Science Progression of Skills and Knowledge Forces

Key to understanding this document: Black = National Curriculum objectives   Red = Knowledge/Skills to be taught Green = Resources to be used

Area of Learning	Year 3	Year 5
Forces	Working scientifically: Asking relevant questions using different types of scientific enquiries to answer them. Making systematic and careful observations and where appropriate taking accurate measurements using a range of equipment. Reporting on findings from enquiries using a simple conclusion. FM1: Compare how things move on different surfaces. Show the children how a tub on a table can be moved by attaching it to string which itself is attached to a mass that can fall to the ground. Ask them to discuss all the variables that they can think of that might affect how well the tub moves on the surface. Then pose the question: **'How does the type of material of the surface affect the speed the tub travels?.** Working scientifically: Setting up simple practical enquiries, comparative and fair tests. Identifying differences, similarities or changes related to simple scientific ideas. Using straightforward scientific evidence to answer questions or to support their findings.	Working Scientifically Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. Recording data and results of increasing complexity using tables and bar graphs. FM1: Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object. Ask the children what they know about forces. This will be a recap of their knowledge for Year 3 and at the end of this unit will be a clear indication of progression. Place the children's knowledge/ words/ideas in the classroom and use as an interactive display for the rest of the topic. Adding words and statements and diagrams accordingly. Begin the lesson asking the children what they know about Gravity and write the ideas they come up with. Watch video about Gravity. BBC bitesize have range to watch. Then scrunch up a piece of paper and place it in one hand then in the other place a flat piece of paper and drop them at the same time. Asking the children what notice. What is pulling objects to Earth? The children could set up their own investigation and see how the size of a material effects how long it takes to fall to the ground. Record using table. Discuss why we would have to test the objects three times. **N.B Link to Space, it is important to remind the children that gravity is everywhere even in space but it has different strengths. E.G the moons gravity is much less than Earth so that it why astronauts float on the moon.**

	FM2: Notice that some forces need contact between two objects, but magnetic forces can act at a distance. Help the children to develop a range of tests for finding out which magnet is the strongest. These could include: (Taken from Andrew Berry scheme) **1. The kite**. Cut out a small piece of card into a kite shape. Attach a paperclip to one end. Using sellotape, attach a length of thread to the other end of the paper (kite). Use the tape to attach the other end of the string to the table. Lift the kite into the air by using a magnet to attract the paperclip. The children could find out the how far away from the paperclip the magnet can be without the kite falling to the table. **2. Paperclip chain.** Attach a metal paperclip to the end of a magnet. How many more paperclips can be attached to form chain? **3. Attract through paper.** Place a magnet below a sheet of paper and a paperclip on top. How many sheets of paper can each of the magnets attract through? **4. How many paperclips?** Have a selection of magnets and ch to predict and then test how many paperclips each magnet can hold. Does the biggest magnet hold the most? If so why do you think this is? Relate back to the fridge magnets and the magnetic part on the back – test these too. Working scientifically: Making systematic and careful observations. Using straightforward scientific evidence to answer questions or to support their findings. Using results to draw simple conclusions. FM3: Observe how magnets attract or repel each other and attract some materials and not others.	Working Scientifically Using test results to make predictions to set up further comparative and fair tests Taking measurements, using a range of scientific equipment, with increasing accuracy and precision recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, and bar and line graphs identifying scientific evidence that has been used to support or refute ideas or arguments FM2:To be able to identify the effects of air resistance that act between moving surfaces. **Illustrative fair-test – How does the surface are a of the blades affect the time it takes the spinner to fall?** Show the children some images of autogyros. Inform them that they are going to be finding out how the length of the blades on an autogyro affects how quickly it falls.  Begin by the children exploring how a spinner falls. Discuss with the children how they can work out the surface are of the blades. The children could decide on how to perform their test fairly, and how to record their results. Use this also as an opportunity to discuss reliability. By performing the test more than once for each of the conditions, the children could end up with more reliable data.

	Children are given a selection of materials to test to see if they are attracted or if they repel the magnet. Children to record their findings and use their evidence to support answering questions. Working scientifically: Asking relevant questions and using different types of scientific enquiries to answer them. Make a prediction. Setting up simple practical enquiries. Record findings using a table. FM4: 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. Get children to brainstorm as many different magnets they can think of (e.g. screw drivers, fridge magnets and can openers) and discuss the material they are made from. Create a truffle moment for children - A mixture has accidently been created; steel nails, copper coins, and plastic paperclips have become mixed in with the sand. One scientist thinks that everything but the sand will be attracted to the magnet. Another scientist thinks that only the objects made from metal will be attracted to the magnet. What do the children think? Children can make a prediction, set up and perform this investigation. Working scientifically: To make a prediction. Using straightforward scientific evidence to answer questions. Recording findings using a labelled diagram.	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. The children must produce 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. **Working Scientifically** 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 FM3:To be able to identify the effects of friction between moving surfaces. Show the videos showing the effects of friction and discuss. The video above provides a range of clips of friction acting between two surfaces. Children can discuss the effects of friction. At the beginning of the lesson 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. **Which shoes provides the best grip?** The children could be testing out trainers for a formula 1 driver who needs a lot of grip between his trainer and the pedals. They can decide how they will measure the amount of friction created between the trainers and a

	FM5: Describe magnets as having two poles. FM6: Predict whether two magnets will attract or repel each other, depending on which poles are facing. (Refer to Andrew Berry for more on this experiment) Children can tie a piece of thread around the middle of a bar magnet and hold it up by its thread. Discuss with them the fact that all magnets have two poles; a north and a south (probably shown in two colours on your bar magnets). Ask them to predict what they think will happen when you bring similar poles together. Now, what will happen when the poles are different? Discuss the vocabulary of repelling or attracting and get children to use this in their predictions and recordings.	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. Working Scientifically Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of results, in oral and written forms such as displays and other presentations. FM4:To be able to identify the effects of water resistance that act between moving surfaces. **Comparative test – How does the shape of an object affect how it moves through water?** The context could be that a submarine company has contacted the children requesting some help with the design of their new mini-sub. Ask children to describe what it is like to walk through water e.g. in a swimming pool and to suggest why it is difficult. Elicit their ideas about why fish and boats can move through water with relative ease. If necessary, prompt them to think about shape. Show children a tall cylinder filled with water and talk with them about what they could do, using this apparatus and a small piece of plasticene, to find out which shapes move easily through water. Discuss the what types of shape the children could use and then they choose three of their own. Help children to decide what to measure e.g. time from dropping the plasticene into the cylinder until it gets halfway down or to the bottom. The children will need to regularly pour the water into a washing-up bowl in order to remove the plasticene. Alternatively, you can try tying piece of string to the blue tack.

The following objectives can be liked to DT The following lessons were taken from Andrew Berry Kent Science Scheme 2014. These activities may can be adapted to suit the DT Topic

FM5 Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. (this objective will be taught over three individual lesson looking each element)

On the white board place the definitions up

1. Levers

These use a long pole and a pivot point to increase a force

2. Pulleys

These use a rope running over a pulley wheel to increase a force

3. Gears

These use cogs with teeth in to increase the force and also transit it from one part of a machine to another.

Watch the flowing video and ask the children to note down what pulleys, levers and gears that see https://www.youtube.com/watch?v=qybUFnY7Y8w The rube Goldberg machine. Then discuss

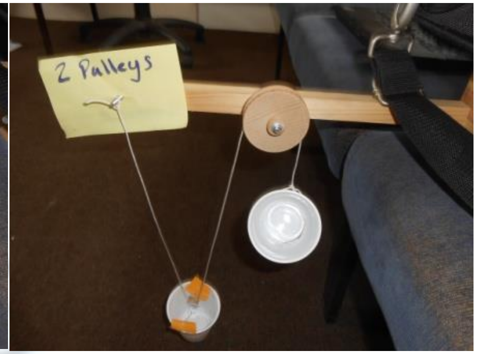
Exploring pulleys – How do pulleys work?

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.



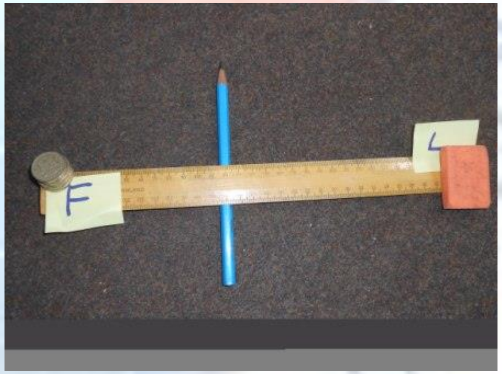
Challenge the children to find out how much mass must be placed in the top cup to make the one at the bottom lift off the ground. They can begin with no pulley by simply placing the string over the wooden pole. They can then try one and then two pulleys.

FM6: Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. (this objective will be taught over three individual lessons looking each element)

Looking at different gears on a base board ask the children to discuss how they move and how we can change the speed and direction.

Explore – How do gears work?

Context – discuss the gears that can be found on bikes.

		Look the following site and the children can follow the activities as an introduction. http://education.lego.com/en-gb/preschool-and-school/upper-primary/8plus-machines-and-mechanisms/constructopedia FM7: Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. Allow children to set up a basic lever: place a hexagonal shaped pencil on the table and lay a ruler across it. 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?** 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 to find out what affect this has on the amount of force required to lift the load to horizontal.
Key Vocabulary	Magnetic Force Poles Repel Attract	gravity, friction, air resistance, upthrust, weight Measuring forces: Newton meter, Newtons (N) Particles Surface area Push, pull Balance Mass – grams and kilograms Mechanical devices – gears, levers, pulleys, springs

Key Resources	String Tubs Paper clips Paper Magnets Selection of materials that are magnetic or not magnetic Coins Metal selection of nails etc Sand	Posters showing the different types of scientific enquiry, Stop watches, Paperclips, Variety of shoes, Planks Protractors Newton/force meters Masses Beakers Metal coat hangers Long transparent cylinders Blue tac Plasticene A range of objects that will partially submerge but not sink to the bottom Washing up bowls Pulleys Wood to attach the pulley to String Plastic cups Base board with axels Gears