YEAR 3: SPRING 1 – INVENTIONS

SCIENCE: Forces and Magnets

Ocean Academy Poole
an Aspirations Academy

UNDERSTAND, DESCRIBE AND EXPLAIN: Forces

To understand and describe different types of forces and whether they are creating a push or pull reaction

To understand and describe the force of friction

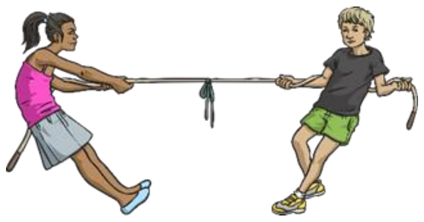
To compare how things move on different surfaces

Learning links:
Year 5: Science Forces
Year 3: DT Building and testing magnetic cranes with a pulley system

Force	***Push***	***Pull***	***Twist***	***Stop***	***Start***	
Balanced	***Unbalanced***	***Size of force***	***Forces 'acting' on an object***	***Motion***	***Direction***	
Energy	***Speed up***	***Slow down***	***Change direction***	***Friction***	***Rough***	***Smooth***

What is a force?

A ***force*** is a ***push***, ***pull*** or ***twist*** acting on an ***object*** because of the object's ***interaction*** with ***another object***. ***Forces*** can make objects ***stop*** or ***start*** moving.
Forces make things ***move***. Whenever an object ***starts*** to ***move*** or moves ***faster***, it is a ***force*** making this ***happen***. ***Forces*** can also make things ***stop*** moving or ***slow down***.
Can you think of times when you use a push, pull or twist force?



Balanced forces:

If ***two forces*** are ***balanced***, it means the forces are the ***same size*** but are ***acting*** in ***opposite directions***. If ***two balanced*** forces are ***acting*** on an ***object***, that object will ***not change*** its ***motion***. If it is ***still***, the object will ***stay still*** or if it is ***moving***, it will ***continue moving*** in the ***same direction*** and at the ***same speed***.

Unbalanced forces:

When ***two forces acting*** on an ***object*** are ***not equal*** in ***size***, we say that they are ***unbalanced forces***. Unbalanced forces ***do change*** the way something is ***moving***. They can ***make objects start to move***, ***speed up***, ***slow down*** or ***change direction***.

How much force?

The ***amount of force*** needed to ***push*** or ***pull*** an ***object*** depends on the ***amount of friction*** or ***resistance*** acting on the object.
If an ***object*** is ***very heavy*** (***weight***), the ***size of force acting on the object*** to ***push*** or ***pull*** will need to be ***greater***.
To push an object across a ***rough, bumpy surface*** (like a gravel path) would be very ***difficult.*** However, if that ***same object*** was on a ***slippery, smooth surface*** (like an ice rink), ***less force*** would be ***needed*** to ***push*** it across the ***surface*** because there would be ***less friction***.

Friction:

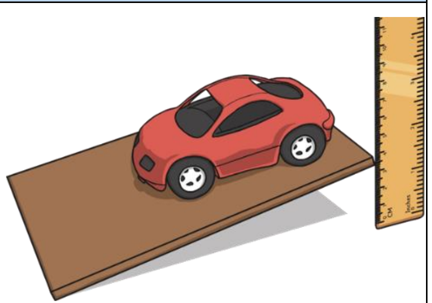
Friction is a ***force*** that ***holds back the movement*** of an ***object***. ***Friction*** acts in the ***opposite direction*** to the ***movement*** of the ***object***.
The ***amount of friction created*** by an object moving over a ***surface*** depends on the ***roughness*** of the ***surface and the object***, and the ***force between them***. For example, if you were riding a bike and ***stopped pedalling***, you would ***eventually slow down and stop***. This is because the ***friction*** of the ***tyres*** on the ***surface slows down*** the ***motion*** of the ***bicycle*** until it eventually ***runs out of energy from the force*** that gave it the forward motion (pedalling). If you were ***cycling*** on a particularly ***bumpy*** or ***rough surface***, the ***friction*** would be ***greater*** and the bike would come to a ***stop sooner*** than if on a ***smooth*** tarmac road. Would it be easier to cycle on a smooth road or a sandy path?

EXPLORE AND INVESTIGATE:

HYPOTHESISE
ENQUIRE
TEST
RECORD
REPORT
CONCLUDE

Investigating friction:

1. Locate some boards covered in different surfaces with varying textures (rough and smooth), a ruler and a toy car.
2. Place the car at the end of one of the boards.
3. Place the ruler at the side of the board, so you can measure the height of the board as you lift the end.
4. Lift the end of the board that the car is on 1 cm at a time.
5. Watch the car carefully, and notice at what height it starts to move. Record this measure.
6. Try this with each of the boards covered with different surfaces.
7. Record the results in a table and evaluate the findings.
8. What did you discover? Which surface created the most friction? Which surface created the least friction? Was your prediction accurate?



KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

EXS:

What is a force?
How can we make objects move?
If I push/roll a ball or toy car on any surface, why does it eventually stop? Is it the same for every surface?

GDS:

How can friction be a useful force in everyday life?
Design a pair of shoes that would help an explorer who had to travel on the following surfaces:

- Ice
- Boggy mud
- Rough, rocky terrain

UNDERSTAND, DESCRIBE AND EXPLAIN: Magnets

To understand that magnetic forces can act at a distance because of the magnetic field

To understand magnetic force and how some objects are magnetic and others are not

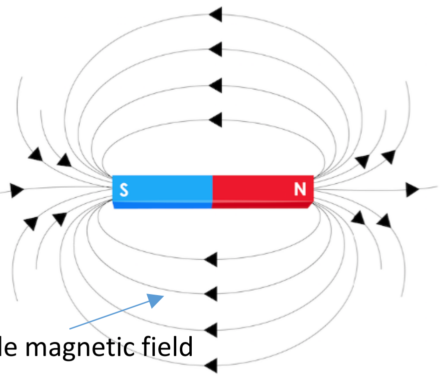
To describe magnets as having two poles and understand whether magnets will attract or repel

Learning links:
Year 5: Science Forces
Year 3: DT Building and testing magnetic cranes

Magnet		*Force*		*Magnetic force*	*Magnetic field*	*Materials*	*Magnetic materials*
Attract		*Repel*		*Magnetic materials*	*Non-magnetic materials*	*Invisible*	*Metal*
Iron	*Cobalt*	*Steel*	*Nickel*	*Attracted*	*Magnetic Poles*	*North*	*South*

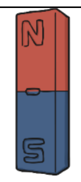
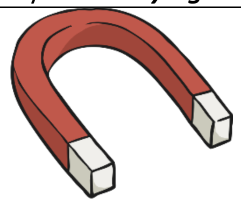
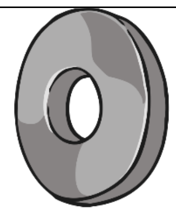
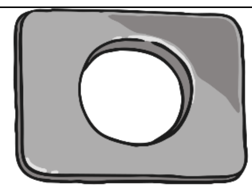
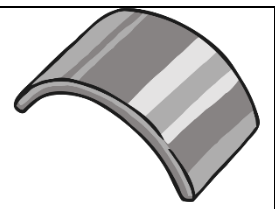
What is a magnet and a magnetic field?

A ***magnet*** is a ***special*** type of ***object***. It produces an ***area of magnetic force*** around itself, called a ***magnetic field***. The ***magnetic force*** in a magnet ***flows*** from the ***North pole to the South pole***. This creates an ***invisible magnetic field*** around a ***magnet***.
If ***certain materials*** enter this ***magnetic field***, they will be ***attracted*** to the ***magnet***. This will ***cause*** the ***materials*** to ***stick*** to the ***magnet***.
For example, as you ***move*** a ***magnet towards*** a ***steel nail,*** the nail will eventually ***enter*** the ***magnetic field*** around ***the magnet***, it will ***'jump'*** towards the magnet and ***stick***. The ***magnetic force*** within the ***magnetic field pulled*** the nail towards it. Therefore, the ***steel nail*** is ***magnetic***!
The ***stronger*** the ***magnet*** is, the ***larger*** its ***magnetic field*** will be. Therefore, it will be ***able to attract magnetic objects*** from ***further away*** and ***hold heavier weights*** of magnetic objects.



Invisible magnetic field

There are lots of ***types of magnets*** and they have ***varying magnetic strength, shape and size***:

						
Bar magnet	**Cylindrical magnet**	**Horseshoe magnet**	**Button magnet**	**Ring magnet**	**Square magnet**	**Arc magnet**

Which materials are magnetic?

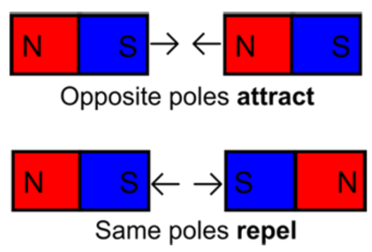
Magnetic materials are ***always*** made of ***metal***, but ***not all metals*** are ***magnetic***.
Iron is ***magnetic***, so any ***metal*** with ***iron in it*** will be ***attracted*** to a ***magnet***. ***Steel contains iron***, so anything made of steel will be attracted to a magnet. ***Most other metals***, for example ***aluminium***, ***copper*** and ***gold***, are ***NOT magnetic***.
Metals, which ***contain iron*** and are therefore ***magnetic,*** are: ***Iron, cobalt, steel and nickel***. A good way to ***remember*** this is: ***'I Can See Nick'***. You can ***test*** if a ***material*** is ***magnetic*** by holding a ***magnet*** close to it to see if it ***attracts*** or not.

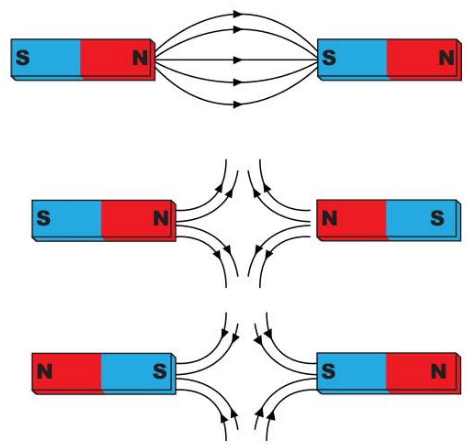
What are magnetic poles?

All magnets, regardless of their shape and size, have ***two*** different ***parts*** called the ***poles***. There is a ***north pole*** and a ***south pole***.
The ***magnetic force*** in a ***magnet flows*** from the ***North*** pole to the ***South*** pole. This ***creates*** a ***magnetic field*** around the magnet. Magnetic force is strongest at the ends of the magnet.

Attract or repel?

Have you ever held two magnets close to each other? They do not act like most objects. Have you noticed that, if you try to push the ***South poles together***, they ***repel each other***? If you try to push the ***North poles together***, they also ***repel each other***. However, if you push the ***North and South poles together*** they ***attract*** and ***pull together*** – with magnets, ***opposites attract***.





EXPLORE AND INVESTIGATE:

HYPOTHESISE
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Testing magnetic strength and magnetic fields:

Test 1:
1. Testing a variety of magnets, add one paper clip at a time to test how many steel paperclips the magnet can hold.
2. Record the results of the different magnets.
3. What did you discover? What does this tell you about each magnet and its magnetic field?

Test 2:
1. Place a ruler flat on a table and a magnet at the 0 measure of the ruler.
2. Place a steel paperclip at the 30cm measure of the ruler. Does it attract to the magnet?
3. Move the paperclip, 1cm at a time, closer to the magnet and record whether it is attracted or not.
4. Repeat and record for different magnets.
5. What did you discover? What does this tell you about each magnet and its magnetic field?

Testing materials – magnetic or not?
1. Compile a collection of everyday objects.
2. Using a magnet, test whether these materials are magnetic or not.
3. Record your results.
4. What did you discover? What does this tell you about the properties of the material? What must it contain?

KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

EXS:
What is a magnetic force?
What does magnetic mean?
How do we know if materials are magnetic?
Describe what happens when you put different parts of 2 magnets together.
Why are only some metals magnetic?
Can you find objects around the classroom that are magnetic? What material is it?

GDS:
Can you see a magnetic field? How do you know it exists?
Explore the use of magnets and explain how they can be useful in everyday life.
Use a labelled diagram to explain to others what you understand about magnetic fields.
Use a labelled diagram to explain to others what you understand about magnetic poles.

YEAR 5: SPRING 1 – INVENTIONS
SCIENCE: Forces

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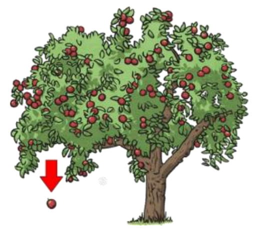
UNDERSTAND, DESCRIBE AND EXPLAIN: Gravity

To understand and explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object

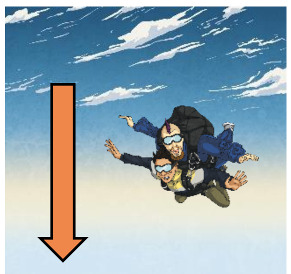
Learning links:
Year 3: Science Forces and magnets
Year 5: DT Building and testing air pressure rockets and exploring the forces in action
Year 4: History Stuart Britain

Forces	***Push***	***Pull***	***Twist***	***Sir Isaac Newton***	***Theory of Gravity, 1687***
Interaction	***Movement***	***Speed***	***Direction***	***Shape***	***Affect (v)/Effect (n)***
Gravity	***Earth***	***Planets***	***Sun***	***Exerted***	***Gravitational force***

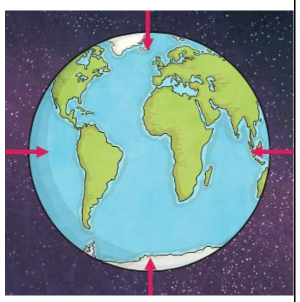
You should remember learning about forces and magnets in Year 3. If you cannot remember, or need to refresh your understanding, have a read of the Year 3 Forces and Magnets Learning Journey Map.



<u>What are forces?</u>
A ***force*** is a ***push***, ***pull*** or ***twist*** acting on an ***object*** because of the object's ***interaction*** with ***another object***.
Forces affect the ***movement*** or ***shape*** of an ***object***. They can make an object ***start to move***, ***stop moving***, ***move faster*** or ***move more slowly***. They ***could*** also make an object ***change its shape*** or cause a moving object to ***change direction***.

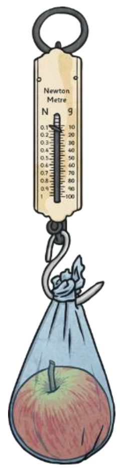


<u>Gravity:</u>
Gravity is an ***invisible force*** that ***pulls*** the ***Earth*** and other ***planets towards*** the ***Sun***. It also ***keeps us*** and other objects ***on the ground***. We can ***represent gravity*** with an ***arrow pointing down towards the Earth***.
Gravity is a ***pulling force exerted*** by the ***Earth***. The ***gravitational force*** from the ***Earth pulls*** in a ***direction towards the centre of the Earth***. ***Gravity*** is ***pulling*** the apple and these skydivers ***towards the Earth***.
Anything, which has ***mass***, ***exerts a gravitational force***. The ***larger the mass***, the ***greater the gravitational force***. For example, the ***Sun*** has a ***mass*** so ***huge*** that it ***creates a gravitational force strong enough*** to ***hold*** the entire ***solar system*** in place. ***Planet Earth*** has a ***mass*** big enough to exert a ***gravitational force*** strong enough to keep everything on it ***in place*** and to ***keep a natural satellite*** (the moon) ***in orbit***.
The ***Moon's gravity*** is ***one-sixth*** (1/6) of ***Earth's gravity***, so an object with the ***same mass*** will ***weigh differently*** on Earth than it does on the ***Moon***. For example, an astronaut ***weighs 120kg*** on Earth. Even though the astronaut ***does not change size or mass***, their ***weight*** on the ***Moon*** would be just ***20kg***.



<u>Weight and Mass:</u>
Mass is a ***measure*** of how much ***matter*** or 'stuff' is in an ***object***. Small objects may contain a lot of matter, like a metal ball. Larger objects may contain very little matter, like a polystyrene block.
Weight is the ***mass*** of an object, ***affected*** by how ***strong*** the ***gravity*** is. Therefore, ***weight*** is ***also*** a ***force***. ***Weight*** is the ***force*** of a ***mass pushing down*** (by ***gravity***) on the ***surface*** on which it is standing. ***Weight*** is ***measured*** in ***Newtons***.

<u>Sir Isaac Newton:</u>
Sir Isaac Newton was ***born*** in ***1642*** and is ***known*** as one of the ***greatest scientists*** to have ***lived***, as he was the man who ***published*** his ***theory*** of ***gravity*** in ***1687***. Legend has it, that ***Newton*** was ***hit on the head*** with an ***apple*** and that is how he discovered gravity. However, this is ***not quite true***… He did ***see an apple fall*** from a tree, but rather than hitting him on the head, it ***got him thinking*** and that is how he ***worked out*** that ***gravity must exist***.
Newton discovered that ***Earth must have a force***, which ***pulls things down*** instead of ***letting things float*** upwards. We call this ***force gravity***. ***Newton*** discovered that ***gravity attracts all objects towards each other***. The ***bigger*** an ***object***, the ***more gravity*** it would ***have***. He ***developed*** this ***theory*** to work out that ***gravity*** kept the ***moon*** in ***orbit around Earth***.
Did you know?
This is why the ***weight of 1 Newton*** is ***approximately*** the ***same*** as ***one apple***.



EXPLORE AND INVESTIGATE:

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<u>Measuring weight on different planets, moons and stars:</u>
Scales have been designed to incorporate the Earth's gravity (9.8 m/s) when measuring mass so that the items weight is reflective of that on Earth. However, depending on the size of the planet/star, the force of gravity is different.
Use a set of measuring scales to measure the weight of various everyday objects on Earth.
You can work out how much the same item would weigh if placed on different stars, moons or planets by multiplying or dividing their Earth weight.

- Gravity of the Sun = 27 x stronger than the Earth.
- Gravity of the Moon = 6 x weaker (divide) than the Earth.
- Gravity of Jupiter = 2.5 x stronger than the Earth.
- Gravity of Mars = 3 x weaker (divide) than the Earth.

KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

<u>EXS:</u>
Name the force that pulls objects towards the Earth.
Who discovered gravity? When was the theory published?
What is gravity? Can you explain it simply in 5 sentences?
What is the difference between weight and mass?
How does gravity differ on different planets? What would happen if I dropped the same tennis ball on Earth, the Moon and Jupiter?

<u>GDS:</u>
What would happen if there was no gravity on earth?
Why do we need gravity?
Could humans survive without gravity?
Using labelled diagrams, create an encyclopaedia page to explain gravity to a target audience of your choice – consider your language choices.

UNDERSTAND, DESCRIBE AND EXPLAIN: Air resistance, water resistance and friction

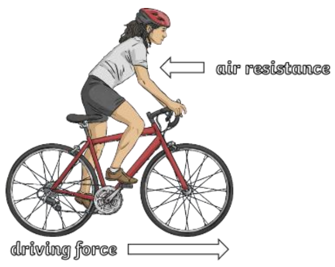
To identify and understand the effects of air resistance, water resistance and friction, that act between moving surfaces

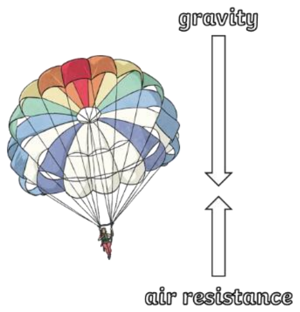
Learning links:
Year 3: Science Forces and magnets
Year 5: DT Building and testing air pressure rockets and exploring the forces in action
Year 4: History Stuart Britain

Air resistance	*Gas*	*Counteracts*	*Galileo Galilei (1564 – 1642)*	*Opposing forces*	*Surface area*	*Comparison*
Water resistance	*LIquid*	*Dense*	*Streamline(d)*	*Efficient*	*Reducing resistance*	

What is air resistance?

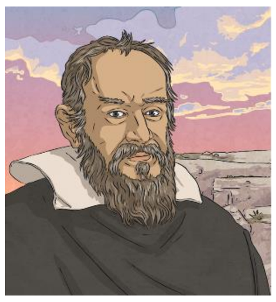
Air resistance is the name of the ***force*** that is ***pushing up against the parachute***.
Gravity is ***pulling*** the skydivers ***towards*** the ***ground***. However, they are ***slowed down*** because a ***force*** (***air resistance***) ***pushes against*** the inside of the ***parachute*** and they ***descend more slowly***. ***Gravity*** and ***air resistance*** are ***opposing*** forces in this situation but ***gravity*** is still the ***stronger of the two***.
Air resistance can be a ***useful force***, but it can ***also*** be ***unhelpful*** in certain situations.
In a ***cyclist's situation***, the ***air resistance*** is ***unhelpful*** as it is ***slowing down*** the ***speed*** being ***generated*** by ***pedalling***; making it ***harder work to move forward***.
When ***parachuting***, ***air resistance*** is a ***useful force*** as it ***counteracts*** the force of ***gravity*** to ***slow*** the ***speed down*** so that the passenger can ***land safely***.





Galileo Galilei, (1564-1642)

Galileo Galilei was an ***Italian scientist*** and ***mathematician*** who wondered about air resistance.
In ***1590***, he decided to ***carry out an investigation*** to ***find the answer***.
He climbed to the top of the ***Leaning Tower of Pisa*** with ***two balls of similar shape and size***, but with ***different masses***. He ***dropped both*** of the balls from the top of the tower at the ***same time***. ***Both*** balls ***hit*** the ***ground*** at the ***same time***.
Galileo's experiment ***proved*** that ***all objects fall at the same rate***, no matter what their mass is. But this can seem ***hard to believe***! Think about a feather and a hammer. If you ***dropped both*** objects at the ***same time***, would they ***hit the ground*** at the ***same time***? No, they wouldn't. However, that isn't because of their mass, it is because of their ability to 'catch air'.



What do you think happened when astronauts stood on the Moon and dropped these two items at the same time?
The feather and the hammer ***hit*** the ***surface*** of the Moon at the ***same time***! This proved that Galileo's findings are correct.

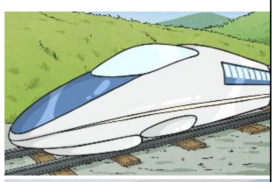
Why did this happen?
There is ***no air on the Moon***. ***Air pushes against*** any ***object*** moving through it: ***air resistance***.
On ***Earth***, ***air resistance acts*** on ***both*** the hammer and the feather. The ***feather*** has a ***large surface area*** in ***comparison*** to its ***mass***. The ***hammer*** has a ***small surface area*** in ***comparison*** to its ***mass***. Therefore, ***air resistance*** has a ***greater upwards force*** on the ***feather*** causing the hammer to reach the ground first. Since there is ***no air*** on the ***Moon***, there is ***no air resistance*** to push against the feather, so the ***two objects fall*** at the ***same speed***.

What is water resistance?

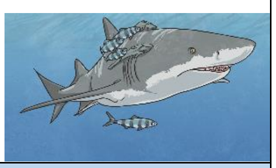
In the ***same way*** that ***air*** can cause ***resistance*** to ***moving objects***, so can ***water***. Being a ***liquid*** (***more dense*** than air), the ***effects*** of ***water resistance*** are more ***obvious***.
If you have ever ***walked through water***, you will have ***felt*** the ***effects*** of ***water resistance pushing against you***.
However, ***water resistance*** is a ***useful force*** as it ***helps*** you to ***swim***. When you ***push against*** the ***water*** with your hands, the ***water resistance pushes back*** and ***helps*** you to ***move forward***, like using oars to push against the water to row a boat.

Streamline shapes to reduce resistance:

For ***speed*** and ***direction purposes***, ***air*** and ***water resistance*** are ***unhelpful forces*** as they ***counteract*** the ***force*** creating ***forward motion***. It is possible to ***reduce*** the ***effects*** of ***water*** and ***air resistance***. For example, cars, trains, planes and boats are ***designed*** to ***reduce*** the ***effects*** of air and water resistance to ensure the ***most efficient use of energy and fuel***. ***Objects*** that ***do not experience*** much ***water or air resistance*** are described as ***streamlined***.
This ***high-speed train*** and ***jet aircraft*** have been ***designed*** to be ***streamlined*** and ***reduce*** the ***impact*** of ***air resistance***.
Both examples have a pointed (cone-shaped) nose so that they can 'cut' through the air, a low, curved top to allow the air to flow over and around it easily and they are both also made of smooth, shiny materials.



Looking at nature too, we can see how certain animals have adapted to be more streamlined.
The great white shark, for example, has a ***pointed nose*** to ***cut through the water***, and a ***smooth, low, curved back*** to allow the ***water*** to ***flow over*** and ***around it***. It does not create much ***water resistance*** so it can ***move*** through the ***water quickly***.



EXPLORE AND INVESTIGATE:

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Investigating air resistance:
1. Find a safe space to drop paper from a height.
2. Each group has 5 pieces of paper: 1 piece will remain in its original form, another piece will be scrunched in to a ball. The remaining 3 pieces can be designed in to any chosen shapes/forms by folding only. The paper must not be cut or ripped, only folded. Nothing can be stuck to or added to any sheet of paper.
3. One piece of paper can then be dropped from a height at once. Using a stopwatch, time how long each piece takes to reach the ground.
4. Record the results. What did you discover? What does this tell you about air resistance, shape design and surface areas?

Investigating water resistance:
1. Fill a deep container or wide measuring cylinder with water.
2. Using 3 equal portions of modelling clay, create 3 shapes (e.g. cone, sphere, cube).
3. One at a time, drop each shape in to the water-filled container.
4. Using a stopwatch, time how long each shape takes to reach the bottom of the container and record the results.
5. What did you discover? What does this tell you about water resistance, shape design and surface areas?

KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

EXS:
Using diagrams, can you explain air and water resistance as forces.
Describe how air resistance/water resistance can be a useful or unhelpful force in different situations.
What does 'streamlined' mean?
Describe how air and water resistance could be reduced or increased and for what this could be useful.

GDS:
If you were stood on the moon and dropped 2 items, which would reach the ground first? Why is this?
Would a parachute be of use if landing on the moon? Why?
Looking at a creature designed to be streamlined, label and justify how it has adapted to be less resistant to air or water.

UNDERSTAND, DESCRIBE AND EXPLAIN: Levers, pulleys, cogs and gears

To recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect

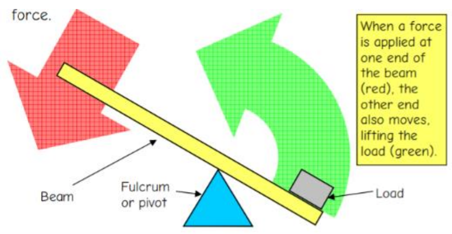
Learning links:
Year 3: Science Forces and magnets
Year 3: DT Building and testing magnetic cranes with a pulley system

Machines	*Devices*	*Gears*	*Cogs*	*Wheels*	*Ramps*	*Wedges*	*Levers*	*Screws*	*Pulleys*
Fulcrum/Pivot		*Direction*		*Speed*	*Force*	*Increase*	*Decrease*	*Drive gear*	*Clockwise/Anticlockwise*

Machines:

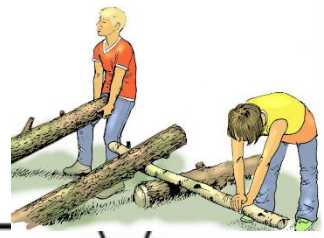
Machines are ***devices*** that ***change*** the ***direction*** or ***size*** of a ***force***. There are ***six types*** of ***simple machines***: ***wheels***, ***ramps***, ***wedges***, ***levers***, ***screws*** and ***pulleys***. ***Most*** simple machines ***reduce*** the ***force*** you need to ***apply*** to ***lift*** or ***move*** a ***heavy object*** by making the ***distance*** over which you ***apply*** the ***force larger*** than the ***distance*** the ***object moves***.

Levers:



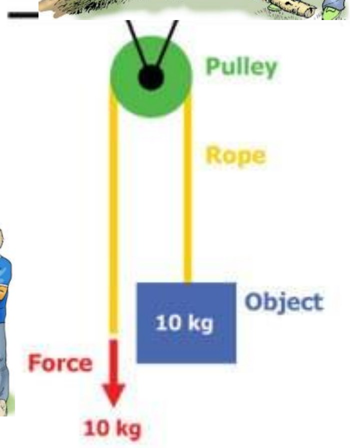
A ***lever*** is one of the oldest and ***simplest machines*** used by humans. A ***lever*** consists of just ***2 parts***: a ***beam*** (the long part) and a ***fulcrum*** or ***pivot*** (hinge). The ***beam rotates*** along the ***fulcrum*** like in this diagram here.

Levers are particularly ***useful*** because they allow ***humans*** to ***lift heavy objects*** by ***applying less force*** than if trying to lift without the lever. The boy in the picture is lifting a heavy log. It is so heavy he can hardly lift it. His friend is lifting a similar heavy log. He is lifting it more easily because he is using a small log resting on another log as a ***lever***. The ***lever*** makes lifting the heavy log easy. A ***lever*** always ***rests*** on a ***pivot***. In this case, the log on the ground is acting as a ***pivot***. A ***lever*** always has ***three things*** – the ***point*** where you ***push*** or ***pull***, the ***point*** where it ***pivots***, and the ***point*** where the ***force is applied***.



Pulleys:

A ***pulley*** is a ***wheel*** with a ***grooved rim*** around which a ***cord passes***. The pulley acts to ***change*** the ***direction*** of a ***force*** applied to the cord and is used to ***raise heavy weights***. In the picture, the boy and the girl are both lifting a bucket full of wood. The girl finds it difficult, but the boy is using a pulley tied to a tree and is lifting the bucket with the rope passing under the pulley. He has to exert the same pull as his friend, but he finds it easier to pull on the rope than she does to lift the bucket up by the handle.



Cogs and Gears:

Gears are ***wheels*** that have ***teeth***, or ***cogs***, around the ***edges***. The cogs of one gear fit into the cogs of another. They move in ***opposite directions***. In other words, when one ***gear*** turns to the right (***clockwise***), the gear attached to it will turn to the left (***anticlockwise***). This pattern continues to ***repeat***, regardless of how many gears are attached to each other. As ***gears turn***, energy is ***transferred*** from one gear to ***another***. They can either ***increase*** or ***decrease speed*** or ***force***.

If a ***large gear*** is ***attached*** to a ***small gear*** with the large gear as the ***drive gear*** (first turn), this will cause the ***small gear to turn***. As the ***larger gear*** (***drive gear***) turns, the ***small gear*** will ***speed up*** to keep up with it. This type of ***gear sequence increases speed***.

Gears are very ***useful*** for ***transferring energy*** in to ***larger movements***, ***speed*** or ***power***. They are used widely in bikes, motorbikes and cars.

EXPLORE AND INVESTIGATE:

HYPOTHESISE
ENQUIRE
TEST
RECORD
REPORT
CONCLUDE

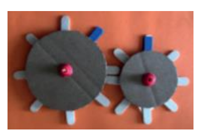
Investigating levers and fulcrums:

1. Place a weight/single object on one end of a 30cm ruler on the 0cm mark.
2. Place a pencil (fulcrum) underneath the ruler at the opposite end on the 30cm mark.
3. Place an equal weight/single object on the ruler at the 30cm mark. Did this lift the weight on the opposite side? Why not?
4. Move the pencil (fulcrum), one cm at a time, towards the original weight. Record whether the weight is lifted by the lever.
5. At what distance, on either side of the fulcrum, does the lever work?
6. Experiment with a lighter weight at the opposite end of the lever. What is the lightest weight that can be used to lever the weight?
7. What did you discover? What does this tell you about the positioning of a fulcrum and the usefulness of a lever in everyday life?

Investigating pulleys:

1. Set up a simple pulley mechanism by taping a metal can to a gap between 2 tables and laying a piece of string over the top.
2. Attach a selected weight to one end of the string and allow it to rest on the ground beneath the table.
3. Investigate and explore how the pulley system makes it easier to lift the weight. If available, use a force metre to measure the force needed to lift the weight with one pulley.
4. One at a time, add more pulleys to the system. Is it easier to lift the weight? Has the amount of force needed reduced?
5. What did you discover? What does this tell you about increasing the number of pulleys and the usefulness of a pulley in everyday life?

Investigating gears:



1. Using a compass, draw and cut various sized circles out of cardboard.
2. Cut lollipop sticks and stick to the cardboard to create cogs on their gears.
3. Once they have created each gear, they can be attached to a larger piece of cardboard using a cocktail stick/skewer.
4. From this gear, begin to create a different size gear with varying numbers of teeth to place next on the cardboard.
5. Once completed, one gear can be selected as the drive gear and the children can explore how the force from the drive gear changes as it moves through the different gears. Experiment by changing the drive gear.
6. What did you discover? What does this tell you about how gears can increase or decrease the original force or speed?

KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

EXS:

What effect can mechanisms like pulleys, levers and gears have?
Using diagrams, explain how a lever/pulley/gear works.
If a large gear is used as the drive gear and is connected to a smaller gear, how will this affect the original force?

GDS:

Can you investigate at what distance the fulcrum in a lever system must be to lift a weight with half of its weight?
What happens to the force needed when you add a pulley to a single pulley system?
If a small gear is used as the drive gear and is connected to a larger gear, how will this affect the original force?