnetic' materials like iron (or things that contain iron, like steel). Hair isn't ferromagnetic, so that's why it wasn't attracted to the magnet. The force created by magnets can be used to pull or push or hold onto things. The children will build their own electromagnet using copper wire wrapped around a nail, that is connected to a battery. The electrical current flowing through the wire creates a magnetic field that can be used to pick up small metal objects like paper clips! The class should work in groups, make predictions and record their results so they can discuss their findings at the end of the lesson.

# Experiment 1 – Static Electricity

This experiment has three sections. Set up one or more testing stations with the necessary materials so the groups can move between all three experiments smoothly and get a chance to try everything.

## Method

Aparatus
Balloons
Plastic rods
(e.g. pen, plastic ruler, Lego stick)
Tissue

### Suggested Materials

Paper/Crepe Paper
Tissue
Hair
Water
Cereal (e.g. rice krispies)
Leaves
Salt & Pepper
Tinfoil
Styrofoam

There are different materials that can be used in this section. Make sure materials like tissue and tinfoil are torn up into smaller pieces so that it is light enough to work with static.

### Station 1

1. Get the children to note what materials they are testing and record their predictions.
2. Rub the balloon/plastic rod and hold it above the testing materials, and move it about slowly.
3. See which materials respond to the static electricity and which ones don't. Record the results. Which materials were attracted? Was your prediction correct?

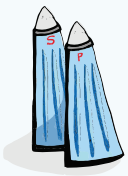
**Note:** Fresh leaves are far less likely to be attracted, some pieces may lift up and fall back down (this is dependent on how much the balloon has been charged and how big the pieces are). Let the class suggest some other materials and predict, test and record if they are attracted.

### Station 2

1. Have the children note what test is being done and record their predictions.
2. Rub the balloon/plastic rod and hold it close to the stream of water from the tap.
3. Note the results! What happened? Was your prediction correct?

### Station 3

1. Get the children to note what materials they are testing and record their predictions.
2. Make sure the salt and pepper together is mixed up and spread out.
3. Rub the balloon/plastic rod and hold it above the salt and pepper and move it about slowly and see the salt and pepper separate. Hold the balloon far away to start and slowly move it. The pepper will be attracted first, if you do it fast and close the salt will also be attracted.
4. Note the results! What happened? Was your prediction correct?




RISE

RESPONSIBLE. INCLUSIVE. SUSTAINABLE. ENABLE.

At Intel, we care about the world and people. That is why we created our RISE goals!

We saw that electricity is a force, unfortunately 85% of the world's electricity is created from nonrenewable sources that harm the earth....like coal and oil. By 2030, we will achieve net positive water use, 100% renewable power, zero total waste to landfill, and additional absolute carbon emissions reductions, even as we grow our manufacturing capacity. We also aim to achieve carbon neutral computing and reduce our emissions at industry level.

**Remember to save energy by turning off lights after you leave a room!**

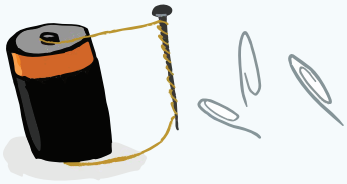
# Experiment 2 – Electromagnet

The aim of this experiment is to see that when electricity flows through a wire it creates a magnetic field around it. Electromagnets work slightly differently than natural magnets. In an electromagnet instead of relying on the magnetic fields in the atoms being all-lined up correctly to make the magnetic effect, a magnetic field is generated by using electricity. When a wire is attached to both ends of a battery, electricity will start to flow through the wire. Just like the little electrons whizzing around the atom, these electrons start to whizz through the wire in an electrical current (a bit like water flowing through a pipe), this current generates a magnetic field. By wrapping the wire around and around the nail, the magnetic field is concentrated and made stronger. As the electrons flow, one end of the nail becomes the south/positive end as it lacks electrons. The other becomes the north/negative end as it has an abundance of electrons.

The electrons build up on one end and lack of electrons on the other end of the circuit results in charged "poles", just like a normal magnet! We can use this magnetic field to pick up different types of metal. As previous, ensure the metal pieces are not too heavy.

**Note:** The copper needs to be one continuous piece wrapped around about 3 times. If it does not work it may be due to the internal resistance of the battery and wire. Try changing the battery.

## Method



**Materials**
- Batteries (size AA, D or PP3)
- Copper wire*
- Electrical tape/Sellotape
- Iron or steel nails 6-7cm, non-magnetic)
- Bits of metal/paper clips
- Scissors

*You may need to scrape the ends of the copper wire that will be touching the battery if it is insulated.

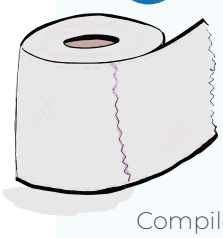
1. Have the children make a note of the materials they are using on the record sheet. Scrape the ends of the copper wire with a blunt scissors, this helps with getting a good connection with the battery.

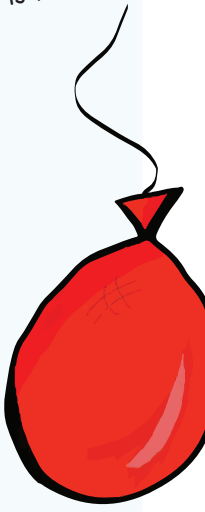
2. Demonstrate how to wind the copper wire around the nail, try and get 2 or 3 layers of wire around the nail.

3. Place one end of the wire at the positive end of the battery and secure with a small piece of tape. Now do the same with the other end of the wire at the negative end of the battery.

4. Once both ends of the wire are attached, test the magnetic properties of their electromagnet on a selection of small metal objects. Try connecting and disconnecting the wire from the battery to show how without the electricity flowing, the electromagnet will not work.

5. If you are extending the lesson to make fishing poles, have some of the children tie 30-50cm of string to their batteries, then tie the other end to a stick. Have other children draw and cut out small paper fish and attach paper clips to them. They can then have a race to see who can pick up the most paper fish in 30 seconds!





## Results

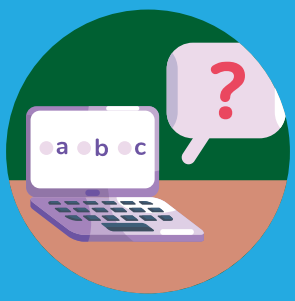
Have the groups share what they built and discovered with the rest of the class and discuss their results. What did they observe and can they explain what is going on?

What other materials could they test for making static electricity? How might they improve or change the tests? What could they change to make the electromagnet fishing rod more sturdy or effective?

## Conclusion

**The children should now be familiar with static electricity and electromagnetism and the attractive and repulsive forces they can generate. They have learned that they can create attractive and repulsive forces ourselves using everyday objects by adding an electric charge through rubbing, or connecting a battery. They have seen that some materials are affected by these forces, but others aren't, and that these forces can be used for practical purposes like separating or picking up objects.**

## Going Further




Expand on what the children learned today by exploring some other ways they can see the effects of static electricity and electromagnetism. Design a basic turbine by cutting paper into a rough shape of turbine blades and mounting it on a toothpick (or similar). Secure your turbine blade to the top of a pencil or lollipop stick and then attach it to the table with bluetac so it stands upright. By charging a plastic rod and holding it beside the turbine we can rotate the blades! Investigate how magnets are used in a type of train called 'Mag-lev' trains. These trains use electromagnetism to generate enough force to make an entire train float above the train tracks and push the train forward. This creates far less friction than using wheels and so these trains can travel at very high speeds! Challenge the class to design and build a levitating device using magnets.

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## "Hi! I'm Chloe Ball and and I am an Electrical Engineer at Intel.

Intel needs a huge amount of energy and electricity to keep it running 24/7, everything from lights to pumps and air-conditioning. I work on a team that makes sure everything is running safely and smoothly. By 2030, we aim to save 4 billion kWh across all our factories, while using 100% renewable energy. My team and I are always looking for new ways to reduce our carbon emissions and make our campus greener!