Chemistry Curriculum Intent

The Chemistry curriculum at Trinity High School has been carefully designed so that students' **knowledge** – both substantive and disciplinary – becomes more broad and more sophisticated as they progress through the key stages. We have used the strong **subject expertise** within our department to ensure **inclusivity -** that all students are able to access and understand even the most complex of concepts.

For example, in Year 9 we introduce them to a number of important key concepts – one being structure of an atom. It is essential students have a strong grasp of this before being able to manipulate it in KS4 (e.g. to develop the concept of ions and isotopes), and into KS5 (to further develop the arrangement of electrons).

Our curriculum also ensures that students' disciplinary knowledge develops in an equally advanced way. For example, students begin by using examples of good practical methods and will progress to writing their own based on preliminary experiments.

We use the principles of **cognitive science** in the planning of our curriculum, to ensure that students develop bodies of knowledge through revisiting key concepts in different contexts. Each element of the curriculum has been **carefully sequenced** to aid the **acquisition and remembering** of this content and through this, students will be enabled in their learning - to think **metacognitively**.

Finally, although outcomes are very important, we know that teaching to the test is counterproductive in developing knowledge and understanding. Our curriculum is therefore enriched by a wealth of **cultural capital** – the glue which helps the core content to stick. For example, while students are studying organic chemistry, they look at articles relating to burning fossil fuels and the environmental impact this has. This often prompts class discussion about what students can do in their everyday lives to have a positive impact on the environment. Cultural Capital is identified in our document as Hinterland.

The documents below details the core substantive and disciplinary knowledge and how these build over time in our subject.

Year 9 Intent: Chemistry

Term	Substantive Knowledge (The What)	Disciplinary Knowledge (The How)	Hinterland
Autumn term	**By the end of the topic you will be able to:** • Explain the properties of acids and alkalis • Give examples of everyday acids and alkalis • Identify the pH of substances using Universal Indicator	**Over the course of the topic students will develop your ability to use your scientific skills to:** • Evaluate lab safety and write corresponding risk assessments • Identify variables	https://www.youtube.com/watch?v=nh-AgNYZsAQ&list=PL-QGHkq8mvvGoiyLzrUVz_z0YQzQ79lBh&index=1

	• Investigate how state changes with temperature • Carry out tests for the products of combustion • Draw and describe the carbon cycle • Calculate density of different objects	• Write a logical method that can be followed to carry out an experiment • Collect results in an appropriate way • Analyse and process data	https://www.youtube.com/watch?v=BfcIOTBTwYs&list=PL-QGHkq8mvvGoiyLzrUVz_z0YQzQ79lBh&index=3
Spring term: C1 Atomic structure and the Periodic Table	**By the end of the topic you will be able to:** • Describe the differences between elements, compounds and mixtures • Name compounds based on their formulae • Describe different methods for separating mixtures • Describe and explain how the understanding of atomic structure has developed • Describe and explain the modern atomic model. • Describe and explain the steps in the development of the periodic table, especially including the work Mendeleev did and how his work was proved right. • Describe the physical and chemical properties of metals and non-metals • Describe and explain the trend in reactivity going down group 1 and group 7	**Over the course of the topic students will develop your ability to use your scientific skills to:** • Understand how scientific methods and theories develop over time. • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Recognise the importance of peer review of results and of communicating results to a range of audiences. • Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. • Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. • Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.	https://www.nytimes.com/2006/10/17/science/17heavy.html https://theday.co.uk/stories/europe-joins-global-race-over-miracle-material

		• Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). • Recognise and use expressions in standard form • Make estimates of the results of simple calculations • Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects	
Year 10 End Point	By the end of year 9 students will have developed an understanding of some of the basics of chemistry. They have revisited and built upon previous KS3 learning and understanding of atoms, elements, compounds and mixtures. They will use their KS3 understanding of chemical reactions and how practical work to hone the skills of planning, carrying out and processing practicals. Students will start to learn some chemistry topics based on the GCSE chemistry course and will start to be introduced to some low, standard and even some high demand CGSE questions (where applicable) in both familiar and unfamiliar contexts. They will have a secure knowledge of the technical language we use in science and will be able to use the keywords covered in Year 9 in a range of contexts, both familiar and new, including interpreting data, both tabulated and graphical.		

Year 10 Intent: Chemistry

Term	Substantive Knowledge (The What)	Disciplinary Knowledge (The How)	Hinterland
C2: Structure, bonding and the properties of matter (Autumn term)	**By the end of the topic you will be able to:** **C2: Structure, bonding and the properties of matter** • Describe ionic bonding and where it occurs • Describe covalent bonding and where it occurs • Describe metallic bonding and where it occurs • Represent and recognise diagrams of 3 types of bonding	**Over the course of the topic students will develop your ability to use your scientific skills to:** • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.	https://www.sciencenewsforstudents.org/article/explainer-what-are-chemical-bonds https://www.sciencedaily.com/releases/2016/09/160914113929.htm

	• Explain properties of different substances given their bonding and structure type • Explain and evaluate the use of nanoparticles for a specified purpose when given appropriate information. **Developing from prior learning** Adapting understanding of atomic model from KS3 and C1	• Appreciate the power and limitations of science and consider any ethical issues which may arise. • Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. • Use scientific vocabulary, terminology and definitions. • Recognise the importance of scientific quantities and understand how they are determined. • Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). • Interconvert units.	
C4 Chemical changes (Autumn term/Spring term for combined Sci)	**By the end of the topic you will be able to:** • Describe reactions of acids to include: with metals, bases, carbonates • Relate the reactivity series to reactions that occur • Establish how metals are extracted and link this to their position on the reactivity series • Explain what is meant by the term "weak acid" • State what oxidation and reduction mean • Explain what electrolysis is and predict products of electrolysis	**Over the course of the topic you will develop your ability to use your scientific skills to:** • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Make order of magnitude calculations	https://www.cnbc.com/2021/02/25/steel-factory-to-be-powered-by-worlds-largest-green-hydrogen-plant.html https://www.sciencedaily.com/releases/2020/09/200930144428.htm

	• **Triple only**: Describe how titrations are performed **Developing prior knowledge** Build on KS3 knowledge of acids and alkalis Develop understanding of how the periodic table is used to categorise elements		
C5 Energy changes (Spring term)	**By the end of the topic you will be able to:** • Describe what is meant by exothermic and endothermic reactions • Represent energy changes on a profile diagram • Calculate energy change using bond energies • **Triple only:** State what a battery is • **Triple only**: Explain the difference between rechargeable and non-rechargeable cells • **Triple only**: Describe the use of fuel cells **Developing prior learning** Use of physics knowledge on energy stores	**Over the course of the topic you will develop your ability to use your scientific skills to:** • Recognise and use expressions in decimal form	Moving to electric cars. How is it done? Why? Is it financially beneficial for families at the moment? https://www.edfenergy.com/electric-cars/benefits Hydrogen revolution: https://theday.co.uk/stories/the-great-hydrogen-revolution-gathers-pace Electric cars https://theday.co.uk/stories/tesla-unveils-electric-car-for-the-people
C3 Quantitative chemistry (Spring term)	**By the end of the topic you will be able to:** • Describe the significance of the law of conservation of mass • Calculate the Relative formula mass of a compound	**Over the course of the topic you will develop your ability to use your scientific skills to:** • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions	The science of addiction https://www.bbc.co.uk/sounds/search?q=The%20Chemistry%20of%20Addiction&suggid=urn%3

	• Calculate the concentration of a solution • **HT only**: Use moles to calculate masses and concentrations in reactions. • **Triple only**: Calculate percentage yield • **Triple only**: Calculate atom economy • **Triple only**: Explain the significance of high percentage yield and atom economy • **Triple only**: Use moles to calculate gases **Developing prior learning** Use of balanced equations Be able to count atoms in a formula	and to develop scientific explanations and understanding of familiar and unfamiliar facts • Representing distributions of results and make estimations of uncertainty. • Use scientific vocabulary, terminology and definitions. • 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. • Interconvert units. • Use an appropriate number of significant figures in calculation. • Recognise and use expressions in standard form • Use ratios, fractions and percentages • Use an appropriate number of significant figures • Understand and use the symbols: =, <>, >, ∝ , ~ • Change the subject of an equation • Substitute numerical values into algebraic equations using appropriate units for physical quantities	Abbc%3Aprogrammes%3Ab009wdhd
C6 The rate and extent of chemical change (Spring term/ Summer term for combined Sci)	**By the end of the topic you will be able to:** • State what rate of reaction means • Describe different ways to measure the rate of reaction • Describe and explain factors which affect the rate of reaction • State what is meant by reversible reactions • **Triple only:** State what is meant by equilibrium	**Over the course of the topic you will develop your ability to use your scientific skills to:** • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Recognise and use expressions in decimal form • Use ratios, fractions and percentages	https://www.birmingham.ac.uk/teachers/study-resources/stem/chemistry/reaction-rates.aspx https://podcasts.apple.com/us/podcast/chemical-bonds-types-bonds-gcse-chemistry-

	• **Triple only**: Describe and explain the affect of changing conditions on a system at equilibrium **<u>Developing prior learning</u>** Build on KS3 knowledge of signs of a chemical reaction	• Make estimates of the results of simple calculations • Make order of magnitude calculations • Translate information between graphical and numeric form • Understand that y = mx + c represents a linear relationship • Plot two variables from experimental or other data • Determine the slope and intercept of a linear graph • Draw and use the slope of a tangent to a curve as a measure of rate of change • Calculate areas of triangles and rectangles, surface areas and volumes of cubes	learning/id1454828100?i=1000475882567
<u>C7 Organic chemistry (Summer term for triple only)</u>	**<u>By the end of the topic you will be able to:</u>** • State what an alkane is • State the name, molecular and displayed formula for the first 4 alkanes • Describe and explain the process of fractional distillation • Explain uses and properties of hydrocarbons • Describe, using equations, cracking • **Triple only**: State what an alkene is • **Triple only:** State the name, molecular and displayed formula for the first 3 alkenes • **Triple only**: explain the reactions of alkenes • **Triple only**: State the name, molecular and displayed formula of the first 4 alcohols • **Triple only**: Explain the reactions of alcohols	**<u>Over the course of the topic you will develop your ability to use your scientific skills to:</u>** • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Use scientific vocabulary, terminology and definitions. • Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects	• https://www.carwow.co.uk/blog/synthetic-fuels-explained#gref https://www.bbc.com/future/article/20191030-why-biodegradables-wont-solve-the-plastic-crisis Local companies: The plastic centre

	• **Triple only**: State the name, molecular and displayed formula of the first 4 carboxylic acids • **Triple only**: Explain the reactions of carboxylic acids • **Triple only:** Describe the 2 types of polymerisation • **Triple only**: Describe the features of amino acids • **Triple only:** Describe the structure and features of DNA **<u>Developing prior learning</u>** Build on KS3 knowledge of fossil fuels and energy stores. Extend understanding of properties of simple covalent molecules to specific examples. Recap understanding of addition polymers and compare and contrast with condensation polymers.		https://plasticcentre.co.uk/pickup_location/plastic-centre-redditch/ Sparlonz https://sparlonz.com/ Redditch plastic products https://rpp.uk.com/
Year 10 End Point	By the end of year 10 students will have developed an understanding of the key principles behind structure and bonding, chemical changes, energy changes, quantitative chemistry, rates of reaction and organic chemistry. Students will also have revisited and built upon previous KS3 learning and understanding of the atomic model topic from yr 9. Students will be able to answer both low, standard and for some high demand CGSE questions in both familiar and unfamiliar contexts. Students will have further developed their practical skills and be confident in following an experimental procedure, risk assessing, recording data, plotting the results of experiments and drawing conclusions based on results for all required practical's studied to date. They will have a secure knowledge of the technical language we use in science and will be able to use the keywords covered in Year 9 & 10 in a range of contexts, both familiar and new, including interpreting data, both tabulated and graphical.		

Year 11 Intent : Chemistry

Term	Substantive Knowledge (The What)	Disciplinary Knowledge (The How)	Hinterland
C8: Chemical analysis (Autumn term/Spring term for Combined Science)	**By the end of the topic you will be able to:** • Describe what is meant by a pure substance and how to test for purity • Describe what a formulation is and give some examples • Describe what chromatography is and analyse results from chromatography experiments • Explain the tests for some common gases • **Triple only:** Describe how to test for positive and negative ions to include flame tests, precipitate tests and testing for sulfates, carbonates and halides • **Triple only:** Explain what flame emission spectroscopy is and analyse example results **Developing from prior learning** Build on knowledge from C1 on knowledge of elements, compounds and mixtures to apply the term "purity" and "formulation" to different substances. Further understanding of separating mixtures built on from C1 to read chromatograms and quantify results.	**Over the course of the topic students will develop your ability to use your scientific skills to:** • Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. • Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. • Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. • Presenting observations and other data using appropriate methods. • Presenting reasoned explanations including relating data to hypotheses. • Use scientific vocabulary, terminology and definitions. • Recognise and use expressions in decimal form • Use ratios, fractions and percentages • Make estimates of the results of simple calculations • Use an appropriate number of significant figures • Translate information between graphical and numeric form	https://www.youtube.com/watch?v=zvGsnqveM_U https://www.youtube.com/watch?v=djordhUz8lM https://newatlas.com/aquadx-mydx-water-chemical-analysis-hand-held/45454/

C6: Rates of reaction (Autumn term for Combined Science)	**By the end of the topic you will be able to:** • State what rate of reaction means • Describe different ways to measure the rate of reaction • Describe and explain factors which affect the rate of reaction • State what is meant by reversible reactions • **Triple only:** State what is meant by equilibrium • **Triple only**: Describe and explain the affect of changing conditions on a system at equilibrium **Developing prior learning** Build on KS3 knowledge of signs of a chemical reaction	**Over the course of the topic you will develop your ability to use your scientific skills to:** • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Recognise and use expressions in decimal form • Use ratios, fractions and percentages • Make estimates of the results of simple calculations • Make order of magnitude calculations • Translate information between graphical and numeric form • Understand that y = mx + c represents a linear relationship • Plot two variables from experimental or other data • Determine the slope and intercept of a linear graph • Draw and use the slope of a tangent to a curve as a measure of rate of change • Calculate areas of triangles and rectangles, surface areas and volumes of cubes	https://www.birmingham.ac.uk/teachers/study-resources/stem/chemistry/reaction-rates.aspx https://podcasts.apple.com/us/podcast/chemical-bonds-types-bonds-gcse-chemistry-learning/id1454828100?i=1000475882567
C10: Using resources (Autumn term)	**By the end of the topic you will be able to:** • Define sustainable development and explain its significance in terms of the Earth's resources	**Over the course of the topic students will develop your ability to use your scientific skills to:** • Appreciate the power and limitations of science and consider any ethical issues which may arise.	https://www.youtube.com/watch?v=y9grdQk5sBE

	• Distinguish between finite and renewable resources • Explain what potable water is and evaluate methods of obtaining it from salt water, ground water, sewage water and agricultural water • Evaluate alternative ways of extracting metals including bioleaching and phytomining • State what an LCA is and describe the significance of the different stages • Explain the significance of reduce, reuse recycle • State what corrosion is and describe and explain methods of preventing corrosion • **Triple only**: describe the differences between ceramics, composites, polymers and alloys • **Triple only**: describe the Haber process and explain the effect of changing reaction conditions **<u>Developing from prior learning</u>** Students often have understanding of the Earth's resources and recycling from C9 and from everyday life. They will build on understanding they have from C1 and C8 on composition of different materials. Triple students will use their understanding of energy changes in a reaction to explain the Haber process and reversible reactions.	• Explain everyday and technological applications of science; evaluate associated 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. • Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. • Evaluate methods and suggest possible improvements and further investigations. • Translating data from one form to another. • Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. • 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. • Recognise and use expressions in decimal form • Use ratios, fractions and percentages • Make estimates of the results of simple calculations	https://www.youtube.com/watch?v=9opyTo7ZIJY https://theday.co.uk/stories/europe-joins-global-race-over-miracle-material

		• Use an appropriate number of significant figures • Construct and interpret frequency tables and diagrams, bar charts and histograms • Make order of magnitude calculations • Translate information between graphical and numeric form	
C9: Chemistry of the atmosphere (Spring term)	**By the end of the topic you will be able to:** • State the gases in the Earth's atmosphere • Describe and explain how the gases in the atmosphere have changed • State greenhouse gases • Describe the greenhouse effect and explain how human activity contributes to this • Describe how other pollutants are produced from fuels **Developing from prior learning** Students often have some understanding of some of the key words in this topic based on their exposure to media and external factors. It is important to clarify misconceptions here.	**Over the course of the topic students will develop your ability to use your scientific skills to:** • Understand how scientific methods and theories develop over time • Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. • Appreciate the power and limitations of science and consider any ethical issues which may arise. • Explain everyday and technological applications of science; evaluate associated 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 • Recognise the importance of peer review of results and of communicating results to a range of audiences	• https://www.carwow.co.uk/blog/synthetic-fuels-explained#gref • • https://www.climatecare.org/resources/news/50-ideas-shrinking-your-carbon-footprint/

		• Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. • Presenting reasoned explanations including relating data to hypotheses. • Use scientific vocabulary, terminology and definitions • Use ratios, fractions and percentages	
Year 11 End Point	By the end of year 11 students will have built on their understanding of the key concepts of chemistry. They will have developed their understanding of chemical analysis, rates of reaction, using resources and chemistry of the atmosphere. Students will also have revisited and built upon previous KS3 learning and understanding of atomic structure, chemical bonding, quantitative chemistry, chemical changes, energy changes and organic chemistry. Students will be able to answer both low, standard and for some high demand CGSE questions in both familiar and unfamiliar contexts. Students will have further developed their practical skills and be confident in following an experimental procedure, risk assessing, recording data, plotting the results of experiments and drawing conclusions based on results for all required practical's studied to date. They will have a secure knowledge of the technical language we use in science and will be able to use the keywords covered in the whole GCSE in a range of contexts, both familiar and new, including interpreting data, both tabulated and graphical.		