YEAR 3 UNIT 5: Opposite Attracts (Forces and Magnets)

Enquiry Question: What are the differences and similarities between magnets and forces?

Related units: Year 2 unit 1: Materials Monster – Why are materials suitable for different purposes?; **Year 2 unit 4 :** Move it – How can the shape of materials be changed; **Year 5 unit 3:** Let's Get Moving – What are forces and how do they work?

Unit overview

National Curriculum Link Year 3: Forces and Magnets.
Magnets are not covered in Key Stage 1. However, the children may well have come across them and seen that they can attract some other materials. Children will compare how things move on different surfaces. They will notice that some forces need contact between 2 objects, but magnetic forces can act a distance. They will observe how magnets repel each other and attract some materials and not others. They will compare and group together a variety of everyday materials based on whether they are attracted to a magnet, and identify some magnetic materials. Children will describe magnets as having 2 poles and predict whether two magnets will attract or repel each other, depending on which poles are facing. Pupils will observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary e.g. opening a door. They will explore the behaviour and everyday uses of different magnets e.g. bar, ring, button and horseshoe.

Scientific vocabulary

- Force
- Magnet
- Contact
- Non-contact
- Magnetic Poles
- Iron
- Attract
- Repel
- Magnetic
- Non-Magnetic
- Compass

Working scientifically

- Comparing how different things move and group them
- Raising questions and carrying out tests to find out how far things move on different surfaces
- Gathering and recording data to answer questions
- Explore strengths of different magnets and finding a fair way to compare them
- Sorting materials into those that are magnetic and those that are not
- Looking for patterns in the way that magnets behave in relation to each other and what might affect this e.g. strength of the magnet or which pole faces another
- Identify how these properties make magnets useful in everyday items and suggesting creative uses for different magnets

Assessment

1. Explain the difference between a contact and a non-contact force
2. Explain what the poles of a magnet are and the properties of magnets
3. Explain the difference between a magnetic and a non-magnetic material
4. Name 5 everyday uses of magnets

Cross-curricular links

English: Plan and write up an investigation
Maths Opportunities: Gather, record and present data in different ways

Teacher knowledge

A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but produces a force that pulls on only a few other metals, most notably iron, and attracts or repels other magnets. The name points to the very earliest discovery of magnetic materials in Ancient Greece: the word 'magnet' in Greek meant 'stone from Magnesia'. These lodestones were naturally magnetised pieces of iron ore that attracted other pieces of iron.

Magnets can only be made out of the metals iron, cobalt and nickel. The ones used in schools are called permanent magnets and retain their magnetism for a very long time if carefully looked after.

Permanent magnets come in many different shapes and sizes. Industrial magnets are made by heating a piece of iron to a high temperature and then hammering it as it cools in a magnetic field. Children can make a magnet by stroking an existing magnet from one end of an unmagnetized iron bar, nail or needle to the other repeatedly in the same direction.

Two magnets either attract or repel each other depending on how they are positioned. At this
stage in the topic it is sufficient to emphasise that two red or blue ends of a magnet always repel, but a red and a blue end attract. There is no need to mention the idea of poles.

Iron, cobalt and nickel are the only pure metals that can be made into magnets.

Some iron alloys, e.g. steel, can also be made into magnets, although some stainless steel is not magnetic. Some 1p and 2p coins are attracted to magnets as they have a think copper coating over a steel disc. Those made before 1992 are magnetic, those made after are not! Most drink cans are made of aluminium and so are not attracted to a magnet. However, tin cans are attracted to magnets because they have a thin coating of tin over iron. Children often find it difficult to understand the distinction between a magnet and the magnetic material. Show children what happens when two magnets are put together – they either attract or repel each other. Then show them what happens when a magnet is brought close to a magnetic material – it is always attracted.

Magnets are used for many different things today. Everything that has an electric motor in it has a magnet. Compasses, speedometers, fridge magnets and Maglev trains all use a magnet as well.

Magnets produce a magnetic force. The area around the magnet where the force can be detected is called a magnetic field. A magnetic field is strongest at the ends of a bar magnet, which are called poles. Horseshoe magnets also have poles at the two ends. Circular magnets have the poles at the top and the bottom. A North and South pole of a bar magnet always attract each other. Two North or South poles always repel. This is summed up in the rule: Like poles repel; unlike poles attract. The idea that magnets have poles comes from the observation that if a bar magnet is allowed to swing on a pivot, it ways comes to rest facing direction at a particular point on the Earth. This is because the magnet is affected by the Earth's magnetic field.

The Earth acts as if it is a large bar magnet with a North and South pole, it is not a bar magnet – it just acts as it if were. So one end of a bar magnet is attracted to the Earth's North magnetic pole. In fact, this end of the magnet is a North seeking pole and is called its North pole – it is actually a South pole because opposite poles attract. Confusing but true.

Earth's North and South magnetic poles are not at the same point as the geographical poles. They are some way off. To complicate matters further, the poles constantly move.

Did you know?

- The first magnets ever used were natural stones called lodestones. The word 'lode' means 'lead' and so the stone was used to magnetise compass needles and lead sailors home.
- Archimedes, the famous scientist from ancient Greek, is supposed to have pulled the nails out of enemy ships by using lodestone. The ships then came apart causing them to sink.
  Some vets use magnets to pick up pieces of wire or other metal from inside the stomachs of large farm animals.
- Today, new trains use magnets to lift them off the ground so that they float above the tracks. Floating allows the train to run more efficiently.

Common misconceptions:

- Magnets can be made out of all metals: false, they can only be made from iron, cobalt or nickel
- Magnetic materials are attracted and repelled by magnets. In fact, they are just attracted
- Iron is the only magnetic metal. In fact, the metals cobalt and nickel also form magnets
- All silver coloured items are attracted to a magnet: false, aluminium is silver but not attracted
- Larger magnets are stronger than smaller ones: false, the size is not directly related
- Magnetic fields and gravity are somehow linked – they are not.
- The Earth's magnetic pole is fixed. In fact, it is constantly moving.

Resources

Uses of strong magnets: www.bbc.co.uk/learningzone/clips/uses-of-strong-magnets/285.html
Pushes and pulls: www.bbc.co.uk/learningzone/clips/pushesand-pulls-no-narration/2435.html
Video about super powerful magnet: www.bbc.co.uk/learningzone/clips/super-pwerful-magnets-the-los-alamso-magnetic-man/2187.html