

Key concept map (age 11-16)

Chemistry and Earth science

The **Best Evidence Science Teaching (BEST)** resources can be incorporated into your existing scheme of work, if desired. However, we have used research evidence on learning pathways and on effective sequencing of ideas to develop maps that can help with curriculum planning.

This map shows how understanding of five **big ideas** of chemistry education and two of Earth science education can be developed through a series of **key concepts**, organised into teaching topics. It presents a possible route for progression through a five-year curriculum in chemistry and Earth science for age 11-16.



The numbering and placement of key concepts in the map gives some guidance about teaching order based on our review of the research and teaching experience.

In general:

- key concepts that appear earlier in the map need to be understood before progressing to key concepts that appear later
- topics that appear in the same row can be taught in any order.

However, the teaching order can be tailored for different classes as appropriate.

Notes about the chemistry and Earth science subject map

Some topics develop understanding of more than one big idea; these are presented as stretching across more than one column.

Two topics are included at 11-14 that cover some introductory key concepts of materials science. Although they help to develop understanding of the big ideas, they are distinguished from the other topics using the code **CMS**. They were developed with funding from the Horner's Company Charity.

Publication of resources

Best Evidence Science Teaching (BEST) resources are developed based on careful consideration of the best available research evidence on learning pathways, common student misunderstandings, and effective teaching approaches.

The research and writing work for key concepts at age 11-14 is complete, and all resources have been published. Resources for age 14-16 will be published on a topic-by-topic basis throughout 2021 and 2022.

Therefore, the key concept map for age 14-16 is a working draft that will be updated during the process of researching and writing resources for the key concepts.

To find out when new topics have been published, please follow [@BestEvSciTeach](https://twitter.com/BestEvSciTeach) on Twitter or check the BEST web pages at www.BestEvidenceScienceTeaching.org

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CHEMISTRY AND EARTH SCIENCE (AGE 11-14)

<p>BIG IDEA CSU: SUBSTANCES AND PROPERTIES</p> <p><i>Materials are either made of a single chemical substance or a mixture of substances which each have distinctive properties.</i></p>	<p>BIG IDEA CPS: PARTICLES AND STRUCTURE</p> <p><i>All matter is made up of atoms. The behaviour and structural arrangement of atoms explains the properties of different materials.</i></p>	<p>BIG IDEA CCR: CHEMICAL REACTIONS</p> <p><i>During chemical reactions, atoms are rearranged and new substances are formed.</i></p>	<p>BIG IDEA EEC: EARTH CHEMISTRY</p> <p><i>Substances can move within and between the atmosphere, hydrosphere, geosphere and biosphere as part of large-scale Earth systems.</i></p>	<p>BIG IDEA EDE: DYNAMIC EARTH</p> <p><i>The Earth's crust is constantly changing as new rocks are formed and older rock is worn away.</i></p>
<p>Topic CMS1 Properties and materials</p> <p>Key concepts: CMS1.1 Combining materials CMS1.2 Classifying materials</p>				
<p>Topic CSU1 Substances and mixtures</p> <p>Key concepts: CSU1.1 Substance CSU1.2 Solutions CSU1.3 Separating solutions</p>	<p>Topic CPS1 Substances and mixtures</p> <p>Key concepts: CPS1.1 Particle model for the solid, liquid and gas states CPS1.2 Particles in solutions</p>			

	<p>Topic CPS2 Elements and compounds</p> <p>Key concepts:</p> <p>CPS2.1 Atoms and molecules</p> <p>CPS2.2 Symbols and formulae</p>			
	<p>Topic CMS2 Designing materials</p> <p>Key concepts:</p> <p>CMS2.1 Polymer properties</p>			
<p>Topic CSU2 Solubility</p> <p>Key concepts:</p> <p>CSU2.1 Comparing solubility</p>	<p>Topic CPS3 Chemical change</p> <p>Key concepts:</p> <p>CPS3.1 Rearrangement of atoms</p>	<p>Topic CCR1 Chemical change</p> <p>Key concepts:</p> <p>CCR1.1 Formation of new substance</p>		<p>Topic EDE1 Earth's resources</p> <p>Key concepts:</p> <p>EDE1.1 What's in a rock?</p> <p>EDE1.2 Inside the Earth</p> <p>EDE1.3 Making rocks by heating</p>
	<p>Topic CPS4 Understanding chemical reactions</p> <p>Key concepts:</p> <p>CPS4.1 Representing reactions</p> <p>CPS4.2 Conservation of mass</p>	<p>Topic CCR2 Understanding chemical reactions</p> <p>Key concepts:</p> <p>CCR2.1 Reactions in solution</p> <p>CCR2.2 Combustion</p>	<p>Topic EEC1 Air pollution</p> <p>Key concepts:</p> <p>EEC1.1 Air quality</p>	

	<p>Topic CPS5 Evaporation</p> <p>Key concepts: CPS5.1 Explaining evaporation</p>	<p>Topic CCR3 Energy and reactions</p> <p>Key concepts: CCR3.1 Exothermic and endothermic reactions</p>	<p>Topic EEC2 Water cycle</p> <p>Key concepts: EEC2.1 Water cycle processes</p>	
<p>Topic CSU3 Acids and alkalis</p> <p>Key concepts: CSU3.1 pH scale</p>		<p>Topic CCR4 Acids and alkalis</p> <p>Key concepts: CCR4.1 Neutralisation</p>	<p>Topic EEC3 Acids and alkalis</p> <p>Key concepts: EEC3.1 Acid rain</p>	
			<p>Topic EEC4 Weathering and erosion</p> <p>Key concepts: EEC4.1 Chemical weathering</p>	<p>Topic EDE2 Weathering and erosion</p> <p>Key concepts: EDE2.1 Physical weathering and erosion</p>
<p>Topic CSU4 Periodic table</p> <p>Key concepts: CSU4.1 Trends in physical properties</p>	<p>Topic CPS6 Periodic table</p> <p>Key concepts: CPS6.1 Atomic model</p>	<p>Topic CCR5 Periodic table</p> <p>Key concepts: CCR5.1 Periodic patterns</p>		<p>Topic EDE3 Rock changes</p> <p>Key concepts: EDE3.1 Making rocks by pressure and cementing EDE3.2 Making fossil fuels</p>

CHEMISTRY AND EARTH SCIENCE (AGE 14-16)

BIG IDEA CSU:

SUBSTANCES AND PROPERTIES

Materials are either made of a single chemical substance or a mixture of substances which each have distinctive properties. The amount of a substance is measured in moles.

BIG IDEA CPS:

PARTICLES AND STRUCTURE

All matter is made up of atomic nuclei and electrons. The behaviour and structural arrangement of atomic nuclei and electrons explains the properties of different materials.

Topic CPS7

Metallic bonding

Key concepts:

CPS7.1 Metallic structure model

Topic CPS8

Ionic bonding

Key concepts:

CPS8.1 Ionic lattice

BIG IDEA CCR:

CHEMICAL REACTIONS

During chemical reactions atomic nuclei and electrons are rearranged and new substances are formed.

BIG IDEA EEC:

EARTH CHEMISTRY

Substances can move within and between the atmosphere, hydrosphere, geosphere and biosphere as part of large-scale Earth systems.

BIG IDEA EDE:

DYNAMIC EARTH

The Earth's crust is constantly changing as new rocks are formed and older rock is worn away.

	<p>Topic CPS9 Covalent bonding</p> <p>Key concepts: CPS9.1 Covalent structures</p>			
<p>Topic CSU5 Crude oil</p> <p>Key concepts: CSU5.1 Hydrocarbon molecules CSU5.2 Fractional distillation</p>		<p>Topic CCR6 Rates of reaction</p> <p>Key concepts: CCR6.1 Instantaneous rate CCR6.2 Collision frequency</p>		
<p>Topic CSU6 Polymers</p> <p>Key concepts: CSU6.1 Polymer synthesis</p>		<p>Topic CCR7 Catalysts</p> <p>Key concepts: CCR7.1 Catalysis</p>		
		<p>Topic CCR8 Chemical equilibrium</p> <p>Key concepts: CCR8.1 Reversible reactions CCR8.2 Dynamic equilibrium</p>		

		<p>Topic CCR9 Redox reactions</p> <p>Key concepts: CCR9.1 Oxidation and reduction</p>		
		<p>Topic CCR10 Electrolysis</p> <p>Key concepts: CCR10.1 Electrolysis of molten compounds CCR10.2 Electrolysis of solutions</p>		
	<p>Topic CPS10 Acids, bases and ions</p> <p>Key concepts: CPS10.1 Acid and base models CPS10.2 Concentration, strength and pH</p>	<p>Topic CCR11 Acids, bases and ions</p> <p>Key concepts: CCR11.1 Neutralisation process</p>		
<p>Topic CSU7 Quantitative chemistry</p> <p>Key concepts: CSU7.1 Amount of substance</p>		<p>Topic CCR12 Quantitative chemistry</p> <p>Key concepts: CCR12.1 Stoichiometry</p>		