KS5 Chemistry

KEVI HWGA Curriculum Map

Curriculum Purpose:

Context	**Beyond KEVI HWGA & careers**	**A Level Chemistry** is a diverse subject to study. It provides learners with many transferable skills, and this is why it is a very popular course which leads to direct employment or further education through either degree level studies or apprenticeships both in the scientific and non-scientific sectors. **Careers**: Which Degree Courses Do Your A-Levels Suit? - The Uni Guide Chemistry career options | RSC Education Pharmacist - Analytical Chemist – Biochemist – Chemical Engineer – Cheminformatics – Cosmetic Chemist – Crystallographer – Food Technologist – Forensic Scientist – Geochemist – Immunologist – Laboratory Analyst – Manufacturing Chemist – Materials Engineer – Organic or Inorganic Chemist –– Process Chemist – Product Developer – Researcher – Toxicologist – Quantum Chemist – Water Chemist -Medical specialist – Doctor. Combined with non-scientific A-level subjects' other careers such as Law and Accountancy are accessible since the skills used in Chemistry are being recognised in other sectors.
	KS5 Intent	KS5 Chemists will embark on a journey that encourages curiosity, inspires, and nurtures a passion for the subject through an in-depth study of Physical chemistry, Inorganic Chemistry and Organic Chemistry through theory, research, independent study, and practical work. We will provide an enriched, broad, and stimulating curriculum that empowers students to make decisions, critically evaluate scientific and technological developments that impact society and equip them with the knowledge and skills to pursue further study and rewarding careers.
	HPL	Key HPL skills such as strategic planning, precision, analyse, evaluate, critical or logical thinking are embedded within the practical experience which complement the scientific investigative skills and assessment objectives set by the exam board. Further HPL skills and teaching toolkit are applied such as big picture thinking, connection finding, generalisation, self-regulation, and meta-cognition will be developed through this broad curriculum; enriched with a range of opportunities from presenting, project work, research, discussion, trips and independent work.

KEVI HWGA Curriculum Map

Year 12	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Key Content	***Baseline assessment*** Atomic Structure Amount of Substance	Bonding Nomenclature & Isomerism Alkanes Periodicity	Halogenoalkanes Alkenes Group 7 & Group 2 Energetics Kinetics	Alcohols Organic Analysis Equilibria Redox	Analytic Techniques Practical Techniques Properties of Period 3 & their Oxides (A Level)	Exam Technique Review of revision strategies Careers Research UCAS Support Supporting Yr11 Taster days Mock Exam
Big Qs	***How do the chemical properties of elements depend on their atomic structure and electron arrangement?*** ***How do chemists identify unknown substances?*** ***What are the key principles for how the mass spectrometer works?*** ***How do chemists measure and calculate the mass of particles?*** ***How do chemists determine the number of fundamental particles in atoms and ions using mass number, atomic number and charge?***	***How do the physical and chemical properties of compounds depend on the ways in which the compounds are held together by chemical bonds and by intermolecular forces?*** ***How do the theories of bonding explain how atoms or ions are held together in these structures?*** ***How do we name Carbon compounds and how do we draw the structures of chain, position, and functional group isomers?*** ***How are alkanes modified by the process of cracking and how are alkenes structured and what effect does this***	***Why are Halogenoalkanes being much more reactive than alkanes. What are their uses and why has the use of some halogenoalkanes has been restricted? Outline the mechanisms for alkene reactions and explain the formation of major and minor products referring to the relative stabilities of primary, secondary, and tertiary carbocation intermediates.*** ***What are the trends and properties in Group 2 and Group 7?*** ***How does the study of kinetics enable chemists to determine how a change in conditions affects the speed of a chemical reaction. How can chemists***	***What is a Redox reaction and what does it involve? How can we identify the elements involved and how do we use half equations?*** ***How do alcohols react and form new products? How is this done in the laboratory, what techniques are used and what conditions are required*** ***How are electrons involved in redox reactions and what are oxidising and reducing agents' involvement?*** ***What is equilibrium and what is Chatelier's principle? How are the principles used?***	***What analytical techniques are used by chemists, to analyse organic compounds?*** ***How are practical techniques being purposeful to complete reactions, separate mixtures, work out concentrations and identify substances?*** ***How do Period 3 elements react with oxygen? How does the pH of the solutions formed when the oxides react with water illustrates further trends in properties across this period?***	***What knowledge and understanding are required to successfully answer required practical questions*** ***How can we reflect on our study skills? How do we revise, retrieve and revisit previously learnt content? How do we study independently?*** ***How to we progress from working memory into long term memory?*** ***How do we consider our subject to planning our Careers further & plan for a successful UCAS application***

	How are quantities calculated for reactants and products in chemical reactions and how is this information used?	***have on their commercial use?***	***manipulate variables in chemical reactions in order to speed them up or slow them down? How can enthalpy change be measured?***	***How do redox reactions occur in inorganic and organic chemistry?***		
Key Knowledge and Skills	Atomic structure Development of atomic models TOF Mass spectrometer Electron configuration Ionisation energies Using balanced equations to calculate masses volumes of gases percentage yields percentage atom economies, concentrations, and volumes for reactions in solutions. Empirical Formula. Make up a standard solution and carry out titrations	Types of chemical bonding, their structures, and properties. Types of physical bonding – forces between molecules and how properties change. Polarity. Shapes of molecules. Organic molecules, nomenclature, and isomerism. Alkanes, fractional distillation, and cracking. Free-radical mechanism Explaining trends across the periodic table.	Enthalpy change and calculations Laboratory methods on measuring enthalpy change Plotting graphs, recording data, and evaluating. Calorimetry Hess's Law Calculating bond enthalpies Reactions of Alkenes. Reactions of group 2 and group 7 elements. Kinetics: Collision theory, Maxwell-Boltzmann distribution, effect of temperature, pressure, concentration on the rate of reaction. Practical work to investigate rates of reaction	Reactions of alcohols, industrial production, reaction conditions and organic laboratory techniques and equipment. Practical skills oxidizing an alcohol. Organic analysis. Chemical Equilibria Le Chatelier's Principle and Kc calculations and constructing expressions. Predicting effects of changing conditions. Redox reactions: oxidation states, half equations and combining half equations.	Mass spectrometry Interpreting Mass Spectra Infrared Spectroscopy Interpreting IR Spectra Practical Exam questions and review of techniques, equipment, and practical skills.	
Key Assessment Objectives	AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques, and procedures. • AO2: Apply knowledge and understanding of scientific ideas, processes, techniques, and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. • AO3: Analyse, interpret and evaluate scientific information, ideas, and evidence, including in relation to issues, to: • make judgements and reach conclusions • develop and refine practical design and procedures.					
Feedback & Assessment	❖ Baseline <u>Fortnightly tests</u>	❖ <u>Fortnightly tests</u> ❖ CPAC assessment	❖ <u>Fortnightly tests</u> ❖ CPAC assessment	❖ <u>Fortnightly tests</u> ❖ CPAC assessment	❖ <u>Fortnightly tests</u> ❖ CPAC assessment	❖ Mock Exams ❖ CPAC catch ups

Year 13	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Key Topics	**Nomenclature & Stereoisomerism Carbonyl Chemistry Rate Equation Kp**	**Aromatic Chemistry Organic Synthesis Acids & Bases Polymers Amines**	**Amino acids, proteins & DNA s Transition Metals Thermodynamic**	**Electrode Potentials Reactions of Aqueous Ions NMR Chromatography**	**Exams**	**Exams**
	How can we distinguish between optical isomers and why do they even exist? How do we name acid anhydrides, amines, other acid derivatives using IUPAC? How do aldehydes, ketones, carboxylic acids, and their derivatives use the carbonyl group to react and interact with nucleophiles? How can we use mechanisms to understand why carbonyls react the way they do? How can we predict the products of these reactions? Why is acylation important? How do we make aspirin? How in rate equations does the mathematical relationship between rate of reaction and concentration give information about the mechanism of a reaction that may occur in several steps?	***Why was the structure of benzene tricky to discover? How is benzene an example of an aromatic and what do we know about its structure and its substitution reactions? How are aromatic compounds used around the world? How are functional groups converted to the desired functional groups? What reagents are required? What conditions are necessary? How do we use mechanisms to understand how molecules will interact with reagents in chemical reactions. How and why are Acids and bases important in domestic, environmental, and industrial contexts. What causes Acidity in aqueous solutions and what kind of scale has been made to measure this? What is a Buffer solutions, and why are they important industrial and biological applications?***	***How are condensation polymers formed and what are their properties and typical uses? What are the problems with the reuse and disposal of both addition and condensation polymers? What's in the current news about this? What are the structures and functions of polyesters/amides, amino acids, proteins, and DNA? How is the double stranded helix structure held together? What is the significance of the various types of bonding in maintaining the structure of DNA? What does the 3d block contain? How are these metals unlike the metals in Groups 1 and 2? What are the properties of these elements, and which can be used as catalysts. How do catalysts work? What are thermodynamics and how does it build on the Energetics section? How does thermodynamics***	***Where do Redox reactions take place? What can the potential difference that is created drive? What are the very important commercial applications of Electrochemical cells? How do we set an electrochemical cell up in the laboratory? How do we test for transition metal ions using aqueous ion reactions? How do chemists use a variety of techniques to deduce the structure of compounds? How is nuclear magnetic resonance used in addition to other methods as an analytical technique. How do we use the analytical data to solve problems?***		

		What are Amines and what do they consist off? How do they react as nucleophiles and cause further substitutions? What difficulties can this lead to?	***allow us to understand the stability of compounds and why chemical reactions occur? How is free-energy change to be calculated.***			
Key Knowledge and skills	Explain and analyse rate equations, orders and initial rate methods as well as being able to explain and use the Arrhenius equation. Reactions, mechanisms, conditions of aldehydes/ketones/ esters/carboxylic acids/acid chlorides/acid anhydrides. Predicting outcomes and uses of products. Use Arrhenius's rearranged equation with experimental data to plot a straight-line graph with slope –Ea /R Measuring the rate of reaction: • by an initial rate method • by a continuous monitoring method	Discovery of the structure of benzene. Evaluating and considering theories. Reaction and mechanisms of aromatic compounds. Making Aspirin. The laboratory techniques required to synthesis and purified organic products. Addition and condensation reactions of polymers. Uses and properties of polymers. How is one functional group changed to another. What conditions are needed and what steps are needed to make the desired product? Structures of acids and bases. The pH scale and how buffer solutions are made. Calculations required to produce buffers.	Students will learn how to name amines and describe their basic properties and synthesis. As well as explaining nucleophilic substitution. The structure of proteins – primary, tertiary, quaternary. Enzymes. Students will be able to describe and explain the properties of condensation polymers and explain the difficulties of reuse and disposal. Students will be able to describe the structure and function of amino acids, proteins, and DNA Chemical properties of transition metals, complex ion shapes and isomerism. Explaining how and why transition metals form coloured compounds. Ligand exchange reactions. Uses as catalysts. Types of catalysts. Autocatalysis. Redox Titrations – practical skills. Students will learn the theory of thermodynamics and enthalpy change in	Redox reactions explain how they produce a potential difference and explain some of their commercial uses. How aqueous ions undergo changes in chemical reactions to cause colour changes and oxidation states. Practical skills of observing and recording accurately. How NMR is used as an analytical technique. How to interpret integration data. Use 1H and 13C NMR data to identify molecules. Applying rules. Types of chromatography and the principles behind how it is used as a separating technique. Practical skills to carry it out.		

			solution. They will be able to explain the Born-Haber process, as well as Equilibrium and Kp			
Key assessment Objectives	AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques, and procedures. • AO2: Apply knowledge and understanding of scientific ideas, processes, techniques, and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. • AO3: Analyse, interpret and evaluate scientific information, ideas, and evidence, including in relation to issues, to: • make judgements and reach conclusions • develop and refine practical design and procedures.					
Feedback & Assessment	❖ AS Baseline Test ❖ <u>Fortnightly tests</u> ❖ CPAC PRACTICAL	❖ <u>Fortnightly tests</u> CPAC PRCATICAL	❖ <u>Fortnightly tests/ MOCK</u> ❖ CPAC PRACTICAL	❖ <u>Fortnightly tests</u> ❖ CPAC PRACTICAL	EXAMS	EXAMS

Chemistry Structure Map RSC 2020 – Shows how we build knowledge within our curriculum to form cohesive SOW.

The Big Questions and key ideas

Our approach to developing a clear narrative has been informed by expert thinking on curriculum design, in particular the *Big Ideas of Science Education*[4], which explains how the links between ideas and experience is better preserved in a narrative form than in a list of disconnected points.

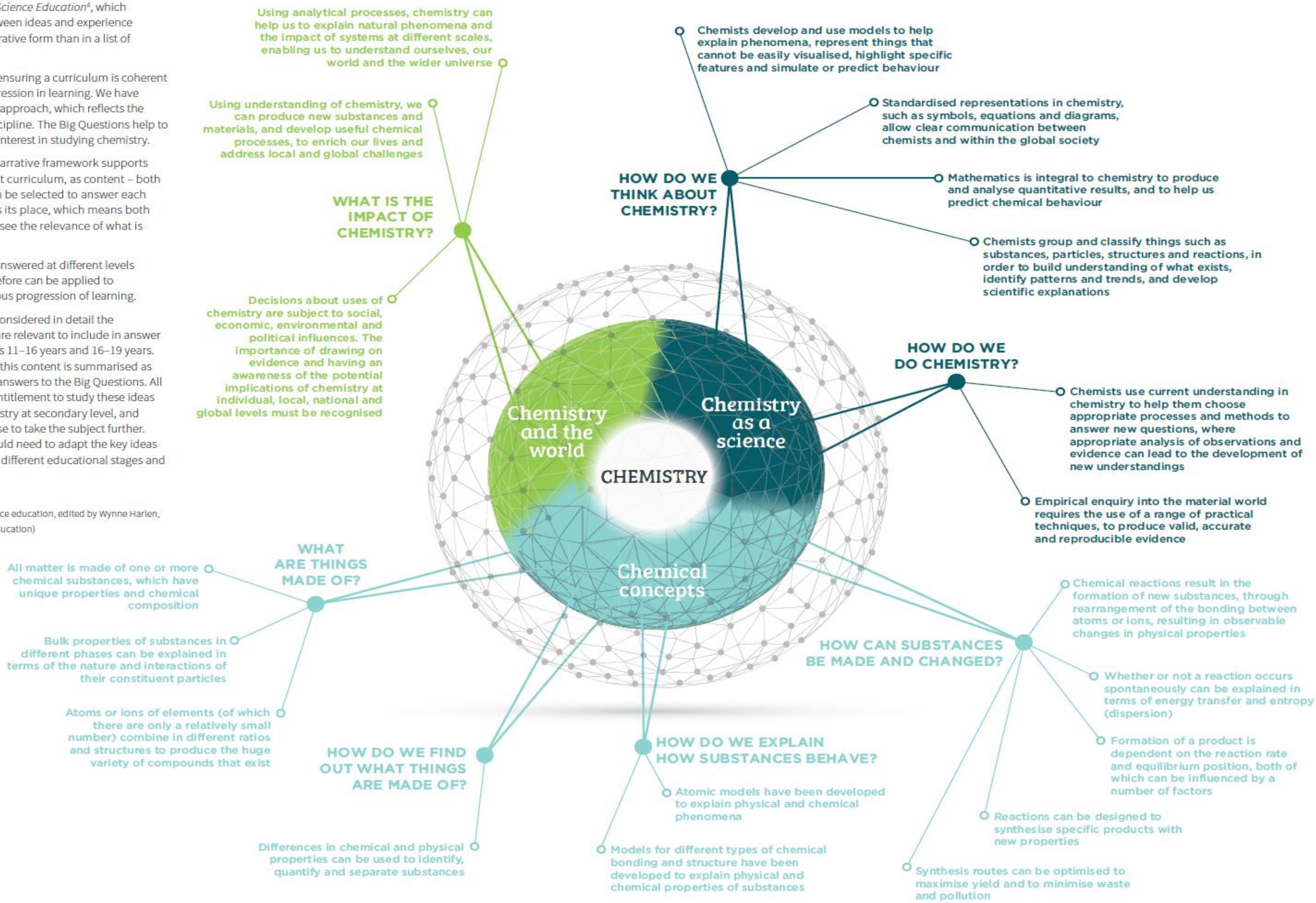
A narrative is important in ensuring a curriculum is coherent and aids planning for progression in learning. We have adopted a "Big Questions" approach, which reflects the enquiring nature of the discipline. The Big Questions help to define the central areas of interest in studying chemistry.

Using Big Questions as a narrative framework supports development of a coherent curriculum, as content – both knowledge and skills – can be selected to answer each question. All content earns its place, which means both teachers and learners can see the relevance of what is being taught.

The Big Questions can be answered at different levels of sophistication, and therefore can be applied to development of a continuous progression of learning.

The working groups have considered in detail the knowledge and skills that are relevant to include in answer to the Big Questions at ages 11–16 years and 16–19 years. In the framework diagram, this content is summarised as the key ideas that provide answers to the Big Questions. All learners should have the entitlement to study these ideas during their study of chemistry at secondary level, and in more depth if they choose to take the subject further. Curriculum developers would need to adapt the key ideas to the appropriate level for different educational stages and qualifications.

[4] Principles and big ideas of science education, edited by Wynne Harlen, 2010 (Association for Science Education)



Linking areas of the framework ▶

The dotted lines on this diagram are indicative of links that can be made between different areas of the framework. Some Big Questions link to most or all areas of the framework, for example *What is the impact of chemistry?* and we envisage that any curriculum would reflect these links. There are many more possible links than, for clarity, can be shown here. No judgement should be made about the relative importance of links if they are, or are not shown.