Year 3 Forces and Magnets

National Curriculum Objectives:

- 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 or 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.

Killer Facts:

- Magnets can attract or repel each other.
- Magnets have a north and a south pole.
- Some materials are attracted to magnets, including iron.
- Magnetic forces can be affected by distance, magnet strength, object mass and object material(s).
- Forces including friction and air resistance, and water resistance need contact.
- Magnets exert non-contact forces.
- Objects move differently on different surfaces.

Prior KS1 Learning

No specific forces objectives, however it links well to previous Year 1 and 2 Materials learning.

Year 1:

- describe the simple physical properties of a variety of everyday materials

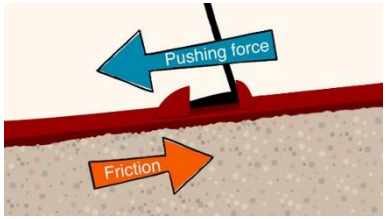
Year 2:

- find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching

How do surfaces alter movement?

Create/give children cars and a ramp with a range of different surfaces and measuring equipment. How far do the cars move on the different surfaces? Record in tables/graphs.

Create/give children spinners/spinning tops and a range of surfaces – investigate which surface it spins for longest on.



What is a magnet?

Give children a range of magnets and magnetic materials to explore – what do they notice? Allow them to explore the attraction/repel of the poles of the magnets and explain scientifically what is occurring.

Allow children to think of a range of things that a move – classify as contact or non-contact forces.
Contact examples: football, a door, running
Non-contact examples: Falling apples, static electricity (hair/balloon) magnets. Misconception: things that are moved by air are contact forces, e.g. an aeroplane.

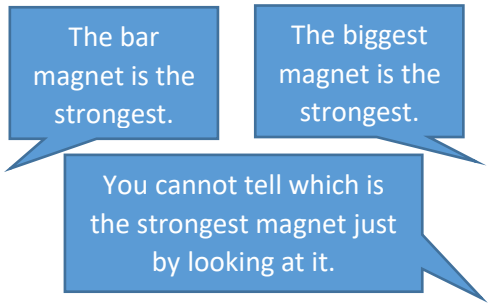
Give children a range of magnetic and non-magnetic materials to sort. Are all magnetic materials metal? Are all metals magnetic? Are all coins magnetic? Allow children to chance to investigate these questions.

DT Link – Design games/mazes that involve moving through the maze using the non-contact magnetic force.

Create a compass by magnetising a needle to identify where magnetic north is.

What affects magnetic strength?

Using a range of size/strength magnets, allow children to carry out an investigation to identify the strongest/weakest magnets. Record the number of centimetres away attraction occurs.



After, allow children the opportunity to explore some statements using a range of magnets.

After identifying the strongest magnets, children could then build on previous knowledge about surfaces – how does the surface affect the distance attraction occurs between a paper clip and the magnet. Record data and write conclusions using scientific vocabulary.

Key Vocabulary

material*
stretchy*
bendy*
float*
sink*
flexible*
stretching*
squashing*
rigid*
push*
pull*
magnet
magnetic
magnetic field
attract
repel
contact
non-contact
north pole
south pole
friction

*prior learning

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
- 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

Year 5 Forces

National Curriculum Objectives:

- 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
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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.

Killer Facts:

- Gravity is a non-contact force that causes unsupported objects to fall towards the Earth.
- Gravity acts between the Earth and the falling object.
- Air resistance is the drag that acts against gravity. It is a type of friction where an object pushes against air particles.
- Water resistance is also a type of friction where the object is pushing against water particles.
- Friction is the force against motion, where two surfaces rub together.
- Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move.

Prior Year 3 Learning

- 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 or repel each other and attract some materials and not others
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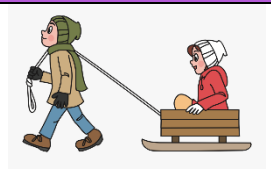
Gravity

Which is the odd one out? Use a pre-assessment – can they identify that 1 and 2 are examples of resistance and friction whereas the jumper falls to Earth because of gravity. Introduce gravity as a force between Earth and objects. Show children clips of someone walking in space where gravity is lower. Use lego figures tacked around a globe – what would happen if each person threw a ball into the air?

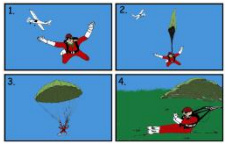
Forces can be measured using a force meter. Misconception: Mass is not a force, weight is. Children to measure the 'pulling' force of a range of objects in newtons.

Create drawings and label balanced and unbalanced forces: The weight of the ball results in gravity crushing the paper table (unbalanced). The football rests, still, on the grass(balanced). Car is accelerating down a slope(unbalanced).

Air and Water Resistance and Friction



Why might the boy find this easy/hard to pull? Recap knowledge of friction from Year 3 - surface moving against another. Build on investigations in Year 3 by adding force meters to measure the force needed to pull a 'sledge' on different surfaces. Investigate with shoes – how does the tread on the shoe affect the friction? Does a rough/smooth surface influence this? Make conclusions about which surface needed the most force – created the most friction.



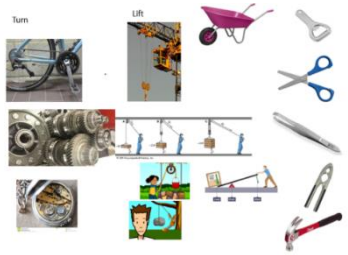
Can children explain the image of a polar bear sliding using scientific vocabulary about friction?

Carry out a parachute investigation to establish which falls to the ground the slowest, therefore the safest. Maths link – measure the area of the parachute used. Which area of parachute is the safest?
Use image – what happens at each stage of a parachute jump? Use scientific vocabulary.
Make different sized spinners to drop – which fall faster?

Using cups of water, oil and glue, make predictions and test how fast a coin will sink and discuss why this happens. Do different objects take more/less time (create more/less resistance).
Investigate the effect of boat shape on water resistance. Investigate the effect of salt water on water resistance. Investigate and present findings to show which boat shape performs best on which waterway – river or ocean?

Levers, Pulleys and Gears

Perhaps best taught through DT



Children to sort – give turning/lifting as headings if they find this tricky. Complete as pre/end assessment for this section. Can they identify which are gears, levers and pulley by the end?

Levers – fulcrum – the point where a platform rests. Make tabletop seesaws – where is the best place to put the fulcrum?
Pulley – make fixed pulleys/block and tackle pulleys. Which pulley makes moving the load easier? How many cotton reels are needed to lift 200N? *See Hamilton Trust Year 5 Science Planning.*

Key Vocabulary

float*
sink*
push*
pull*
magnet*
magnetic*
attract*
repel*
contact force*
non-contact force*
north pole*
south pole*
friction*
gravity
Earth
air resistance
drag
water resistance
particles
gears
pulley
levers

*prior learning

In Year 5: (*Earth and Space)*

- 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
- use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky

Year 5 Earth and Space

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
- use 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.

Killer Facts:

- Stars, planets and moons have such large masses that they attract other things, including each other. This force is called gravity.
- Objects with larger masses exert larger gravitational forces.
- Objects like planets, moons and stars spin.
- Smaller mass objects like planets orbit larger 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 light.
- The sun is the star at the centre of our solar system.
- Our solar system has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune).
- The Earth rotates once on its axis every 24 hours and he Earth orbits the sun once a year.
- The modern heliocentric model of the solar system has the planets orbiting the sun; the geocentric (older) model had the sun and other planets orbit the Earth.

Prior Year 5 Learning

- explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
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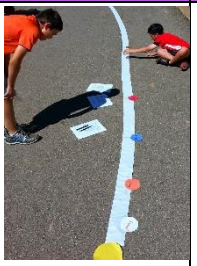
(If Forces unit is taught before Earth and Space in Year 5)

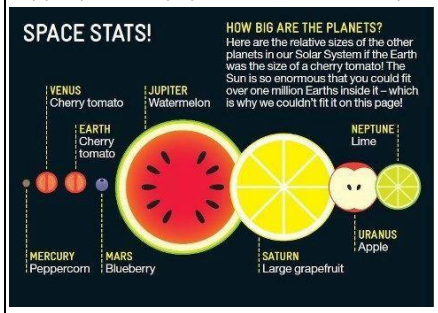
Where is the Earth in space?

Role play the movement of the Earth and other planets within the solar system – consider the speed of each planet and distance from sun (scaled).Could be done on the playground using chalks to map out orbits. Why does Mercury orbit the sun faster than Neptune?

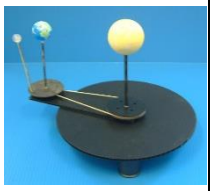
- ➔ Use this to explain how many days we have in a year.
- ➔ Compare to other planets year lengths – could be recorded as a graph/chart.



Create a scale model of where each planet is in relation to the sun – children to measure using appropriate equipment. This can be quite effective with toilet roll to show heliocentric model.



Create a scale model to demonstrate the size of different planets using fruit. Draw on previous geocentric model, believed by philosophers such as Aristotle.



Create a simple orrery (see Hamilton planning), or more complex versions (pictured) as part of a DT project using pulleys.

Using knowledge of where each planet is in the solar system, make predictions about their temperatures and compare this to real data. Make predictions about which planets could support life now/in the future.

Make links with previous Year 5 forces unit (revise and recap) and consider the forces that would be acting upon a spacecraft during different stages of its journey.

Research and present the different gravitational forces between the sun and different planets scientifically in graphs/charts. Because different planets have different gravitational attraction, smaller objects (like planets) orbit larger objects(stars/the sun). Challenge children to come to this conclusion.

Why do we get day and night?

Make observations of shadows at different points in the day – show their understanding of this using a diagram.

Use a lego person, a globe and a torch to demonstrate the position of the sun during the day and night – make videos and create explanations.

Create working shadow clocks. This could be calibrated to regular school day timings.

How does the distance from the light source affect how much light hits the object? Apply this to the solar system and make predictions about what the light levels are like on each planet. Are day/night different on different planets?

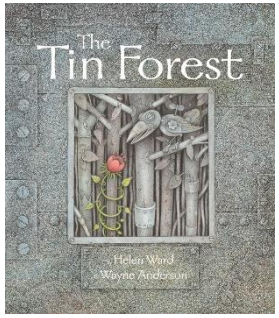
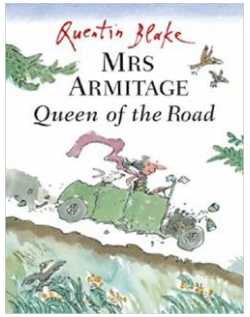
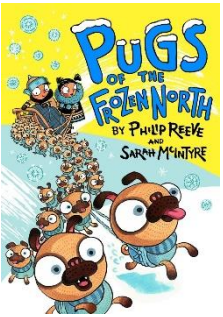
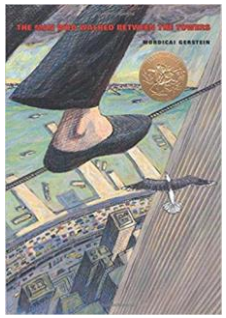
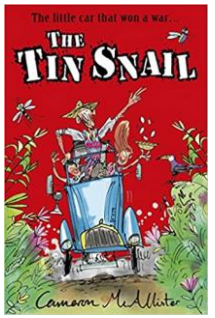
Challenge: Why does the moon appear different throughout the month? Create phases of the moon diagrams, showing where the sun is and where it shines. Create monthly moon diaries to record observations.

Key Vocabulary

magnet*
magnetic*
attract*
repel*
sun*
moon*
contact force*
non-contact force*
friction*
gravity*
Earth*
planet (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune)
solar system
spherical body
star
geocentric model
heliocentric model
day
night
rotation
orbit
phases of the moon
*prior learning

In KS3:

- https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/335174/SECONDARY_national_curriculum_-_Science_220714.pdf

Year Group	Common Misconceptions	Recommended Linked Texts for Forces	
Year 3	- the bigger the magnet the stronger it is - all metals are magnetic	**The Tin Forest** by Helen Ward **Mrs Armitage Queen of the Road** by Quentin Blake **Pugs of the Frozen North** by Philip Reeve	  
Year 5 *Forces*	- the heavier the object the faster it falls, because it has more gravity acting on it - forces always act in pairs which are equal - smooth surfaces have no friction - objects always travel better on smooth surfaces - a non-moving object has no forces acting on it - heavy objects sink and light objects float	**The Man who Walked Between the Towers** by Mardacai Gerstein **FArTHER** by Grahame Baker-Smith **The Tin Snail** by Cameron McAllister	  
Year 5 *Space*	- the Earth is flat - the Sun is a planet - the Sun rotates around the Earth - the Sun moves across the sky during the day - the Sun rises in the morning and sets in the evening - the Moon appears only at night - the Moon is in the way of the Sun at night	**The Skies Above my Eyes** by Charlotte Guillain **Cosmic** by Frank Cottrell Boyce **Curiosity: The Story of a Mars Rover** by Markus Motum