Science & Engineering Education Research and Innovation Hub

Progression in **MATERIALS – CHANGES 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							• asking simple questions and recognising that they can be answered in different ways • observing closely, using simple equipment • performing simple tests • identifying and classifying • using their observations and ideas to suggest answers to questions • gathering and recording data to help in answering questions.
Year 2	• find out how the shapes of solid objects made from some materials can be changed by: 1) squashing, 2)bending, 3)twisting 4)stretching.	How can you change the shape of these materials? What materials can you bend and twist? How can we group materials by the changes that can be made to them?	Venn diagrams	Billy Goat's Gruff 3 Little Pigs Dragon in a Wagon		Fair & comparative testing Research using secondary sources Identifying, classifying & grouping Pattern seeking Observing over time	

Year 3	• describe in simple terms how fossils are formed when things that have lived are trapped within rock • recognise that soils are made from rocks and organic matter.	Classifying rocks based on their physical properties What is a fossil and how is it formed? What is soil made from? Which soil drains fastest?	Classification key/ venn diagrams/ tables Measuring the mass or volume of soil	The Pebble in my pocket Pebble - the story of belonging		Fair & comparative testing Research using secondary sources Identifying, classifying & grouping 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 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
Year 4	• observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) • identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.	Where is the best place to dry washing? How does temperature affect the speed an ice cube melts? How does ice change as it is heated to 100 degrees? Does everything boil at 100 degrees?	Measuring temperature/ time Tables and graphs - minutes it takes for ice cubes to melt	Charlie and the Chocolate Factory		Fair & comparative testing Research using secondary sources Identifying, classifying & grouping Pattern seeking Observing over time	

							related to simple scientific ideas and processes ● using straightforward scientific evidence to answer questions or to support their findings.
Year 5	● know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution ● give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic ● demonstrate that dissolving, mixing and changes of state are reversible changes ● explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.	How much sugar can be dissolved in a cup of water? (How sweet can you make your tea?) What material is best for making a coat? Which of the following experiments (give some reversible and some irreversible) can be reversed? How can you get the salt back from the water? What amount of vinegar/ bicarbonate of soda best inflates the balloon?	Graph work for changes in state Measurement and reading scales Data logging Looking for the trends in results	Itch		Fair & comparative testing Research using secondary sources Identifying, classifying & grouping 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

Year 6							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.
Key Stage 3	**The particulate nature of matter** ● changes of state in terms of the particle model. **Atoms, elements & compounds** ● differences between atoms, elements and compounds ● chemical symbols and formulae for elements and compounds ● conservation of mass changes of state and chemical reactions. **Pure and impure substances** ● mixtures, including dissolving ● diffusion in terms of the particle model ● simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography	What happens to the temperature of water as it changes state? What do you have to do to iron and sulphur for it to react? What happens to the mass when you burn magnesium? Can you get the salt back out of the water? How can you separate - sand and water; ink and water; different food dyes	Ratios of atoms in compounds Graph work Comparing masses in conservation of mass Measuring mass, pH and temperature			Fair & comparative testing Research using secondary sources Identifying, classifying & grouping 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

	Chemical reactions ● chemical reactions as the rearrangement of atoms ● representing chemical reactions using formulae and using equations ● combustion, thermal decomposition, oxidation and displacement reactions ● defining acids and alkalis in terms of neutralisation reactions ● the pH scale for measuring acidity/alkalinity; and indicators ● reactions of acids with metals to produce a salt plus hydrogen ● reactions of acids with alkalis to produce a salt plus water ● what catalysts do. **Energetics** ● energy changes on changes of state (qualitative) ● exothermic and endothermic chemical reactions (qualitative). ● the order of metals and carbon in the reactivity series ● the use of carbon in obtaining metals from metal oxides ● properties of ceramics, polymers and composites (qualitative).	What has happened to the elements? (for any chemical reaction). What happens to atoms in a chemical reaction? (can use molymod) What household solutions are acids and alkalis? What is the pH of different household products? What does an acid and alkali produce? How can they be separated? How can we speed up a reaction? What happens to the temperature when 2 chemicals react? How is iron/copper/aluminium extracted from its ore?					● 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 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

	Earth and atmosphere ● the rock cycle and the formation of igneous, sedimentary and metamorphic rocks ● the carbon cycle ● the production of carbon dioxide by human activity and the impact on climate.	How can the following materials (composites and plastics) be grouped? Based on chemical reactions, how would you order the following metals? How do we recycle carbon naturally? Why has the concentration of carbon dioxide remained constant for thousands of years up until the industrial revolution? How are humans having an impact on the Earth's climate? How would you classify the following rocks? What properties would you use to classify them?					● 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** ● 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.