Materials

Core Lesson 1	Option lesson 1a	Option lesson 1b	Option lesson 1c	Core Lesson 2	Option lesson 2a	Option lesson 2b
1 - 1 ¼ hours	1 ½ - 2 hours	30-40 minutes	30 – 40 minutes + writeup	1 - 1 ¼ hours	30-40 minutes	20-30 minutes + independent study
Applying the particle model	Sticky ice	Observing and modelling crystals	Thermal expansion of a liquid	Making new materials	Making a polymer slime	Strengthening a paper clip
Chemistry Objectives Pupils explore a number of contexts that can be explained by using the particle model, in particular Brownian motion, and the increase of pressure or volume caused by increased particle movement in a gas.	**Chemistry Objectives**	**Chemistry Objectives**	**Chemistry Objectives**	**Chemistry Objectives** Pupils learn about some of the chemical processes involved in making new materials by making biodiesel from vegetable oil. This is a catalysed decomposition reaction followed by a synthesis reaction.	**Chemistry Objectives**	**Chemistry Objectives**
Key concepts and processes Pupils use the particle model to predict the effect of temperature on particle motion. They plan and carry out a fair-testing enquiry into factors affecting gas pressure inside a sealed container, using the particle model to explain conclusions about their observations.	**Key concepts and processes** Pupils explore how ice behaves under pressure and relate what they observe to other familiar contexts, and to predictions from the particle model. They note that some questions cannot be completely answered using their existing knowledge.	**Key concepts and processes** Pupils observe crystals and consider how the physical appearance and growth of materials in this form can be explained using the idea of particles arranged in regular structures.	**Key concepts and processes** Pupils observe the effect of heating a liquid in a tube. They analyse their results and attempt to deduce a quantitative relationship, and explain the expansion using the idea of increased particle movement caused by the heat supplied.	**Key concepts and processes** Pupils understand and control the risks of handling hazardous chemicals. They also consider the applications and implications of science and technology in the benefits and drawbacks of biofuels	**Key concepts and processes** Pupils make a polymer gel and test its properties, noting that the properties can be altered by changing the 'recipe'. Although polymer chemistry is not studied at KS3, the idea is generally that chemical reactions can be employed to make useful products.	**Key concepts and processes** Pupils determine the strength of paper clips in an untreated condition, and then compare following heat treatment.
PLTS - Support conclusions using reasoned arguments and evidence, by explaining their observations using the theory of moving particles and collisions	**PLTS** - Adapt ideas as circumstances change by formulating hypotheses that might then not be supported by their evidence, and being prepared to accept that another hypothesis must be formulated	**PLTS** - Support conclusions using reasoned arguments by using diagrams and models to explain the observed regularity of crystal shapes	**PLTS** - Support conclusions using reasoned arguments and evidence, by using a graph to determine a link between the temperature increase of the water and the amount of expansion	**PLTS** - Anticipate, take and manage risks, by following appropriate safety procedures as they handle chemicals and deciding what steps they should take in managing the risks	**PLTS** - Try out alternatives or new solutions and follow ideas through by thinking of ways to test the properties of the slime	**PLTS** - Communicate their learning in relevant ways for different audiences by writing a scientific report for a technical audience
Technician's notes 35 mm film canisters, shallow trays, Blu-tak, water jug, paper towels, stopwatches, effervescent tablets (vitamin C, denture tablets or antacid such as Alka Seltzer). NB Alka Seltzer tablets react readily with water but Rennies do not. Alka Seltzer contains aspirin so distribute only when required. Eye protection should be worn. Keep well away from the canisters - launch outside if possible. Stand the 'rockets' in the tray to contain most of the liquid, but ensure any spills are cleared up promptly. Magdeburg hemispheres can come apart suddenly, causing those pulling to fall backwards.	**Technician's notes**			**Technician's notes** Each group will need: goggles, deionised water, 10cm^3 rapeseed oil or other vegetable oil (e.g. cooking oil), 1.5cm^3 5% (w/v) potassium hydroxide solution in methanol in a stoppered test tube (see CLEAPSS PS 67-10 for preparation), another text tube, one 10cm^3 measuring cylinder, teat pipettes, sample tube and label. A centrifuge may optionally be used. Care is needed with methanol: it is flammable and toxic. Potassium hydroxide is very corrosive. Goggles must be worn.		**Technician's notes**

Assessment: During each lesson each student should assess their own level using the pupil speak level ladders and show their partner where the evidence is for that level. They should record this in the grid at the front of the book. The member of staff should then assess the level of a maximum of 2 students work each lesson. At the end of each lesson there will be an end of topic test to check the content level.
Homework: For each topic there is a task booklet that students should use for homework.

Option lesson 2c	Core Lesson 3	Core Lesson 4	Option lesson 4a	Option lesson 4b	Core lesson 5	Core Lesson 6
30 – 40 minutes + independent study time	3 - 4 hours	1 ¼ hours	20-30 minutes + independent study	20-30 minutes + independent study	40 – 50 minutes	40-50 minutes
Identifying plastics	Manufacturing chemicals	Atoms and elements	The ideas of atoms and elements	Alchemy and chemistry	Combining elements - compounds	Mixtures and compounds
Chemistry Objectives	**Chemistry Objectives** Pupils use another synthesis reaction involving the heating of solutions to make a useful product, glue, and use a neutralisation reaction to neutralise the residue.	**Chemistry Objectives** Pupils learn that elements contain only one type of atom; whereas 'non-element substances' have more than one type.	**Chemistry Objectives**	**Chemistry Objectives**	**Chemistry Objectives** Pupils carry out simple reactions to make compounds from elements and compare the properties of compounds and elements. They identify patterns in reactions and use the idea of atoms to explain the chemical combination of elements to make compounds.	**Chemistry Objectives** Pupils do separation experiments that show the differences between mixtures and compounds. Explain why compounds do not share the properties of their constituent elements.
Key concepts and processes Pupils place samples of different plastics into solutions of different (known) densities to determine the identity of the polymer. They relate this to methods used to separate different plastics for recycling.	**Key concepts and processes** Pupils safely follow procedures and manage risks in carrying out a chemical reaction. They plan and carry out a fair-testing procedure to test the strength of different adhesives.	**Key concepts and processes** Pupils sort chemicals into simple and complex, then use the ideas of elements and compounds to refine their sort. They communicate their findings using particle diagrams and the terms atoms and elements.	**Key concepts and processes** Pupils investigate the history of ideas in relation to atoms and elements. They recognise that theories change when they are not supported by evidence, and that modern science has its roots in many different societies and cultures.	**Key concepts and processes** Pupils investigate the history of alchemy and its similarities and differences compared with modern chemistry and devise an approach to researching a particular question, including selecting reliable information sources. They appreciate how modern science has its roots in many different societies, cultures and approaches to science.	**Key concepts and processes** Pupils use the model of atoms to explain their observations. They describe reactions using chemical symbols and word equations.	**Key concepts and processes** Pupils use particle diagrams and symbols to communicate their ideas about atoms, physical separation processes and chemical reactions.
PLTS - Support conclusions using reasoned arguments and evidence, by comparing the data they have recorded with the reference data in order to identify each plastic sample	**PLTS** - Anticipate, take and manage risks by planning how to experiment safely when heating solutions, by using eye protection and by maintaining correct lab procedures	**PLTS** - Ask questions to extend their thinking by evaluating the strengths and weaknesses of the particle model	**PLTS** - Support conclusions using reasoned arguments and evidence, by specifying how evidence supports the idea of the existence of particles of matter	**PLTS** - Work towards goals, showing initiative, commitment and perseverance, by setting a suitable question to pursue, deciding on an approach, following up appropriate secondary sources and producing written work that meets their target	**PLTS** - Support conclusions, using reasoned arguments and evidence, by using an atom model to explain the formation of compounds from elements	**PLTS** - Connect their own and others' ideas and experiences in inventive ways by making connections between the principles for separating mixtures and the idea of atoms
Technician's notes	**Technician's notes** Engage and explore; different samples of glue (e.g. superglue, paper glue, PVA), eye protection, small pieces of paper and card, wood, metal or plastic, G-glamps, newton meter. Superglue vapour is an irritant to skin and nose; these adhesives can stick skin and eyelids in seconds. Eye protection must be worn. Extend: 250cm^3 beakers, 250cm^3 conical flask, stirring rods, measuring cylinders, paper towels, scissors, skimmed milk, ethanoic acid (vinegar), sodium hydrogen carbonate (baking soda $NaHC0_3$), Bunsen burners, heatproof mats, tripods, gauze	**Technician's notes** Engage and explore: a set of powders, including e.g.~salt, sugar, sand, copper sutphate, copper chloride, ., potassium permanganate, sulphur; plus samples of copper, calcium, zinc, iron, water Explain: Lego (different colours and sizes) or Molymod kit Evaluate: electrolysis of water apparatus			**Technician's notes** Engage: mixture of 0.3 g aluminium powder and 2 g crushed iodine. Explore: magnesium ribbon, iron wool, tongs, Bunsen burners, heatproof mat, eye protection Explain: 2-cm length pieces of magnesium ribbon, iron wool, sodium, carbon, phosphorus, deflagrating spoons, gas jars of oxygen, universal indicator solution, Lego or Molymod kits Extend: calcium, universal indicator paper, boiling tubes, splints	**Technician's notes** Engage: iron and sand mix, magnet Explore: iron filings mixed with sulphur powder in a sealed bag, sand-water mixture, beakers of diluted ink, magnets, funnels, conical flasks, beakers, filter paper Extend: test tubes, dilute hydrochloric acid, iron-sulphur mixture (seven parts iron filings to four parts sulphur powder), ignition tubes, mineral wool, magnets, Bunsen burner, tripod, heatproof mat, gauze pestle and mortar, dilute hydrochloric acid

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Homework: For each topic there is a task booklet that students should use for homework.

Option lesson 6a	Option lesson 6b	Option lesson 6c	Core Lesson 7	Option lesson 7a
30-40 minutes	30-40 minutes	30 minutes	1 hour	30-40 minutes + writeup
Decomposition of copper carbonate	Dyes and dying	Formation and decomposition	Mixtures and pure substances	Investigating seawater
Chemistry Objectives	**Chemistry Objectives**	**Chemistry Objectives**	**Chemistry Objectives** Pupils Learn that a pure substance contains only a single element or compound. Impure mixtures can be purified by separation; they apply the particle model to describe the techniques.	**Chemistry Objectives**
Key concepts and processes Building on their knowledge of compounds and reactions, pupils are supported in deducing the products of the thermal decomposition of copper carbonate. They use a word equation to describe the reaction. This work reinforces key ideas about compounds forming through the rearrangement of atoms, and that chemical reactions are needed to break down compounds.	**Key concepts and processes** Pupils investigate the effects of a dye mixture on a selection of fabrics and use their results to identify a mystery fabric.	**Key concepts and processes** Pupils observe a demonstration of heating magnesium powder with silicon to produce magnesium silicide (two elements combining to make a compound). This compound is then reacted with water to produce silane, a flammable gas. This work reinforces key ideas about compounds forming through the arrangement of atoms.	**Key concepts and processes** Pupils plan and carry out a safe method to test unknown Liquids to see if they are pure or mixtures.	**Key concepts and processes** Pupils boil 'seawater', precipitating different dissolved salts at different saturation levels depending on their solubility. They understand that seawater is a mixture, and that chemists can take advantage of differences in solubility to separate and purify materials.
PLTS - Support conclusions using reasoned arguments and evidence, by identifying the compounds created, using theoretical models (atom diagrams) to support the conclusions	**PLTS** - Question their own and others' assumptions by thinking how a blend of dye colours is a mixture of separate dyes and so the assumption that they will produce a uniform dyed colour might be incorrect	**PLTS** - Generate ideas and explore possibilities by suggesting what types of atoms are in the silane compound, based on its flammable properties, and where these atoms came from	**PLTS** - Anticipate, take and manage risks by planning each stage of the purification, showing awareness of the risks	**PLTS** - Communicate their learning in relevant ways for different audiences, by writing a scientific report for a technical audience
			Technician's notes Explore: sand/mud and water mixture in a beaker, funnels, conical flasks, filter paper Extend: 5 samples of colourless liquids, labelled A to E (distilled water; mineral water; solution, e.g. salty water; one that does not contain water, e.g. ethanol; water with sand), boiling tubes, Bunsen burners, test tube holders, thermometers, watch glasses, cobalt chloride paper, pH paper, filter paper and funnels	

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