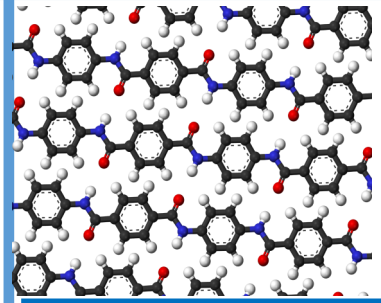


Stephanie Kwolek: Changing state and Kevlar

(Solids, Liquids and Gases - Properties and changes of materials)

CHEMISTRY and PHYSICS

Overview and rationale:

Year 5's first science topic of the year builds on their knowledge of changing states of matter in Year 4. Whereas the year before, children looked at how solids, liquids and gases interchange (as well as some properties such as effective conductors and insulators), here they extend their understanding of irreversible changes and the procedures such as dissolving, filtering and burning, often taking things that step too far for materials to return to their original state. Stephanie Kwolek's work on manipulating molecules at extremely low temperatures to create super-strong synthetic fibres, led to the discovery of Kevlar; this provides a stimulus for a very hands-on topic where the children explore, enquire and investigate processes, the impact they have on various materials, and the reasons for this impact. Importantly, the children are given contextual knowledge and understanding of how these processes happen naturally in the world (and how human methods of separation can help), again enabling them to ask and explore fascinating questions in order to further their appreciation for the state of Planet Earth.

SCIENCE LEARNING STATEMENTS

Area of Learning	Knowledge and Skills
Scientific Enquiry and applying knowledge in context	I can use my science experience to explore ideas and raise questions about the world.
	I can talk about how different scientific ideas have developed over time.
	I can select and plan, with help, the most appropriate type of scientific enquiry I might use to answer questions and give justifications.
	I can recognise when and how to set up comparative and fair tests. I can explain which variables need to be controlled and why.
	I can use and develop keys and other information records to identify, classify and describe living things and materials. I can identify patterns that might be found in natural environments.
	I can recognise which secondary sources will be most useful to research my ideas and begin to separate opinion from fact.
	I can make decisions about what observations to make, what measurements to use and how long to make them for.
	I can spot causal relationships in my data and identify evidence that refutes or supports my ideas.
	I can choose the most appropriate equipment to make measurements with increasing precision and explain how to use it accurately. I can take repeat measurements where appropriate.
	I can decide how to record data and results of increasing complexity from a choice of familiar approaches: scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
	I can identify scientific evidence that has been used to support of refute ideas or arguments.
	I can use relevant scientific language and illustrations to discuss, communicate and justify my scientific ideas, use oral and written forms (such as displays and other presentations) to report conclusions, causal relationships and explanations of degree of trust in results.
	I can use results to make predictions and identify when further observations, comparative and fair tests might be needed.

MATHS AND SCIENCE ACROSS THE CURRICULUM – Data Handling and Statistics

Science NC: recording data and results of increasing complexity using scientific diagrams and labels, tables, scatter graph

NATIONAL CURRICULUM OBJECTIVES

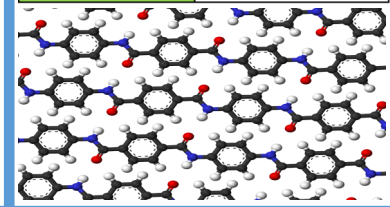
1. compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets know that some materials will **dissolve** in liquid to form a solution, and describe how to recover a substance from a solution
2. use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating
3. give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
4. demonstrate that dissolving, mixing and changes of state are reversible changes
5. 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

KEY VOCABULARY

thermal/electrical insulator/conductor, change of state, mixture, dissolve, solution, soluble, insoluble, evaporation, filter, sieve reversible/non-reversible change, burning, rusting, new material, Stephanie Kwolek, Kevlar, molecules

'CORE' KNOWLEDGE	'ADDITIONAL' KNOWLEDGE
1) I know that Stephanie Kwolek was an American Chemist who, in 1965, invented Kevlar.	a) I know that Kevlar is plastic - synthetic fibres so strong that not even steel bullets can penetrate!
	b) I know that it can be used for protective vests and clothing, boats, ropes, cables and planes.
	c) I know that Kevlar is so strong because its molecules are naturally arranged in regular, parallel lines and due to the way it's made, through chemistry/chemical reactions, into fibres are knitted tightly together (like pencils in a box).
2) I know that materials have different uses depending on their properties and state (liquid, solid, gas). ***PLAN: Ask questions and plan enquiry: NAPPIES REVIEW: Interpret and report: CHAMPION TAPE***	a) I can explain how these different materials' hardness make them perfect for different purposes – e.g. bricks, wood, glass and metal being used for buildings (but not cardboard!). I can explain what I found from the Champion Tape experiment and which tape could be used for what purpose.
	b) I know that some materials need to be transparent (like glass/windows).
	c) I know how materials might be used/not used because they are good thermal and electrical conductors and insulators and can name some of these materials. ***PLAN and DO: Set up enquiry: INSULATION LAYERS***
	d) I know that some materials' properties are developed to be more effective than others...like nappy absorption.
3) I know some materials will dissolve in a liquid and form a solution while others are insoluble and form sediment. ***PLAN: Ask questions and plan enquiry: DISSOLVING DO: Record: SUGAR CUBE STACKS***	a) I can explain what dissolving means, giving examples – such as salt water and sugar in tea.
	b) I know that different solids may take different times to dissolve – and I can explain how I know this.
	c) I can say whether the amount of solution or the amount of solid affects the time it takes to dissolve...or whether it dissolves at all!
4) I know that mixtures can be separated by filtering, sieving and evaporation.	a) I can name equipment used for filtering and sieving. (WHAT ARE THEY?)
	b) I can name some materials that can be separated by evaporation, filtering or sieving.
	c) I can use my knowledge of liquids, gases and solids to suggest ***how*** materials can be recovered from solutions or mixtures by evaporation, filtering or sieving.
5) I know some changes to materials such as dissolving, mixing and changes of state are reversible, but some changes are irreversible.	a) I can name some reversible changes due to melting, boiling, evaporation, freezing, condensation, dissolution and can give some examples of materials that can change state and be reversed back to their original state.
	b) I can name some irreversible changes such as burning wood, rusting and mixing vinegar with bicarbonate of soda and these result in the formation of new materials – like the chemical process of making Kevlar!

Possible Enrichment activities	Investigating graphene. What's it all about?



Possible 'higher order' questioning	
Remember	Can you name the process where solids can be separated from liquids?
Understand	Why does burning create an irreversible change? When can a magnet be used to separate materials?
Apply	If you filtered _____, could the change be reversed? Is it a reversible change?
Analyse	What have you learnt about why rusting happens? What is the cause?
Evaluate	What would happen if you heated _____?
Create	Can you think of a way to separate ____ and ____?