Key Knowledge:

Progression of Learning - Prior Learning:

- To explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.
- To identify the effects of air resistance, water resistance and friction, that act between moving surfaces.
- To recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

What is a force? What can different forces do?

- To know that a force is a push or a pull.
- To know that a force can make things change shape.
- To know that when things move there are forces acting on them.
- To know that if the forces acting on an object are equal, they cancel each other out and no movement or change is seen.
- To compare how objects, move on different surfaces.
- To know that there are forces that act between moving objects such as air resistance, water resistance and friction.

Which materials do magnets attract?

- To observe how magnets, attract some materials and not others.
- To compare and group together a variety of everyday materials based on whether they are attracted to a magnet and identify some magnetic materials.
- To know that magnetism demonstrates that there are forces we cannot see that act upon objects.
- To identify familiar, everyday uses of magnets. For example: in toys, in cabinet locks etc.
- To know how to classify materials according to whether they are or are not attracted by a magnet.
- To know that most magnets contain iron.

What is the law of magnetic attraction?

- To know that there are two magnetic poles: north-seeking and south-seeking poles.
- To know that a magnetic field is the area around a magnet where you would feel a magnetic force, and this is at the strongest pole.
- To know the law of magnetic attraction: unlike poles attract and like poles repel.

Why does the Earth have magnetic poles?

- To know that the Earth behaves as if it were a huge magnet: north and south magnetic poles (near, but not the same as geographic North Pole and South Pole).
- To know that an electromagnet is a special type of magnet which can be switched on or off.
- To know that orienteering uses a magnetised needle in a compass, which will always point to the north.

Progression of Learning - Future Learning:

- To understand that a non-contact force is a force which acts on an object, without coming physically in contact with it.
- To know examples of non-contact forces such as gravity which acts at a distance on Earth and in space, in addition to forces between magnets due to static electricity.

Lesson Sequence:

Core Focus Text:	Lesson 1A: Pre-Learning: Explore, Engage, Extend.	Lesson 1B: The Bigger Scientific Picture
	Discover what children know... and 'what children would like to know...' Completion of pre-learning Vital Vocabulary.	Explore the name of the unit, considering the questions: 'why are we studying this unit?' and 'what are the big scientific ideas?' Explore the disciplines of Chemistry, Physics and Biology making extensive links to all areas of prior learning through retrieval opportunities, mind map creation, research and discussion.

What is a force? What can different forces do?

- Complete unit pre-assessment questions and glossary.
- Teaching (Explain the key terminology and allow the children to explore the concept of a force in different ways e.g. using playdough (changing shape), child demonstrations to act out the forces (push and pull), diagrams (arrows to indicate the direction of the forces being applied) and exploring real-world examples. Introduce the concept of other types of forces, particularly those that act between moving objects e.g. friction, air resistance and water resistance. Play BBC clip to explain what these forces are in more detail).
- Vocabulary (Force, friction, gravity, air resistance, contact force, non-contact force).
- Activity (Children to plan for and carry out a practical investigation, to find out how the type of surface affects the friction force. Results to be recorded in a chart and a conclusion should be made).
- Scientific Enquiry (**Comparative and fair testing (controlled investigations)**).
- Working Scientifically (Sc4/1.1: asking relevant questions and using different types of scientific enquiries to answer them; Sc4/1.2 setting up simple practical enquiries, comparative and fair tests).

Which materials do magnets attract?

- Retrieval Activity (Quick fire quiz, which will cover the knowledge and vital vocabulary learnt in the previous lesson).
- Teaching (Children to brainstorm examples of where they may have seen magnets used in their everyday lives. 'Magnetic Hunt' - provide pupils with a variety of magnets to investigate magnetic materials around the classroom. Children to record the name of the object, their prediction and whether it is magnetic/not magnetic, in a table format).
- Vocabulary (Attract, repel, magnet, magnetic).
- Activity (Children to compare and group together a variety of everyday materials based on whether they are attracted to a magnet, using a Venn Diagram).
- Scientific Enquiry (**Identifying, classifying and sorting**).
- Working Scientifically (Sc4/1.5: recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables).

What is the law of magnetic attraction?

- Retrieval Activity (Sorting activity in groups using hula hoops, images of everyday materials and headings, to create a practical Venn Diagram. This will work to consolidate the children's understanding of which materials magnets attract).
- Teaching (Children to tie a piece of thread around the middle of a bar magnet and hold it up by the thread. Discuss that all magnets have two poles; a North and a South. Ask them to predict what they think will happen when you bring similar poles together (attract/repel). Now, what will happen when the poles are different? Pupils can draw what happens when the poles are placed close to each other).
- Vocabulary (Pole (North and South), magnet, attract, repel, non-contact force, magnetic field).
- Activity (Investigation Stations - Ask pupils to investigate some aspects of magnetism for example, do magnets work through a table/aluminium foil/other materials? Do magnets work in water? How many books will prevent a magnet working? How far away can a magnet attract a paperclip? How many grams can a magnet lift? Children to record answers to each of the questions. Discuss the idea that magnetism is also a non-contact force and can act through space. Introduce the idea of a magnetic field as the area around a magnet where a magnetic force is felt and this is strongest at the poles. This can be demonstrated with bar magnets and iron filings. Children to draw a labelled diagram to demonstrate their findings).
- Scientific Enquiry (**Observing; pattern seeking; comparative and fair testing (controlled investigations)**).
- Working Scientifically (Sc4/1.1: asking relevant questions and using different types of scientific enquiries to answer them; Sc4/1.7: using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions).

Why does the Earth have magnetic poles?

- Retrieval Activity (Dual coding mind-map based on the key learning to date).
- Teaching (Part 1: Recap the concept of magnetic poles. Begin by asking the children to rub a bar magnet onto a metal paper clip, before asking them to place the paperclip near many others. They should find that for a few moments, they have created their own magnet. Next, ask them to push the magnetised paper clip into a cork. Place the cork in a bowl of water. Try this several times. Can the children explain what is happening? Discuss the fact that the Earth has its own magnetic field. The paper clip is lining up with the magnetic North. The children can write the compass direction on small post-its and place them around their bowls. Part 2: Return to examples of uses of magnets and use this as a platform to introduce another type of magnet - an electromagnet - Play BBC video clip).
- Vocabulary (Compass, pole (North and South), magnetic field, electromagnet, motor).
- Activity (Children to record their findings of electromagnets in their own creative way. However, their work must include a labelled diagram and an explanation. They will then be provided with a series of reasoning questions, based on the BBC clip, to consolidate their understanding).
- Scientific Enquiry (**Pattern seeking; researching using secondary sources**).
- Working Scientifically (Sc4/1.6: reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions).
- Complete unit post-assessment questions and glossary.

Exit Task: A combination of Plan Bee end of topic questions (to consolidate learning), followed by the completion of an 'application of knowledge' activity. This will require the children to interpret data from a graph, in relation to a practical investigation using forces and magnets.

Common Misconceptions to Consider:

- **All silver metals are magnetic** - Iron, nickel and cobalt are the only magnetic elements, so any alloys containing these will be magnetic.
- **Large magnets are stronger than smaller magnets**.
- **Magnetic and geographic poles of the Earth are located in the same place** - They are close, but not at the same places. Compasses point to magnetic north.
- **Magnets only attract and repel through air** - Magnets do not only attract and repel through air. Magnets work in vacuum and through materials.
- **The magnetic pole in the northern hemisphere is a north pole and the pole in the southern hemisphere is a south pole** - The magnetic pole in the northern hemisphere is a south pole and the one in the south is a north pole. The north pole is called the north pole because it attracts a north pole.
- **If an object is stationary, there are no forces acting on it** - There can be multiple forces acting on it, but they are equal.
- **If a force acts on an object, it must move** - Gravitational force is constantly acting on all objects but doesn't cause movement.

Year 3 Science – Forces and Magnets.

Our Journey Drivers:

Scientific Enquiry:

Observing over time; pattern seeking; identifying, classifying and grouping; comparative and fair testing (controlled investigations); researching using secondary sources.

Pupils might work scientifically by comparing how different objects move and grouping them accordingly. They should be encouraged to raise questions and carry out fair tests/practical enquiries, to find out how far objects move on different surfaces. Providing children with opportunities to gather, record, classify and present their data in different ways, would allow them to find answers to their questions. The children should explore the strengths of different magnets and find a fair way to compare them, for example, sorting materials into those that are magnetic and those that are not, using a Venn Diagram. This would encourage them to look for patterns in the way that magnets behave in relation to each other and what might affect this, for example, the strength of the magnet or which pole faces another. Finally, they could identify how these properties make magnets useful in everyday items and suggest creative uses for different magnets.

Local and Cross-Curricular Links

History: Pieces of lodestone were the first magnetic compasses and their importance to early navigation.
English: The Iron Man, by Ted Hughes, is a key, cross-curricular text that could be introduced to the children.
Geography: Magnetic and geographic poles of the Earth.
Local: Exploring the uses of magnets in everyday

National Curriculum Coverage

- Compare how objects move on different surfaces.
- Notice that some forces need contact between two objects, but magnetic forces can act at a distance.
- Observe how magnets attract or repel each other and attract some materials and not others.
- Compare and group together a variety of everyday materials based on whether they are attracted to a magnet.
- Describe magnets as having two poles.
- Predict whether two magnets will attract or repel each other, depending on which poles are facing.
- Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.
- Identify the effects of air resistance, water resistance and friction, that act between moving surfaces
- Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

Think like a Scientist by:

Sorting/ grouping / comparing / identifying, researching, recording, predicting, questioning, planning including use of equipment and measurement, communicating, recording, concluding, collaborating, observing.

Transferrable Knowledge:

Physics (helps us understand how objects, forces and energy all interact. Physical things).

P2: Forces are different kinds of pushes and pulls that act on all the matter that is in the universe. (Magnets can exert a force.)

Vital Vocabulary:

Force
Magnet
Magnetic
Attract
Repel
Pole
North Pole
South Pole
Compass
Contact force
Non-contact force
Friction
Gravity
Air resistance
Electromagnet
Motor

Idioms:

'A force to be reckoned with.'

'Out in full force.'

J	Reading spine books with reading embedded throughout all lessons.
O	Knowledge and skills progressively sequenced; see planning overleaf.
U	Focus on creation and endurance as our core Scientific Christian Values. Mutual respect for the ideas of other people as our core British Christian Values
R	Five strands of scientific enquiry, with child-led investigations.
N	Subject WOW. Quest approach to teaching. Five strands of scientific enquiry. Opportunities for wider scientific reading.
E	Vital vocabulary, oracy opportunities including P4C and speak its, exit task and use of academic keystone words.
Y	Focus on health and wellbeing woven throughout the Curriculum, linked to St James Spirit Curriculum. Appreciation of the natural world and sense of awe and wonder.