CHEMISTRY CURRICULUM MAP

Intent:

By studying chemistry at RMGS the students should have gain an insight into the importance of the subject in the 21st Century. Along the journey the students will learn the basics of the subject in order to support the understanding later in the course, eg understanding the make-up of the atom allows us to then use this to explain how different types of bonding can arise, and how we can calculate expected mass of products (via the mole). We have carefully sequenced the units to allow the students to build on their knowledge though the course as well as distributing the more practical topics evenly. We aspire for our students to retain a sense of wonder about our vast and complex world - and try to instil into them the importance of understanding how scientific and technological progress is changing the world and knowledge of the science behind this is important, eg how and why burning fossils results in the ULEZ, climate change ocean acidification, how do electrochemical cells work and why we are switching from fossil-fuels to cells to power our vehicles. In order to do this the students must have an understanding of the Scientific Method and how this is integral into how we perform, and challenge existing ideas, the model of the atom has undergone many iterations to the one we use today, built on scientific evidence. Also, of importance in a social media-oriented society is the ability of the student to critique ideas in the media, by teaching the students how to analyse, interpret data, knowing which sources of data are 'trust-worthy' (a post on Instagram or a peer-reviewed article from a reputable source?) they can then make an informed decision on a subject. All this brings together a lot of knowledge and gives the students insight into the complex world we live in and which they can be a part of via their understanding either in a discussion with friends or as a future career.

YEAR 9	Atomic Structure	The Periodic Table	Structure and Bonding	Chemical Changes
Key Knowledge	• Explain the structure of the atom. • Explore the evidence used to obtain the current atomic model. • Describe, explain processes of separation.	• Explain why the elements in a group have similar properties. Explain why group 0 are 'inert'. • Understand why the trend in reactivities in Groups 1 and 7. • Describe the steps involved with the development of the modern periodic table. • Contrast the properties of the transition metals with group 1. • Explain Mendeleev's key contributions to the development of the periodic table.	• Explore states of matter. • Explore Ionic bonding. • Explore covalent bonding, simple and giant structures. • Explore metallic bonding. • Explore nanoparticles and their unique uses/properties.	• Understand the terms oxidation and reduction using electrons. • Describe the reactions of metals with acids and water. • Evaluate metals extraction processes. • Predict products from neutralisation reactions. • Deduce formulae of salts. • Describe the preparation of a dry salt. • Identify acids/bases on the pH scale. • Describe how to carry out a titration (Chemistry). • Explain strong/weak, dilute/concentrated when referring to an acid. • Describe acidity/pH and hydrogen ion concentration.
Key Subject Skills	• Understand how scientific methods and theories develop over time. • Recognise the importance of peer review of results and of communicating results to a range of audiences.	• Understand how scientific methods and theories develop over time. • Use a variety of models to solve problems and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Safe use and careful handling of liquids, including careful mixing	• Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects. • Recognise substances as small molecules, polymers or giant structures from diagrams showing their bonding.	• Use a variety of models such as representational, spatial, descriptive to solve problems and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Make order of magnitude calculations. • Safe use of a range of equipment to separate chemical mixtures

		of reagents under controlled conditions, using appropriate apparatus to explore chemical changes.		including evaporation, filtration and crystallisation.
Connections with careers			Material Scientists, Nanotechnologists, Analytical chemists Metallurgist	
Home support	Following assessments, the students are asked to reflect on their learning using the Teams-based Feedback Sheet and how they can improve going forward. There are various platforms to enable them to do this, eg BBC BiteSize, FreeScienceLessons, ContinuityOak(Videos), Exam Questions			

Key stage 4: GCSE

YEAR 10	Earth's Resources	Rates of Reaction	Electrolysis	Chemical Equilibria
Key Knowledge	• Exploring damage to the Earth's resources. • Considering the importance of recycling. • How to extract metals • State where natural products are supplemented by synthetic. • Distinguish between finite and renewable. • Extract and interpret information. • Use orders of magnitude to evaluate significance. • Distinguish between potable and pure water. • Describe difference in treatment of ground, waste and salty water. • Rationalise steps used to produce potable water. • Evaluate biological methods to extract metals. • Compare Life Cycle Assessments.	• Calculate the mean rate of a reaction. • Draw, and interpret, graphs. • Draw tangents to the curves to measure the rate. • Recall how changing factors affects the rate of chemical reactions. • Predict and explain using collision theory the effects of changing conditions. • Identify catalysts in reactions from their effect on the rate of reaction. • Explain catalytic action.	• Predict products of a molten ionic compound. • Explain the extraction of aluminium extraction using electrolysis. • Predict products of a solution of an ionic compound. • Write half-equations for the reactions occurring at the electrodes during electrolysis.	• Understand the concept of reversible reactions. • Define Chemical equilibrium and dynamic equilibrium • Understand how changes in concentration and pressure affect equilibrium. • Apply Le Châtelier's Principle to changes in concentration and pressure. • Understand how temperature and catalysts affect equilibrium. • Apply Le Châtelier's Principle to temperature changes. • Apply equilibrium concepts to industrial applications of equilibrium such as the Haber process.
Key Subject Skills	• Appreciate the power and limitations of science and consider any ethical issues which may arise.	• Making and recording of appropriate observations during chemical reactions including changes in temperature and the	• Use of appropriate apparatus and techniques to draw, set up and use electrochemical cells for separation of elements.	• Use a variety of models such as representational, spatial, descriptive to solve problems and to develop scientific

	• Explain every day and technological applications of science; evaluate associated ad personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. • Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences. • Translate information between graphical and numeric form. • Safe use of equipment to purify chemical mixtures including evaporation, and distillation.	measurement of rates of reaction by a variety of methods such as production of gas and colour change. • Calculate areas of triangles and rectangles, surface areas and volumes of cubes. • Translate information between graphical and numeric form • Plot two variables from experimental data • Determine the slope of a linear graph • Draw and use the slope of a tangent to a curve as a measure of rate of change.	• Use of gas tests to analyse products.	explanations and understanding of familiar and unfamiliar facts.
Connections with careers	Analytic chemist Sustainability technologist Science communicator	Chemical engineer	Metallurgist	Chemical engineer
Home support	Following assessments, the students are asked to reflect on their learning using the Teams-based Feedback Sheet and how they can improve going forward. There are various platforms to enable them to do this, eg BBC BiteSize, FreeScienceLessons, ContinuityOak(Videos), Exam Questions			

YEAR 10 cont.	**Chemical Calculations – 1**	**Crude Oil**	**Earth's Atmosphere**	**Energy**
Key Knowledge	• Calculate the percentage by mass. • Explain any observed changes in mass in non-enclosed systems.	• Recognise substances as alkanes. • Explain how fractional distillation works in terms of evaporation and condensation.	• Interpret evidence and evaluate different theories about the Earth's early atmosphere.	• Distinguish between exothermic and endothermic reactions.

	• Understand about uncertainty. • Understand about moles of substance. • Calculate the masses of substances given information. • Balance an equation given the masses of substances. • Explain the effect of a limiting quantity of a reactant on the amount of products. • Calculate concentrations.	• Recall how boiling point, viscosity and flammability change with increasing molecular size • Write balanced equations for the complete combustion of hydrocarbons • Describe in general terms the conditions used for cracking. • Recall the colour change when bromine water reacts with an alkene. • Illustrate the usefulness of cracking.	• Describe the main changes in the atmosphere over time and some of the likely causes. • Describe and explain the formation of deposits of limestone and fossil fuels. • Describe the greenhouse effect and climate change and human involvement. • Describe actions to reduce emissions of carbon dioxide and methane. • Describe and explain the problems of combustion products on the atmosphere.	• Evaluate uses and applications of exothermic and endothermic reactions. • Draw simple reaction profiles. • Explain that the activation energy is the energy needed for a reaction to occur. • Calculate the energy transferred in chemical reactions using bond energies. • Interpret data for relative reactivity of different metals and evaluate the use of cells. • Evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries.
Key Subject Skills	• Recognise the importance of scientific quantities and understand how they are determined. • Use ratios, fractions and percentages. • Use SI units (eg kg, g, mg). • Interconvert units. • Use an appropriate number of significant figures in calculation. • Change the subject of an equation. • Substitute numerical values into algebraic equations using appropriate units for physical quantities.	• Recognise substances that are alkenes from their names or from given formulae in these forms. • Use scientific vocabulary, terminology and definitions. • Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects.	• Interpreting observations and other data including identifying patterns and trends, making inferences and drawing conclusions. • Presenting reasoned explanations including relating data to hypotheses. • Appreciate the power and limitations of science and consider any ethical issues which may arise. • Evaluate risks both in practical science and the wider societal context, including perception of	• Use of appropriate apparatus to make and record a range of measurements accurately, including temperature. • Use of appropriate apparatus and techniques for conducting and monitoring chemical reactions.

			risk in relation to data and consequences. • Recognise the importance of peer review of results and of communicating results to a range of audiences.	
Connections with careers		Petroleum chemists Organic chemists Geochemist	Atmospheric chemists Environmental chemist	Chemical engineers Electrochemist
Home support	Following assessments, the students are asked to reflect on their learning using the Teams-based Feedback Sheet and how they can improve going forward. There are various platforms to enable them to do this, eg BBC BiteSize, FreeScienceLessons, ContinuityOak(Videos), Exam Questions			

YEAR 11	Chemical Analysis	Chemical Calculations – 2 (Not combined)	Organic Chemistry (Not combined)	Polymers (Not combined)	Use of Resources (Not combined)
Key Knowledge	• Distinguish pure and impure substance using melting/boiling point data. • Identify formulations. • Explain how paper chromatography works. • Suggest the use of chromatography in identifying pure substance. • Determine Rf values. • Identify gases from chemical tests.	• Calculate concentrations. • Calculate % yield • Calculate atom economy. • Calculate volumes of gases.	• Describe the reactions and conditions of alkenes. • Describe the reactions of alcohols. • Recall the uses of alcohols. • Recall the conditions for fermentation. • Describe the reactions of carboxylic acids. • Explain why carboxylic acids are weak acids.	• Recognise addition polymers and monomers. • Draw diagrams of polymers and monomers. • Explain basic principles of condensation polymers. • Name types of monomers used to make naturally occurring polymers.	• Describe experiments and interpret data to show air and water are needed for rusting. • Explain sacrificial protection. • Recall uses of alloys. • Evaluate uses of alloys given information. • Explain how both low and high density polyethene can be produced.

	• Identify positive ions using flame/precipitation tests (**Not combined**). • Identify negative ions using chemical tests (**Not combined**). • Compare tests with instrumental analyses (**Not combined**). • Interpret flame emission spectroscopic data (**Not combined**).				• Explain the difference in thermosoftening and thermosetting polymers. • Compare physical properties of glass, ceramics, polymers, composites and metals. • Explain how the use of material properties is related to their use. • Sources of the gases for the Haber process. • Interpret data for the conditions of the Haber process. • Recall names of salts when phosphate rock is treated with acids. • Compare lab and industrial preparations of the same products.
Key Subject Skills	• Presenting observations and other data using appropriate methods. • Translating data from one form to another. • Arithmetic and numerical computation • Carrying out and represent mathematical analysis. • Use of appropriate qualitative reagents and	• Recognise the importance of scientific quantities and understand how they are determined. • Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate. • Use of appropriate apparatus and	• Safe use and careful handling of liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes and/or products.	• Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Visualise and represent 2D and 3D forms	• Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypothesis, check data or explore phenomena. • Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical

	techniques to analyse and identify unknown samples or products including gas tests, flame tests, and precipitation reactions. (**Not combined**).	techniques for conducting and monitoring chemical reactions for the measurement of pH in different situations. • Use of appropriate techniques to analyse and determine concentrations of strong acids and strong alkalis. • Change the subject of an equation. • Substitute numerical values into algebraic equations using appropriate units for physical quantities		including 2D representation s of 3D objects.	form), including identifying patterns and trends, making inferences and drawing conclusions. • Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error. • Communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms.
Connections with careers	Industrial chemists Analytical scientists Toxicologist Forensic scientist		Organic chemists Biochemist Synthetic chemists Medicinal/pharmaceutical chemists	Industrial chemists Material scientists Polymer scientist	Material scientists Chemical engineers
Home support	Following assessments, the students are asked to reflect on their learning using the Teams-based Feedback Sheet and how they can improve going forward. There are various platforms to enable them to do this, eg BBC BiteSize, FreeScienceLessons, ContinuityOak(Videos), Exam Questions,				

Key Stage 5: A Level

YEAR 12	Foundations in Chemistry	Electrons, Bonding and Structure	Physical Chemistry - 1	Organic Chemistry - 1
Key Knowledge	• Atomic structure. • Quantitative chemistry: formulae, equations, amount of substance and the mole. • Reactions of acids. • Oxidation number and redox reactions. • Bonding and structure.	• Atomic orbitals and electron configurations. • The central role of electrons in ionic and covalent bonding is then studied. The important role of molecules is studied, including an explanation of • Polarity and intermolecular forces. • Properties of substances. • The periodic table: periodic and group properties. • Analysis of ions.	• Enthalpy changes and their determination • Rates of reaction • Reversible reactions and chemical equilibrium • Consideration of energy and yield in improving sustainability.	• Nomenclature and formula representation. • Functional groups. • Organic reactions and isomerism. • Aliphatic hydrocarbons. • Alcohols and haloalkanes. • Organic practical skills and organic synthesis • Instrumental analytical techniques (infra-red and mass spectroscopy)
Key subjects Skills	**PAG 1 and 2** • Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts • Know that scientific knowledge and understanding develops over time • Communicate information and ideas in appropriate ways using appropriate terminology • Recognise and make use of appropriate units in calculations	**PAG 4** • Use theories, models and ideas to develop scientific explanations. • Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas • Know that scientific knowledge and understanding develops over time • Consider applications and implications of science and	**PAG 3 and 9** • Use theories, models and ideas to develop scientific explanations • Analyse and interpret data to provide evidence, recognising correlations and causal relationships • Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas	**PAG 5, 6 and 7** • Communicate information and ideas in appropriate ways using appropriate terminology • Use theories, models and ideas to develop scientific explanations • Analyse and interpret data to provide evidence, recognising correlations and causal relationships • Use knowledge and understanding to pose scientific questions, define scientific

	• Use calculators to find and use power, exponential and logarithmic functions • Find arithmetic means • Substitute numerical values into algebraic equations using appropriate units for physical quantities • Calculate percentage yields • Calculate the atom economy of a reaction • Construct and/or balance equations using ratios. • Carry out calculations using the Avogadro constant • Calculate weighted means, e.g. Calculation of an atomic mass based on supplied isotopic abundances • Select appropriate titration data (i.e. Identification of outliers) in order to calculate mean titres. • Determine uncertainty when two burette readings are used to calculate a titre value. • Predict/identify shapes of and bond angles in molecules with and without a lone pair(s), for example NH3, CH4, H2O etc.	evaluate their associated benefits and risks • Evaluate the role of the scientific community in validating new knowledge and ensuring integrity • Consider ethical issues in the treatment of humans, other organisms and the environment • Evaluate the role of the scientific community in validating new knowledge and ensuring integrity • Evaluate the ways in which society uses science to inform decision making.	• Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts • Recognise and make use of appropriate units in calculations • Use calculators to find and use power, exponential and logarithmic functions • Report calculations to an appropriate number of significant figures given raw data quoted to varying numbers of significant figures • Calculate the value of an equilibrium constant, *K* • Carry out Hess' law calculations • Plot graphs from collected or supplied data to follow the course of a reaction • Draw lines of best fit • Extrapolate and interpolate • Construct calibration curves.	problems, present scientific arguments and scientific ideas • Consider applications and implications of science and evaluate their associated benefits and risks • Consider ethical issues in the treatment of humans, other organisms and the environment • Evaluate the role of the scientific community in validating new knowledge and ensuring integrity • Evaluate the ways in which society uses science to inform decision making. • Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts • Use appropriate methodology, including information and communication technology (ICT), to answer scientific questions and solve scientific problems • Interpret and analyse spectra • Draw different forms of isomer • Describe the types of stereoisomerism shown by molecules/complexes

Personal development: • **RSE** • **Online safety** • **Enrichment**	Cambridge Chemistry Challenge RSC Analytical Taster Day (Analyses samples of aspirin) RSC Analyst Competition			
Connections with careers	Analytical chemist Toxicologist Forensic scientist	Material Scientist Nanotechnologist Analytical chemist Metallurgist Industrial chemist Analytical scientist Toxicologist Forensic scientist	Chemical engineers	Organic chemist Medicinal chemist Pharmaceutical scientist Bioorganic chemist
Home support	Following assessments, the students are asked to reflect on their learning using the Teams-based Feedback Sheet and how they can improve going forward. There are a lot of resources and links on Teams (Useful Stuff) to guide the students on self-improving their work.			

YEAR 13	**Physical Chemistry – 2**	**Transition Metals**	**Organic Chemistry - 2**
Key Knowledge	• Rate equations, orders of reaction, the rate-determining step. • Equilibrium constants, *Kc* and *Kp.* • Acid–base equilibria including pH, *K*a and buffer solutions. • Lattice enthalpy and Born–Haber cycles. • Entropy and free energy. • Electrochemical cells.	• Redox chemistry • Transition elements.	• Aromatic compounds. • Carboxylic acids and esters. • Organic nitrogen compounds: amines and amino acids. • Polymerisation: addition polymers and condensation polymers. • Synthetic organic chemistry. • Analytical techniques (chromatography and nuclear magnetic resonance spectroscopy)
Key subjects Skills	**PAG 8, 9, 10 and 11**	**PAG 12**	**PAG 7**

	• Use theories, models and ideas to develop scientific explanations • Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas • Analyse and interpret data to provide evidence, recognising correlations and causal relationships • Evaluate methodology, evidence and data, and resolve conflicting evidence • Communicate information and ideas in appropriate ways using appropriate terminology • Recognise and make use of appropriate units in calculations • Use calculators to find and use power, exponential and logarithmic functions • Use an appropriate number of significant figures • Carry out pH and pKa calculations • Calculate a rate constant, *k* from a rate equation. • Determine the order of a reaction from a graph and derive rate expression. • Calculate values for *E*a and *A* from the gradient and intercept of a graph using the Arrhenius equation. • Calculate the rate constant of a first-order reaction by determination of the gradient of a rate– concentration graph.	• Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas • Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts • Communicate information and ideas in appropriate ways using appropriate terminology • Qualitative analysis. • Consider applications and implications of science and evaluate their associated benefits and risks • Use calculators to find and use power, exponential and logarithmic functions • Find arithmetic means	• Use theories, models and ideas to develop scientific explanations • Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas • Communicate information and ideas in appropriate ways using appropriate terminology • Analyse and interpret data to provide evidence, recognising correlations and causal relationships • Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts • Use appropriate methodology, including information and communication technology (ICT), to answer scientific questions and solve scientific problems • Development of synthetic routes. • Interpretation of TLC to analyse organic compounds. • Interpretation of GC to analyse organic compounds. • Interpretation of spectra to analyse organic compounds. • Interpretation of a variety of different evidence to analyse organic compounds. • Interpret and analyse spectra • Identify chiral centres from a 2-D or 3-D representation.

Personal development: • **RSE** • **Online safety** • **Enrichment**	RSC Olympiad Science in Action Lectures		
Connections with careers	Chemical engineers Electrochemist	Analytical chemist Toxicologist Forensic scientist	Organic chemist Medicinal chemist Pharmaceutical scientist Bioorganic chemist Polymer scientist Analytical chemist Toxicologist Forensic scientist Radiology
Home support	Following assessments, the students are asked to reflect on their learning using the Teams-based Feedback Sheet and how they can improve going forward. There are a lot of resources and links on Teams (Useful Stuff) to guide the students on self-improving their work.		