St Peter's CE Primary School

Forces Topic Overview

Unit Overview:

This topic fills the National Curriculum requirement to learn about forces. Pupils will compare and group materials according to their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. Pupils will notice that some forces need contact between two objects, but magnetic forces can act at a distance. They will observe how magnets attract or repel each other and attract some materials and not others and 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. Pupils will describe magnets as having two poles and predict whether two magnets will attract or repel each other, depending on which poles are facing. They will identify the effects of air resistance, water resistance and friction, that act between moving surfaces and compare how things move on different surfaces. Pupils will give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.

Working Scientifically

Throughout the year, pupils will continue to work scientifically in lower KS2 by:

- asking relevant questions and using different types of scientific enquiries to answer them.
- setting up simple practical enquiries, comparative and fair tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.
- Comparing, contrasting and sorting
- Show my results in a variety of ways including branching databases

In upper KS2 by:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
- recording data and results of increasing complexity. Using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
- using test results to make predictions to set up further comparative and fair tests.
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations.
- identifying scientific evidence that has been used to support or refute ideas or arguments
- I can compare, contrast and sort
- I can choose to show my results in a variety of ways including branching databases

Key Questions:

LKS2

1. Which forces need contact between objects?
2. What affect do magnets have on other magnets and materials? (Investigation)
3. What is air resistance, water resistance and friction? (Friction experiment)

UKS2

1. How do the properties of different materials effect its function?
2. What is air resistance, water resistance and friction? (Investigation)
3. Which mechanisms allow a smaller force to have a greater effect?

Objectives covered in this unit:	
Science (see progression in expectations document)	<u>LKS2:</u> • 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. • Identify the effects of air resistance, water resistance and friction, that act between moving surfaces • Compare how things move on different surfaces <u>Investigation Suggestions:</u> - Which materials are magnetic? <u>UKS2:</u> Compare and group together everyday materials on the basis of their response to magnets. • Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic. • 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. <u>Investigation Suggestions:</u> - Parachute investigation - Water resistance investigation
Geography	n/a
History	n/a
Art	n/a
DT	Linked in with science by a DT project based on forces.

Forces
Key Knowledge

LKS2	
Which forces need contact between objects and which ones don't?	**Forces**- Pushes or pulls and will change the motion of an object. They will either make it start to move, speed up, slow it down or even make it stop. **Push:** A force to move something away and needs contact. **Pull:** A force to move something towards you and needs contact. **Friction:** A directly applied force that slows or stops motion when objects rub together. A force which acts between two surfaces or objects that are moving, or trying to move across each other. It works against the motion and in the other direction. Like if you're trying to slide a piece of furniture along the floor in your house, it's going to be easier to slide on laminate or wooden floor than it is on the carpet. And that's all to do with the friction caused between the carpet and the piece of furniture. Sometimes we need friction if we're riding a scooter, when we put our foot to the pavement, we use the friction to slow us down. This is also how ice skaters change their speed and direction, using the friction between the ice and their skates for example. Friction can also create heat, like when we're cold and we rub our hands together to warm up. That's because of the friction of our two palms rubbing together. But it can sometimes be bad, too, for example, when we fall on the ground and the friction between our skin and the floor causes us to scrape our knee. Or when our shoes get worn out at the bottom because of the constant friction between them and the ground. Or it's a good excuse to buy some new shoes. There are also two types of friction- static and kinetic. Static friction happens when two objects aren't moving and kinetic friction happens between two objects that are. **Definitions:** **Surface:** The top layer of something- different surfaces create different amounts of friction- this depends on the roughness of the surface and the object, and the force between them. **Driving force:** Pushes something like a bicycle, making it move. **Gravity:** A natural force that attracts two objects to each other. Objects have weight on Earth because gravity pulls them down. **Magnet:** An object which produces a magnetic force that pulls certain objects towards it.

Magnetic: Object which are attracted to a magnet are magnetic. Objects which contain iron, nickel or cobalt metals are magnetic. Not all metals are magnetic.
Magnetic field: The area around the magnet where there is a magnetic force which will pull magnetic objects towards the magnet. A magnetic field is invisible but can be made visible by using iron fillings on paper with a magnet underneath.
Poles: North and south poles are found at different ends of a magnet.
Magnetism: Magnets attract magnetic materials without contact, such as metals and other magnets. Two magnets held close together can create pushing (repelling) or pulling (attracting) forces on one another.
Repel: Repulsion is a force which pushes objects away. North pole to north pole repel.
Attract: Attraction is a force which pulls objects together. When north pole is placed near the south pole of another magnet, the two poles attract.
Like poles repel.
Opposite poles attract.
The needle in a compass is a magnet and always points north- south on earth.

By the end of the unit all pupils should be able to:

- Identify forces as pushes and pulls.
- Describe friction as a force that slows objects down.
- Feel the pulling force of a magnet.
- Sort materials according to whether they are magnetic or not.
- Participate in an investigation into magnet strength.
- Identify the different poles of a bar magnet.
- Use a magnetic compass with four points.
- Make a prediction.
- Record results from an investigation.
- Form a conclusion from their results.

Most children will be able to:

- Identify the type of force required to carry out an action.
- Investigate the force of friction produced by different surfaces.
- Explain that magnets produce an invisible pulling force.
- Identify magnetic materials.
- Identify different types of magnet.
- Investigate the strength of different magnets.
- Identify when magnets will repel or attract based on their poles.
- Construct a bar chart of their results.
- Explain their predictions and conclusions using key words or prompts.

	Some children will be able to: • Make generalisations about the types of surfaces that produce the most or least friction. • Identify and describe the invisible magnetic field around a magnet. • Make generalisations about the types of materials that are attracted to magnets. • Use a magnetic compass with 8 points. • Construct results more independently. • Explain their predictions and conclusions.
What affect do magnets have on other magnets and materials?	A magnet is an object that is made of materials that create a magnetic field. Magnets have at least one north pole and one south pole. A magnetic field is the region in space where a magnetic force can be detected. If you put two north poles or two south poles together, they will repel. If you put two opposite poles together, they will attract. If you bring two bar magnets together, there are two things that can happen, attraction and repulsion: if you bring a north pole and a south pole together, they attract and the magnets stick together. if you bring two north poles together, or two south poles together, they repel and the magnets push each other away. Magnetism can be described as a force that attracts and repels magnetic objects. This force is mediated by magnetic fields that penetrate different media. Some materials naturally have magnetism as a default property. However, certain materials can be magnetised or demagnetised according to the requirements. **Definitions:** **Magnet:** An object which produces a magnetic force that pulls certain objects towards it. **Magnetic:** Object which are attracted to a magnet are magnetic. Objects which contain iron, nickel or cobalt metals are magnetic. Not all metals are magnetic. **Magnetic field:** The area around the magnet where there is a magnetic force which will pull magnetic objects towards the magnet. A magnetic field is invisible but can be made visible by using iron fillings on paper with a magnet underneath. **Poles:** North and south poles are found at different ends of a magnet. **Magnetism:** Magnets attract magnetic materials without contact, such as metals and other magnets. Two magnets held close together can create pushing (repelling) or pulling (attracting) forces on one another. **Repel:** Repulsion is a force which pushes objects away. North pole to north pole repel.

	Attract: Attraction is a force which pulls objects together. When north pole is placed near the south pole of another magnet, the two poles attract. Like poles repel. Opposite poles attract. Twinkl has many resources about forces including a forces and magnets quiz: Forces and Magnets Quiz PowerPoint (teacher made) (twinkl.co.uk)
How can materials be grouped together? (Investigation)	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 Investigate which materials are attracted to magnets and which ones are not. Identify which materials are magnetic. Predict whether two magnets will attract or repel each other, depending on which poles are facing.
What is air resistance, water resistance and friction?	Investigate the effects of air resistance, water resistance and friction, that act between moving surfaces. Air resistance is a kind of friction that occurs between air and another object. It is the opposing force that the object experiences as it passes through the air. Air resistance and gravity are the two fixed forces of nature which move on any object lifted from the earth and moved through the air. For example, when a plane flies through the air, the air particles are resisting the aeroplane, making it harder for the aircraft to move. That's why when you see a feather or some cotton wool, it doesn't seem to fall to the ground very fast. This is partly because these things are light, but also because they fluff or branch out, creating air resistance. Also known as 'drag,' air resistance is a force caused by air. The air particles hit the front of an object, causing it to slow down. The greater the surface area, the greater the number of air particles hit the object and the greater the overall resistance. There are two main things that affect air resistance- the speed of the object, and the cross-sectional area of the object. The faster an object is going, the more air resistance there'll be. It's the same for a large cross-sectional area; an increased area leads to an increased amount of air resistance.

	Here are some examples of air resistance in everyday life. Wind. When the wind blows, it is sometimes difficult to walk through the air. This is because the air resists your force and pushes back against you. Parachute. When a skydiver jumps out of an aeroplane, they open a parachute. Air resistance causes them to parachute slowly to the ground. Bicycle. When you ride a fast bike, air resistance pushes you back. Aeroplane. When an aeroplane is flying up in the air, the air particles hit the aeroplane so that it's more difficult to move through the air. Leaves. On a windy day, when you see leaves falling from a tree really slowly, that's because air resistance is slowing down its fall. Umbrellas. You know that annoying experience when it's raining cats and dogs and you put up your umbrella, but it's really difficult to hold because of the wind. For things to move quickly and efficiently through air or water, objects need to have a small surface area. This is because the bigger the surface area, the greater the resistance. This means that objects need to be streamlined in order to push against the air's force. Trains are designed to be streamlined so they can move quicker, getting you from one destination to the next! Even people can try and be streamlined, like swimmers, for example. They try and maintain a streamlined shape during races so that they can get through the water quicker. But this is because of water resistance, rather than air resistance (hence, you know, them being in water and everything). Can your students think of any more items that are streamlined to reduce air resistance? One way of testing how streamlining works is to create your own paper aeroplanes. Get some pieces of paper, screw some up, and turn some into planes, and then see which falls faster. Through this, you can see how having a streamlined shape affects how fast you fall. Air resistance, or drag, can be put into one of three categories; lift induced, parasitic, and wave. Each of these types of air resistance affects an object's ability to stay up and the power it will need to keep it there. Lift induced air resistance happens as the result of the creation of lift on a three-dimensional lifting body (wing or fuselage).

	Parasitic drag happens when a solid object moves through a fluid. This type of air resistance is made up of lots of components like 'form drag' and 'skin friction drag'. Wave drag is made when an object moves at a high speed through a compressible fluid. **Fun Facts** Because of air resistance, cyclists crouch low on their bikes to make them go faster! They also have streamlined cycling equipment so that air passes easier so it doesn't slow them down. Because sports cars have a streamlined shape, they'll go faster than other vehicles because they experience less air resistance. Because of air resistance, using a parachute slows your fall to around 12 mph, making a much safer landing. Friction can generate static electricity. You can see this when you rub a balloon against your head and the friction causes your hair to stand up. Or you rub your feet along the carpet and give someone an electric shock. Water resistance is a type of force that uses friction to slow things down that are moving through water. It is often called drag. Water resistance doesn't have to be just water, however, it can happen to objects moving through any type of fluid. Water resistance happens because of the particles in water or the fluid.
UKS2	
How can materials be grouped together?	Investigate how materials can be grouped on the basis of their properties- Which materials are magnetic? Materials can be divided into five categories; metals, glass, plastics, wood, and fabrics- recap this.
How do the properties of different materials effect its function?	Metals are strong, hard and are often used for building durable items such as pots and pans. They can conduct heat and electricity very well, and some are magnetic. Glass is a transparent material that can be found in windows and other items that need to be seen through. Plastics are useful for many purposes. They are strong and do not conduct heat or electricity, so are often used in packaging, household objects, and other common items. Wood is a material that we can commonly find in nature, as it is what trees are made out of. It is strong and can insulate heat and electricity, making it a top choice for houses and furniture.

	Fabrics are used to make clothes and can have many different properties. They are made by weaving together small fibres to create the larger fabric. Plastics are an example of synthetic material, as you cannot find them in nature. Instead, they are created by using chemicals for a specific purpose. Plastic was only developed in the 20th century, but are used often nowadays. Based on the previous investigation, discuss which materials are used for a specific function. All building materials are solids, which means their particles are closely packed together and are difficult to break apart. The two other states of matter are liquids and gases, both of which have particles with different behaviours to solids. Some materials are more environmentally-friendly than others. For example, most plastics are not biodegradable and will not be able to be recycled. Others such as metal, can be reused by heating and melting them into other objects. On average, it takes around 500 years for plastic to decompose, so it's important to change practices and use sustainable alternatives where we can. All of the five categories can be used to make a variety of objects. For instance, wood is used to make paper products. Metals are found in underground deposits and can vary in their properties. Iron and steel are very strong and can be used to construct buildings and other large structures. Plastics were almost unheard of a century ago, but have been developed to be used in almost every area today. Laptops, bottles, chairs, and even clothes are all likely to have some plastic used to build them.
What is air resistance, water resistance and friction?	Y5- Water resistance experiment Y6- Air resistance experiment For things to move quickly and efficiently through air or water, objects need to have a small surface area. This is because the bigger the surface area, the greater the resistance. This means that objects need to be streamlined in order to push against the air's force. Objects such as trains, cars and aeroplanes are designed to be streamlined so they can move quicker, getting you from one destination to the nex. Even people can try and be streamlined, like swimmers, for example. They try and maintain a streamlined shape during races so that they can get through the water quicker. But this is because of water resistance, rather than air resistance (hence, you know, them being in water and everything). Can your students think of any more items that are streamlined to reduce air resistance? One way of testing how streamlining works is to create your own paper aeroplanes. Get some pieces of paper, screw some up, and turn some into

planes, and then see which falls faster. Through this, you can see how having a streamlined shape affects how fast you fall.

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Fun Facts

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Investigate the effects of air resistance, water resistance and friction, that act between moving surfaces.

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	nature which move on any object lifted from the earth and moved through the air. For example, when a plane flies through the air, the air particles are resisting the aeroplane, making it harder for the aircraft to move. That's why when you see a feather or some cotton wool, it doesn't seem to fall to the ground very fast. This is partly because these things are light, but also because they fluff or branch out, creating air resistance. Also known as 'drag,' air resistance is a force caused by air. The air particles hit the front of an object, causing it to slow down. The greater the surface area, the greater the number of air particles hit the object and the greater the overall resistance. There are two main things that affect air resistance- the speed of the object, and the cross-sectional area of the object. The faster an object is going, the more air resistance there'll be. It's the same for a large cross-sectional area; an increased area leads to an increased amount of air resistance. Here are some examples of air resistance in everyday life. Wind. When the wind blows, it is sometimes difficult to walk through the air. This is because the air resists your force and pushes back against you. Parachute. When a skydiver jumps out of an aeroplane, they open a parachute. Air resistance causes them to parachute slowly to the ground. Bicycle. When you ride a fast bike, air resistance pushes you back. Aeroplane. When an aeroplane is flying up in the air, the air particles hit the aeroplane so that it's more difficult to move through the air. Leaves. On a windy day, when you see leaves falling from a tree really slowly, that's because air resistance is slowing down its fall. Umbrellas. You know that annoying experience when it's raining cats and dogs and you put up your umbrella, but it's really difficult to hold because of the wind. Friction is a force, the resistance of motion when one object rubs against another. Whenever two objects rub against each other, they cause friction. Friction works against the motion and acts in the opposite direction.

Which mechanisms allow a smaller force to have a greater effect?	A mechanism is a device that changes an input force or motion, into a different output force or motion. Some mechanisms make work easier to do, by allowing a smaller force to have a greater effect. There are different types of mechanisms: 1. Levers Levers are the simplest type of mechanism. They are really good at lifting objects and can be used to make objects easier to lift. 2. Gears Gears are toothed wheels that lock together and turn one another. The wheels are usually different sizes so that one gear speeds up to slow down the next gear. Gears are also used to change the direction of movement. 3. Pulleys Pulleys are like gears, but the two wheels do not lock together. Instead, the wheels are joined by a belt. Pulleys can be used to change the speed, direction or force of a movement.

Forces Vocabulary

Vocabulary				
Tier 1 (general)	Material Investigate Experiment Metal Hard	Compare Surface Drag Plastics	Motion Attract Streamlined Wood	Repel Compare Glass Fabric
Tier 2	Magnet Magnetic Push Absorbent Translucent Insulating	Pull Friction Levers Gears Pulleys Flexible	Forces Force Driving force Particles Permeable Flammable	Resistance Poles Reflective Flexible Transparent Conductor Insulator
Tier 3	Friction Magnet Air resistance Water resistance	Gravity Magnetic Mechanism	Magnetic field Poles: Magnetism	Iron Nickel Cobalt