CURRICULUM INTENT

SCIENCE

In studying science, students will develop their understanding of the scientific process as well as a working knowledge of the fundamental concepts, language, skills and the critical thinking nature of the scientific community. It provides students the tools with which they can explore, understand, marvel at, and describe the world and universe around them. It empowers them to go on and make informed decisions to help them navigate their complex futures. Ultimately, through the language acquisition, academic challenge and subject specific skills gained during their study of the Biology, Chemistry and Physics disciplines our students will become more powerful and adaptable thinkers, better problem solvers, with improved analytical numeracy and literacy and with a greater appreciation of the natural world and their place and responsibilities within it.

CURRICULUM INTENT OVERVIEW

HEAD

KNOWLEDGE-RICH

Science students will:

- Have sufficient information and scientific literacy to comprehend scientific advancements and engage in meaningful discussion and be able to make informed decisions.
- Know the stages of the *Scientific Process*, how to identify variables and plan investigations to gather valid, accurate, precise and reliable data and how to analyse and evaluate evidence. They will also know how this process models the fundamental stages of scientific research into us and our surroundings.
- Know the names, uses and associated techniques of key laboratory equipment and how to use them effectively and safely to investigate a problem.

Biology students will:

- Know the levels of organisation of life on the planet, from molecules up to interconnecting ecosystems, their functional detail and the key theories of how complex life evolved from simpler structures.
- Know the impacts of pathogens, genetics, lifestyle and pollution on the health of organisms and ecosystems and how to treat or prevent these issues.
- Know that research into naturally occurring chemicals, DNA and stem cells has enabled the development of future sustainable technologies which offer solutions to many healthcare and environmental problems that humans are faced with.

Chemistry students will:

- Understand sub-atomic particles and in particular the importance of electrons on the properties of elements and compounds in terms of reactivity and bonding
- Be able to perform calculations, for example be able to calculate an expected yield or analyse data from a titration to determine purity. (Chemistry only)
- Have a basic understanding of organic chemistry including naming some hydrocarbons.
- Understand how reactivity of metals determines how they behave and how they can be extracted from their ores.

Physics students will:

- Know the equations and laws that enable physicists to make predictions using models and the limitations that make making accurate long-term predictions difficult.
- Know how to use the complex terminology required to describe the world around them in a concise, accurate and mathematical manner.
- Know how to use specialist apparatus to make and record measurements of physical quantities and how to interpret this data with a critical approach.
- Know about the universe, from the very small to the very big and have an appreciation of the structure and the scale of the levels of organisation from subatomic particles all the way up to galaxies and the universe.

HEART

FAITH, LOVE AND RESPECT

Students will:

- Discuss the ethics of scientific research, technological advancements and their impact on society. Topics such as animal testing, genetic engineering, climate change and human experimentation provoke discussions about ethical boundaries, responsibility and the greater good. These discussions encourage students to reflect on honesty, integrity and responsible conduct of scientists as well as on their own values and thus facilitates their development of a moral compass.
- Develop critical thinking and problem-solving skills; these skills are inherent in science education and vital for moral development. Students learn to analyse evidence, evaluate arguments and make informed decisions. They are encouraged to question assumptions, challenge bias and consider multiple perspectives. These skills help students examine ethical dilemmas from different angles facilitating a deeper understanding of complex issues.
- Develop environmental and social awareness through the study of human impact on the environment, sustainability, and conservation. By learning about these topics, students become more aware of how interconnected science, society and the environment are.
- Develop an understanding of the responsible use of technology through the study and discussion of both past and emerging technologies such as drug testing, genetic engineering, and biotechnology. They explore the potential benefits and risks associated with these technologies which will enable them to make informed decisions about the use of technology and its impact on society.
- Develop an understanding of the scientific process which promotes objectivity, evidence-based reasoning, and scepticism. By engaging in scientific enquiry students learn to approach problems in an impartial manner, separate facts from opinions and draw conclusions based on evidence. These experiences contribute to moral development by fostering rational thinking and 'truth-seeking'.
- Develop interpersonal and organisational skills along with an awareness of self-control and consequence with others of different scientific aptitude through group practical work in a mixed ability setting in Years 7 & 8 in a hazardous environment.
- Develop empathy and tolerance for others through understanding the causes of differences or natural variation between humans as well as in other organisms and that natural variation or genetic diversity is good for the species. Also, through the study of the roles of scientists from different backgrounds, students learn that prejudice impairs progress.
- Develop techniques for life-long learning through the progressive mastery of many detailed concepts ideas and theories as well as the accumulation of knowledge of all three sciences and retrieval practice of key content therein.
- Understand that their science teachers have very high ambitions for their knowledge and learning, and that this means they have high expectations of their attention, completion of homework and engagement in class tasks.

HANDS

APPLICATION OF KNOWLEDGE

Students will:

- Be able to think critically, analyse and evaluate information objectively.
- Be able to extract relevant information from multiple sources to deduce or evaluate conclusions.
- Be able to develop their scientific literacy to comprehend scientific advancements and innovation and thereby engage in informed discussions and better make evidence-based decisions.
- Be able to use laboratory equipment safely and collaboratively to investigate a hypothesis, gather, present, and analyse precise, reliable, and valid data to draw conclusions and evaluate methods and ideas.
- Be able to communicate effectively, share responsibilities, appreciate diverse perspectives, and use their practical understanding and creative thinking to devise investigations in novel situations.
- Be able to innovate and solve problems by applying scientific principles to real-world challenges.
- Be able to write in a scientific writing style modelled regularly by their teachers.
- Have a working knowledge of the scientific language and ideas to be able to progress to study science at a higher level and/or gain employment in science communication, healthcare, education, or specific fields of research working towards solutions for issues facing humanity. They can inspire others, disseminate scientific knowledge, and promote scientific and information literacy among the public.

CURRICULUM TO CLASSROOM

HEAD KNOWLEDGE-RICH	KNOWLEDGE FOCUSED	Students are provided with knowledge organisers or knowledge books for each topic which provide access to the whole curriculum. The booklets are sequenced in the order in which the curriculum is taught. Lesson activities are focused on students understanding and then retaining the content in the knowledge books. Sometimes this content is delivered via PowerPoint and on other occasions is communally read and annotated live in the knowledge book/organiser. Knowledge books also contain many questions to develop student's ability to retrieve content and manipulate concepts using their working memory.
	EXPERT TEACHERS (EXPLANATIONS)	Teachers use demonstrations, visuals, questioning sequences to engage students with the subject expert explanations. Teachers quiz students on knowledge from previous lessons which is relevant to the upcoming material, this helps students make links between the current and prior learning. Teachers limit the text on screen, or guide students through reading chunks of text with annotations/bullet points. Almost all topics taught in years 7-9 are revisited at GCSE which typically teach new content explicitly via the knowledge organiser/book, PowerPoint or textbook.
	TAUGHT TO BE REMEMBERED	Retrieval practice is used at the start of most lessons to develop students' retrieval from long-term and working memories. Revision homework using knowledge books/organisers, Seneca homework and low stakes testing of student's knowledge are used to provide a variety of methods to develop schemas in the student's long-term memories. Formal end of topic tests are used at regular intervals (roughly half-termly) alongside revision homework and feedback. We are minimising the notes taken by students to maximise the lesson time available for processing the information, and activities that test knowledge. Cold calling/whiteboards/quizzing and low-stakes-testing are often used to promote student engagement with the content.

HEART **FAITH, LOVE AND RESPECT**	ENCOURAGING CLASSROOMS BASED ON FAITH, LOVE & RESPECT	Teachers communicate their high expectations of pupils' behaviour and work ethic in the context of a strict yet supportive and forgiving culture. Students are expected to sit up and maintain eye contact with the teacher or focus on the board, demonstration or text when being taught. Teachers may insist on silence for specific activities to enable students to focus or think without distraction. Students are reminded of expectations and that the reason for focus and silent working is to achieve their best. Mistakes are welcomed and discussed in science classrooms where they help all students develop their understanding/knowledge. Science teachers develop positive and productive relationships with their classes and use these to good effect guiding students through the challenges of secondary science.
HANDS **APPLICATION OF KNOWLEDGE**	EXPERT TEACHERS (MODELLING)	At GCSE and A Level Biology, Chemistry and Physics are taught by specialists, as is each Unit of the Applied Science. Teachers will model how to ask questions, formulate a hypothesis, plan, and carry out all stages of practical investigations using a wide variety of standard techniques and equipment. They also model how to analyse data and deduce conclusions emphasizing the importance of precision, accuracy, validity, and attention to detail. Science teachers model effective communication skills by explaining scientific concepts clearly using appropriate scientific vocabulary and organising information in a logical manner. Science teachers will model the use of equations and using a consistent approach to layout and working. Science teachers model ethical behaviour in discussions of research where honesty, integrity and responsible conduct are emphasised. Science teachers will model how to answer exam questions. The sheer quantity of content and variety of different skills in science lessons facilitates a high level of challenge to students of all abilities and the modelling is part and parcel of what happens in lessons at all key stages. At KS3 the department have developed specific literacy tasks in which students develop their ability to answer 6-mark questions prior to topic tests, in these tasks teachers model how to break down the question and construct an answer to their students. Visualisers are increasingly being adopted by science teachers to model classwork and exam questions.
	DELIBERATE PRACTICE	Students regularly complete exam-style questions at all levels in science lessons and for homework. If answering questions in class, the teacher will circulate to support students. Teachers will project, model answers, or use visualisers to show examples of students' work.

LEARNING SEQUENCE – YEAR 7

OUTCOMES	Students will be familiar with the nature of the different disciplines of Biology, Chemistry and Physics and know some links between them. Students will have practised: • Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out. • Using basic lab equipment safely and effectively to gather evidence and investigate a hypothesis. • Applying scientific conventions to data collection, presentation, and analysis i.e. How to set out results tables, graphs, and calculations. • Writing explanations in a scientific writing style Students will have accumulated detailed knowledge and understanding of: • The fundamental building block ideas of cells, and systems. • Particles and reactions between them including how metals react with acids. • Fundamental forces acting on matter and energy transfer between stores.

EPISODE 1 TOPICS	**Introduction** The Year 7 curriculum begins with an introduction to the scientific methods, scientific inquiry, and the nature of science the context of everything the students will study over the next 5-7 years and hopefully beyond.	**Biology** This is taught first as the subject matter is less abstract and easier to relate to by a Year 7 student than other subjects - thereby promoting confidence in the students.	**Chemistry** This is taught after the biology as it is more abstract and therefore more challenging. It is taught before the Physics as the Physics builds on the particle model by introducing fundamental forces acting on or between particles of matter.	**Physics** This is taught as it builds upon and extends students understanding of the particle model covered in the previous Chemistry topics.
ROUND 1 EXPLANATION	The introduction is largely based on practical investigations and develops student's knowledge of the basic lab equipment and the hazards therein as well as how to use the equipment safely.	**Biology** **Topic B1.1 Cells** Cells are studied first because they are the fundamental unit of life. It introduces the idea of specialised cells which provides a foundation for specialised tissues and organ systems in the following topic. It introduces the idea of prokaryotic and eukaryotic cells which will be revisited in Year 8 when discussing about bacteria in the gut. **Topic B1.2 Systems** This builds on the first section by showing how cells are organised into organ systems and introduces the ideas of complex organ systems with specific roles.	**Chemistry** **Topic C1.1 Particles** Particle theory is taught first because they are the fundamental building blocks of matter – by understanding particles students can then move onto how particles interact **Topic 1 C1.2 Atoms, molecules & compounds** This builds on the first Chemistry section teaching students how particles interact to form compounds/molecules.	**Physics** **Topic P1.1 Forces** this topic extends the student's schema of the particle model by considering the effects of fundamental forces acting on and between matter (particles). It also introduces students to the use of equations in physics to solve problems. **Topic P1.2 Sound** This topic also extends student's particle theory schema by teaching them how the movement of particles can transfer energy. It also builds on the idea of specialised organ systems by studying the structure of the ear.

ROUND 2 TOPICS		**Biology** This second round of Biology facilitates a revisiting and extension of the fundamental ideas covered in the Round 1 Biology topics.	**Chemistry** This second round of Chemistry facilitates a revisiting and extension of the fundamental ideas covered in the Round 1 Chemistry topics.	**Physics** This second round of Physics facilitates a revisiting of the fundamental ideas covered in the Round 1 Physics topics.
ROUND 2 TOPICS		**Biology** **Topic B1.3 Reproduction** This is taught after the Round 1 Chemistry and Physics topics to allow students to revisit the idea of cells and specialised cells within the study of the human reproductive system. This topic also provides a foundation in the idea of sexual reproduction and variation needed for the Year 8 study of adaptation and inheritance.	**Chemistry** **Topic C1.3 Reactions** This is taught to facilitate a revisiting of the fundamental ideas of particles and how they interact in chemical reactions. This provides a foundation for the study of Bioenergetics (Photosynthesis and Respiration) in the Year 8 Ecology topic. **Topic C1.4 Acids & Alkalis** This builds on extends the students ideas about reactions and brings various real-world examples of reactions of household chemicals it also provides students with critically importance experience of handling dangerous chemicals safely early on in their career. It also provides a foundation for the Year 8 study of the reactions between metals and acids.	**Physics** **Topic P1.3 Light** This physics section allows the students to revisit the earlier physics topics of sound and forces and introduces the idea of energy transfers and links to the student's ideas about particles as it introduces the idea of vacuum. It also provides a foundation for the Space topic's ideas about the solar system and eclipses as well as the Year 8 study of photosynthesis. **Topic P1.4 Space** This is the final topic as it requires 'big picture' thinking which many students find difficult. It also extends the student's ideas about a particle-less vacuum from the previous topic and provides and builds on the ideas about light. It is also an excellent motivator at the end of the year as students love thinking about Space.

LEARNING SEQUENCE – YEAR 8

OUTCOMES	Students will have developed their understanding of the fundamental ideas and skills in Biology, Chemistry and Physics and how working scientifically links the three disciplines. Students will have practised: • Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out. • Separating mixtures and working safely with hazardous materials. • Writing in a scientific style, composing, and communicating their 'sustained reasoning' in explanations/answers. Students will have accumulated detailed knowledge and understanding of: • The fundamental building block ideas of atoms, molecules, compounds and the reactions of acids and metals. • Electricity and magnetism, energy, motion and pressure and the laws that govern them and practised using equations to solve problems. • How organisms evolved adaptations in the context of their ecosystems as well as how health is affected by lifestyle.

ROUND 1 TOPICS	**Chemistry** is taught first as each science is on a changing rota to ensure equitable delivery of content across all 3 sciences.		
ROUND 1 EXPLANATIONS	**Chemistry Topic C2.1** **The Periodic Table** This Topic builds on and extends the students understanding of particles/ atoms, elements and compounds from Year 7 and introduces them to the idea of organising elements based on their properties as well as group trends in properties – which provides a foundation for the following study of separation techniques based on differences between chemical and physical properties and the ideas of trends provides a foundation for the reactivity series studied in metals and acids. **Chemistry Topic C2.2** **Separation techniques** This topic builds on and extends the student's knowledge and understanding of particle theory studied in Year 7 by introducing the idea of mixtures and pure substances as well as revisiting the idea of chemical and physical properties studied in the previous topic. The practical nature of this topic allows students to develop essential practical skills building on those developed during Year 7.	**Physics P2.1** **Electricity and Magnetism** This topic introduces the components used in electrical circuits and continues to build on and extend the student's schema of particle theory by teaching about metallic bonding and free electrons and their flow in the context of current, voltage and resistance. The study of current and voltage provides a foundation for the following topic on energy which looks at generating electricity and electrical power. **Physics P2.2** **Energy** This topic builds on the idea of energy transfer from the sound and light topics in year 7 as well as developing student's schema of electricity by studying power generation and cost. It extends student's schemas of the particle model and energy transfer through the study of conduction and convection. It also introduces the idea of renewable and non-renewable resources which are built on in the Ecology topic later this year as well as providing an energy transfer foundation for the Bioenergetics encountered in the Ecology topic.	**Biology B2.1** **Health and Lifestyle** This topic introduces the effect of a human's lifestyle on the health of the body's systems which provides a foundation for the study of the effects of humans on the health of ecosystems in the following topics. This topic also extends the student's knowledge from year 7 about the functioning of organ systems as it takes in in depth study of the digestive system. **B2.2** **Ecology** In this topic, students study Ecosystems and processes. Bioenergetics is introduced here which consolidates the ideas of energy transfer from the Physics energy topic in the context of energy flow through ecosystems. The chemical reactions of Photosynthesis and Respiration build on and develop the ideas of chemical reactions from Year 7. It also develops the ideas of factors effecting the health of systems from the previous topic. The idea of adaptation to habitat is introduced here which provides a foundation for the adaptation and variation topic later in Year 8.

ROUND 2 TOPICS	Chemistry	Physics	Biology
ROUND 2 EXPLANATIONS	**Chemistry Topic C2.3** **Metals and Acids** This Topic builds on and extends the students understanding of acids and alkalis from Year 7 whilst revisiting ideas from the earlier Year 8 Chemistry. It introduces the idea of the reactivity series developing the idea of trends from the periodic table topic. **Chemistry Topic C2.4** **The Earth** This is essentially a stand-alone topic as it is Geology rather than Chemistry. However, it does introduce the composition of the atmosphere which prepares students for atmosphere topic in Year 9 and builds on the idea of metal ores in the crust which links to the reactivity series and prepares students for and the extraction of metals in the GCSE. It also introduces the idea of the structure of the Earth which links with the previous Physics topic on magnetism in which students study the Earth's magnetic field.	**Physics P2.3** **Motion and Pressure** This allows key ideas from the Year 8 Physics to be revisited. This builds on the idea of using equations to solve problems from the Year 7 Forces Topic. It revisits the idea of particle theory through the study of pressure in gases extending student's schema of laws that govern particle interactions through the use of pressure, speed, and moment equations. The study of distance-time graphs provides an excellent introduction to interpreting graphs which is fundamental to all areas of science.	**Biology B2.3** **Adaptation and inheritance** This allows key ideas from the Year 8 Biology to be revisited. It looks at population biology, variation and adaptation which are difficult concepts for students to comprehend and which is why this topic is the last topic in year 8. It builds on the Ecosystem processes topic from earlier in year 8 but challenges students understanding by linking the concepts of variation and inheritance to natural selection. It builds on the Reproduction and cells topics from Year 7 and introduces the idea of DNA and inheritance of genetic material which provides a foundation for the GCSE topic of the same name.

LEARNING SEQUENCE – YEAR 9

OUTCOMES	Students will have developed their understanding of the fundamental ideas and skills in Biology, Chemistry and Physics and how working scientifically links the three disciplines. They will also begin their exploration of GCSE content. Students will have practised: • Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out. • Writing in a scientific style, composing, and communicating their 'sustained reasoning' in explanations/answers. • Microscopy techniques. • Using equations to solve problems in novel situations. • Calculating energy loss along food chains. Students will have accumulated detailed knowledge and understanding of: • The particle model of matter and energy stores and transfers. • Factors that affect rate of reaction, the composition of the atmosphere and the effects of changing it. • Cell structure and function, as well as feeding relationships/energy transfer in ecosystems.

ROUND 1 TOPICS	**Physics** is taught first as each science is on a changing rota to ensure equitable delivery of content across all 3 sciences. Also, the fundamental concept of energy transfers and energy stores link strongly with all areas of science, for example the Bioenergetics studied in the following Biology cells topic and the rate of reaction topic studied in Chemistry.		
ROUND 1 EXPLANATIONS	**P3.1 Energy** The Energy topic develops the ideas of energy stores and transfers that were encountered in Year 8. The topic introduces a much more mathematical approach where pupils encounter an array of equations and learn to use and manipulate these to solve problems. This topic unlocks all the other GCSE topics as energy is a fundamental concept in electricity, mechanics, waves, and radioactivity, along with topics in both biology and chemistry. This topic provides the required language and mathematical skills for pupils to tackle the thermal energy topic at the start of Year 10 in a confident manner. The topic is finishes with some applications of energy transfers when pupils look at energy resources. This topic links with the chemistry later in the year when pupils will look further at problems associated with fossil fuels and renewable resources. This topic area also allows for some extended writing and argument to balance the more mathematical work at the start of the topic.	**B3.1 Animal Cells** This topic develops the ideas of cell structure and function that have been developed over the last 2 years. Students are taught several challenging ideas from the GCSE spec all of which were studied at some point over the last 2 years. This topic builds on the Cells, Systems and Reproduction topics studied in Year 7, revisits the ideas of Bioenergetics and the Inheritance topics studied in Year 8. It provides a strong foundation from which students can develop their ideas in many of the GCSE Topics by exploring some of the more complex ideas related to cells which provides foundations for further study of for example; Health and Disease by revisiting prokaryotic cells and also provides some foundation for the Inheritance and evolution topics at GCSE by studying genes, and alleles and DNA and protein. It also introduces the complexity stem cells and cell differentiation. The higher-level mathematical skills are also introduced in this unit.	**C3.1 Rate of Reaction** Rates of reactions builds on the particle theory met earlier in KS3, and the idea that particles must collide for a reaction to take place. It allows for plenty of differentiated practical work with the opportunity to have some open-ended investigative work. It also provides plenty of chances to reinforce graph drawing skills and some higher-level mathematical skills (calculating gradients using tangents). We will introduce activation energy which will be revisited in year 10, and rates along with equilibria are built upon in topic 10 when discussing industrial reactions and their conditions. We also briefly recap the 3 states of matter model and increase our understanding of the changes of state that take place at various temperatures, including the more demanding concepts when using negative numbers. It has been chosen to be taught at this point as the content is identical regardless of which GCSE course they will embark upon.

ROUND 2 TOPICS	Physics	Biology	Chemistry
ROUND 2 EXPLANATIONS	**P3.2 The Particle Model of Matter** Pupils meet the idea of the particle model, having encountered it in a simplified form in earlier years as part of the spiral curriculum. This topic builds on the idea of energy stores and applies it to particles. This allows pupils to better describe osmosis and diffusion, as well as changes of state in chemistry. This knowledge is returned to later in KS4 when pupils encounter gas laws and pressure in physics and moles and state changes in chemistry.	**B3.2 Ecology** In this topic students revisit the concepts of Ecosystems, interdependence and adaptation taught in Year 8. Students develop their understanding of through the introduction of the idea of Biomass and the transfer of energy/biomass through a food chain. The idea of quantifiable losses from food chains provides a foundation for the efficiency of food production in Year 11 as well as develop the maths skills needed for the higher-level Ecology questions at GCSE.	**C3.2 Atmosphere** The second chemistry topic is the atmosphere, which is another stand-alone topic for GCSE, and again the content is identical regardless of which GSCE option the students take. We build upon the ideas of elements, compounds, reactants, and products to talk about the origin of different pollutants and their negative effects. We look at the greenhouse effect and acid rain and practice identifying which pollutants are made from different fuels. We discuss opportunities to reduce our carbon footprint. These ideas will be built upon when we study the organic chemistry topic in year 11.

LEARNING SEQUENCE – YEAR 10 BIOLOGY (AQA)

<table>
<tr><td>OUTCOMES</td><td colspan="4">Students will have developed their understanding of the fundamental ideas, skills and techniques used in Biology and how these relate to emerging technologies.

Students will have practised:
• Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out.
• Writing in a scientific style, composing, and communicating their ‘sustained reasoning’ in explanations/answers.
• Various laboratory techniques including microscopy.
• Interpreting, analysing, and evaluating data from microscope images, tables, graphs and subsequently evaluating studies and conclusions from such studies.

Students will have accumulated detailed knowledge and understanding of:
• Cell structure/function and differentiation/specialisation of cells, cancer, and stem therapy.
• Cross membrane transport mechanisms in plants and animals and their involvements in organ systems and how the body’s systems are adapted to maximise these processes.
• Health, the factors that affect it and the socio-economic impact of poor health on individuals and the NHS.
• Disease and the causes of disease in plants and animals and their defence mechanisms.</td></tr>
<tr><td>PAPER 1 TOPICS</td><td>Cell Biology</td><td>Transport and Exchange in animals</td><td>Plants and Photosynthesis</td><td>Health Matters</td></tr>
<tr><td>PAPER 1 EXPLANATIONS</td><td>Cell Biology quickly recaps the Year 9 Cells and Bioenergetics content and explores additional higher-level ideas such as cell division and cancer and stem cell therapy. It provides a foundation for next topic which looks at cell transport mechanisms and the functioning of organ systems.</td><td>In this topic students study cell transport processes, e.g., Osmosis and diffusion and relate these processes to the functioning of the whole organism. Students then study enzymes and the Digestive System and the circulatory system. This topic builds on the foundations of Cell Biology and provides a foundation for the fourth topic which looks at Health which links with the digestive and circulatory systems.</td><td>This topic again builds on the Cells and Bioenergetics topics from Year 9 and extends the students ideas about osmosis and diffusion through the study of the movement of water through the plant. It introduces the idea of plant minerals which is followed in the next topic when students study plant deficiency diseases.</td><td>Health Matters looks at Human and Plant defences. It builds on the cell biology from topic 1, and the components of the blood in the second topic through the study of prokaryotic cells and the immune response to diseases.</td></tr>
</table>

LEARNING SEQUENCE – YEAR 11 BIOLOGY (AQA)

OUTCOMES	Students will have developed their understanding of the fundamental ideas, skills and techniques used in Biology and how these relate to emerging technologies. Students will have practised: • Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out. • Writing in a scientific style, composing, and communicating their 'sustained reasoning' in explanations/answers. • Calculating percentages and using these in energy loss along food chain calculations. Students will have accumulated detailed knowledge and understanding of: • The differences between nervous and hormonal communication and their importance in homeostatic mechanisms. • DNA, inheritance, and the mechanisms by which life has evolved on the planet. • The transfer of energy along a food chain and how this understanding is used to maximise efficiency of food production.		
TOPIC	**Homeostasis and Response**	**Inheritance and Evolution**	**Ecology**
EXPLANATION	In this topic students study the detail of nervous and endocrine systems and their roles in homeostasis and human fertility. It builds on the study of reproduction at KS3 whilst providing a foundation for some of the A level Biology topics.	In this this topic students will learn about the link between DNA/genetic code and the link between DNA, Inheritance and Evolution. This topic builds on the Cell Biology Topic from year 10 and the DNA to protein studied in Year 9. The content from this topic links to many abstract and complex ideas related to the DNA molecule.	In this topic there is a recap of the Ecology studied in Year 9 and the idea of efficiency of energy flow through Ecosystems. These ideas are then extended into the efficiency of food production and the effect of humans on natural systems.

LEARNING SEQUENCE – YEAR 12 BIOLOGY (EDEXCEL)

Please note – the context led approach contextualises the biology content to enable students to assimilate the information. Consequently, there is a thematic 'story' formed by the content and for this reason we follow the topics in the order that the spec suggests. This allows key themes/ideas to be revisited throughout the course.

OUTCOMES	**Students will:** • Have knowledge and understanding of the structure and function of cells with particular focus on DNA structure and its role in protein synthesis/cell function, differentiation, inheritance, evolution, and biodiversity. • Relate a detailed knowledge of biochemistry and the structure of the circulatory system to explain the role of risk factors on cardiovascular health. • Develop an awareness of the causes and potential value of the Planet's biodiversity, as well as solutions to the threats it faces. • Develop a range of practical techniques and commensurate with A Level Practical Laboratory and Field Biology using specific equipment/instrumentation such as burettes, colorimeters, microscopes, and quadrats. • Be able to evaluate and mange risks, consider the ethical issues presented by their work in the laboratory, which might include consideration for the ethical use of live subjects, the safe disposal of waste materials.			
TOPIC	**Topic 1 – Lifestyle, Health and Risk**	**Topic 2 – Genes and Health**	**Topic 3 – The Voice of the Genome**	**Topic 4 – Biodiversity and Natural Resources**
EXPLANATION	Students build on their GCSE knowledge and understanding of the functioning of the circulatory system and the correlation/ causation of risk factors with circulatory health. This topic is taught first as it builds on GCSE knowledge to help students develop their confidence.	Students cover many ideas which form the core of the biology through the context of the genetic disease cystic fibrosis. Students also discuss social and ethical issues surrounding genetic screening. Whilst this builds on a few GCSE ideas much of this is novel and high-level content. Consequently, this content is delivered concurrently with Topic 1 as the material is foundational to many ideas covered throughout the course such as the idea of differential gene expression in Topic 3.	Students learn about the development of complex multicellular organisms from single cells though gene expression and cell differentiation.	Students learn about the causes and potentials of the wealth of Earth's Biodiversity and how it is being affected by humans. The concepts of niche and adaptation through natural selection build on GCSE topics but then lead to some challenging ideas about quantifying biodiversity/genetic biodiversity and population genetics.

LEARNING SEQUENCE – YEAR 13 BIOLOGY (EDEXCEL)

Please note – the context led approach contextualises the biology content to better able students to assimilate the information. Consequently, there is a thematic 'story' formed by the content and for this reason we follow the topics pretty much in the order that the spec suggests. This allows key themes/ideas to be revisited throughout the course.

OUTCOMES	**Students will** • Develop an awareness of the role of green plants in ecosystems energy budgets and how humans are changing the nature of the Planet. • Have knowledge and understanding of: • Human immunity and how specific pathogens have evolved to be able to avoid human defence mechanisms. • How genetic fingerprinting can be used in forensics/research. • The structure and functioning of the human nervous and muscular systems and the interplay between them. • Have an awareness of the ethics of doping in sport and new technologies which may be used to augment humans and other organisms. • Develop a range of practical techniques and commensurate with A Level Practical Laboratory and Field Biology using specific equipment/instrumentation such as burettes, colorimeters, microscopes, and quadrats. • Be able to evaluate and manage risks, consider the ethical issues presented by their work in the laboratory, which might include consideration for the ethical use of live subjects, the safe disposal of waste materials.			
TOPIC	**Topic 5 - On the wild Side**	**Topic 6 - Immunity, Infection and Forensics**	**Topic 7 - Run for Your Life**	**Topic 8 - Grey Matter**
EXPLANATION	Students learn that photosynthesis is the primary process that underpins life on earth and links this to the likely effects of global warming on adaptation, speciation and extinction. This develops student's ecological understanding from (topic 4) as well as their functional knowledge of cell ultrastructure (topic 3). By the end of the topic students should appreciate how scientific understanding can make us aware of our responsibilities as stewards of the environment.	Students learn forensic pathology techniques to determine identity and the time and cause of death. The also considers how bacteria and viruses have evolved to infect hosts who have evolved defence mechanisms to combat infections. It develops their knowledge and understanding of key cell processes and linked cell ultrastructure (topics 2 and 3).	This topic is centred around physiological adaptations for strenuous exercise. It explores the links between an animal's physiology and its performance. It ends by looking at how medical technology is enabling more people to participate in sport, and raising the issue of whether the use of performance-enhancing substances by athletes can be justified.	Students learn how the nervous system enables us to respond to stimuli. It also investigates how imbalances in brain chemicals may result in diseases and how drug treatment works for them. Students discuss ethical issues raised by the Human Genome Project and the risks and benefits of using genetically modified organisms.

LEARNING SEQUENCE – YEAR 10 CHEMISTRY (AQA)

OUTCOMES	• The structure of atoms, ions and isotopes and be able to describe how one becomes another. They will know of the evidence for atomic structure • They will be able to construct and balance chemical equations using state symbols correctly • How to explain the properties of a substance based on its structure and bonding. • How to use moles to carry out chemical calculations. • The chemistry of the reactivity series and the relevance of this for selecting metal extraction techniques for the essay questions.		
TOPIC	**Atomic Structure**	**Bonding and Structure**	**Quantitative Chemistry**
EXPLANATION	The foundation of all chemistry! The components of atoms and how to calculate their numbers in atoms, ions and isotopes. The arrangement of electrons and how that governs chemical properties. The theories behind the development of the atoms' structure and the current periodic table. The behaviour of the elements in groups 1, 7 and 0 *and the transition metals*. This builds on their work on particles in KS3 and will provide an essential understanding for the rest of the year.	The concepts of ionic, metallic and covalent bonding, including representations of these and their limitations. The properties of substances with these types of bonding. The three states of matter and the limitations of the portrayal of these states as particle pictures. *Nanotechnology- its risks and benefits.* The arrangement of electrons in an atom determines how it bonds and thus how it behaves.	The mole as an amount of substance. Calculations involving solids, *gases and solutions.* Avogadro's number, limiting reactants, *% yield, % atom economy* and using moles to balance an equation. Law of conservation of mass. The mole is a new concept, but calculations rely on using relative mass so that links back to atomic structure again in chapter 1. Mole calculations are then revisited with titrations (Chemistry only) in the next chapter.
TOPIC	**Chemical Changes**		**Energy Changes**
EXPLANATION	The reactivity series and its use to predict the reactions of metals with oxygen, water and acid, and the methods of extraction of metals from their ores. Redox. The reactions to form soluble salts and the method for producing these. The definition of acid and the terms weak and dilute and strong and concentrated, the pH scale and neutralisation. Prediction of the products of electrolysis of solutions and liquids including equations and the specific example of extraction of aluminium.		The meaning of endothermic and exothermic and applications to everyday life. Drawing and interpreting energy level diagrams to include Ea and overall energy change. Technique to investigate temperature change. Bond energies and associated calculations. *Cells and batteries, including rechargeable ones. Fuel cells and their risks and benefits*. Relies upon reactivity of metals. We mention Ea in this topic

	Titrations- method and use in determining and unknown concentration. The ease of losing electrons governs a metal's reactivity which is the underlying theme in this topic. We will revisit reactivity of metals in the next topic as electrochemical cells and as a factor that affects temperature change. This builds on their work on particles in KS3 and will provide an essential understanding for the rest of the year.	

LEARNING SEQUENCE – YEAR 11 CHEMISTRY (AQA)

OUTCOMES	• How to manipulate the rate at which a chemical reaction occurs and how to explain this in terms of collision theory • The basic principles of organic chemistry as the study of carbon-based compounds and how to name and draw particular functional groups and how these functional groups dictate the reactivity of a compound • Analytical techniques used for the identification of particular compounds or ions • How our atmosphere has changed over time and the evidence we have for its continuing evolution • The industrial and commercial importance of the chemistry they study. In particular in the production of potable water, NPK fertilisers, alloys, composites, ceramics and glass.	
TOPIC	**Rates and Equilibria**	**Organic Chemistry**
EXPLANATION	Recap of factors that affect reaction rate with reasoning. Methods to follow rates of reactions. Factors that affect the position of an equilibrium. Be able to predict and explain how an equilibrium will respond to an external change. Rate of reaction is affected by Ea, and both rates and equilibria will be revisited in topic 10 (for Chemistry only)	The formation and separation of crude oil. Hydrocarbons to include alkanes and alkenes. Combustion reactions. Cracking and the test for alkenes. *Other homologous series and their reactions to include alcohols and carboxylic acids. Introduction to other types of organic compounds including esters and amino acids. Polymers- addition and condensation and examples of natural polymers.* The bonding carbon (topic 2) is unique and leads us to the topic of organic chemistry.
TOPIC	**Chemical Analysis**	**Using Resources**
EXPLANATION	Formulations. Chromatography and interpreting chromatograms. Gas tests. *Flame tests, testing for cations and anions. Instrumental techniques.* *We met chromatography in topic 1 and it is revised here.* The ease of losing electrons governs a metal's reactivity which is the underlying theme in this topic. We will revisit reactivity of metals in the next topic as electrochemical cells and as a factor that affects temperature change. This builds on their work on particles in KS3 and will provide an essential understanding for the rest of the year.	Water- production of potable water from various sources and the treatment of sewage. Life cycle assessments. Extraction of metals from low-grade ores. Conserving resources. *Corrosion and its prevention. Alloys, ceramics, composites and polymers. The Haber process, and its ideal conditions. Fertilizers and their production.* *Rates and equilibria and reactivity of metals are revisited here*

LEARNING SEQUENCE – YEAR 12 CHEMISTRY (OCR)

Please note – the context led approach contextualises the chemistry content to better enable students to assimilate the information. Consequently, there is a thematic 'story' formed by the content and for this reason we follow the topics in the order that the textbook suggests. This spiral curriculum means key themes/ideas are revisited throughout the course.

SKILLS	• Writing ionic equations • Interpreting spectra (IR & mass) • Changing units, standard form, sig figs, rearranging equations • Representing and naming organic molecules (displayed, skeletal, structural) • Functional groups and homologous series • Oxidation numbers • Drawing of mechanisms including the use of curly arrows		
TOPIC	**Elements of Life**	**Developing Fuel**	**Elements of the Sea**
EXPLANATION	Evidence for atomic structure, atomic spectroscopy, electrons in orbitals, RAM, periodicity. Recap of bonding and properties. Shapes of molecules. Moles, empirical formulae etc. Solubility and identification of salts. Group 2 chemistry. Acid-base titrations including standard solutions- techniques and associated calculations.	Types of enthalpy change, including techniques, The law of Hess and associated calculations. Hydrocarbons, aliphatic and aromatic. Representations of molecules. Isomers and nomenclature. Bond enthalpy calculations. Cracking chemistry and the mechanism of catalysis. Alkenes, properties and reactions including mechanism of electrophilic addition. Addition polymerisation. The ideal gas equation. Atmospheric pollutants and their effects. Alternative fuels.	Group 7, Redox including oxidation numbers and redox titrations. Electrolysis. Equilibria and Kc. Hydrogen halides.
TOPIC	**The O-Zone Story**	**What's in a Medicine?**	
EXPLANATION	Interaction of radiation on matter, with associated calculations. Radical formation and radical substitution mechanism. Rates of reaction, Ea including Maxwell-Boltzmann curves and homogeneous catalysis. The ozone hole. Halogenoalkanes, nomenclature, reactions and nucleophilic substitution mechanism. Electronegativity and intermolecular bonding and their effects on properties of substances.	Alcohols and carboxylic acids and the chemistry of the -OH group. Their reactions including ester formation. Prediction and interpretation of IR and mass spectra. Techniques for the synthesis of organic liquids and solids and their purification.	

Please note that EL is split into 2 halves to be taught concurrently. It is designed to be a recap of key KS4 ideas so that all students, regardless of the course taken at GSCE (here or at another institution) are brought up to a similar level. On completion of this topic DF and ES are taught by separate teachers concurrently. Finally, OZ and WM are taught concurrently.

LEARNING SEQUENCE – YEAR 13 CHEMISTRY (OCR)

Please note – the context led approach contextualises the chemistry content to better enable students to assimilate the information. Consequently, there is a thematic 'story' formed by the content and for this reason we follow the topics in the order that the textbook suggests. This spiral curriculum means key themes/ideas are revisited throughout the course.

SKILLS	• Interpreting spectra (as in AS & NMR) • Functional groups and homologous series • Drawing of mechanisms including the use of curly arrows • Organic syntheses maps • Interpretation of data to include electrode potentials and rates • Maths skills to include calculating half-lives and tangents, using logs, rearranging equations.		
TOPIC	**The Chemical Industry**	**Polymers and Life**	**The Oceans**
EXPLANATION	The chemistry of Nitrogen, equilibria and Kc, rates of reactions including techniques, calculation of k with units. Interpretation of data to suggest orders of reactions, rate equations and rate determining steps. Factors that affect industrial processes.	Carboxylic acids, esters & amines, nomenclature and reactions. Amides. Products of hydrolysis. Optical isomerism. Protein structure including enzymes and their specificity. Protein synthesis. Structure of DNA. High resolution mass spectroscopy and NMR.	The energy changes behind dissolving including charge density and lattice enthalpy. The greenhouse effect. Strong and weak acids and bases including pH calculations with assumptions. Buffers and pH calculations with assumptions. Ka, Kw and Ksp. Technique for calculating Ksp. Entropy calculations.
TOPIC	**Developing Metals**	**Colour by Design**	
EXPLANATION	The d block- electronic configuration, properties, catalysis and explanation of colours. Complex formation, including shapes, colours and reactions. Electrochemistry including use of SEP data to make predictions about feasibility of reactions, and including techniques to measure SEP and Ecell. The chemistry of rusting and its prevention.	Aromatic chemistry- origin of colour in aromatics, the bonding in benzene. Nomenclature and reactions of benzene and its derivatives. Azo dyes and the chemistry of attaching dyes to fibres. Fats and oils. GLC. Nomenclature and reactions of aldehydes and ketones. The mechanisms of electrophilic substitution and nucleophilic addition. Summary of all organic functional groups and reactions covered in the course. Planning organic conversions.	

LEARNING SEQUENCE – YEAR 10 PHYSICS (AQA)

OUTCOMES	Students will have practised: • Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out. • Writing in a scientific style, composing, and communicating their 'sustained reasoning' in explanations/answers. • Various laboratory techniques including safe working practices and reduction of risk. • Using a range of equipment and meters to record data accurately. • Using and manipulating a wide range of equations to solve multi-step problems Students will have accumulated detailed knowledge and understanding of: • Thermal physics and the concepts of specific heat capacity and latent heat • Electrical circuits, components and their functions and the concepts of resistance, current and potential difference in series and parallel circuits • Domestic electricity, safety and distribution • Atomic structure, nuclear radiation, fission and fusion, activity, dose and risk • Forces and motion and Newton's laws and their effect on velocity and acceleration	
TOPIC	**Thermal Physics**	**Electricity**
EXPLANATION	P1b Thermal Physics develops the concepts of the Particle Model of Matter taught in Year 9 by introducing a mathematical approach to calculating changes in energy and temperature.	This topic builds on the fundamentals of electricity that are encountered in Years 7 and 8. Pupils again meet a more mathematical approach to problem solving, alongside a variety of new components such as thermistors, LDRs, and LEDs. Pupils draw on the idea of the national grid from Year 9 and look at the distribution of power through mains circuits.
TOPIC	**Atomic Structure**	**Forces and Motion**
EXPLANATION	This topic overlaps and interlaces with the GCSE chemistry scheme where there is shared content on atomic structure. The ideas are then developed into brand new areas as we study how the nucleus of an atom can change and learn about nuclear decay and the resulting radiation that is emitted. The topic also relies on ratio and graphing which are delivered part way through Year 10 by the maths dept.	This is a large and complex topic. The topic is therefore split into two parts, one half delivered in Year 10, the other in Year 11. There is high mathematical demand in this topic so it has been delayed as much as possible to allow the maths dept to deliver as much GCSE content first. This topic ties together many of the ideas from the Energy topic from Y9 and develops them further, whilst also building on work on motion from Year 7 and Year 8.

LEARNING SEQUENCE – YEAR 11 PHYSICS (AQA)

OUTCOMES	Students will have practised: • Using the language relevant to the stages of the scientific process (working scientifically) in the practical work they carry out. • Writing in a scientific style, composing, and communicating their 'sustained reasoning' in explanations/answers. • Manipulating equations and solving mathematical problems Students will have accumulated detailed knowledge and understanding of: • The forces and their effects on deforming objects • Pressure, moments and turning effects and some of their applications in physics • How to describe different types of waves and how frequency, wavelength and amplitude can affect the properties of the wave • How waves interact with matter in reflection, refraction, emission and absorption • Magnetic fields around permanent and electromagnets • The uses of electromagnetism in different devices • [Separate Only] Space, the origins of the universe and the structure of stars and the solar system.	
TOPIC	**Forces and Motion**	**Waves**
EXPLANATION	This is the second half of the Forces and Motion unit and uses the ideas of force, work done, and energy encountered in Year 10 to develop understanding of how objects can be deformed (e.g. springs). Ideas about particles and density from Year 9 are brought together with ideas on turning effects and pressure from Year 8 to develop a more mathematical approach to moments and pressure in gases and liquids.	Waves are encountered first in Year 7 as light and sound. These basic concepts are further developed using significantly more advanced language and maths to describe the waves. The idea of gamma rays and radiation met in Year 10 are drawn together with the rest of the EM spectrum. The basic concept of refraction is developed significantly in Separate Physics through the study of lenses. The concept of black-body radiation links back to the ideas of heat loss encountered in Year 9.
TOPIC	**Atomic Structure**	**Forces and Motion**
EXPLANATION	This topic pulls together ideas developed in the electricity unit in Year 10 with the basics of magnetism encountered in Year 8. Pupils develop ideas of different field patterns. Separate Physics explore the concept of electromagnetism at a much greater depth and apply their understanding to new devices such as transformers, motors, generators and loudspeakers. This requires significantly developed language and understanding to be able to articulate these ideas.	Space draws together ideas developed in the Year 10 Waves topic to introduce the idea of the doppler effect, and ideas from Year 10 Atomic Structure and Year 11 Forces topics to explain the formation and lifecycle of stars.

LEARNING SEQUENCE – YEAR 12 PHYSICS (EDEXCEL)

A concept-led approach

<table>
<tr><td>OUTCOMES</td><td colspan="4">Students will:
Develop a range of practical skills and techniques, including those contained within Unit 1
Build resilience in problem solving
Gain a broad understanding of the fundamentals of the A-level course in preparation for Year 2.
Learn to manipulate and combine equations
Be able to critically analyse data including estimating uncertainty in data</td></tr>
<tr><td rowspan="2">TOPIC</td><td colspan="2">Unit 2 and 3 are taught concurrently</td><td colspan="2">Unit 4 and 5 are taught concurrently</td></tr>
<tr><td>Unit 2 - Mechanics</td><td>Unit 3 – Electric Circuits</td><td>Unit 4 - Materials</td><td>Unit 5 – Waves and the Nature of Light</td></tr>
<tr><td>EXPLANATION</td><td>Students build on their understanding of forces and motion from GCSE. The level of mathematical problem solving greatly increases and extends to 2D problem solving. This unit is taught first as it is fundamental to explaining the materials topic and introduces many key concepts such as resolving vectors.</td><td>This unit builds on the electricity topic covered at GCSE. Students meet new circuits and explore the underlying physics behind the working of the familiar components. This unit offers excellent opportunities to develop practical skills and techniques such as the use of micrometers, vernier calipers and the use of very large and very small numbers.</td><td>Much of this unit is novel to students, although it does draw on concepts from forces and motion. There is again a wealth of opportunity for practical experimentation and for development of skills as students study the reasons behind different material choices based on material properties.</td><td>This unit is split into two. The first part, focused on waves, builds on the prior knowledge of waves from GCSE. However, this is dramatically extended as students study the idea of interference and superposition. The second half of the unit explores the new concept of electronic transitions and photons which introduces pupils to the quantum nature of reality.</td></tr>
</table>

LEARNING SEQUENCE – YEAR 13 PHYSICS (EDEXCEL)

A concept-led approach

OUTCOMES	**Students will:** • Develop a range of practical skills and techniques, including those contained within Unit 1 • Build resilience in problem solving • Gain a broad understanding of the fundamentals of the A-level course in preparation for Year 2. • Learn to manipulate and combine equations • Be able to critically analyse data including estimating uncertainty in data			
TOPIC	**Teacher 1**			
	Unit 7 – Electric and Magnetic Fields	**Unit 8 – Nuclear and Particle Physics**	**Unit 11 – Nuclear Radiation**	**Unit 12 – Gravitational Fields**
EXPLANATION	This unit draws heavily on the electric circuits from Y12, but also revisits work from Y11 on magnets and magnetic fields. This unit prepares the way for Unit 8 where pupils need to interpret particles tracks and consider LINACs etc.	Much of this is novel content as it involves new particles. However Students draw on knowledge from Unit 7 as they learn about subatomic particles and their detection as well as accelerating particles in synchrotrons, cyclotrons and LINACs etc.	Pupils expand their knowledge of radiation using knowledge about the particle model and building on prior knowledge from Atomic Structure in Year 10.	This unit is dependent on Electric and Magnetic fields where similarities are commonly drawn and on Unit 10 Space. This draws together the idea of inverse square laws and ratios.
TOPIC	**Teacher 2**			
	Unit 6 – Further Mechanics	**Unit 13 – Oscillations**	**Unit 9 – Thermodynamics**	**Unit 10 – Space**
EXPLANATION	This unit extends the mechanics encountered in Year 12 and introduces the idea of circular motion. This is a prerequisite for the latter parts of Unit 7 and Unit 8 and prepares pupils well for the Unit 13 content.	This topic further develops the “rates of change” ideas encountered in the E+M fields topic (e.g. v = ds/dt). It builds on the waves topic from Year 12 and allows a more mathematical treatment of it.	This builds on the Year 10 Thermal physics knowledge and prepares pupils to work with absolute temperature which is a prerequisite for teaching Unit 10 Space. This draws together kinetic theory with the laws of thermodynamics.	Draws together ideas from the Thermodynamics unit and from Nuclear Radiation as the idea of stars and star lifecycles is developed. This also brings together ideas from waves as students explore the Doppler effect.

ENRICHMENT, SUPPORT, EXTRA-CURRICULAR

- We run a Science Club to engage keen scientists!
- We have excellent A-level uptake and run regular help sessions to support them.
- We regularly seek student voice in order to reflect upon and tweak our practice.