Chemistry KS5 - Statement of Intent

'Nothing can be more certain than this: that we are just beginning to learn something of the wonders of the world on which we live and move and have our being. William Ramsay

Students who study Chemistry 'A' Level will have four lessons per week. We align the curriculum delivery to the school vision of *Living Well Together with Dignity, Faith and Hope.* Students are taught to live well together through opportunities throughout the course to draw on and develop social skills and personal virtues.

Practical work demands that students develop skills through cooperation and collaboration. Students will be guided to consider the skills needed to be a successful chemist and will develop essential knowledge, and understanding of different areas of the subject and how they relate to each other.

They will:

• Develop and demonstrate a deep appreciation of the skills, knowledge and understanding of scientific methods

• Develop competence and confidence in a variety of practical, mathematical and problem solving skills

• Develop their interest in, and enthusiasm for the subject, including developing an interest in further study and careers associated with the subject

• Understand how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society

SEND students are supported in lessons where needed by student support workers and staff support students directly in the lessons. Where appropriate the use of writing frames, coloured films, increased font size, extra time, scribes, readers and any other interventions are used.

Pupil Premium students are provided with a free laptop and access to the academy's online resources. The students will be given work books and other resources that might be needed to remove barriers to learning.

High attaining students are challenged to think beyond the subject and to look for link between different topics and their other subjects. The use of 'thinking hard' style tasks which are active rather than passive will ensure the students are stretched so that they can develop the thinking agility needed to access the highest grades in Chemistry

Year 12

<u>Substantive Knowledge</u>

Students will cover three Chemistry topics during Year 12. This will include Foundations in Chemistry, which will provide students with the core knowledge that will underpin their learning over the two years. This core knowledge topic will develop their understanding of atoms, ions and molecules, and how chemists describe them using symbols and chemical formulae.

Students will also look at how chemists obtain data about the masses of atoms, and how chemical equations are used to describe chemical reactions. When students carry out chemical reactions they will use known quantities of the reacting substances by measuring out their mass or volume. They will use these measurements to calculate the number or ratio of atoms, molecules or ions that react together. Students will develop their skills in using mass, volume, and concentration to find the number of moles of particles involved in chemical reactions. Two of the most common types of chemical process students will encounter during Year 12 are acid-base reactions and redox reactions. They will study what happens when acids and alkalis dissolve in water and learn more about neutralisation. To develop understanding of oxidation and reduction, students will be introduced to the idea of oxidation number and how it can be used to make sense of redox reactions.

Our aspiring chemists will learn about two of the most important ways in which particles bond together – ionic bonding between oppositely charged ions, and covalent bonding between atoms in molecules. Students will begin by developing their knowledge of the atomic model to describe how the electrons are arranged and how they are involved in the different bonds. Students will also consider how the properties of ionic compounds can be explained using ideas about their bonding and structure. Students will see how they can use a dot and cross diagrams to help

predict the shape of a molecule and the bond angles. They will use the idea of electronegativity to explain how small particle charges can exist even within uncharged molecules, and how the presence of these partial charges can lead to the formation of weak intermolecular forces. This will lead to consideration of how an understanding of intermolecular forces can help to explain the properties of simple molecular substances.

Students will then build on the core knowledge to focus on inorganic and physical chemistry, the applications of energy use to everyday life and industrial processes, and current environmental concerns associated with sustainability. The aim is to provide knowledge and understanding of the important chemical ideas that underpin the study of inorganic and physical chemistry; the periodic table: periodic and group properties; enthalpy changes and their determination; rates of reaction; reversible reactions and chemical equilibrium; consideration of energy and yield in improving sustainability.

Finally, they will learn about organic chemistry and its important applications to everyday life, including current environmental concerns associated with sustainability. The aim is to provide students with a knowledge and understanding of the important chemical ideas that underpin the study of organic chemistry: nomenclature and formula representation; functional groups; organic reactions and isomerism; aliphatic hydrocarbons; alcohols and halo-alkanes; organic practical skills and organic synthesis; and instrumental analytical techniques to provide evidence of structural features in molecules.

Disciplinary Knowledge

Throughout Year 12 students will develop the practical skills needed to be a successful chemist. Students will hone skills through class practical experiments that directly support the current content of the course and specific practicals designed to meet the requirements of the practical endorsement. They will learn to use appropriate apparatus to record a range of measurements (to include mass, time, volume of liquids and gases, temperature). There will be the opportunity to set up and use water baths, electric heaters and sand baths for heating. Students will train in the use of laboratory apparatus for a variety of experimental techniques including, titration, using burette and pipette, distillation and heating under reflux, setting up glassware, using retort stands and clamps. They will also carry out qualitative tests for ions and organic functional groups. Students will develop techniques for filtration, including use of fluted filter paper, or filtration under reduced pressure and will need to use volumetric flasks for making up a standard solution.

Students will have opportunities to develop their skills of analysis and interpretation. Through processing data and understanding the significance of what the data shows students will also need to be reflective in order to build cognitive links between different topics.

Year 13

Substantive Knowledge

The topics in this second year build on the content learned last year. Students will learn about Physical Chemistry and Transition Elements. This topic will build on the knowledge from last year's inorganic content.

Students will study chemical equilibrium and reversible reactions. They will revisit rates, in order to understand the quantitative effect of temperature, pressure and concentration on reactions. They will start to develop links to real applications such as the control of industrial processes. Year 13 will also learn how an understanding of reaction rates allows chemists to predict the very steps that make up reaction mechanisms. Students will study acids, bases, and pH as these are important in many chemical and biological processes. The role of buffers in maintaining the pH of blood will be studied to show the essential role of acids and bases to our health and well-being. Students will look at entropy, free energy and electrode potentials, which allow then to predict whether reactions are feasible and how conditions could be changed to make them feasible. Finally, they will look at the chemical and physical properties of the central region of the periodic table. Students will learn about the colours, shapes, and reactions of transition metal ions and learn about the different types of isomerism shown by transition metal complexes.

In the final part of the course, students will focus on Organic Chemistry and Analysis. This will largely build on work from the previous year on Core Organic Chemistry.

Students will learn that aromatic compounds are chemicals containing a benzene ring. The structure of benzene and the use of its reactions in the production of medicine will be covered. They will learn about the reactions of ketones, aldehydes, and carboxylic acids. They will also deepen their understanding of several functional groups derived from carboxylic acids, esters, acyl chlorides, and amides. They will learn about amines, amino acids, and polymers. Amino acids are the building blocks of life and students will learn about their acid-base behaviour and ability to show optical isomerism. They will learn of the importance of condensation polymers, polyamides, and polyesters and their uses in synthetic fibres and many modern plastics. Students will learn about further practical techniques. They will also develop their understanding of multi-stage reaction pathways to convert one organic molecule into another. They will also learn about how carbon–carbon bond formation allows the carbon structure of complex organic structures to be synthesised. Students will learn about NMR spectroscopy and how it can be combined with infrared spectroscopy and mass spectrometry. They will see how these techniques can be used to find the complete structure of organic compounds.

Disciplinary Knowledge

Students will continue to develop their practical skills in order to better support their understanding of the subject knowledge. They will continue to work towards completing the practical endorsement and will complete the relevant PAG (Practical Activity Group) activities.

Students will carry out practicals involving the qualitative analysis of organic functional groups, reactions of alkanes and alkenes, and the oxidation of a primary alcohol. They will also investigate the partial oxidation of alcohols to form aldehydes and will identifying unknown organic compounds. They will investigate rates of reaction using the initial rate method. This will link nicely to practicals investigating reaction kinetics using a continuous monitoring method. Specifically, students will investigate the kinetics of the decomposition of hydrogen peroxide. They will use the iodine clock method to find the order of a reaction. Students will develop techniques for measuring pH including the use of probes and data loggers. They will give consideration to the suitability of indicators and the limitations associated with different indicator solutions. Finally, students will further develop their research and reference skills. They will have to research and present on open ended topics/investigations. For example, "How long does it take iron tablets to break down in the stomach?". Students will be encouraged to build links between current topics and their previous studies. They will also have the opportunity to be creative and develop their own questions and mark schemes. Students will also need to develop their research and presentation skills in order to complete the PAG activities and pass the practical endorsement.