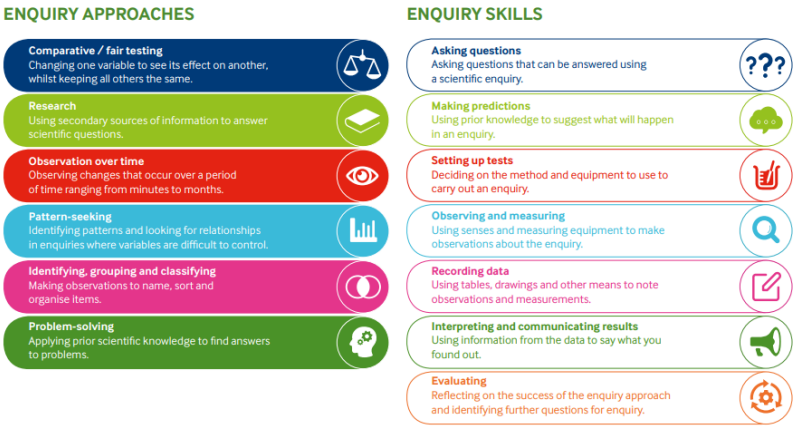
Year Group:	6	Strand: 1	How can we change materials?
CHEMISTRY			
Key NC Reference and Objectives	• use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating • demonstrate that dissolving, mixing and changes of state are 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. • know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution		
Enquiry Approaches and Skills in Science			
Key Investigation	- Investigate the saturation point of liquids **Enquiry Approach: Comparative fair testing, problem solving** **Enquiry Skills: Making predictions, setting up tests, observing and measuring, recording data, interpreting data** **Guidance:** Children to investigate the saturation point of liquids at different temperatures. This could be set in the context of a hot drink. A cup of tea can only dissolve a certain amount of sugar. Once this limit is reached, the sugar simply falls to the bottom of the cup and remains undissolved. We say that the tea has reached its saturation point. The amount of sugar that can be dissolved depends on the temperature of the tea. A hotter solution can dissolve more solute than a cooler one. This is because the warmer the liquid, the bigger the gaps between the particles. Discussion will need to be around how pupils identify when the saturation point is, and keeping variables consistent, such as ensuring that the tea doesn't drop in temperature before adding the sugar etc.		
Other suggestions for investigations and activities	- Investigating a physical change **Enquiry Approach: Comparative fair testing** **Enquiry Skills: Setting up tests, Observing and measuring, Recording data, Interpreting data** **Guidance:** Ask the children to investigate what happens when they drop some Mentos mints into bottles of fizzy drinks. Which drinks create the highest fountains? What happens if you change the number of mints that you add to the bottles? Measuring the height of the fountain is tricky, so the children could instead measure the volume of cola left in the bottle at the end of the reaction – this is an interesting discussion point when planning the experiment, or letting children plan it themselves. This is considered a physical reaction, not a chemical reaction, as no new materials are formed. The mints cause the dissolved carbon dioxide in the fizzy drink to be released as bubbles of gas, resulting in the creation of lots of foam. - Rusting Investigation **Enquiry Approach: Observation over time** **Enquiry Skills: Asking questions, making predictions, observing over time**		

	Guidance: Ask the children to investigate the effects of rusting on different materials. They can do this by placing a range of objects, such as erasers, a brass screw, a steel paperclip, an iron nail and a plastic pen top onto some damp cotton wool, and leaving for several days. Ask the children to make observations of the different materials every day to find out which materials rust. As the materials are all in different shapes, forms and sizes, it is important to acknowledge that we aren't controlling these variables. We can still conduct investigations and observations without controlling everything, as long as we acknowledge that within class discussions. **Examples of chemical changes:** **Make Invisible Ink:** Squeeze half a lemon into a bowl and add a few drops of water. Ask the children to write a message on a sheet of white paper using a toothpick or cotton bud dipped into the juice/water mixture. Once dry, the message will be invisible, but if you hold the paper next to a light bulb or warm radiator, a chemical change in the lemon juice occurs and the message reappears. As this is a chemical change (through heat) it cannot be reversed. **The bicarbonate of soda and vinegar 'volcano' demonstration:** Vinegar contains a chemical called acetic acid, and lemon juice contains citric acid. A solution of bicarbonate of soda and water is an alkali – the chemical opposite of an acid. When an acid and an alkali come together they react to form new substances. When vinegar/lemon juice is mixed with bicarbonate of soda, the acid and the alkali react together to produce carbon dioxide gas and water (to be precise, carbonic acid is first produced, which then breaks down into carbon dioxide and water, but it is not important for the children to know this at this teaching stage). As the carbon dioxide gas bubbles through the washing up liquid, it creates lots of foaming soapsuds.
Key scientists to learn about	N/A
Previously Taught Vocabulary	property, suitability, natural, synthetic, flexible, translucent, magnetic, strength, hardness, object, material, hard, soft, rough, smooth, bendy, stretchy, waterproof, not waterproof, absorbent, not absorbent, transparent, opaque, matter, mass, particle, solid, liquid, gas, water cycle, melting, freezing, evaporation, condensation, precipitation, temperature, permeable, impermeable, electrical conductor/insulator, thermal conductor/insulator, mixture, compound, dissolving, solution, soluble, insoluble
New Key Vocabulary	**Chemical change:** A process in which two or more substances react together to produce a new substance. **Physical change:** A process in which materials are mixed together, they can appear to be in a different state. **Solute:** A substance that dissolves in a liquid to form a solution. **Solvent:** The liquid in which a solute dissolves to form a solution. **Acid:** A substance that forms a solution with a pH of less than 7. Everyday examples of acids include vinegar (acetic acid) or lemon juice (citric acid). **Alkali:** A substance that forms a solution with a pH of greater than 7. Everyday examples of alkalis include bicarbonate of soda (sodium hydrogen carbonate) or caustic soda (sodium hydroxide) **Chromatography:** The process by which chemicals of different density or solubility can be separated using a solvent. **Previously taught but now have more advanced definitions:** **Dissolving**: The process by which a solid, liquid or gas breaks down into small particles and mixes with a solvent so that it can no longer be distinguished separately in the solution.
Core Substantive Knowledge	**Chemical Changes** **At primary level, it is acceptable for chemical changes to be classed as irreversible (or non-reversible) changes, although technically, not all are irreversible.**

A chemical change is a process in which two or more substances react together to produce a new substance. These changes (reactions) take place at a molecular level, meaning the molecules of the substances change to make a new substance that was not there before. Examples of chemical changes children might be aware of: cooking food, burning fuel in a car engine, rusting.

Chemical reactions are often used to create new materials that have useful properties. For example, two liquids might react to form a solid material, such as in the production of nylon.

There are usually noticeable signs that a chemical reaction is taking place. In some reactions, the reacting substances get hot and give off heat. These are known as exothermic reactions. In other reactions, the reacting substances might get colder and absorb heat. These are known as endothermic reactions. Other signs that a reaction is taking place include the production of light or a change in colour. A reaction could also produce a flame, or some bubbles of gas.

Physical Changes
These can be classed as reversible changes.
When a physical change occurs, materials may mix together or appear in a different state, but their chemical properties have not changed in any way. When a chemical change occurs, completely new substances are produced. Visible signs that a chemical change is taking place include colour changes, temperature changes, bubbles of gas, a flame or an explosion.

Physical changes, such as melting and boiling, are all reversible changes, see Year 4 Unit for further details: Changes of state (4.1)

Mixture or Compound?
A **mixture** forms when two or more materials are combined together but do not undergo a chemical change. Although the mixture may be very different from its constituent parts, the original materials do not chemically change and no new material is made. Mixtures can usually be separated using physical processes, although not always. Mixtures can take the form of solids, liquids or gases, or they can even be a combination of all three.

A **compound** forms when two or more elements join together in a chemical reaction. Water is a compound formed from the reaction between hydrogen gas and oxygen gas. Each molecule of water is made from two hydrogen atoms joined to one oxygen atom (H_2O). Other compounds, such as plastics or the proteins in our bodies, can be made up of long chains of hundreds of atoms.

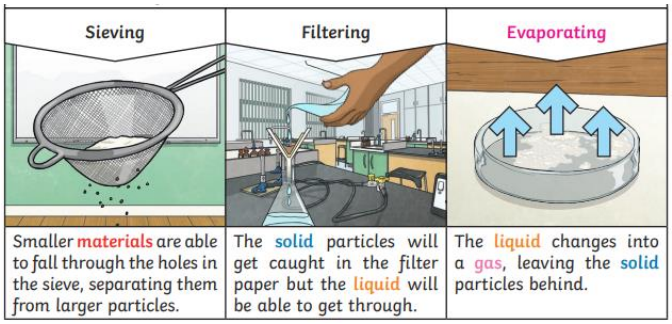
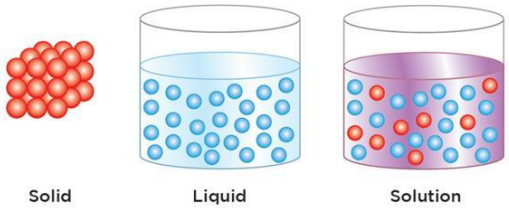
Many of the materials we encounter each day are compounds. Many compounds can be put into mixtures without reacting further. For example, salt and water are both compounds, and can be mixed together to form salt water, which is a mixture.

The properties of a compound are often very different from those of its constituent elements . For example: oxygen and hydrogen are flammable gases, but when they react and combine they form water (H_2O), which is a non-flammable liquid.

Separating Mixtures
In a mixture, two or more substances are combined together but do not undergo a chemical change. This means that mixtures can be separated back out into their constituent parts.

There are many different processes for separating mixtures.

- Filtration can be used to separate a mixture of mud and water, turning dirty water into clean water.
- Distillation can be used to separate a solution of water and salt, turning seawater into fresh drinking water.
- Sieves of different grades can be used to separate mixtures by material size.
- Magnets can be used to separate mixtures which contain iron or compound forms of iron and other magnetic metals.
- Chromatography can be used to separate the various pigments in a sample of ink. The mixture is placed on filter paper, and a solvent (such as water) is added. As the water

	travels across the paper, it carries the various inks along with it. Different colours travel different distances, so the colours can be separated out into bands.  **Dissolving** When a substance (such as sugar) dissolves in water, it breaks into small particles that are dispersed throughout the liquid until they are too small to see. The resulting mixture of water and sugar particles is called a solution. The solid sugar does not change state and become a liquid; it simply breaks into smaller pieces and spreads throughout the solvent. Dissolving is a physical change: the sugar does not react with the water, and there is no chemical change to either substance.  This is why if you add 5 g of sugar to 10 g of water, the overall weight of the solution will be 15 g. If you then evaporate all the water from the solution, the sugar will be left behind. Because we can't see a solute when it is dissolved in a solution, children sometimes think that it has disappeared. You can prove to them that a solute does not vanish by dissolving sugar in water and asking them to take a sip. The water will taste sweet, proving the sugar particles are still in there. **Common Misconceptions:** **Burning** Some children may be confused about the difference between burning and melting. It is important for the children to understand that burning is a chemical reaction in which new products, such as smoke and ash, are produced, whereas melting is a physical change in which a solid turns into a liquid. Burning is irreversible, as it is not possible to turn smoke and ash back into unburned fuel. Melting is reversible, as the liquid can be frozen back into a solid. **Smoke or steam?** Children also sometimes struggle to distinguish between smoke and steam. Smoke is a combination of different chemicals that results from an irreversible chemical reaction, whereas steam is a form of water vapour that results from a reversible physical change. If you hold a sheet of glass close to a boiling kettle, you will see the steam condense back into water droplets.
Prior Knowledge	6.1 Year 5 Materials – Comparing Materials: Which shall we use and why? Children have identified and compared the properties of materials, including hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. Children have conducted comparative and fair tests to investigate the properties of materials. Children have discussed variables in the context of a fair test.
Assessment	Thorough assessment of outcomes in books and folders, quizzes and written scientific investigations, also supported by observations and questioning in lessons, assessing the following: Substantive Knowledge: - Pupils can identify the difference between a physical change (reversible) and a chemical change (irreversible) - Pupils know that some changes result in new materials being formed

	- Pupils know that dissolving, mixing and changes of state are reversible changes - Pupils know that know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution Disciplinary Knowledge: - Pupils have investigated a range of methods to separate mixtures, including filtering, sieving and evaporating - Pupils have planned and set up their own investigations to separate mixtures - Pupils have discussed have uncontrolled variables could affect their results
Useful Planning Resources and Links	• Reach Out CPD, Unit: Changing Materials • BBC Bitesize https://www.bbc.co.uk/bitesize/topics/zcvv4wx • STEM Learning: https://www.stem.org.uk/resources/community/collection/12742/year-5-properties-materials