The University of Manchester

Science & Engineering Education Research and Innovation Hub

fascinate

Progression in **FORCES – Year 1-9** key for use Fair & comparative testing | Research using secondary sources | Identifying, classifying & grouping | Pattern seeking | Observing over time

Year group	English National Curriculum statement	Child led enquiry opportunities (write as questions)	Maths opportunities	Story opportunities	Resources links	Enquiry type (highlight)	Working scientifically links (highlight)
Year 1 Year 2							
Year 3	1. compare how things move on different surfaces 2. notice that some forces need contact between two objects, but magnetic forces can act at a distance	1. How do different surfaces affect the distance a car travels? Do magnets need to touch for them to work?	• Graphs - Bar (masking tape) • Displaying data in chart/table	The Iron Man by Ted Hughes Swim Little Wombat Swim by Charles Fuge	Variety of magnets Magnetic and non magnetic materials Magnetic toys Different surfaces with	1. Fair & comparative testing 2. Research using secondary sources 3. Identifying, classifying & grouping 4. Pattern seeking Observing over time	• asking relevant questions & using different types of scientific enquiries to answer them • setting up simple practical enquiries, comparative & fair tests • making systematic and careful observations &, where appropriate, taking accurate measurements using standard units, using

	3. observe how magnets attract or repel each other and attract some materials and not others 4. 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 5. describe magnets as having two poles 6. predict whether two magnets will attract or repel each other, depending on which poles are facing.	Which ends of the magnet attract/repel? 4. Are all materials magnetic? 5. Are magnets the same all the way through? 6. Which ends of a magnet attract/repel?			different frictions		a range of equipment, including thermometers & data loggers ● gathering, recording, classifying and presenting data in a variety of ways to help in answering questions ● recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, & tables ● reporting on findings from enquiries, including oral & written explanations, displays or presentations of results & conclusions ● using results to draw simple conclusions, make predictions for new values, suggest improvements & raise further questions ● identifying differences, similarities or changes related to simple scientific ideas and processes ● using straightforward scientific evidence to answer questions or to support their findings.
Year 4							

Year 5	7. explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object 8. identify the effects of air resistance, water resistance and friction, that act between moving surfaces 9. recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.	• How does the size if an object affect the rate it falls at? • How do the planets in the solar system differ? • What size wing makes the best paper sycamore helicopter? • What is the best material to make a parachute out of? • Does the length of a lever effect the size of a force produced (making a shaduf/trabuchte)? • Where do you find gears in the real world?	Drawing graphs/charts Measuring distance, time, force	The Tin Snail by Cameron McAllister	Stopwatch Variety of items to drop Paper helicopters Levers, gears and pulleys Mini kites	1. Fair & comparative testing 2. Research using secondary sources 3. Identifying, classifying & grouping 4. Pattern seeking Observing over time	• 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 • using test results to make predictions to set up further comparative and fair tests • 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 • identifying scientific evidence that has been used to support or refute ideas or arguments.
Year 6							

Key Stage 3	***Motion and forces*** **Describing motion** • speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time) • the representation of a journey on a distance-time graph • relative motion: trains and cars passing one another. **Forces** • forces as pushes or pulls, arising from the interaction between two objects • using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces • moment as the turning effect of a force • 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 • forces measured in newtons, measurements of stretch or compression as force is changed • force-extension linear relation; Hooke's Law as a special case • work done and energy changes on deformation	• Can you order these objects in terms of speed they travel? • How many miles are covered by a lorry over the period of a week? • Can you classify these actions into the Venn Diagram? What do forces do to these different objects? How can you make a better lever? What effect does mass have on extension of a springs - Hookes law? How do noncontact forces affect an object ? What happens to the air as you fly higher in the	measuring distance distance time graph rearrange formula Measuring distance. drawing a graph and work out the gradient of the graph		Images of different fast and slow objects Data sets Images of scenarios involving forces Levers, gears and pulleys Springs and masses Clamps Different materials	1. Fair & comparative testing 2. Research using secondary sources 3. Identifying, classifying & grouping 4. Pattern seeking Observing over time	**Scientific attitudes** • pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility • understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review • evaluate risks. **Experimental skills and investigations** • ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience • make predictions using scientific knowledge and understanding • select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate • use appropriate techniques, apparatus, and materials during

	● non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity. **Pressure in fluids** ● atmospheric pressure, decreases with increase of height as weight of air above decreases with height ● pressure in liquids, increasing with depth; upthrust effects, floating and sinking ● pressure measured by ratio of force over area – acting normal to any surface. **Balanced forces** ● opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface. **Forces and motion** ● forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only) ● change depending on direction of force and its size. ***Electricity & electromagnetism*** **Static electricity** ● separation of positive or negative charges when objects are rubbed	plane OR climb higher up a mountain? Do these objects float / sink ? How does pressure change with surface area - if force is kept the same? What materials make the best rock climbing shoes ? What effect does the number of `rubs` have on the strength of electro- static attraction?			BBC clips - ballerina vs tank		fieldwork and laboratory work, paying attention to health and safety ● make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements ● apply sampling techniques. **Analysis and evaluation** ● apply mathematical concepts and calculate results ● present observations and data using appropriate methods, including tables and graphs ● interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions ● present reasoned explanations, including explaining data in relation to predictions and hypotheses ● evaluate data, showing awareness of potential sources of random and systematic error ● identify further questions arising from their results. **Measurement**

	together: transfer of electrons, forces between charged objects ● the idea of electric field, forces acting across the space between objects not in contact **Magnetism** ● magnetic poles, attraction and repulsion ***Matter*** **Space physics** ● gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and sun (qualitative only)						● understand and use SI units and IUPAC chemical nomenclature ● use and derive simple equations and carry out appropriate calculations ● undertake basic data analysis including simple statistical techniques.