Year 3 – Forces and Magnets

National Curriculum Objectives/Knowledge Statements (Substantive):

- Compare how things 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 and repel each other and attract some materials and not others.
- Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials.
- Describe magnets as having two poles.
- Predict whether two magnets with attract or repel each other, depending on which poles are facing.

Pupils should observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary (for example, opening a door, pushing a swing). They should explore the behaviour and everyday uses of different magnets (for example, bar, ring, button and horseshoe).
Pupils might work scientifically by: comparing how different things move and grouping them; raising questions and carrying out tests to find out how far things move on different surfaces and gathering and recording data to find answers their questions; exploring the 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, for example, the strength of the magnet or which pole faces another; identifying how these properties make magnets useful in everyday items and suggesting creative uses for different magnets.

Key Ideas:

a) Magnets exert attractive and repulsive forces on each other.
b) Magnets exert **non-contact** forces, which work through some materials.
c) Magnets exert attractive forces on some materials.
d) Magnet forces are affected by magnet strength, object mass, distance from object and object material.

Prior Learning	Breakdown of Lessons		Vocabulary
	Lesson and Big Question	Knowledge **(Progression of substantive knowledge – what?).** Or Science Enquiry/Skill Based Lesson **(Disciplinary/National Curriculum Working Scientifically Statements – why/how?).** These inc: Fair Testing (Asking Scientific Questions, Planning and Enquiry, Observing closely, Drawing Conclusions, Making Predictions, Evaluating an Enquiry), Identifying & Classifying, Observation Over Time (Observing closely), Pattern Seeking/Research.	
In Year 2: • No Forces National Curriculum objectives in KS1. • May have an awareness of how to make things stop and start.	Isaac Newton is best known for his work on gravity and friction. He thought forces were really important to explaining the world and how things moved. **Big Question:** Things will move more quickly and easier on smoother surfaces. Prove it.	Science Enquiry – Fair Testing Which surface is there more friction on?	Force, push, pull, friction, surface, magnet, magnetic, magnetic field, pole, north, south, attract, repel, compass.
	André-Marie Amphere discovered magnetic fields. Through his experiments he believed that to move an object you did not need contact. **Big Question 2:** Do all forces need contact between 2 objects?	Scientific Enquiry - Observation and Pattern Seeking Look at whether objects are moved by contact or not. If not, what is the force that it casing the object to move? (magnetic)	
	Pierre Weiss is a French physicist who specialises in magnetism. He thinks objects can be grouped according to their magnetic properties. **Big Question 3:** Materials can be grouped by magnetic properties. Prove it.	Scientific Enquiry – Identifying and Classifying How magnets attract some materials and not others?	
	William Gilbert was the first scientist to make a magnet. He discovered that the Earth was a magnet, that magnets could be forged out of iron and that their magnetic properties could be lost if the iron was heated. He looked at what happens when magnets come together. **Big Question 4:** What happens when similar and opposite poles of a magnet meet?	Knowledge Magnets attract or repel each other (including poles attract and repel) Scientific Enquiry Predict – what do they think will happen before they test it? What happens when similar and opposite poles of a magnet meet?	
	William Gilbert was the first scientist to make a magnet. He discovered that the Earth was a magnet, that magnets could be forged out of iron and that their magnetic properties could be lost if the iron was heated. He thinks that magnets can be used for a variety of everyday things. **Big Question 5:** Magnets are used in everyday life. Prove it.	Knowledge and Research	

In Year 5:

- Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object and the impact of gravity on our lives.
- Identify the effects of air resistance, water resistance and friction, which act between moving surfaces.
- Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.
- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- Describe the movement of the Moon relative to the Earth
- Describe the Sun, Earth and Moon as approximately spherical bodies
- Describe the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

Year 5 - Forces

National Curriculum Objectives/Knowledge Statements (Substantive):

- Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object and the impact of gravity on our lives.
- Identify the effects of air resistance, water resistance and friction, which act between moving surfaces.
- Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

Pupils should explore falling objects and raise questions about the effects of air resistance. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. They should experience forces that make things begin to move, get faster or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example, by observing the effects of a brake on a bicycle wheel. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists, for example, *Galileo Galilei and Isaac Newton* helped to develop the theory of gravitation.
Pupils might work scientifically by: exploring falling paper cones or cup-cake cases, and designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most effective. They might explore resistance in water by making and testing boats of different shapes. They might design and make products that use levers, pulleys, gears and/or springs and explore their effects.

Key Ideas:

a) Air resistance and water resistance are forces against motion caused by objects having to move air and water out of their way.
b) Friction is a force against motion caused by two surfaces rubbing against each other.
c) Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move.

Prior Learning	Breakdown of Lessons		Vocabulary
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In Year 3: • Compare how things move on different surfaces. • Know how a simple pulley works and use making lifting an object simpler • Notice that some forces need contact between two objects, but magnetic forces can act at a distance. • Observe how magnets attract and repel each other and attract some materials and not others. • Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials. • Describe magnets as having two poles. • Predict whether two magnets with attract or repel each other, depending on which poles are facing.	Aristotle was a famous Ancient Greek physicist (a scientist who studies matter (stuff) and its motion). He thought that objects fell towards a point because of their heaviness! Do you agree – prove it.	Identifying scientific evidence that has been used to support or refute ideas or arguments. (Knowledge/Pattern Seeking/Research)	Air resistance, Water resistance, Friction, Gravity, Newton, Gears, Pulleys, force, push, pull, opposing, streamline, brake, mechanism, lever, cog, machine, pulley.
	Isaac Newton was a famous English physicist (a scientist who studies matter (stuff) and its motion). He discovered the force: gravity. He asks this question: are mass and weight always the same? Prove it.	Identifying scientific evidence that has been used to support or refute ideas or arguments. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms. (Knowledge/Pattern Seeking/Research)	
	Galileo Galilei was a famous Italian physicist (a scientist who studies matter (stuff) and its motion). He was one of first scientists to understand air resistance. As a class, he challenges you to construct different parachutes and measure their air resistance. What variables will there be and how will we conduct the investigation?	Science Enquiry/Skill Based Lesson (Fair Testing/Observation Over Time). Record data using tables, scatter graphs, bar and line graphs. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms. Identify scientific evidence that has been used to support or refute ideas or argument.	
	Eily Keary was a naval architect (she designed ships). Eily designed a destroyer that could travel as fast as 39 knots! She believed her heavy ship was able to travel so fast because of its streamlined design. Do you agree? Can you prove that streamlined designs travel faster in water?	Science Enquiry/Skill Based Lesson (Fair Testing/Observation Over Time). Record data using tables, scatter graphs, bar and line graphs. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms. Identify scientific evidence that has been used to support or refute ideas or argument.	
	Issac Newton came up with three Laws of Motion to describe how things move scientifically. The first law of motion says that any object in motion will continue to move in the same direction and speed unless forces act on it. Friction is one of the forces that can act on a moving object. Issac Newton thinks that the time it takes for an object to move along a surface is dependent on the texture of the material. Prove it.	Science Enquiry/Skill Based Lesson (Fair Testing/Observation Over Time). Record data using tables, scatter graphs, bar and line graphs. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms. Identify scientific evidence that has been used to support or refute ideas or argument.	

In KS3:

- opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface
- forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only)
- change depending on direction of force and its size.

Year 5 – Earth and Space

National Curriculum Objectives/Knowledge Statements (Substantive):

- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- Describe the movement of the Moon relative to the Earth
- Describe the Sun, Earth and Moon as approximately spherical bodies
- Describe the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

Pupils should be introduced to a model of the Sun and Earth that enables them to explain day and night. Pupils should learn that the Sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a 'dwarf planet' in 2006). They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones).
Note: Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.
Pupils should find out about the way that ideas about the solar system have developed, understanding how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as *Ptolemy, Alhazen and Copernicus*.
Pupils might work scientifically by: comparing the time of day at different places on the Earth through internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day; finding out why some people think that structures such as Stonehenge might have been used as astronomical clocks.

Key Ideas:

a) Stars, planets and moons have so much mass they attract other things, including each other due to a force called gravity. Gravity works over distance.
b) Objects with larger masses exert bigger gravitational forces.
c) Objects like planets, moons and stars spin.
d) Smaller mass objects like planets orbit large mass objects like stars.
e) Stars produce vast amounts of heat and light. All other objects are lumps of rock, metal or ice and can be seen because they reflect the light of stars.

Prior Learning	Earth and Space		Vocabulary
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	Johann Galle was a famous astronomer; in 1846 he discovered the last planet in our solar system: Neptune. It is now believed that there are eight major planets in our solar system - prove it.	Identifying scientific evidence that has been used to support or refute ideas or arguments in the context of how ideas changed from a flat earth view.	
	This week, you choose a famous astronomer (physicist who studies space) and produce a Seesaw video presentation about their understanding of the heliocentric model of our solar system. Were they correct? Prove it!	Identifying and classifying scientists into heliocentric and non-heliocentric. Research and present findings to support knowledge of science history and modern ideas about the shape of the earth.	
	Léon Foucault was a famous physicist (a scientist who studies energy and force); in 1851 he invented the pendulum (a device that provided proof of the Earth's rotation). He believed that it was due to rotation that we have night and day - prove it.	Observation over time and pattern seeking. Investigate the big question, and demonstrate rotation and what happens as a result, via multiple ideas e.g. observe the differing positions of the sun throughout the day.	
	George Airy was a famous English astronomer; in 1851 he created the prime meridian at Greenwich in London – it is now the centre of global time. If it is 09:00am in England, will it be the same time on the other side of the Earth? Prove it!	Pattern seeking and making predictions and using another location on Google Maps. Model how to pick one country on the map. State that if it is 12:00 in the UK then the Sun is fully above them. Move the globe and complete the prediction table.	
	Galileo Galilei was a famous Italian astronomer (and one of the inventors of the telescope). He discovered details about the surface of the moon never before written down! He thinks that the moon's orbit is tidally locked to the Earth – prove it.	Observation over time in the form of Moon diaries. Pattern seeking by observing orbits (via video) and orbiting and rotating each other on the playground – knowing the difference between orbit and rotation and understanding these can happen simultaneously.	

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Science Progression from EYFS to Year 6