Department of Primary & Childhood Education

Edge Hill University

Lesson Sequences 2021/22

This plan for a sequence of lessons should ensure clear progression in **composite knowledge** *through* **component knowledge**.

Date: Summer 1	**Class: YEAR 5**	**Subject/topic: Science - Forces**

Prior knowledge:

how does this lesson fit in with a sequence of lessons-what components have previously been taught? 2
Children studied space at the beginning of year 5 and have previously learnt about gravity. Elements of space unit of study are interleaved into this unit to support retrieval and consolidate understanding.
In year 4 pupils compared how objects move on different surfaces and learnt that movement normally requires contact to initiate it. There should retain an awareness of magnetism and be familiar with the terms force, attract, repel.

Composite learning:

By the end of this sequence of lessons, pupils will know:

- That unsupported objects fall to the earth because of the force of gravity acting between the earth and the object.
- What a force meter is and how to use it to measure the magnitude of a force in Newtons.

By the end of this sequence of lessons, pupils will understand:

- What is meant by air resistance, water resistance and friction and that they act between moving surfaces to slow down the movement of objects.
- That levers, pulleys and gears are used to change the magnitude or direction and/or direction of a force.
- Pupils will understand how to set up tests to identify the effects of these forces.

By the end of this sequence of lessons, pupils will be able to:

- Apply their substantive knowledge relating to forces to work scientifically - By making reasoned predictions, and by planning, conducting, recording, presenting and interpreting the results of investigations

	Learning objective(s) [components]	**Outline of Learning Sequence:** *Consider the role of the teacher, children's steps in learning and adaptive teaching*	**Resources**	**Evaluation:**
Lesson 1	To explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object To take accurate measurements using a force meter	Watch clip on National History Museum webpage of meteorite falling in Cheltenham March 2021. Facilitate discussion and retrieval practice of space topic. Elicit children's understanding about gravity – Why did the meteorite fall? where could it have come from? https://www.nhm.ac.uk/discover/news/2021/march/uk-fireball-meteorite-has-been-recovered-driveway-gloucestershire.html Children to help the NHM as forces experts. Pose learning activities as forces training. Complete key word/ definition challenge and force meter training. Children to measure the mass of objects accurately using a force meter. Hinge question - difference between mass and weight. Forces video for second phase of training https://www.bbc.co.uk/teach/class-clips-video/discovering-the-work-of-sir-isaac-newton/zr4mf4j. Review space content gravitational pull and planets. Ask what stops us being pulled to the centre of the earth? (Think, pair, share) Explore equal and opposite forces. Use thin ice analogy to ensure understanding. Explain that gravity is actually a relatively weak force – compare the magnets (link with earlier learning). Children to find objects not directly on the ground but that are not touching the ground (things on tables or bookshelves). Chn to use force arrows to explain what is happening. As the forces are balanced, the objects do not move. Training phase 3 chn to explore photos and draw labelled arrows showing the direction of gravity and resistance	Selection of photos Cameras/ I pads Forces arrows Force meters	

		forces then to write observation statements that support the science behind the diagrams. Chn to consider 'why don't the clouds fall to the ground?' and ask their own questions. How could they find out the answer? Plenary Quiz to cover forces key aspects.		
Lesson 2	To explain the impact of friction on the motion of an object and identify its direction. To present the results of an investigation in a bar chart and draw conclusions	Share experiences of walking to school on an icy day. What did children feel? What happened? Why? Elicit children's ideas on topic of friction through concept cartoon. Children to sit down and slide their feet across the tiled floor with and without shoes describe the difference. Arrange for bike to be in school - Use bike wheel and breaks to explain how friction slows down movement. Can children suggest other circumstances where this happens? Chn to rub hands together – heat they feel is the result of friction between two surfaces. Look carefully at the bike tyres and describe them. Why do chn think they have been designed this way? Explore images to develop this point and support chn to identify the direction forces are acting. When can friction be useful? Chn to suggest examples explore the forces existing in these examples or provide them if children struggle for ideas e.g. football boots and ice skates. Context: Mission to mars is being planned. Nasa scientists would like help to design tread for the Mars rover and to identify a suitable route on the surface. Chn to draw and label a diagram of their Mars rover tread explaining their choices. investigate the friction present on a range of difference surfaces and test their mars rover design. Children to present their findings as a bar chart and email their conclusions to NASA	Bike Range of surfaces Test vehicles Force meters Graph paper	
Lesson 3	To explain the effect of air resistance on the time taken for a parachute to fall. To plan and conduct a pattern seeking investigation and draw conclusions.	Do it now activity: Gravity concept cartoon Retrieval activity: Think, pair share and mini whiteboards used to establish if children can retrieve information for the last two sessions – gravity, thrust, friction. LOtC: Children to explore force of air resistance with running parachutes and umbrellas. TA ensure XX fully involved. Set context: NHM have been inContact with NASA who want to trace the origin of the meteorite – they think it originated from Mars. NASA are asking for chn to help design a parachute to allow the Mars rover to safely land. Children to work in mixed ability groups to plan a pattern seeking investigation. What will they measure? Chance to challenge more able to measure speed of fall. Observe to assess children's disciplinary knowledge. Envoy to quality assure investigation and adapt if required. Children to predict and complete their test and look for evidence of patterns in their results. TA to ensure XX engaged within a group – allow whole group to work in a quieter location if required. Were there any surprising results? Why? Can a parachute ever be too big? How could we solve this issue for the Mars rover? Show video of multiple parachutes. Children to write tweet to explain their findings. Quiz to assess children understanding Show vacuum video clip to demonstrate the effect of air resistance on time taken to fall.	Gravity concept cartoon, NASA email and design brief, materials for parachute making, rulers, scissors, stop watches	
Lesson 4	To explain how the shape of an object affects the amount of water resistance it encounters. To explain how the density of the water affects the amount of up thrust it provides	Draw on children's experiences from swimming lessons (whole class participated in school swimming during Autumn 1) Ask chn about floating and sinking in the pool. Ask chn to think about the science of making a star shape and floating, sinking when vertical; and surface diving to the bottom of the pool to retrieve something or 'running' through the water, based on their forces knowledge so far. Why can you both float and sink in water, even though they don't change weight? What makes them float? In the deep end of a pool they might be 3m above the ground. What would happen if they were 3m above the ground in air? Why doesn't this happen in water? Give chn a lump of Plasticine in pairs and a bowl of water and try to get them to reconstruct the first two of these 'experiences' (i.e. can they make it sink and float?). Discuss what the chn discover. Attach a piece of plasticine to an elastic band lowered into a bowl of water – note that the band shortens in length. Repeat using a force meter (assess if children remember how to use this accurately). Explain how apparent loss of weight is due to the 'upthrust' of the liquid trying to support the objects. When things travel through air they experience air	Plasticine, half drain pipe full of water, hair dryers/hand held fans, tin foil, guidance for boat investigations,	

	To make a prediction and justify why they think this.	resistance, so what do chn think things experience when they travel through water? Water resistance! Ask chn to suggest if a greater or smaller surface area increases the ability to float - remind them of their findings in the parachute investigation. Watch video on water resistance to consolidate and ask hinge question before moving on. Set context: Email from scientists collecting the meteorite. Have to cross a water way. 2 choices one salty and one fresh. Found 3 boats they could use with different shaped fronts. Children to decide which is the best option. Children make and record a prediction with justification. Children to work in mixed ability groups to test which boat shape encounters the least water resistance and if salty or fresh water provides the greatest up thrust. Share findings and ask chn to explain the science behind their findings. Discuss the effect of the shape on speed and therefore its level of water resistance. Listen to chn's suggestions of what is happening with the salty water and discuss the greater density of the molecules.		
Lesson 5	To explain that levers allow a smaller force to have a greater effect and identify the direction forces are acting. To record numerical measurements accurately using standard units (Maths follow up lesson– To present results in a line graph)	Arrange to use EYFS outdoor area and construction materials. Challenge groups of children to make seesaws. Ensure children are aware of the health and safety information, set behaviour expectations and safety check designs. Allow children to explore. Provide children with tape measure to ensure fulcrum at the centre – Why is this important? Use seesaw to model what happens when you add a mass to one side – chn to explain applying scientific language. Support chn with new vocab lever, fulcrum, mass. Label the seesaw. Model what happens when the fulcrum is placed off centre. Children to explain. Explore a range of levers to consolidate that a lever increases the force. Lever hunt around the classroom. (close a door pushing at the hinge and at the handle edge) Watch video to reinforce. Chn to answer questions on mini whiteboards. Pose challenge to the children – how can we lift this!? (Large rock in the classroom too heavy to lift) – children to suggest answers, draw diagram and explain why their suggestion would work. Peer share and try out suggestions. Pattern seeking investigation. Using a scaled down version of the challenge, children to explore the amount of force required to lift an object when changing the location of the fulcrum. (plant to act as a lever under the object, fulcrum to be moved in cm intervals and force meter used to pull down the end of the lever (position at the end of a table to allow space to take readings accurately.) Children to record their results using the correct units for distance (cm) and force (N) challenge children to use decimal places if appropriate. Two numerical values will allow line graphs to be constructed in their maths lesson later in the week. Assess understanding via a class quiz on Kahoot using ipads	EYFS outdoor area and construction materials Large rock, large plank, block to act as fulcrum Small planks, masses, small black fulcrum for group investigation Force meters Ipads	
	Learn that pulleys can reduce the amount of force required to move objects. Apply understanding of levers and pulleys to solve a problem.	Share model flag pole with children – explore how pulling the pully raises the flag. Ask chn to talk to their partner to explain how the flag moves. Children to explore how the blinds move using pulleys. Mass on floor (not too heavy to injure). Ask children to lift it by pulling on the rope. Suspend a pulley on an axel using construction toys – explain these terms to children. Ask children to lift the mass by pulling the rope over the pulley to feel the difference. How might this be useful? Explore range of uses with the children. Consolidate with direct teaching. Ask hinge question to ensure children understand the concept. Children to use the construction material to create their own pully. Use force meter to measure how much the force is reduced by. Challenge to add an additional pulley – does it reduce the force needed further? Share context from Primary Action - squashed tomatoes. Cross curricular link to geography. Children are tasked with designing a system to transport tomatoes down from the growing location up in the hills to the market (set geography context here and discuss challenges and impact machine would have) Working in groups children apply what they know about levers and pulleys to design their machine. Set time limit for the challenge and test out designs as a class. Evaluate their designs and suggest improvements. Watch video of real machine and identify levers and pulleys within the clip.	Flagpole model, mass, rope, string, construction material, wheels, cotton reels, force meters. Range of construction resources to create their tomato transporting machines.	

Lesson 6	Explore how gears can change the direction of movement and the resulting force Present findings clearly in written an oral presentation	Provide the children with a range of gears construction materials and mounting boards – borrow these from EYFS. Challenge the children to make two gears spin when only turning one. What did they do to get it to work? Explain that gears are parts of a machine that are used to make other parts turn. What happens when you interlock two gears of the same size? Which way do the gears turn? What happens when you interlock a large gear with a small gear? How many times does the gear turn on one rotation of the smaller gear? Can children change the movement from horizontal to vertical? Children to explore. How could this be useful? Explore a range of models to demonstrate this. Discuss gears on a bike – Ask children to explore their experiences. What happens when you cycle uphill? Use bike with gears to show relationship between pedal rotation and distance travelled. Measure out on playground. Discuss relationship between force needed to turn pedals and distance covered by the bike. Children to write seesaw sentences 'The smaller the size of the gear…' Children to design a machine where the Children to construct a simple machine using pulleys, levels and gears. Children to select from the range of challenge cards and work in mixed ability groups. Children to write an explanation card (or record a video) to accompany their machine and showcase in a science show.	Range of gear construction materials Bike Tape measure Challenge cards Construction material.	