



Year 5	Topic: Forces							
<p><b>Scientific Knowledge</b></p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> <li>• Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.</li> <li>• Identify the effects of air resistance, water resistance and friction, that act between moving surfaces.</li> <li>• Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.</li> </ul>	<p><b>Enquiry Types covered during this unit:</b></p> <table border="1" data-bbox="1137 300 2132 443"> <tr> <td>Identifying and classifying</td> <td>Comparative Testing</td> <td>Fair Testing</td> <td>Pattern Seeking</td> <td>Research using Secondary Sources</td> <td>Observation over time</td> </tr> </table> <p><b>Elements of Working Scientifically covered:</b></p> <ol style="list-style-type: none"> <li>1. Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary</li> <li>2. Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate</li> <li>3. Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs</li> <li>4. Using test results to make predictions to set up further comparative and fair tests</li> <li>5. Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations</li> <li>6. Identifying scientific evidence that has been used to support or refute ideas or arguments.</li> </ol>		Identifying and classifying	Comparative Testing	Fair Testing	Pattern Seeking	Research using Secondary Sources	Observation over time
Identifying and classifying	Comparative Testing	Fair Testing	Pattern Seeking	Research using Secondary Sources	Observation over time			
<p><b>Prior learning:</b></p> <ul style="list-style-type: none"> <li>•May have an awareness of how to make things stop and start.</li> <li>•Compare how things move on different surfaces.</li> <li>•Notice that some forces need contact between two objects, but magnetic forces can act at a distance.</li> <li>•Observe how magnets attract or repel each other and attract some materials and not others.</li> <li>•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.</li> <li>•Describe magnets as having two poles.</li> <li>•Predict whether two magnets will attract or repel each other, depending on which poles are facing.</li> </ul>	<p><b>End of Unit TAPs Assessment:</b></p> <p><b>Spinners</b></p> <ul style="list-style-type: none"> <li>•Can children improve accuracy by repeating measurements?</li> <li>•Can children identify patterns in results?</li> </ul> <p><b>Focus – Do (Observe and Measure)</b> Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate</p> <p><b>Aqua dynamics</b></p> <ul style="list-style-type: none"> <li>•Can children use test results to make predictions relating water resistance to surface area?</li> <li>•Can children identify variables which may affect the results?</li> </ul> <p><b>Focus – Review (Evaluate)</b> Explain degree of trust in results. Identify and evaluate scientific evidence (their own and others’) that has been used to support or refute ideas or arguments.</p>							
<p><b>Later learning:</b></p>								
<p><b>Vocabulary</b></p> <p>Force, push, pull, opposing, gravity, air resistance, water resistance, friction, streamline, brake, gear, mechanism, lever, cog, pulley, machine, Earth, buoyancy, upthrust</p>								
<p><b>Common Misconceptions</b></p> <p>Some children may think:</p>								

<ul style="list-style-type: none"> <li>• the heavier the object the faster it falls, because it has more gravity acting on it</li> <li>• forces always act in pairs which are equal and opposite</li> <li>• smooth surfaces have no friction</li> <li>• objects always travel better on smooth surfaces</li> <li>• a moving object has a force which is pushing it forwards and it stops when the pushing force wears out</li> <li>• a non-moving object has no forces acting on it</li> <li>• heavy objects sink and light objects float.</li> </ul>	<p><b>Famous scientists</b></p> <p>Sir Isaac Newton (1642 – 1727) – Formulated the laws of motion</p> <p>Christopher Cockerell (1910- 1999) – Inventor of the hovercraft</p> <p>Galileo – gravity (also Earth in Space)</p> <p>Archimedes - levers</p>
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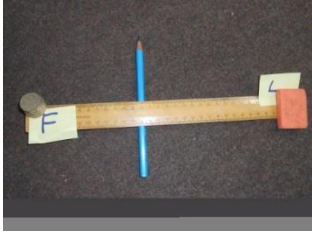
Lesson	Key Learning Objectives		Activities + Resources
	Knowledge and Understanding	Working Scientifically	

1	To identify forces acting on objects	To record data and results of increasing complexity using scientific diagrams and labels	<p>Discussion of prior forces knowledge, to include magnets from Year 3 - magnetic force acts at a distance, attract and repel, materials that are attracted to a magnet, poles, opposite poles attract, same poles repel.</p> <p>Knowledge organiser (Twinkl) – copies in books and discuss.</p> <p>Use slides:</p> <p><a href="https://www.twinkl.co.uk/resource/science-forces-fabulous-forces-year-5-lesson-pack-1-tp2-s-295">https://www.twinkl.co.uk/resource/science-forces-fabulous-forces-year-5-lesson-pack-1-tp2-s-295</a></p> <ul style="list-style-type: none"> <li>-What is a force? - pushes, pulls, twists, turns,</li> <li>-What do forces do to an object? Speed, slow, change direction, change shape.</li> <li>-Explain that forces are measured in newtons (N)</li> <li>-Gravity and Air Resistance.</li> <li>-Friction</li> <li>-Upthrust</li> </ul> <p>Activity - <b>Identifying and Classifying</b>: Draw, label and name all the forces acting on the objects in each of the pictures (Twinkl activity sheet)</p>
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2	To explain the effect of gravity	<p>Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations</p> <p>Identifying scientific evidence that has been used to support or refute ideas or arguments.</p>	<p><a href="https://www.twinkl.co.uk/resource/science-forces-gravity-year-5-lesson-pack-2-tp2-s-297">https://www.twinkl.co.uk/resource/science-forces-gravity-year-5-lesson-pack-2-tp2-s-297</a></p> <p>Recap: What is a force? What is gravity?</p> <ul style="list-style-type: none"> <li>- Clarify we can't feel gravity - only the effects and that gravity always pulls it never pushes</li> <li>- Weight and mass – the difference.</li> <li>- What do the children think stops us being sucked to the very centre of the Earth?</li> <li>- Idea of balancing forces so objects don't fall to the ground if they are on e.g. a shelf.</li> <li>- 400 years ago Galileo stood on top of the Leaning tower of Pisa and dropped two balls of different masses -what do they think happened? Hold two balls -of differing size e.g. tennis ball/ basketball. What will happen if I drop both balls at the same time? Draw a diagram to show what will happen – label any forces you think you know.</li> </ul>
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			<p>Main: Allow children to explore what happens on the playground with different sized balls – can they explain why they both fall? Why do they both hit the ground at the same time? Drop a feather and a ball – if what I have explained is true why has the feather fallen at a slower rate? Discuss ideas.</p>
3	To investigate the relationship between mass and weight	To take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate (use Newton meters to take accurate readings of weight and scales to measure mass)	<p><a href="https://www.twinkl.co.uk/resource/science-forces-gravity-year-5-lesson-pack-2-tp2-s-297">https://www.twinkl.co.uk/resource/science-forces-gravity-year-5-lesson-pack-2-tp2-s-297</a> Relationship between mass and weight. <u>Measure the force of gravity slide:</u></p> <ul style="list-style-type: none"> <li>- Measure the weight and mass of some different objects</li> <li>- The weight of an object is measured using a newton meter. Remember, weight is a measure of how strongly gravity is pulling on the object</li> <li>- The mass of an object is measured using a set of scales. Remember, mass is a measure of how much matter (or 'stuff') is in the object.</li> <li>- You can find an object's weight by placing the object in a bag and hanging the bag from the newton meter to measure how strongly gravity is acting on the object.</li> <li>- Children complete the measuring activity (Twinkl sheet shows this) – use table to record results</li> <li>- Discuss the link: should have discovered that gravity pulls objects down with a force of approximately 1N for every 100g. So if an object weighs 200g, gravity will pull it down with a force of 2N. Have another look at your results. Do they follow this pattern?</li> </ul>
4	LO To research a key scientist related to the topic	<p>Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations</p> <p>Identifying scientific evidence that has been used to support or refute ideas or arguments.</p>	<p><u>Intro:</u> Show a picture of Isaac Newton – How did Newton change our understanding of forces? <u>Galileo and Newton link.</u> Developing Experts Lesson 1 slides and/or <a href="https://www.bbc.co.uk/teach/class-clips-video/discovering-the-work-of-sir-isaac-newton/zr4mf4j">https://www.bbc.co.uk/teach/class-clips-video/discovering-the-work-of-sir-isaac-newton/zr4mf4j</a></p> <ul style="list-style-type: none"> <li>- <u>Main – Research using Secondary Sources:</u> Children to use given sources/I pads to research an answer to the question (How did Newton change our understanding of forces?) – alternatively they could create a scientist profile, write an interview with Newton about his work on gravity or answer the Twinkl questions (using the Twinkl fact sheet). Or use Developing Experts idea of writing a 100 word 'mini saga' about Newton.</li> <li>- <u>Plenary:</u> Discuss findings.</li> </ul>
5	To identify and explore air resistance	<p>Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate</p> <p>Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations</p>	<p><u>Intro:</u> Developing Experts - explore gravity and air resistance lesson, especially focus on the Mission Assignment video (the slides could be used to recap learning from lesson 2) <u>Main:</u> Fair test – how does the surface area of a parachute affect how long it takes to fall to the ground? Fold paper to get smaller but keep the same mass, then drop it to see effects of air resistance– see Developing Experts lesson. <u>Plenary:</u> Draw out explanation/conclusion</p> <p>-Possible additional activity: Using the letters of the word GRAVITY, create a mnemonic using each letter as the start of a sentence. Using the mnemonic, you should explain how gravity and air resistance works!</p>
6	To further investigate air resistance	Using test results to make predictions to set up further comparative and fair tests	-Pupils to conduct their own parachute investigation

		Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations	Depending on the investigation chosen, children may complete a <b>fair test</b> (height dropped/weight are continuous variables) or a <b>comparative test</b> (how material/shape affects time taken to fall). -Plan investigation – possible ideas: How does the weight of parachutist affect the time taken to fall? How does the material the parachute is made from affect its time taken to fall? How does the height dropped affects time taken to fall? How does the shape of parachute affect time taken to fall. -Make a prediction. -Suggest what the independent variable (what they are changing) and dependent variable (what outcome they are measuring) will be. -List the control variables (factors they are keeping the same, to ensure a fair test). -Carry out investigation.
7	To identify and explore air resistance  (This may not be needed – see how lessons 5 and 6 have gone)	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.  Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.  Using test results to make predictions to set up further comparative and fair tests.	<u>Intro</u> : Explain air resistance to children. Go outside and let children explore running with and without loose coat behind you– what is the effect? Introduce the concept of a streamline shape – look at examples. <u>Main - Comparative Test</u> : In groups children to compete to create a paper aeroplane that reduces air resistance. Children should create prototypes – they can record results and reasoning for design choices on the planes themselves. In groups children to compete to see which travels the furthest. They should record /present their groups results and explain the effectiveness of designs – they will need to repeat tests to make the results more accurate – they could do multiple tests of their own plane and look at graphs with a line of best fit. Children should draw a diagram of how forces acting upon their plane. If time allows let children have time to design their planes and test further.
8	To investigate and understand: 1. upthrust 2. water resistance	Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations	- Why do some objects float and others sink? <b>Archimedes video clip. Water displacement and upthrust</b> - Simple displacement experiment – put 1 finger into a container of liquid and see the level rise, then 2 fingers and it rises further etc. - <b>Pattern Seeking</b> : Do all objects fall through water the same way? Twinkl Forces Lesson 4 content: <a href="https://www.twinkl.co.uk/resource/science-forces-water-resistance-year-5-lesson-pack-4-tp2-s-296">https://www.twinkl.co.uk/resource/science-forces-water-resistance-year-5-lesson-pack-4-tp2-s-296</a> Explain streamlining. Investigate different shaped objects falling through water at different speeds (alternatively could use TAPS plan).

9	To investigate the effects of friction, including the effect on different surfaces	<p>Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary</p> <p>Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate</p> <p>Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs</p>	<p>Friction discussion: What is friction? Friction is the resulting force from two surfaces rubbing together. These surfaces include solids, liquids and gases. What is produced when friction occurs? What is the effect of friction?</p> <p>Investigate friction – different shoes, same surface, use Newton meter to measure. Not a fair test. Confounding (interfering) variables can be:</p> <ul style="list-style-type: none"> <li>•the weight of the shoe.</li> <li>•the size of the shoe (e.g. surface area)</li> </ul> <p><b>Fair test:</b> Pupils to look at second brief – which is the best surface. Fairness – same trainer, keep surface flat. Conduct investigation with adult supervision throughout the school for different surfaces: carpet, laminate, rubber mat, concrete path, wood (bench) etc. Pupils to collect data and use the observations column to describe the surface of each. Pupils to write a summary of findings.</p> <p><u>Possible Extra Curricular Writing Session:</u> Pupils to design a new trainer. The trainer must be designed to have good grip – write persuasively.</p>
10	To investigate the impact of levers.	<p>Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate</p> <p>Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs</p>	<p>-Give pupils rubbers, pencils and rulers separated on tables (front 2 rows together and back 2 rows together)</p> <p>Problem: <i>These two people weigh different amounts. Is it possible for the see-saw to be balanced with both of them riding it?</i></p> <p>If you move the bigger person closer to the fulcrum, then they see-saw becomes balanced. Tell the pupils that the effect which they have observed is an example of how levers work. Levers are types of machines. What is a machine?</p> <p>A machine is anything that makes a force bigger. When you apply a force to them, they increase its size and apply a greater force somewhere else. Show examples.</p> <p>Main: A fair ground is looking to create a new ride where a pod at one end will be lifted up and down by a weight dropping at the other end. See slides.</p> <p>Before they create the ride, they want you to investigate how much weight is required to lift the load (rubber) when the fulcrum is in different positions along ruler.</p>  <p>Record in table</p> <p><u>Plenary:</u> Discuss findings and refer back to investigation context.</p>
11	To understand how a pulley works	Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral	<p>Developing Experts Levers and Pulleys Lesson slides.</p> <p>Make a simple pulley – need a small bottle, bottle cap, two circles of card and wooden skewer</p> <p><a href="https://www.youtube.com/watch?v=rc0cpp3i8GA">https://www.youtube.com/watch?v=rc0cpp3i8GA</a></p>

	To understand how gears work (might be two separate lessons)	and written forms such as displays and other presentations	<p>Draw a diagram of the finished pulley and explain how it works.  <a href="https://www.bbc.co.uk/teach/class-clips-video/science-physics-ks2-ks3-will-pulleys-let-9-year-olds-beat-Britain%E2%80%99s-strongest-man/zvm4d6f">https://www.bbc.co.uk/teach/class-clips-video/science-physics-ks2-ks3-will-pulleys-let-9-year-olds-beat-Britain%E2%80%99s-strongest-man/zvm4d6f</a></p> <p>Developing Experts lesson slides – explains the different types of gears.          Explain gears in context of bikes: <a href="https://www.bbc.co.uk/teach/class-clips-video/science-physics-ks2-ks3-will-gears-let-children-pull-a-piano-uphill-with-their-bikes/zmcpy9q">https://www.bbc.co.uk/teach/class-clips-video/science-physics-ks2-ks3-will-gears-let-children-pull-a-piano-uphill-with-their-bikes/zmcpy9q</a>          Make simple gears, using the Ogden Trust guide/Twinkl resource.</p>
12	End of Unit Assessment(s)		<p>-Working Scientifically TAPS assessment lesson- spinners – see TAPS plan:          Explore: make and drop a spinner. In groups consider variables and formulate a question e.g. How does the length of wing/number of paper clips/size of paper affect the time it takes to fall? Groups or individuals to draw graphs then consider patterns in results.</p> <ul style="list-style-type: none"> <li>- End of unit subject knowledge assessment</li> <li>- Forces escape room activity from Twinkl</li> </ul>