

Forces and Magnets (including Earth and Space)

Year 2 - Forces

National Curriculum Objectives:

☐ No National Curriculum Objectives for KS1

Key Ideas:

Forces Key Ideas have been included despite there being no 'Forces' unit in KS1

- a) Pushing and pulling can make things move faster or slower.
- b) Pushing and pulling can make things move or stop.
- c) Things can move in different ways.
- d) Larger masses take bigger pushes and pulls to move or stop them.
- e) Pushing and pulling can change the shape of things.
- f) Bigger pushes and pulls have bigger effects.

Prior Learning	Pushes, Pulls and their Effects.				Vocabulary
<p>In Early Years:</p> <ul style="list-style-type: none"> • Children know about similarities and differences in relation to places, objects, materials and living things. • They talk about the features of their own immediate environment and how environments might vary from one another. • They make observations of animals and plants and explain why some things occur, and talk about changes. 	<p>Chapter 1: How things move.</p> <p>Objects move in different ways; they roll, slide, bounce etc</p>	<p>Chapter 2: Forces change how things move.</p> <p>We can change the way an object moves by pushing or pulling them. Sometimes pushing and pulling slows things down, sometimes it speeds them up and sometimes it makes it change direction.</p>	<p>Chapter 3: Making forces bigger.</p> <p>Bigger pushes and pulls have bigger effects. (They change how things move more.)</p>	<p>Chapter 4: Forces change shapes.</p> <p>Sometimes when an object is pushed, pulled or twisted it changes shape.</p>	<p>Force, push, pull, surface, attract, repel, compass.</p>
	<p>☐ Make a toy box that only contains the very best bouncing balls, rolling cars and sliding blocks.</p>	<p>☐ Show children a marble run and challenge them to find out how they could make a marble move down a run really slowly (draw out an investigation question e.g. How does the material affect how fast a ball rolls down a slope?)</p>	<ul style="list-style-type: none"> • How does the length / steepness of a slope affect how far a ball / car / tin will roll off the end? Was it a push or a pull that made it go further? • How does how hard / long I press a pop up toy for affect how high it jumps? • On what surface do objects roll the best on? Is it the same for sliding? 	<ul style="list-style-type: none"> • Which material would be best for a teddy bungee cord? From this you should draw out an investigation question e.g. does the length of elastic band affect how elastic it is? Which sock is the most elastic? How does the denier of tights affect how elastic they are? • Which recipe play dough needs the greatest push to squash it? • How does the height an egg is dropped from affect how big the splat pattern is? (You could use wet tissue paper balls) 	
<p>In Year 3:</p> <ul style="list-style-type: none"> • 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 will attract or repel each other, depending on which poles are facing. 					

Year 3 – Forces and Magnets

National Curriculum Objectives:

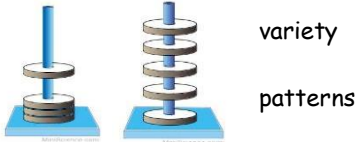
- Compare how things move on different surfaces.
- Know how a simple pulley works and use making lifting an object simpler
- Notice that some forces need contact between two objects, but magnetic forces can act at a distance.
- Observe how magnets attract and repel each other and attract some materials 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 will 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.

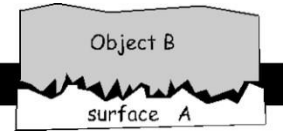
Prior Learning	Magnets and their Effects				Vocabulary
<p>In Year 2:</p> <ul style="list-style-type: none"> • No Forces National Curriculum objectives in KS1. • May have an awareness of how to make things stop and start. 	<p>Chapter 1: What magnets do. Magnets exert attractive forces on some metals</p>	<p>Chapter 2: Magnets don't need to touch. Magnetic forces work through other materials including air, so magnets don't need to be touching to exert their force. It is called a non-contact force</p>	<p>Chapter 3: Magnets attract and repel. Each end of a magnet is called a pole, opposite poles are called north and south. Magnets exert attractive forces on each other when the poles facing each other are north and south (opposites). Magnets exert repulsive forces on each other when the poles facing each other are the same.</p>	<p>Chapter 4: What affects magnetic strength? The strength of magnetic forces are affected by:</p> <ul style="list-style-type: none"> • The strength of the magnet. • The distance between the magnet and the object. • The material the object is made from. 	<p>Force, push, pull, friction, surface, magnet, magnetic, magnetic field, pole, north, south, attract, repel, compass.</p>
	<ul style="list-style-type: none"> • Magnetic material hunt, what can they say about magnetic materials? • Can I make a magnetic material non-magnetic? 	<p>How far away does a magnet need to be before it attracts a magnetic material?</p>	<p>How far away can the magnetic attraction between two magnets be experienced? Is the repulsive force the same size?</p> <ul style="list-style-type: none"> • Ring magnets can be stacked to create a variety of patterns depending on how their poles are arranged. Challenge children to recreate these and explain how they did it. • How is the magnetic attraction or repulsion force affected by putting materials between the magnets? <div style="text-align: center;">  </div>	<ul style="list-style-type: none"> • Are bigger magnets stronger? (You could make larger magnets by putting together lots of smaller neo or super magnets) • How could you use magnets to measure the number of pages in a book? 	

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

<p>National Curriculum Objectives:</p> <ul style="list-style-type: none"> • 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. <p>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, <u>Galileo Galilei and Isaac Newton</u> helped to develop the theory of gravitation.</p> <p>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.</p>	<p>Key Ideas:</p> <p>a) Air resistance and water resistance are forces against motion caused by objects having to move air and water out of their way.</p> <p>b) Friction is a force against motion caused by two surfaces rubbing against each other.</p> <p>c) Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move.</p>
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Prior Learning	Forces that oppose motion.			Vocabulary
<p>In Year 3:</p> <ul style="list-style-type: none"> • 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 will attract or repel each other, depending on which poles are facing. 	<p>Chapter 1: Water and air resistance.</p> <ul style="list-style-type: none"> • When objects move through air and water they have to push it out of the way. The water and air push back with forces called water resistance and air resistance. The harder it is to push the material out of the way the greater the resistance. • Gases weigh less than liquids and so water resistance is greater than air resistance 	<p>Chapter 2: Friction.</p> <ul style="list-style-type: none"> • Friction is a force against motion caused by two surfaces rubbing against each other. It occurs because no surfaces are perfectly smooth; they have bumps and undulations that can interlock when placed on top of each other. • To move one interlocking surface over another one of three things must happen: <ol style="list-style-type: none"> 1. The surfaces must rise slightly 2. The bumps on the surface must bend 3. The bumps on the surface must break <p>All of these actions requires a force, this is what causes friction</p> 	<p>Chapter 3: Managing forces.</p> <p>Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move.</p> <p>(These are particularly complex ideas. It might be better to teach them through a design technology project where children make toys using cogs, pulleys and levers)</p>	<p>Air resistance, Water resistance, Friction, Gravity, Newton, Gears, Pulleys, force, push, pull, opposing, streamline, brake, mechanism, lever, cog, machine, pulley.</p>
	<ul style="list-style-type: none"> • How does the saltiness (salinity) of water affect water resistance? • How does the length of a paper helicopter's wings affect the time it takes to fall? • How does changing the shape of a piece of plasticene affect water resistance? • How does adding holes to a parachute affect the time it takes to fall? 	<ul style="list-style-type: none"> • How does the amount / depth of tread affect the friction between a shoe and a surface (model this with a material they can change the tread on rather than a real shoe). Is the same conclusion reached if the surface is rough and smooth? • Modern racing cars have very wide tyres; is this to improve grip? How does surface area affect friction? • Putting small granules (cous cous is effective) under a block allows it to be dragged more easily. How does the amount of cous cous affect the friction? • How does the type of liquid put between two surfaces affect the friction between them? • How does the roughness of a surface affect the effectiveness of a lubricant in reducing friction? 	<p>□</p>	

<p>In KS3:</p> <ul style="list-style-type: none"> • 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.
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National Curriculum Objectives:

- 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).

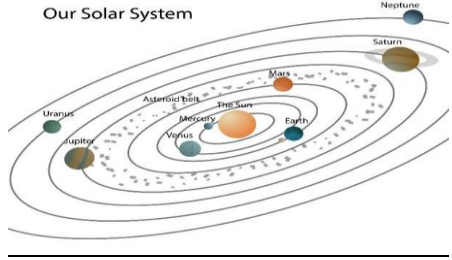
Note: Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.

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:

- 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.
- Objects with larger masses exert bigger gravitational forces.
- Objects like planets, moons and stars spin.
- Smaller mass objects like planets orbit large mass objects like stars.
- 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
<p>In Year 3:</p> <ul style="list-style-type: none"> • 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. 	<p>Chapter 1: Where the Earth is in space</p> <ul style="list-style-type: none"> • The universe is vast and contains billions of stars. • The solar system is a collection of planets and moons orbiting our nearest star, the sun. It can be represented using a model.  <p style="text-align: center;">Our Solar System</p> <ul style="list-style-type: none"> • All objects in the solar system are spinning as well as orbiting. • The time it takes for an object to spin once is called a day • The time it takes a planet to orbit the sun is called a year 	<p>Chapter 2: Stars and other objects</p> <ul style="list-style-type: none"> □ 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 	<p>Chapter 3: Gravity and its effects</p> <ul style="list-style-type: none"> • Gravity is a force of attraction between any two things that have mass and bigger masses exert bigger forces. • Gravity works over a distance but gets weaker as the distance increases. Stars, planets and moons have so much mass they exert a large gravitational attraction on other things, including each other. • Differences in gravity result in smaller mass objects like planets (or moons) orbiting larger mass objects like stars (or planets) 	<p>Earth, Sun, Moon, Axis, Rotation, Day, Night, Phases of the Moon, star, constellation, waxing, waning, crescent, gibbous.</p> <p>Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, planets, solar system, day, night, rotate, orbit, axis, spherical, geocentric, heliocentric.</p>
<p>In KS3:</p> <ul style="list-style-type: none"> • Gravity force, weight = mass x gravitational field strength (g), on Earth $g=10 \text{ N/kg}$, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only) • Our Sun as a star, other stars in our galaxy, other galaxies • The seasons and the Earth's tilt, day length at different times of year, in different hemispheres The light year as a unit of astronomical distance 	<ul style="list-style-type: none"> • Predict and explain how the temperature of each planet may vary. Use data to check and then consider which planets could possibly host life (it must contain liquid water for at least some time) • Predict how long each planetary year might be and compare with data. 	<ul style="list-style-type: none"> • How does the distance from a light source affect how much light hits an object? Apply this to the solar system and predict how much light each planet receives. • Does having more moons result in more light hitting a planet? How could you test this idea? • Using knowledge of the solar system and the importance of water and light for life, predict the temperature and light levels on different planets and suggest which planets might be possible to support life in the future. They then look at real temperature and light data and reflect upon what they suggested. 	<ul style="list-style-type: none"> • Investigate moon craters. How does the speed / size of a meteorite affect the size of a moon crater formed? • If the moon became heavier as a result of meteorite collisions what would happen to its position relative to the Earth? • Imagine that somewhere in the universe is a vast (bigger than the solar system) cloud of dust of varying sized bits and varying distances apart. What might happen to this cloud over many years? (This can be modelled using a handful of pom poms of varying sizes randomly dropped onto a table) • Consider a spacecraft travelling from the Earth to the moon. Predict the forces acting on the craft at various stages in its journey. (The mass of the earth is 80 x that of the moon) • If the mass of the earth is 80x that of the moon why is the gravity at the Earth's surface only 6 x greater than that at the surface of the moon? 	