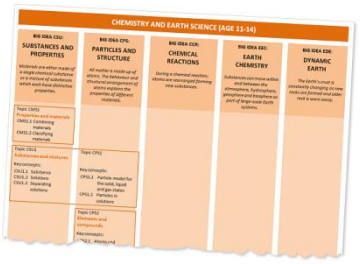
Chemistry and Earth science

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 Horners' 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 on Twitter or check the BEST web pages at **www.BestEvidenceScienceTeaching.org**

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CHEMISTRY AND EARTH SCIENCE (AGE 11-14)

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

Topic CPS2
Elements and compounds

Key concepts:

CPS2.1 Atoms and molecules
CPS2.2 Symbols and formulae

Topic CMS2
Designing materials

Key concepts:

CMS2.1 Polymer properties

Topic CSU2
Solubility

Key concepts:

CSU2.1 Comparing solubility

Topic CPS3
Chemical change

Key concepts:

CPS3.1 Rearrangement of atoms

Topic CCR1
Chemical change

Key concepts:

CCR1.1 Formation of new substance

Topic EDE1
Earth's resources

Key concepts:

EDE1.1 What's in a rock?
EDE1.2 Inside the Earth
EDE1.3 Making rocks by heating

Topic CPS4
Understanding chemical reactions

Key concepts:

CPS4.1 Representing reactions
CPS4.2 Conservation of mass

Topic CCR2
Understanding chemical reactions

Key concepts:

CCR2.1 Reactions in solution
CCR2.2 Combustion

Topic EEC1
Air pollution

Key concepts:

EEC1.1 Air quality

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

CHEMISTRY AND EARTH SCIENCE (AGE 14-16)

BIG IDEA CSU:	BIG IDEA CPS:	BIG IDEA CCR:	BIG IDEA EEC:	BIG IDEA EDE:
SUBSTANCES AND PROPERTIES	**PARTICLES AND STRUCTURE**	**CHEMICAL REACTIONS**	**EARTH CHEMISTRY**	**DYNAMIC EARTH**
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.	*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.*	*During chemical reactions atomic nuclei and electrons are rearranged and new substances are formed.*	*Substances can move within and between the atmosphere, hydrosphere, geosphere and biosphere as part of large-scale Earth systems.*	*The Earth's crust is constantly changing as new rocks are formed and older rock is worn away.*
	Topic CPS7 **Metallic bonding** Key concepts: CPS7.1 Metallic structure model			
	Topic CPS8 **Ionic bonding** Key concepts: CPS8.1 Ionic lattice			

Topic CPS9
Covalent bonding

Key concepts:

CPS9.1 Covalent structures

Topic CSU5
Crude oil

Key concepts:

CSU5.1 Hydrocarbon molecules
CSU5.2 Fractional distillation

Topic CCR6
Rates of reaction

Key concepts:

CCR6.1 Instantaneous rate
CCR6.2 Collision frequency

Topic CCR7
Catalysts

Key concepts:

CCR7.1 Catalysis

Topic CCR8
Chemical equilibrium

Key concepts:

CCR8.1 Dynamic equilibrium

Topic CCR9
Redox reactions

Key concepts:

CCR9.1 Oxidation and reduction

Topic CCR10
Electrolysis

Key concepts:

CCR10.1 Electrolysis of molten compounds

CCR10.2 Electrolysis of solutions

Topic CPS10
Acids, bases and ions

Key concepts:

CPS10.1 Acid and base models

CPS10.2 Concentration, strength and pH

Topic CCR11
Acids, bases and ions

Key concepts:

CCR11.1 Neutralisation process

Topic CSU6
Quantitative chemistry

Key concepts:

CSU6.1 Amount of substance

Topic CCR12
Quantitative chemistry

Key concepts:

CCR12.1 Stoichiometry