Chemistry Curriculum Map

Curriculum - Overview						
Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
During Year 7, students start to develop their ideas from KS2 about energy, forces, waves and space. We build working scientifically skills into our science curriculum. This includes; • Basic safety • Measuring accurately and units • Reliability, precision and accuracy • Calculating averages and identifying errors • Identifying and selecting variables • Adding data to and creating tables • Creating simple methods • Graphs • Patterns in data • Predictions and hypothesis	During Year 8, students continue to develop their understanding of substances, states of matter, chemical changes and start of build upon KS2 knowledge about the Earth and rocks. We continue build on their working scientifically skills, including; • Risk assessing • Bias and objectivity • Reducing bias and peer review • Method writing • Reliability, precision and accuracy • Judging data • Evaluating methods • Patterns in data • Graphs and lines of best fit • Hypothesis • Concluding • Analysis and evaluation	During Year 9 students complete their KS3 work on the periodic table and rocks. Later in the year students move onto GCSE content and develop their understanding of energy further. Working scientifically skill development is continued in KS3 and develop these skills further at GCSE. • Precision and accuracy • Evaluating risk • Method creation • Analysis and evaluation • Designing further experiments and questions to support data • Patterns and concluding GCSE core practical work further enhances student skills. In Year 9 students carry out:	**Information in bold is only relevant to separate science students.** During Year 10 students build further their understanding of substances and atomic structure, by investigating types of bonding., calculations linking to chemistry, topics related to chemical changes and the periodic table. Core practical work further enhances student skills. In Year 10 students carry out: • Electrolysis • Rates of reaction • **Acid-alkali titration** These core practical pieces are carried out by combined students in Year 11 • Investigating pH • Preparation of copper sulfate	**Information in bold is only relevant to separate science students.** During Year 11 students continue to build their understanding of ions, elements, chemical reactions and chemistry calculations. They start to build an understanding of organic chemistry, by looking at a range of organic molecules. Core practical work further enhances student skills. In Year 11 students carry out: • **Identifying ions** • **Combustion of alcohols**	The initial topics of atomic structure, Amount of substance and Bonding build upon a student's KS4 knowledge. Proceeding topics have strong links to KS4 content covering energetics, kinetics (rates of reaction), equilibrium and characteristics of the Periodic table. Organic chemistry builds upon carbon based substantive knowledge learnt at KS4 but also introduces new organic chemistry homologous series not studied during KS4. Practical based investigative chemistry is used throughout the curriculum to reinforce substantive knowledge and build upon disciplinary knowledge.	In Year 13 students develop their knowledge from Year 12 to gain deeper knowledge of the key aspects of physical, inorganic and organic chemistry. The initial topics of thermodynamics and rates build upon the energetics and kinetics topics covered in Year 12. Other topics; electrode potentials and cells, and acids and bases extent as student's knowledge of physical chemistry. In inorganic chemistry the students extend their knowledge of the elements in the Periodic table, covering trends in Periods and transition metal chemistry.

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	• Global connectivity • Role of research	• Investigating the composition of inks				
Curriculum – Topic Sequencing						
Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
C1: Materials Students build upon their KS2 learning about materials and their properties. They focus on the properties that can be used to classify materials. Composite materials are examined and practically investigated. **C2: Substances and mixtures** Students build upon their KS2 knowledge of solutions and some methods of separating mixtures. Students investigate solutions in more depth and investigate a wider range of method of separating mixtures.	**C7: Earth's resources** Students build upon KS2 knowledge of the Earth, by developing their ideas of rock and minerals. They focus on the interior structure of the Earth, plate tectonics and the formation of igneous rocks. **C8: Understanding chemical reactions** Students build upon their understanding of chemical changes. They focus on the way in which chemical reactions can be shown through word and formula equations. They build knowledge about the law of conservation of mass. Through theory and practical work, they investigate types of chemical reactions	**C14: The periodic table** Students build upon their understanding of atoms and elements. In this topic they develop their understanding of the pattern in physical and chemical properties within the periodic table and looking at similarities. Enhance their understanding of atoms and the nucleus of an atom, whilst comparing the particle and atomic model. **C15: Rock changes** Student build on their understanding of rock, weathering and erosion to investigate the three types of rock and how they create the rock cycle.	**Ionic bonding** This topic starts to develop student understanding in how particles in substances are held together. We investigate how ionic substances form between metal and non-metal atoms, the means of an ionic bond and looking at explaining the properties these substances have. **Masses and empirical formula** We have split the calculations involving mass, into more manageable chunks. This part of the topic looks at relative formula mass, how we calculate the percentage of an element in a substance and calculating	**Fuels** Students build upon their KS3 knowledge of chemical reactions and air pollutants. This is students first real introduction to organic chemistry. They learn about the mixture of hydrocarbons we call crude oil. During this topic students focus on how useful substances are extracted from crude oil and how large hydrocarbons can be cracked to create more useful substances. They develop their understanding of how air pollutants are created and from combustion of fuels and the dangers associated with this. Investigating different fuels, students learn how to evaluate fuels for different purposed	**<u>Physical chemistry</u>** **Atomic structure** Students build upon their KS4 chemical properties of elements knowledge and link this to the way in which elements are organised in the Periodic Table. The principles and operation of a modern mass spectrometers are studied and linked to the determination of atomic structure. Students gain a deeper understanding of the arrangement of electrons in an atom and how this influences ionisation energies. **Amount of substance** The application of mathematical concepts to chemistry underpins A level Chemistry. In this topic students re-visit and apply the	Students broaden their knowledge of organic compounds, the transformations between each other and their characteristic properties and reactions. In addition, students expand their application of spectroscopy techniques used in the elucidation of organic compounds. **<u>Physical chemistry</u>** **Thermodynamics** Students use Born-Haber cycles to calculate lattice enthalpies. They then dive into the world of entropy and disorder in chemical systems, using Gibbs free-energy changes to calculate feasibility conditions for reactions.

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	including displacement reactions in solution and combustion.		empirical and molecular formula.		concept of the 'mole' in more complex chemistry calculations.	
C3: Elements and compounds Students develop their ideas about substances. They focus on atoms and molecules, building up to elements and compounds. Students start to link structure to the physical properties of substances. Element symbols and chemical formula are explored. **C4: Polymers** Students continue their thinking about materials and focus on polymers. They focus on process of making a polymer and the properties of polymers. Students explore alternative to using oil and plastics, whilst evaluating our use of plastics.	**C9: The atmosphere** Building upon student work on the Earth, they expand this to investigate the atmosphere. They look at the composition of the atmosphere and focus on air pollutants and how pollutants can spread. **C10: Understanding evaporation** Students investigate how a mixture of liquids can be separated through distillation. They build upon their understanding to look at the reason for evaporation and how this compares to boiling. **C11: Heat energy changes in chemical reactions**	**GCSE** **States of matter and mixtures** Student build upon KS3 knowledge about states of matter and changes of state, linking to particles and energy. Students enhance their understanding by comparing the properties of pure substances and mixtures and using this to make predictions. **Atomic structure** Students build upon their understanding of atoms and being to appreciate sizes. They learn fundamental skills; such as the use of the mass and atomic number of work out the number of sub-atomic particles in an atom. This work is developed	**Electrolytic processes** Students build upon their understanding to investigate how ionic substances can be decomposed using electricity. They focus on molten electrolysis, aqueous electrolysis and investigate how electrolysis is used to purify copper. **Covalent bonding** Students continue to look at how particles in substances are held together. We investigate covalent bonding and how non-metals atoms are held together in molecular substances. **Conservation of mass** This build upon the calculations using mass topic. Students develop an understanding of	**Reversible reactions and equilibria** Student push forward in their understanding of how chemical reactions happen to look at examples of reaction that can reverse and move backward. This includes looking at the Haber process and the production of ammonia. Higher tier students develop their understanding further, by looking reversible reactions that reach equilibrium and the factors that can affect the concentration of reactants and products within the mixture. **Atmospheric science** Student build upon their KS3 knowledge of gases within the atmosphere and air pollutants to investigate	**Bonding** Students build upon substantive knowledge studied in KS4 chemistry. Ionic, covalent and metallic structures and properties are all revisited in more detail. In addition, forces between molecules are extensively discussed, and how the arrangement of the electrons and their repulsive nature leads to different molecular shapes. **Energetics** In A level Chemistry students build on their understanding of exothermic and endothermic reactions. The explanation and measurement of energy (enthalpy) changes and their application in Hess	**Rate equations** The elucidation, using tabulated and graphical data, and the application of a rate equation to explain changes in rates of reaction is covered in this topic. Students then graphically manipulate the Arrhenius equation to determine activation energies for reactions. **Equilibrium constant, K_p** Building upon knowledge covered in Year 12 students consider how the mathematical expression for the equilibrium constant Kp enables us to calculate equilibrium yields of gaseous systems. This has important

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C5: Comparing solubility Students continue to develop their understanding of solutions and solubility, including the use of different solvents.	Students build upon their understanding of chemical reactions to look at how temperature changes during a chemical change. This includes investigating endothermic and exothermic reactions and starting to build an explanation about how the temperature changes during these reactions.	further to build and understanding of isotopes and how they link to an elements relative atomic mass. **Separating techniques** Building upon student understanding of mixtures and distillation, they expand their understanding of different mixtures and the range of separating techniques used. This includes simple filtration, evaporation and chromatography.	how during chemical reaction mass is conserved. This concept is used to predict, through calculations, the mass of products made, or reactants used. We also start to develop the skill of balancing chemical equations during this topic.	how the Earth's atmosphere evolved since the formation of the Earth around 4.5 billion years ago. This then builds upon their work at KS3 and in the fuel unit, to examine the evidence for climate change and the role of greenhouse gases.	cycles allows students to gain a deeper insight into the thermochemical changes that occur in chemical reactions. **Kinetics** The rates of chemical reactions is an important topic during a student's KS$ chemistry studies. At A level this is re-addressed to include the kinetics of molecules and how these determine the rate of a reaction.	consequences for many industrial processes.
C6: Chemical changes Students start to build upon their KS2 understanding about chemical changes and physical changes. This includes, how compounds are made, physical and chemical changes, how we can observe chemical changes and thermal decomposition reactions.	**C12: Acid and Alkali** Students investigate acid, bases and alkalis. m They look at how we can classify these substances using indicators and the pH scale. Building on their knowledge of chemical reactions, neutralisation is developed. **C13: Weathering and Erosion**	**The periodic table** Students build upon their understanding of the periodic table to investigate the history of how the periodic table developed. The focus on the structure of the periodic table and how this links to atomic structure.	**Heat energy changes in chemical reactions** We expand on students understanding of endothermic and exothermic reactions, through more Indepth explanations and how graphs can show heat energy changes. Higher tier students use calculations to work out how much energy is released or absorbed	**Quantitative analysis: yields and atom economy** **Students learn how to calculate percentage yield and atom economy. They learn about the two calculations role in industry. Students learn about why percentage yield is never 100%, but atom economy can be.**	**Chemical equilibria** Building on their KS4 knowledge of LeChatelier's principle, students deepen their knowledge by using mathematical models to explain reactions in equilibrium. **Redox equations** The concept of reduction and oxidation was introduced during KS4 chemistry studies.	**Electrode potentials and electrochemical cells** Students studied redox reactions in Year 12, and they now extrapolate this knowledge to electrochemical cells and the generation of a potential difference. Students learn how to correctly represent cells and use standard electrode potentials to

	Building upon student understanding about the Earth and rocks, students develop their understanding of the method of weathering rocks and the causes of erosion.		during a chemical reaction. **Concentration** Continuing with calculations linked to mass, students learn how to calculate the concentration of solutions. **Rates of reaction** Build upon students understanding of chemical reaction, we focus on measuring the speed of chemical reactions and factors that affect the speed of a chemical reaction. Students develop practical and graphical skills, including measuring the gradient on a graph to determine rate.	**Hydrocarbons** **Students build on their work on hydrocarbons to understand two main groups of hydrocarbons; alkanes and alkenes. This included some of their reactions, such as addition in alkenes, and how alkenes can be used to make polymers.**	Within A level Chemistry more complex reduction/oxidation (redox) situations, the introduction of oxidation states and the use of redox in explaining chemical reactions is introduced. **<u>Inorganic chemistry</u>** **Periodicity** The ability of students to explain trends in atomic radius, ionisation energies and melting points for the elements in Period 3 of the Periodic table builds on basic trends and patterns learnt in KS4.	predict the direction of redox reactions. In addition, students study commercial rechargeable (fuel cells) and non-rechargeable cells and use electrode potentials to deduce the reactions that occurring inside the cells.
			Types of substances Students build on their understanding of ionic and covalent substances, by looking at metallic substances and how metal atoms are held together and the structure they	**Transition metals, alloys and corrosion** **Students investigate the properties of transition metals and how metals can corrode, focusing on iron. They build on their understanding of**	**Group 2 & Group 7** At KS4 students learnt about the group chemistry of group 1 and group 7. Students build upon this knowledge by studying the chemistry of group 2 and then deepening	**Acids and bases** Students build upon their KS4 knowledge of acids and bases, employing mathematical expressions to calculate values for pH and equilibrium constants

			create. They expand beyond covalent molecular structures by comparing these structures to giant covalent structures. This leads to different covalent substances made from carbon atoms and the properties these substances have. Comparing all type of bonding and structure enable students the ability to see similarities and difference in properties and how we explain these. **Groups in the periodic table** Students build upon their understanding of the periodic table to focus on specific groups. We investigate, group 0, 1 and 7. This includes looking at trends in physical and chemical properties. We build on KS3 knowledge of displacement reactions, by focusing on these	**electrolysis to look at how metals are plated and the impact that metals alloys have on their properties. They investigate how iron can be protected and the uses of electroplating and alloys.** **Quantitative analysis: concentration and titrations** **Students build on their learning about the mole and use this to calculate concentration. They focus on the use of acid-alkali titrations to determine the concentration of an unknown acid or alkali. This is carried out practically, using indicators they have learned about in Y10 and through calculations** **Alcohols and carboxylic acids** **Students build on their organic chemistry**	their understanding of the properties of group 7. **<u>Organic chemistry</u>** **Introduction to organic chemistry** Students extensively develop their substantive knowledge of organic molecules throughout A level Chemistry. At KS4 the plethora of organic based substances was only introduced, students now begin to name, using international nomenclature, and draw more complex organic molecules. In addition, the reaction mechanisms that underpin organic chemistry are introduced and applied to organic synthesis, and knowledge of the different structural arrangements of atoms in an organic molecule (isomerism) are developed.	for weak and strong acids and bases. Furthermore, students develop their understanding in the use of titrations and indicators first practically used at the start of Yer 12. The explanation of how buffers work and calculation of operating pH's of buffers is also included in this topic. **<u>Inorganic chemistry</u>** **Properties of Period 3** The reactions of the Period 3 elements with oxygen are considered in this topic. Students look at further trends, including the pH of solutions of oxides. **Transition metals** At KS4 the transition metals are introduced. Here, students build upon their KS4 knowledge of the properties of the transition metals, consider how they behave in substitution

			reactions within group 7. Chemical trends within groups are explained, using their understanding of atomic structure, electron structures and ionic bonding. Group 0 focuses on their lack of reactivity and how we use these elements.	**knowledge, related to hydrocarbons to investigate other organic molecules: alcohols and carboxylic acids. This includes; the scientific naming and drawing of molecules and how these molecules can react, including combustion. Students focus on more depth on alcohols and ethanol production.**	**Alkanes and halogenoalkanes** In KS4 students learnt about the separation and processing of the simplest series of organic molecules. At A level this knowledge is built upon to include the reactions of the alkanes and their link to ozone depletion.	reactions, and examine the shapes of complex ions produced by transition metals. They also look at the range of coloured compounds produced by transitions and how their properties allow them to be utilised as catalysts in industry.
			These final three topics in Year 10, are completed by combined science students at the start of Year 11. **Obtaining and using metals** Student focus on the reactivity of metals and how metals are extracted dependent on their reactivity. They develop their ideas around the terms, oxidation and reduction	**Quantitative analysis: Molar volumes of gases Students continue developing their use of the mole, to build an understanding around gases. They use this to calculate gas volumes.** **Dynamic equilibria Students build on their understanding of reversible reactions and equilibria to focus on the rate of reaching equilibrium. This is linked to chemical**	**Alkenes** Students observe and evaluate the use of alkenes in polymerisation in KS4. At A level a student's knowledge of the structure, bonding and reactivity of the alkenes is greatly deepened. **Alcohols** Students build on a basic knowledge of the structure, synthesis and reactions of alcohols learnt within the KS4	**Reactions of ions in aqueous solutions** The reactions of transition metal ions in aqueous solution allow students to develop their practical knowledge to show and to understand how transition metal ions can be identified by test-tube reactions in the laboratory. **<u>Organic chemistry</u>** **Optical isomerism**

			with half equations being introduced. Students also look at industry and the purpose of a LCA – life cycle assessment. **Acid and Alkali** Students build on their KS3 knowledge of acids, bases and alkali to investigate a wider range of indicators and the pH scale in more depth. Skills build as they look at the numerical relationship between different pH values, use this concept in calculations and show neutralisation in a graphical way. An introduction to apparatus, such as a burette and a more accurate pipette.	**industry and how chemicals are produced to create chemical fertilisers.** **Polymers** **Building on student understanding of the addition reaction that alkenes undertake to create polymers, students focus on other types of polymers. These polymers directly link to alcohols and carboxylic acids and student learn how they are created by condensation reactions. A focus on all polymers allows students to investigate the uses of these substances and the environmental issues associated.**	Chemistry curriculum. Students learn about the oxidation of alcohols to produce other series of organic compounds. **Organic analysis** The elucidation of the structure and the functional group of an organic compound is vital for the development of future useful organic molecules. In this topic students learn how to use chemical reactions and analytical techniques (mass spectrometry and infra-red spectroscopy) to determine the molecular formula and particular bonds within an organic compound.	Students study the chirality within organic substances and linking this to a special type of isomerism. **Aldehydes and ketones** The carbonyl functional group, its reactions and the chemical tests to distinguish between aldehyde and ketone compounds is examined in this topic. **Carboxylic acids and derivatives** The oxidation products of aldehydes; acidic carboxylic acids and further derivatives, such as the fruity smelling esters, acid anhydrides, and acyl chlorides are discussed. Their use in further organic synthesis reactions to produce important chemicals are studied.
			Moles Student build upon their calculation work to develop an	**Quantitative analysis: Testing for ions** **Students investigate how we can test for the**		**Aromatic chemistry** The structure and bonding and the extensive range of

			understanding of a chemistry measurement unit called a mole. Students use the concept of the mole in a variety of calculations, which we will continue to develop in Year 11.	**presence of different ions in solutions. We look at flame testing and analytical use of photometry. Students practical investigate the chemical tests for a range of positive and negative ions.** **Chemical cells and fuels cell** **Students developing their understaning of ions and electricity to learn about how chemical cells and fuels cells work to produce electricity. This included considering the application of these type of cell.** **Bulk and surface properties of matter** **Student build upon their KS3 understanding of materials to investigate in more depth, including composite materials. We look at nanoparticles and how when particles get very small, this can impact**		organic compounds based around aromatic rings is considered in this topic. **Amines** In KS4 students came across ammonia-based compounds. At A level this knowledge is built upon with respect to the properties and reactions of organic compounds based on ammonia. **Polymers** To build upon knowledge learnt in KS4 and extended during the first year of A level, students develop their knowledge of biodegradable polymers. **Amino acids, proteins and DNA** Students would have learnt of the proteins and amino acids in KS4 Biology. In A level Chemistry the

				on the properties they display.		structures and links to enzymes, DNA and drug action are considered.
						Organic synthesis Students apply their knowledge of all the series of organic compounds they have learnt throughout their A level studies to organic synthesis pathways **Nuclear magnetic resonance spectroscopy** In addition to the spectroscopy and analytical techniques used in structure determination in year 1 of A level studies, students now learn how to use the technique of nuclear magnetic resonance spectroscopy to fully elucidate organic compound structures. **Chromatography** Students studied chromatography and

						the separation of mixtures in KS3 and KS4. At A level students build upon this knowledge and study three different types of chromatography; thin layer, column and gas chromatography. They then apply these techniques to the separation and identification of organic compounds.