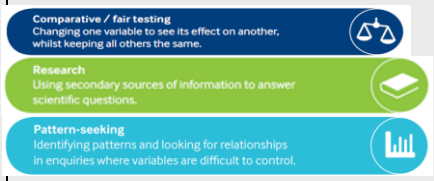
Mendell Primary School

Aspire Challenge Achieve

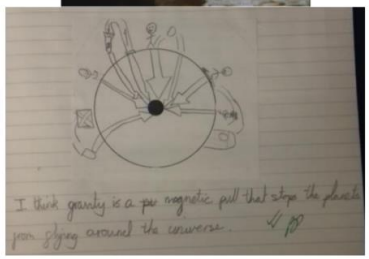
Medium Term Plan Science

Year Group: 5	**Term:** Autumn 1	**Teacher:** Jordyn Keelan	**Subject lead:** Sarah Bride	**Overview:** Forces	**Key End Points:** By the end of this unit children will be able to:
Common Misconceptions: **Some children may think:** • the heavier the object the faster it falls, because it has more gravity acting on it • forces always act in pairs which are equal and opposite • smooth surfaces have no friction • objects always travel better on smooth surfaces • a moving object has a force which is pushing it forwards and it stops when the pushing force wears out • a non-moving object has no forces acting on it • heavy objects sink and light objects float.		**Unit key Vocabulary:** Force, gravity, Earth, air resistance, water resistance, friction, mechanisms, simple machines, levers, pulleys, gears		• 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. 	• Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object. • Explain the effects of friction on different materials. • To explain that friction can occur when two surfaces are in contact with each other. • Identify and explain the effects of air resistance. Identify and explain the effects of water resistance. • Explain how a lever and a pulley works • Explain that levers and pulleys allow a smaller force to have a greater effect. • Explain that gears allow a smaller force to have a greater effect. • Explain that force and motion can be transferred through mechanical devices such as gears, pulleys, levers and springs.

Links to other learning: DT levers and pulleys	**Prior Learning:** • Floating and sinking **(FS2)** • Compare how things move on different surfaces. **(Y3** - Forces and magnets) • Notice that some forces need contact between two objects, but magnetic forces can act at a distance. (**Y3** - Forces and magnets) • Observe how magnets attract or repel each other and attract some materials and not others. (**Y3** - Forces and magnets) • 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. (**Y3** - Forces and magnets) • Describe magnets as having two poles. (**Y3** - Forces and magnets) • Predict whether two magnets will attract or repel each other, depending on which poles are facing. (**Y3** - Forces and magnets)	**Future Learning:** Forces as pushes or pulls, arising from the interaction between two objects. **(KS3)** • Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces. **(KS3)** • Moment as the turning effect of a force. **(KS3)** • Forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water. **(KS3)** • Forces measured in Newtons, measurements of stretch or compression as force is changed. **(KS3)**	**High Quality Text:** The Tin Snail - This book provides a great backdrop for exploring the effects of air resistance and friction, mechanisms, including levers, pulleys and gears. **Scientist to study:** **Famous Scientists to be introduced to children: Friction;** Leonardo Da Vinci, Guillaume Amontons, Leonhard Euler, Charles-Augustin de Coulomb, Philip Bowden and David Tabor **Gravity:** Aristotle, Brahmagupta, Galileo Galilei, Isaac Newton, Albert Einstein	**Risk Assessment:** Weights with pulley systems. Working with oil and glue.	**Teacher CPD:** **https://www.stem.org.uk/resources/elibrary/resource/30668/forces-and-motion** - A film by Teacher's TV demonstrating how to teach about forces to children in key stage two. Reach Out CPD - https://www.reachoutcpd.com/ sign up for free. ASE Plan Jimmy work.

	Learning Intention	Lesson Outline (Key Questions in colour)	Resources	Vocabulary	Lowest 20% Adaptations
1	L.I. I can say what gravity and resistance are and	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is asking questions and recording.** Explore what the children remember about forces from Year 3 by completing a Kahoot quiz of key knowledge about friction, magnetism, push and pull forces. Use the following questions;	https://www.bbc.co.uk/bitesize/clips/zp4g9j6	**support, fall, Earth, gravity, air resistance, friction, balancing force, weight, newtons, resistance force**	

	identify balanced and unbalanced forces.	Which is an example of a pull force? A: Opening curtains B: Inserting a plug in a socket C: Kicking a ball Which is an example of a push force? A: Taking a plug out of the socket B: Moving a trolley forwards. C: Tug of war What is the name for the force that occurs when two objects rub together? A: Gravity B: Pull Force C: Friction All metals are magnetic. True or False? When will magnets be attracted to each other? A: When a South pole is facing a South Pole B: When North Pole and North pole are facing each other C: When a South pole and North pole are facing each other. **Pre assessment:** allow children to record what they already know about force from previous years - return to this after lesson 6 to annotate with what they now know. **Big question: What is a force?** https://www.bbc.co.uk/bitesize/clips/zp4g9j6 - ask the children to watch the clip of different forces in action and allow discussions in groups of four. Provide each group with four still pictures from the clip and ask them to use post it notes to record their thinking about how the pictures are linked and any forces they can identify – see example of work in ASE Plan. Odd one out – now show the children three pictures showing gravity – ask them to discuss what is similar and different about each picture. Drop a ball and ask them to think about how the images link to this. The children were shown three different images from the video clip and asked to talk about which one they thought was the odd one out and why. The teacher then dropped a ball and asked them to think about how the images were linked to this. EVIDENCE OF LEARNING / ASSESSMENT Oral evidence: "The middle one is the only one with people in it. The two people are moving differently. One is in the air and one is on the ground. The bottom one is a bit of a plant." "They are all falling down." Examples of work:  Knowledge: Jimmy recognises that objects fall to the ground, but does not use the word 'gravity'. Teacher observations Working scientifically **Big Question – What is gravity?** **Word of the week** – Gravity – gather ideas about what the children already know about gravity and the examples they can give – these will vary from child to child. Watch: https://www.bbc.co.uk/teach/class-clips-video/discovering-the-work-of-sir-isaac-newton/zr4mf4j - discuss. Ask children what they think stops us being sucked to the very centre of the Earth - give them a couple of minutes to come up with some ideas. Explain that gravity is actually a relatively weak force, much weaker than the forces that hold together the ground or floor we stand on, so it is not strong enough to pull us through to its centre. The ground provides an 'equal and opposite' balancing force to our weight. Because these separate forces are in balance, we do not fall through the ground. If what we stand on is not strong enough to hold us – like a thin layer of ice on water, or a rotten wood floor for example – then our weight will overcome the resistance that the floor can provide and we fall through it. 60 second challenge: Get children to look around the room and give them 60 seconds to write down as many things as they can that are not directly on the ground but that are not touching the ground (things on tables or bookshelves). **Can they explain what is happening?**	Photos to add forces in to resource, sample annotated photo.		

		- (While the objects are pushing on the table/bookcase because it they are being pulled down by the gravitational pull of the Earth, the furniture items are providing resistance; we say they are pushing back. As the forces are balanced, the objects do not move.) Explain that for part three they are going to explore some photos and see if they can identify the forces in play and the direction they are pushing or pulling in. *Get children work in pairs* Capturing forces: give children photos from the resource provided and get them to discuss each one with a partner. Ask them to draw labelled arrows showing the direction of gravity and resistance forces then to write observation statements that support the science behind the diagrams (see e.g.). Show the statement on the board: gravity as a force acting between the Earth and an object pulling it down. Watch a moonwalking clip to show the impact of reduced gravity and then ask to consider the idea of 'A world without gravity' and identify consequences. Show the children a globe with some LEGO people stuck on and ask them to think about what would happen to a ball that each person threw. After discussion, ask them to draw their ideas about this. **EVIDENCE OF LEARNING** / **ASSESSMENT** Oral evidence: "It would be really fun to float around. Everything would need to be tied down to the ground. You would have to use baby cups with lids. How would you go to the toilet?" Examples of work:   Knowledge: Jimmy understands that gravity on Earth pulls objects down to the ground. Teacher observations: Jimmy shows the ball falling back to Earth wherever it is on the Earth's surface. His written comment shows that he recognises that gravity reaches a long way. At this point, the children had not learnt about the solar system, so he is only considering the gravity of Earth. This is sufficient to be secure in this statement. He links the concept to a magnetic pull. Although this is incorrect, it shows good thinking. Working scientifically			
2	L.I. I can identify the effects of friction between moving surfaces. I can plan a fair-test; identifying the control variables.	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is setting up a test and communicating results.** **Recap of prior learning:** **What is a force?** **What do you know about magnets? Is this a contact force?** **What is an unbalanced force?** Give children envelopes containing key words and definitions (prepared using 'The Force Factor') and explain that they need to discuss the key word cards and try to match them to the definitions. Once completed get them to come back together and discuss their ideas (Use this as an initial assessment of understanding.) **Where can we find examples of friction?** http://www.bbc.co.uk/learningzone/clips/examples-of-friction-no-narration/2177.html The video above provides a range of clips of friction acting between two surfaces. Children can discuss the effects of friction.	Words and definitions. http://www.bbc.co.uk/learningzone/clips/examples-of-friction-no-narration/2177.html force meters, enquiry symbols, range of trainers and surfaces to test.	**Friction, pull, push, force meter, newton's.**	

Skill-focussed activity – Using a force meter

Show children force meters and point out the spring inside them. Ask them to suggest how they work. Help children to practise reading the force meter e.g. only using little fingers – try to stop at say 3 Newtons without looking.

Begin by sharing with children the ways in which we can find things out in science. You could show these on the white board alongside their symbol:

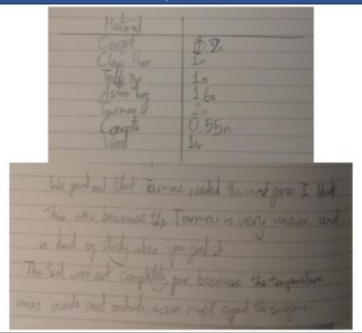
Big question: Which trainer provides the best grip? – Which enquiry type do you think we could use?

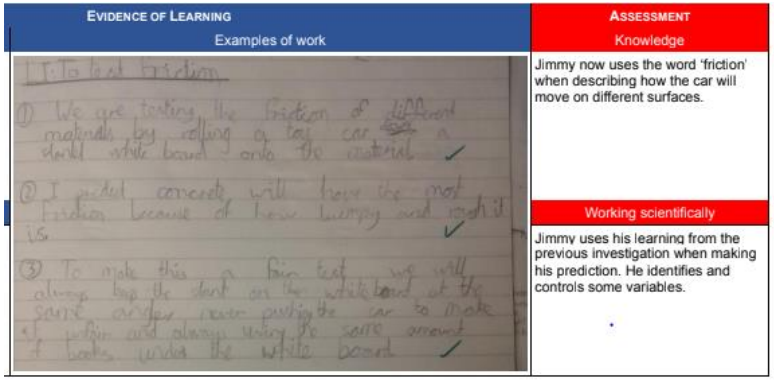
Show the image below to the children and ask them to consider why the boy is finding it hard pulling the girl and the dog. Allow children to design a fair test to find the trainer that provides the best grip use the examples below.

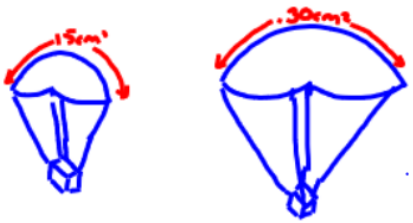
Description of activity
The children were shown the image and asked to think about why the boy was finding it hard to pull the girl and the dog. The teacher then introduced friction as a force acting when one solid moves over another solid.

Evidence of Learning		Assessment
Oral evidence	Examples of work	Knowledge
"They are in a sledge, so they should be on snow, but they are on grass. It would be easier to pull them on snow."		Jimmy shows an awareness that objects move differently on different surfaces, showing that is secure in the Year 3 statement. He does not use the word 'friction'.
Teacher observations		Working scientifically
		Jimmy uses appropriate subject knowledge to make a prediction. He also identifies a variable that should be controlled but does not make it explicit that they should use the same shoe.

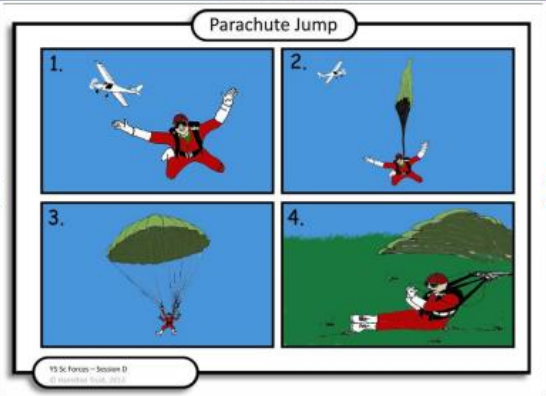
The children measured the force required to move the trainer across different surfaces.

Evidence of Learning		Assessment
Oral evidence	Examples of work	Knowledge
		Jimmy links the ease of movement with the texture of the surface, recognising that the trainer was more difficult to move on the uneven surface of the tarmac. He still does not link this to friction.
Teacher observations		Working scientifically
		Jimmy draws a table to record his results but does not give the second column a heading. Jimmy uses his results to draw conclusions. He identifies a variable that they did not control – the difference in temperature between inside and outside.

		They can decide how they will measure the amount of friction created between the trainers and a surface. For example, they could pull the trainer with a Newton/ force meter until it starts to move. Alternatively, they could place them at the top of a plank and then move the plank upwards at the end. Children can measure the angle of the ramp when the trainer starts to move.  **EVIDENCE OF LEARNING** / Examples of work **ASSESSMENT** / Knowledge Jimmy now uses the word 'friction' when describing how the car will move on different surfaces. Working scientifically Jimmy uses his learning from the previous investigation when making his prediction. He identifies and controls some variables. **Recording – see above** The children draw what they did. They explain what they found out. **Exit Pass:** The children were shown the image and asked to discuss what was happening. The children were then asked to discuss living in a world without friction. **EVIDENCE OF LEARNING** / **ASSESSMENT** Oral evidence / Examples of work / Knowledge "The polar bear is sliding on his back. The ice is smooth so there is less friction between the ice and his back which is helping him to slide. When he wants to walk, he has claws which dig in the ice. This increases the friction. "We could slide everywhere, but we would keep crashing because we couldn't stop. We wouldn't need cars and things with engines, so it would be better for the environment. You would have to put objects down really carefully because otherwise they would keep moving. Friction is really important."  Jimmy talks confidently about friction acting between two surfaces. Jimmy has a secure understanding of friction and can apply it in different contexts. Teacher observations Working scientifically			
3	L.I I can investigate the effects of air resistance.	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is setting up a test and recording data.** Explorify – What is going on? - Soft landing. https://explorify.uk/en/activities/whats-going-on/soft-landing Allow children to discuss ideas in pairs and then in fours. Groups come up with an explanation to share with the class.	Two parachutes on 15cm and one 30cm. Paper for spinners.	**Air resistance surface area, up thrust, gravity**	

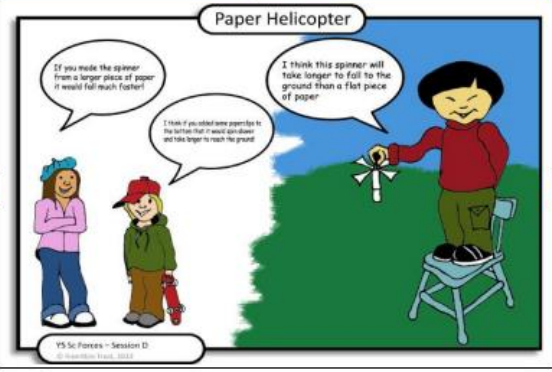
		Recap of prior learning: **What is a force?** **What is friction?** **What is a balanced force?** **Word of the week** – air resistance. **Big Question**: **what is the effect of air resistance?** Hold a parachute in the air and ask what would happen if it was let go. Share predictions. Now drop two identical parachutes at the same time, but scrunch one up and ensure the other remains open. Ask the children to make observations. - Air resistance is a force that slows an object down as it moves through air as the air particles block the path of the object. Show two parachutes with different sized canopies and ask the children to make predictions. Then drop them and ask the children to make observations. **Evidence of Learning** / **Assessment** Oral evidence: "It will be pulled to the ground by gravity." "The scrunched up one fell more quickly. It went straight down, and it made more noise when it hit the floor. The air holds the open one up, so it comes down more slowly. It floats down." "The bigger one fell more slowly as there is more air under the canopy slowing it down." Examples of work:  Assessment – Knowledge: Although Jimmy is not yet using the word 'air resistance', his comments show an understanding of the concept. This is not yet sufficient to be secure. Teacher observations Working scientifically Ask the children to record their observations and conclusions.	Prepared 'dodgy data'		

Description of activity
The children were asked to talk about a parachute jump including, if possible the words 'gravity' and 'air resistance'.

Evidence of Learning		Assessment
Oral evidence	Examples of work	Knowledge
"When the man jumps out of the plane, he will fall down as gravity is pulling him. While his parachute is closed, he will fall fast as there is not much air resistance. When the parachute opens, this make the air resistance bigger as there is more air slowing the parachute down. He will fall more slowly and hopefully not break his legs!"		Jimmy shows a good understanding of the effect of air resistance on the man falling.
Teacher observations		Working scientifically

Allow time for the children to discuss the concept cartoon:

Description of activity
The children were asked to discuss the concept cartoon.

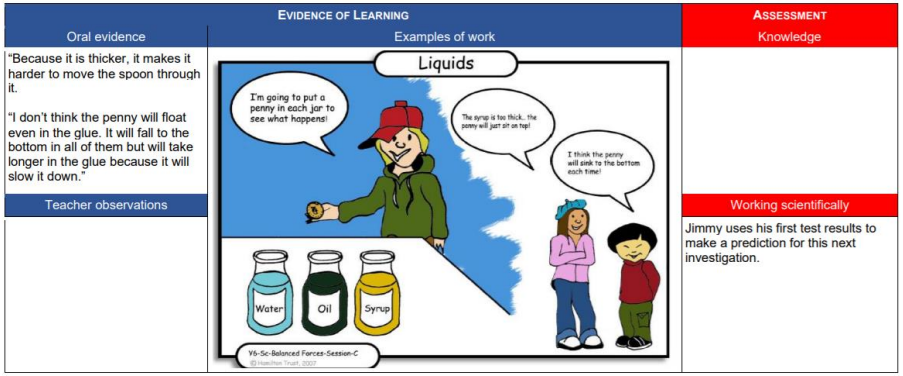
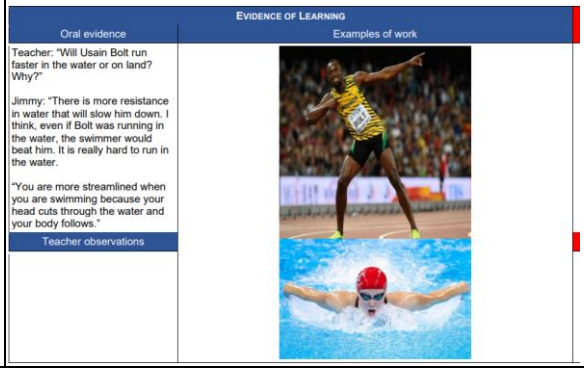
Evidence of Learning		Assessment
Oral evidence	Examples of work	Knowledge
"I think spinning will slow the paper down like the sycamore seed. The more it spins, the slower it will go. I think, if it is bigger, it will go more slowly as there is more air resistance."		Jimmy now uses the word air resistance and understands the effect this will have on the paper falling.
Teacher observations		Working scientifically
		Jimmy uses his prior observations when making predictions.

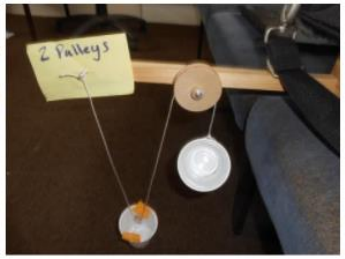
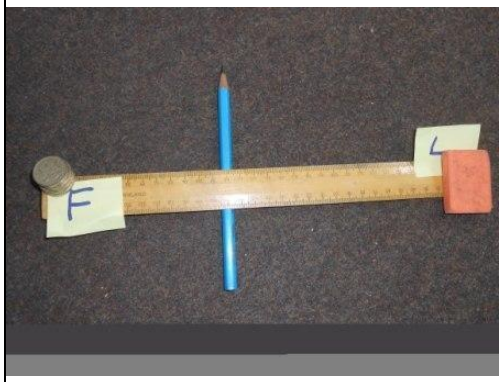
Based on the spinner cartoon ask the children to plan an investigation to answer their own question. E.g., How does the size of blades effect how fast it falls? How does the surface area effect how fast it falls?

Children perform their investigation and record their results in a table and bar chart.
Conclusions should be drawn with labels providing explanations.

Exit pass:
Evaluating the reliability - In order to help children develop their concept of reliability, show the following table of results on the board. Even though in this instance the scientist has performed repeated measurements, there is some 'dodgy data' that does not

		fit an overall pattern of results. Ask children to help identify the dodgy data - highlighted on the example below, ensure it is not highlighted for the children **Surface area of blades (cm squared)** / **Time taken to fall (seconds)** / **Time taken to fall (seconds)** / **Time taken to fall (seconds)** / **Average time taken to fall (seconds)** 10 / 2 / 3 / 6 / 3.6 20 / 3 / 3 / 3 / 3 30 / 5 / 1 / 5 / 3.6 The children can provide an explanation as to the degrees of trust they can have in their own data. They might record that they tried to make their results reliable by repeating their measurements, but it was difficult to accurately measure the time that the spinner fell.			
4	L.I. I can explore and investigate the effects of water resistance.	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is setting up a test and making predictions.** **Recap of prior learning:** **What is air resistance?** **Can you name a contact force?** To review previous work on air resistance take the children outside and ask them to throw a javelin and a rugby ball – **which travels further why?** Back in the classroom as them to use a post note or a picture to demonstrate which forces had been acting on the two pieces of PE equipment. Outside, the children compared throwing a rugby ball and a javelin. EVIDENCE OF LEARNING / ASSESSMENT Oral evidence / Examples of work / Knowledge Jimmy applies his knowledge of air resistance in another familiar context. He is secure with this concept. Teacher observations Jimmy uses the word streamlined to describe the javelin. This is picked up on in a future water resistance lesson. Working scientifically **Big Question:** **what is the effect of water resistance?** **Word of the week:** water resistance Pass four bowls around the class with a spoon in each, one empty and the others water, oil or glue. Ask the children to stir each to see how they compared. They should find the glue the hardest to stir. Ask them to think about why the glue is harder to stir. Ask the children to consider the link to air resistance – resistance a force that slows an object. Now ask the children to discuss the concept cartoon – annotate with post it notes in groups.	Javelin, rugby ball. Bowls Cups, pennies, glue, oil and water.	**Air resistance, water resistance, force.**	

		Focus of investigation – predicting using previous knowledge.  Allow the children to test their predictions and time how long the penny takes to sink in each liquid in groups using stopwatches. Children record their results. Encourage the children to say if their prediction was correct and why resistance is greater in some liquids. **Exit pass:** show the children two Olympic athletes (Usain Bolt and a swimmer.) Ask the children to answer the questions: **Will Usain Bolt run faster on land or in water? Why?**  			
5	L.I. I can recognise that some mechanisms, including pulleys and levers, allow a smaller force	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is setting up a test and communicating results.** **Recap of prior learning:** **What is water resistance?** **What is friction?** Give an example of a push or pull force.	Pulleys Wood to attach the pulley to String Plastic cups Masses	**Force, pulley, lever, fulcrum, mass, load.**	

	to have a greater effect.	Give the children a range of pictures (pulleys, gears, levers) and ask them to think about how they could group them together. – see Jimmy work example. **Exploring pulleys –Big question:** **How do pulleys work?** - **https://www.youtube.com/watch?v=LiBcur1aqcg** The context could be pulleys on a crane. Get the children to discuss when they have seen pulleys. Pictures can be found on the following website: http://www.mikids.com/SMachinesPulleys.htm Establish with the children that pulleys allow a smaller force to have a greater effect. Challenge the children to find out how much mass must be placed in the top cup to make the one at the bottom lift off the ground. They can begin with no pulley by simply placing the string over the wooden pole. They can then try one and then two pulleys.   **Recording** The children can record in a table the amount of mass added to make the tub lift next to the number of pulleys. **Exploring levers** Once again, the context could be a new ride at the theme park. The 'load' could be the people inside a pod. Allow children to set up a basic lever: place a hexagonal shaped pencil on the table and lay a ruler across it, ensure the pencil is in the middle. Children can try to add masses on one end and then see how much force they need to push down on the other end to make the ruler horizontal.  **Pattern-seeking –** **How much force is required at when the fulcrum is in different place to lift a mass at the other end?**	Rulers Post-its		

		Label one end of the ruler with 'L' post it (load). Label the other end with a 'F' post-it for 'force'. Place a rubber at the 'L' end. Place the fulcrum (pencil) under the middle of the rule. Add masses to the 'F' end of the ruler. Find out how many grams were required to lift the load to horizontal. The children could work out how much force this is (100g = 1 Newton). The children can then try moving the fulcrum (placement of pencil) to find out what affect this has on the amount of force required to lift the load to horizontal. **Recording** Place of fulcrum along the ruler (cm) | Mass of load (g) – i.e. the mass of the rubber | Force required to lift the load | | | | | | | | |			
6	L.I. I can recognise that some mechanisms, including gears, allow a smaller force to have a greater effect.	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is setting up a test and recording data.** **Recap of prior learning:** **What is a force?** **What is friction?** **What is a balanced force?** **Explorify – odd one out – levers in action - https://explorify.uk/en/activities/odd-one-out/levers-in-action** **Big Question: How do gears work?** Context – discuss the gears that can be found on bikes.  1. Put one axle in each of the small gears. 2. Find or make a mark on one tooth on each gear. 3. Use the stickers to label one gear as the driver, 'D', and one as the follower, 'F'. The driver will move the follower. 4. Put these two gears on the base board with the marked teeth touching. 5. Turn the driver one complete time around in a clockwise direction. Watch the follower as you do. Record how many times the follower turns and in what direction. 6. Now put another gear between the driver and the follower as in the second picture above. Turn the driver as in step 5 and record what happens to the follower.	Base board with axels Gears Explorify – levers in action Pictures from lesson 5	**Gear, force, mechanisms, levers, pulleys.**	

7. Repeat this procedure with two gears between the driver and follower.

Recording

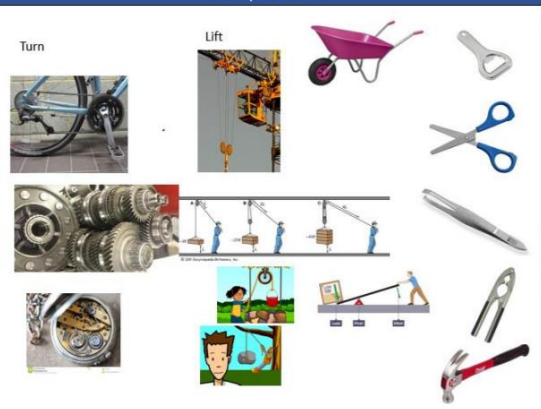
Number of gears	Turns	Direction
0		
1		
2		

What do the children notice? What happens when more gears are added? Do more gears allow a smaller force to have a greater effect?

How can you change the direction of turn and the speed of the gears?

http://education.lego.com/en-gb/preschool-and-school/upper-primary/8plus-machines-and-mechanisms/constructopedia

Provide the children with the pictures from lesson 5 and ask them to group them again providing reasons why.

EVIDENCE OF LEARNING		ASSESSMENT
Oral evidence	Examples of work	Knowledge
"The turning pictures are all gears. They turn at different speeds depending on how big they are. It makes it easier for you to cycle up hill. You have to push less hard on the pedals in a lower gear, but you go more slowly. The lifting ones are pulleys. You have to pull further on the rope when it is looped over more times, but it is easier to pull. The man is using a lever to lift the box. The longer the lever, the easier it is."		Jimmy understands the effect of using gears, levers and pulleys.
Teacher observations		Working scientifically
		Jimmy uses comparative statements to describe how the gears, levers and pulleys work.

Post Assessment - return to mind map from lesson 1 and annotate with what the children now know.