Programme of study for Applied Science Year 12 Extended Certificate 2024-2025

Autumn (1st and 2nd term) Teacher 1, 2 and 3	Spring and Summer terms Teacher 1, 2 and 3
Other timescale: From: September 2024 To: May 2025	**Other timescale:** From: End of May 2025 To: July 2025 and will continue into year 13
Topic: **Unit 1:** Fundamentals of Science. Each paper Biology, Chemistry and Physics are 30min each. **Skills (students should be able to do):** Researching, reading, essay writing, exam practice. Personal learning thinking skills including: • independent enquirers, • creative thinkers, • reflective learners, • team workers, • self-managers	**Topic:** **Unit 3:** Scientific Investigative skills. Exam based. **Skills (students should be able to do):** • Researching, reading, essay writing, exam practice. Personal learning thinking skills including: • independent enquirers, • creative thinkers, • reflective learners, • team workers, • self-managers, • effective participants
Key Learning Outcomes (students should know): **AO1**: Students should be able to demonstrate knowledge of scientific facts, terms, definitions and scientific formulae Command words: give, label, name, state Marks: ranges from 12 to 18 marks **AO2:** Students should be able to demonstrate understanding of scientific concepts, procedures, processes and techniques and their application Command words: calculate, compare, discuss, draw, explain, state, write Marks: ranges from 39 to 45 marks **AO3:** Students should be able to analyse, interpret and evaluate scientific information to make judgements and reach	**Key Learning Outcomes (students should know):** **AO1:** Students should be able to demonstrate knowledge and understanding of scientific concepts, procedures, processes and techniques and their application in a practical investigative context. **AO2:** Students should be able to interpret and analyse qualitative and quantitative scientific information to make reasoned judgements and draw conclusions based on evidence in a practical investigative context **AO3:** Students should be able to evaluate practical investigative procedures used and their effect on the qualitative and

conclusions Command words: calculate, comment, compare, complete, describe, discuss, explain, state Marks: ranges from 18 to 24 marks **AO4:** Students should be able to make connections, use and integrate different scientific concepts, procedures, processes or techniques Command words: comment, compare, complete, discuss, explain Marks: ranges from 9 to 12 marks	quantitative scientific information obtained to make reasoned judgements **AO4:** Students should be able to make connections between different scientific concepts, procedures, processes and techniques to make a hypothesis and write a plan for a practical investigation.
End of year assessment to cover: • End of chapter test on various Chemistry topics • End of chapter test on various Biology topics • End of chapter test on various Physics topics. • Mock exam to be sat after before Easter.	**End of term 1 assessment to cover:** • Unit 3 only: various practical exams and then practical write-ups will be assessed.
Building understanding: Rationale for your sequence of lessons: **Biology:** This sequence of lessons appears to be focused on building a comprehensive understanding of cell biology, tissue structure, and physiological processes, which are essential concepts in both biology and medicine. Here's a rationale for structuring the lessons in this way: **1. Cell Theory as a Unifying Concept** Cell theory serves as the foundation of biological understanding, stating that cells are the fundamental units of life. Understanding this allows students to appreciate how all life forms, regardless of complexity, share this basic structure and function. It also sets up the framework for exploring both the similarities and differences between different cell types (e.g., prokaryotic and eukaryotic). **2. Ultrastructure and Function of Organelles** Breaking down cells into their organelles in both prokaryotic and eukaryotic cells ensures that students develop an in-depth understanding of cell architecture and its function. Prokaryotic cells (like bacterial cells) and eukaryotic cells (like plant and animal cells) have significant structural differences,	**Building understanding: Rationale for your sequence of lessons:** The sequence of lessons designed to address Assessment Objectives (AOs) AO1 through AO4 is structured to build progressively upon students' knowledge and skills. The lessons aim to ensure a thorough understanding of scientific concepts, procedures, and processes, while also developing students' analytical and evaluative abilities. By following a logical progression, students will be able to confidently apply their knowledge in a practical investigative context. Below is the rationale for this sequence of lessons: **1. Introduction to Scientific Concepts and Terminology (AO1)** **Objective:** To establish a solid foundation of the essential scientific concepts, procedures, and processes that will be explored throughout the sequence. **Why first?** Students need to have a clear understanding of the basic scientific terminology and concepts before they can apply them in practical investigative work. This lesson sets the stage for deeper learning by providing the theoretical knowledge needed for the rest of the course.

which influence their roles in organisms. Key organelles to focus on include: • **Prokaryotes:** Nucleoid, plasmids, ribosomes, and cell wall features such as gram-positive and gram-negative classifications, which are crucial for understanding antibiotic resistance. • **Eukaryotes:** Plasma membrane, nucleus, ribosomes, ER, Golgi apparatus, mitochondria, and lysosomes. This also includes unique plant cell organelles like the cell wall, chloroplasts, and vacuoles, which distinguish plant cells from animal cells. **3. Use of Microscopy** The use of light and electron microscopes introduces students to key tools in cell biology. Identifying organelles via electron micrographs is crucial for visual learning and understanding scale, which leads to calculations of magnification and size—skills vital in both academic and practical settings (e.g., lab work). **4. Cell Specialization and Tissue Structure** Once students understand the basic structure of cells, the next step is to show how cells specialize in structure and function. Special attention to: • **Palisade mesophyll cells** in leaves (photosynthesis), • **Epithelial tissue** (gas exchange in the lungs, including the impact of diseases like COPD), • **Muscular tissue** (differences between fast- and slow-twitch muscle fibers), • **Nervous tissue** (nerve impulse conduction, synaptic transmission, and neurotransmitter imbalances). **5. Physiological Applications**	**Skills/knowledge:** Students will become familiar with key scientific concepts, such as experimental design, data collection, and the role of controls, giving them a framework for applying this knowledge in later investigations. **2. Introduction to Practical Investigative Techniques (AO1, AO4)** **Objective:** To demonstrate practical investigative techniques and introduce students to the concept of hypothesis formation and experimental planning. **Why here?** Once students have a theoretical understanding of scientific procedures, they need to begin applying these concepts practically. This lesson introduces basic investigative techniques and encourages students to think critically about how to design experiments based on a hypothesis. **Skills/knowledge:** Students will learn how to make connections between different scientific procedures, interpret practical setups, and begin planning their own investigations. **3. Collecting Qualitative and Quantitative Data (AO2)** **Objective:** To introduce students to methods for collecting and recording both qualitative and quantitative data in a scientific investigation. **Why now?** After students have a basic understanding of investigative techniques, they need to learn how to effectively collect and interpret data. This lesson provides practical guidance on recording data in ways that allow for meaningful analysis later. **Skills/knowledge:** Students will learn the differences between qualitative and quantitative data, as well as methods for collecting each. They will be introduced to equipment and techniques relevant to their investigative tasks. **4. Analysis of Qualitative and Quantitative Data (AO2)**

Connecting cellular and tissue structure to physiological processes gives the lessons real-world relevance. For example:

- Understanding **COPD** in smokers via the role of alveolar epithelium,
- The importance of **endothelial cells** in blood vessels and how damage contributes to cardiovascular diseases like atherosclerosis,
- The role of neurotransmitters like **dopamine and serotonin** in brain function and how imbalances can lead to Parkinson's disease and depression,
- How drugs affect **synaptic transmission**, highlighting L-Dopa's use in Parkinson's treatment.

6. Specialized Cells in Reproduction and Other Systems

Reproductive cells (sperm and egg), blood cells (white and red), and **root hair cells** in plants offer examples of specialization in various physiological systems. Understanding how these cells are adapted to their roles offers insights into the bigger picture of organismal biology.

7. Interpreting Data from Graphical Displays

By introducing concepts like nerve impulses, action potentials, and ECG recordings, students can develop their skills in interpreting biological data, crucial for fields like neuroscience and cardiology.

This lesson sequence builds progressively, starting with foundational cell theory, moving into detailed structures and functions, and culminating in specialized cells, tissues, and physiological processes. The practical aspect of recognizing structures through microscopy and applying these concepts to real-world examples (like disease mechanisms and drug treatments) ensures a well-rounded understanding of cell biology.

Chemistry: The sequence of lessons outlined focuses on the **production and uses of substances** in relation to their

Objective: To teach students how to interpret and analyse the data collected during investigations, focusing on drawing reasonable conclusions based on evidence.

Why here? Once students have learned how to collect data, they need to be able to analyse it to make informed judgments. This lesson provides students with the tools to critically examine their data, ensuring that their conclusions are evidence-based.

Skills/knowledge: Students will be able to apply mathematical and statistical techniques to analyse quantitative data, as well as interpret qualitative results in a scientific context. This lesson emphasizes critical thinking and making reasoned judgments based on collected evidence.

5. Evaluation of Practical Investigative Procedures (AO3)

Objective: To introduce students to the concept of evaluating their practical investigative procedures, focusing on assessing the reliability, accuracy, and validity of their methods and results.

Why now? After students have collected and analysed data, it is important for them to reflect on the strengths and limitations of their investigative procedures. This skill is essential for refining future experiments and improving the quality of their results.

Skills/knowledge: Students will evaluate the effectiveness of their investigative methods, identifying any potential sources of error or bias. They will learn to assess the impact of these factors on their data and draw conclusions about the overall reliability of their investigation.

6. Hypothesis Formation and Experimental Design (AO4)

Objective: To further develop students' abilities to make connections between scientific concepts and design their own practical investigations, starting with hypothesis formation.

Why now? Having learned the basics of scientific investigation, students are now ready to apply this knowledge in designing their

properties, emphasizing the link between an element's position in the periodic table and its chemical and physical behaviour. Here's a rationale for structuring these lessons:

1. Understanding the Periodic Table

Introducing the periodic table is essential for organizing the study of elements. The periodic table provides a visual and systematic way to understand the relationships between elements, allowing students to predict their properties based on position.

- **Periods and Groups**: Focusing on Periods 1–4 and the differentiation between s-block, p-block, and d-block elements introduces the idea that the position of an element reflects its electronic configuration, which in turn influences both its chemical and physical properties.
- **Electronic Configuration (s, p, d notation)**: Learning how to write the electronic configurations using s, p, and d notation is critical for predicting how atoms will interact with each other. This provides the foundation for understanding bonding and reactivity.

2. Physical Properties of Elements

Understanding the physical properties of elements connects the concepts of atomic structure with real-world characteristics. Key trends like **ionization energy**, **atomic and ionic radius**, **electronegativity**, and **bonding type** are essential for predicting how elements will behave in different environments.

- **Trends in Ionization Energy**: Introducing first ionization energy and examining trends across periods and down groups builds a conceptual understanding of atomic structure and nuclear charge.
- **Physical Properties and Trends**: Exploring the properties of metals—electrical and thermal conductivity, malleability, and ductility—

own experiments. This lesson encourages them to synthesize different scientific ideas and concepts to create a well-structured experimental plan.

Skills/knowledge: Students will be guided in making connections between scientific theories and practical investigation techniques, leading to the formation of a hypothesis. They will then draft a detailed experimental plan, outlining their method, variables, and how they intend to collect and analyse data.

7. Applying Scientific Knowledge to Real-World Investigations (AO4)

Objective: To guide students in making connections between scientific theories and real-world investigations, helping them apply their practical skills in a broader context.

Why now? Once students have developed the skills needed to form hypotheses and design experiments, it is important to give them opportunities to apply these skills in more complex, real-world scenarios. This lesson expands their understanding of how scientific investigations can be used to solve practical problems.

Skills/knowledge: Students will apply their theoretical and practical knowledge to design investigations that address real-world scientific questions or challenges. This lesson encourages critical thinking and problem-solving in contexts beyond the classroom.

8. Evaluation and Refinement of Experimental Designs (AO3)

Objective: To further develop students' evaluative skills by having them review and refine their experimental designs based on feedback and potential issues encountered during the investigation process.

Why now? As students gain experience designing experiments, it is essential that they also learn how to refine and improve their plans. This lesson helps them develop resilience and adaptability

demonstrates how atomic structure affects bulk properties. The emphasis on trends in **melting and boiling points** helps students link the periodic table with observable phenomena.

3. Chemical Properties of Elements

The chemical behaviour of elements is explored in relation to their reactivity with oxygen, water, and acids. By understanding the reactions of metals and non-metals, students grasp how **position in the periodic table** influences chemical reactivity and product formation.

- **Reactivity Series and Periodic Table**: Linking the reactivity of metals with their position in the periodic table teaches students how electron configuration influences how easily metals lose or gain electrons.
- **Oxidation and Reduction**: These core concepts are critical for understanding redox reactions, which are fundamental to many chemical processes, including industrial production, corrosion, and metabolism.

4. Transition Metals and Their Unique Properties

Transition metals offer a unique opportunity to explore **variable oxidation states** and their special properties, such as the ability to act as catalysts or form complex ions. The d-block elements serve as a bridge between fundamental concepts of electron configuration and more advanced chemical behaviour, such as **displacement reactions** involving metals and halogens.

Displacement Reactions: Introducing displacement reactions helps students understand the concept of reactivity in a more dynamic way, where a more reactive element displaces a less reactive one from a compound.

5. Application of Concepts to Real-World Uses

by encouraging iterative improvement of their investigative procedures.

Skills/knowledge: Students will critically review their experimental designs, identify areas for improvement, and adjust enhance the reliability and accuracy of their investigations. They will also learn to incorporate feedback from peers and instructors into their revised plans.

9. Synthesizing Learning: Final Practical Investigation (AO1, AO2, AO3, AO4)

Objective: To give students the opportunity to design, conduct, analyse, and evaluate a full practical investigation, applying all the skills and knowledge gained in previous lessons.

Why now? This lesson serves as a culminating experience, where students bring together all the knowledge and skills they have learned throughout the sequence. It ensures that they are prepared for both assessments and real-world scientific challenges.

Skills/knowledge: Students will complete a comprehensive investigation, from hypothesis formation to analysis and evaluation. They will demonstrate their ability to apply scientific concepts, analyse data, make evidence-based conclusions, and refine their methods based on evaluative feedback.

Overall Structure and Flow:

Building Foundational Knowledge: The sequence starts with foundational lessons that establish core scientific concepts, ensuring that students have the theoretical understanding necessary for practical investigations.

Gradual Progression: The lessons build progressively, starting with simple investigative techniques and moving toward more complex analysis and evaluation, ensuring students develop practical and analytical skills simultaneously.

Connecting theory to real-world applications deepens student understanding of why these properties matter. For instance:

Reactivity with Oxygen, Water, and Acids: Understanding these reactions is essential for grasping how materials behave in natural environments (e.g., rusting, corrosion, weathering) and industrial settings (e.g., extraction of metals).

Industrial Uses of Transition Metals: The unique chemical behaviour of transition metals and their compounds can be connected to their widespread use in industries—catalysts in chemical reactions, structural materials, etc.

6. Uses and Applications of Substances Produced

Once students understand the fundamental properties of elements and their chemical behaviours, they can explore how these properties lead to practical applications. For instance:

- Metals like **aluminium** are lightweight, strong, and resistant to corrosion, making them useful in aircraft construction.
- **Copper** is highly conductive and malleable, so it is widely used in electrical wiring.
- **Platinum and palladium** are used as catalysts in car exhaust systems because of their unique oxidation states.

This practical application reinforces the importance of chemical properties and helps students see the relevance of what they are learning to everyday life.

Sequence Justification:

Foundation in Atomic Structure: Understanding the periodic table and electronic configuration lays the groundwork for all subsequent learning.

Emphasis on Evaluation and Refinement: Throughout the sequence, there is a strong focus on developing students' evaluative skills, encouraging them to critically assess their methods and results to improve their investigative work.

Real-World Application: The lessons culminate in the application of scientific knowledge to real-world problems, preparing students to tackle complex scientific investigations in both academic and professional settings.

This sequence ensures that students develop the skills necessary to meet the Assessment Objectives (AO1-AO4), with a strong emphasis on practical investigation, critical thinking, and the application of scientific knowledge in real-world contexts.

Progression from Simple to Complex: Moving from simple trends (like ionization energy) to more complex concepts (like transition metals and their variable oxidation states) build a scaffolded approach to learning. 1. **Application to Real-World Phenomena**: Emphasizing chemical reactions, trends, and applications ensures that students connect abstract chemical properties with tangible, observable effects in the world around them. 2. **Integration of Physical and Chemical Properties**: Teaching physical and chemical properties together shows the interconnectedness of these two aspects, giving a more holistic view of how elements behave. **Physics:** The sequence of lessons is designed to build a comprehensive understanding of wave phenomena, their characteristics, and applications, with a logical progression from foundational wave concepts to more complex applications in communication and technology. Here's a rationale for the sequence: **1. Understanding the Common Features of Waves** **Objective:** To introduce fundamental concepts common to all waves. **Why first?** These concepts (periodic time, speed, wavelength, frequency, amplitude, oscillation) are basic to all types of waves and form the foundation for further study. **Key skills/knowledge:** Graphical representation of wave features such as amplitude and wavelength will visually cement students' understanding of wave behaviour. **2. Types of Waves: Transverse vs. Longitudinal** **Objective:** To help students differentiate between the two main types of waves (transverse and longitudinal).	

Why here? Understanding wave types is crucial for recognizing how different waves (e.g., sound and light) behave in real-world scenarios. **Key skills/knowledge:** Students will see how displacement in these waves varies, preparing them for more advanced wave concepts. **3. Wave Interactions: Superposition, Coherence, Path Difference, and Phase Difference** **Objective:** To explore the interactions between waves, especially in the context of diffraction and interference. **Why now?** These more abstract wave properties naturally follow understanding basic wave types and characteristics. **Key skills/knowledge:** The concepts of coherence, phase difference, and path difference are essential for studying diffraction gratings and interference patterns. **4. Diffraction Gratings and Their Industrial Applications** **Objective:** To understand diffraction and its practical applications in areas like spectroscopy. **Why here?** Once students grasp wave interference, diffraction gratings are a real-world application that links theory to industry (e.g., emission spectra used in identifying materials). **Key skills/knowledge:** Industrial relevance solidifies learning, showing how concepts are used in fields like physics and engineering. **5. Electromagnetic Waves and Their Properties** **Objective:** To focus on electromagnetic waves, emphasizing their speed in a vacuum and the inverse square law.	

Why now? Understanding the behaviour of light and other EM waves is critical as students move towards modern communication technologies. **Key skills/knowledge:** Application of the inverse square law to wave intensity provides mathematical grounding in wave behaviour, helping students apply these principles in real-world contexts. **6. The Electromagnetic Spectrum and Applications** **Objective:** To explore the grouping of electromagnetic waves by frequency and their applications in technology. **Why here?** After understanding basic wave properties, students are ready to explore the wide range of wave applications, from satellite communication to Wi-Fi and Bluetooth. **Key skills/knowledge:** Connecting wave frequency with technology (e.g., mobile phones, identifying gases) shows students the practical impact of wave science. **7. Wave Equations and Calculations** **Objective:** To apply wave equations to calculate speed, frequency, and wavelength. **Why now?** Mathematical representation through equations like v=fλv = f \lambdav=fλ is key to deepening the understanding of how waves function. **Key skills/knowledge:** Mastering these equations prepares students for practical problem-solving in both physics and engineering. **8. Stationary Waves and Resonance**	

Objective: To understand stationary waves and the concept of resonance, including applications in musical instruments. **Why here?** Resonance and stationary waves build on basic wave behaviour and are essential for understanding sound and vibration in systems like musical instruments. **Key skills/knowledge:** This step allows students to connect theoretical physics to everyday objects and phenomena, making the material relatable. **9. Fibre Optics and Communication** **Objective:** To understand the principles and applications of fibre optics, including total internal reflection and critical angles. **Why now?** After understanding wave behaviour in open systems, students move into more advanced applications in confined systems like fibre optics. **Key skills/knowledge:** Total internal reflection, refraction, and calculations involving critical angles tie directly into modern communication technologies and medical devices like endoscopes. **10. Analogue vs. Digital Signals** **Objective:** To differentiate between analogue and digital signals, covering analogue-to-digital conversion and broadband. **Why here?** After covering wave applications in communication (fibre optics), it's logical to delve deeper into how wave signals are transmitted in modern systems. **Key skills/knowledge:** This final step connects back to real-world communication systems, cementing students'	

understanding of how waves are used in digital technologies like broadband. **Overall Structure and Flow:** The lessons start with foundational knowledge (features of waves, types of waves) and gradually introduce more complex ideas like diffraction, EM spectrum, and wave equations. Applications of waves (in communication, medicine, and industry) are integrated later to show real-world relevance and solidify students' conceptual understanding. Mathematical aspects (inverse square law, wave equations) are incorporated progressively, ensuring students have a deep understanding before they tackle more challenging problems. This sequence ensures a cohesive learning journey from the basics of wave mechanics to the sophisticated applications in modern technology, ensuring students build a solid conceptual and practical foundation.	
Home – Learning: • Knowledge (flipped learning) • -6 Mark essays to be set when appropriate. • -Exam Practice • -Pupils are to read extracts prior to the lessons. • -Revision for end of topic tests.	**Home – Learning:** • Knowledge (flipped learning) • Pupils are to read extracts prior to the lessons. • Exam Papers
Reading and literacy: Unit 1 revision guide students to read and make notes. Unit 1 Applied science textbook Unit 1 PowerPoints for Biology, Chemistry and Physics.	**Reading and literacy:** Unit 3 revision guide students to read and make notes. Unit 3 Applied science textbook Unit 3 PowerPoints for Biology, Chemistry and Physics. **Literacy:**

Literacy: Key terms which all students will need to understand for the exam: Understand these definitions in order to understand the question: **Add/label:** Learners label or add to a stimulus material given in the question, for example labelling a diagram or adding units to a table. **Assess:** Learners give careful consideration to all the factors or events that apply and identify which are the most important or relevant. Make a judgement on the importance of something and come to a conclusion where needed. **Calculate:** Learners obtain a numerical answer, showing relevant working. If the answer has a unit, this must be included. **Comment on:** Learners synthesise a number of variables from data/ information to form a judgement. More than two factors need to be synthesised. marks there must be a quantitative element to the answer. **Devise:** Learners plan or invent a procedure from existing principles/ideas. **Discuss:** Learners identify the issue/situation/problem/argument that is being assessed in the question. Explore all aspects of an issue/situation/problem/argument. Investigate the issue/situation, etc. by reasoning or argument. **Draw:** Learners produce a diagram, either using a ruler or using freehand. **Evaluate:** Learners review information then bring it together to form a conclusion, drawing on evidence, including strengths, weaknesses, alternative actions, relevant data or information. Come to a supported judgement of a subject's qualities and relation to its context.	**Planning a scientific investigation** Developing a hypothesis for an investigation • Be able to formulate a hypothesis or a null hypothesis based on relevant scientific ideas. Selection of appropriate equipment, techniques and standard procedures • Be able to select and justify the use of equipment/techniques/standard procedures for quantitative and/or qualitative investigations. **Health and safety associated with the investigation** • Understand risks and hazards associated with the investigation. **Variables in the investigation** • Independent. • Dependent. • Control. **Method for data collection and analysis** • Be able to produce a clear, logically ordered method to obtain results. • Be able to select relevant measurements and the range of measurements to be recorded. • Understand the importance of obtaining data accurately/reliably and to appropriate levels of precision. • Understand how variables can be controlled/measured/monitored. • Understand how the data/information can be analysed. **Evaluation** • Be able to make any recommendations for improvements to the investigation. • Be able to explain anomalous data. • Be able to determine quantitative and discuss qualitative sources of error. • Be able to discuss evidence of the reliability of the data collected during the investigation. • Be able to identify strengths and weaknesses within method/techniques/standard procedures/equipment used. • Be able to suggest improvements to an investigation.

Explain: Learners' explanations require a justification/ exemplification of a point. The answer must contain some element of reasoning/justification – this can include mathematical explanations. **Give/state/name:** These generally require recall of one or more pieces of information. Give a reason why When a statement has been made and the requirement is only to give the reasons why. **Identify:** Usually requires some key information to be selected from a given stimulus/resource. **Plot:** Learners produce a graph by marking points accurately on a grid from data that is provided and then drawing a line of best fit through these points. A suitable scale and appropriately labelled axes must be included if these are not provided in the question. **Predict:** Learners give an expected result. **Show that:** Learners prove that a numerical figure is as stated in the question. The answer must be to at least one more significant figure than the numerical figure in the question. **Sketch:** Learners produce a freehand drawing. For a graph this would need a line and labelled axes with important features indicated. The axes are not scaled. **State and justify/identify and justify:** When a selection is made and a justification has to be given for the selection. **State what is meant by:** When the meaning of a term is expected but there are different ways in which this meaning can be described. **Write:** When the question asks for an equation.	

Numeracy: **Physics:** Graphical representation of wave features. Be able to use the wave equation: v f = λ Be able to use the equation: calculation of speed T v = μ Understand the principles of fibre optics: o refractive index o calculation of critical angles at a glass–air interface Be able to use the inverse square law in relation to the intensity of a wave. **Biology:** Interpretation of graphical displays of a nerve impulse and electrocardiogram (ECG) recordings. Calculate magnification and size of cells and organelles from drawings or images. **Chemistry:** Understand the following: o balanced equations o relative atomic mass o atomic number and relative molecular mass o moles, molar masses and molarities. Understand the quantities used in chemical reactions: o mass, volume of solution, concentration o reacting quantities o percentage yields.	**Numeracy:** **Physics:** Equations • Power = VI (voltage × current). • Power = work done time • Work done = energy supplied or transformed. • Define – joules, kJ, calories (1 g by 1 oC), kilocalories, kWh. • The heat capacity of water will be given if required. • Calculate heat energy supplied by a fuel to water using: o heat energy = mass of water × specific heat capacity of water × temperature rise of water. • Calculate heat energy released from a fuel in kJ mol-1. **Biology:** Sampling sizes • Select sample sizes for investigation with regards to practical constraints and the need to collect sufficient data to make valid conclusions. **Drawing conclusions and evaluation:** Interpretation/analysis of data • Be able to identify trends/patterns in data. • Be able to compare primary and secondary data. • Be able to use data to draw conclusions that are valid and relevant to the purpose of the investigation. • Interpretation of statistical tests using tables of critical values and a 5% significance level, with reference to the null hypothesis. **Collection of quantitative/qualitative data** • Be able to collect data accurately/reliably and to appropriate levels of precision. • Be able to tabulate data in a clear and logical format using correct headings with units where appropriate. • Be able to identify anomalous data and take appropriate action. • Be able to recognise when it is appropriate to take repeats. • Be able to make qualitative observations and draw inferences. **Processing data**

	• Be able to carry out relevant calculations where appropriate, involving: o mean and standard deviation o use and interpretation of error bars o use of statistical tests, including t-test, chi-squared and correlation analysis o use of formulae o transposition of formulae o conversion of units o use of standard form o percentage error of measuring equipment. • Be able to display data in an appropriate format, including: o choosing an appropriate graph/chart/tables o correct plotting/labelling/scales.
Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC): Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit. However we offer a chance during Science week and throughout the year for these students to go on visits to universities, companies visiting the school so that students can understand the purpose of this course and enhance practical skills. These visits and talks enable students to choose a career pathway for them too.	**Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):** Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit. However we offer a chance during Science week and throughout the year for these students to go on visits to universities, companies visiting the school so that students can understand the purpose of this course and enhance practical skills. These visits and talks enable students to choose a career pathway for them too.