Subject: Science

Curriculum Vision

- Our core aim is to help students climb the tree of knowledge, so they can access university, higher education, employment or an apprenticeship
- Our curriculum is embedded in a knowledge rich approach and we firmly believe that knowledge begets knowledge
- Through the enacted curriculum there is an expectation that students retain what they have been taught in their long term memory (schema)
- There is a strong emphasis on retrieval practice, sequencing and interleaving, with the curriculum seen as a progression model

Curriculum Intent

- Our educational philosophy in science is to promote science literacy for the future for all students, including students who do not study science beyond Year 11 including:
  - Awareness of how science affects our everyday lives.
  - Understanding how evidence is used to support or refute scientific theories.
  - Providing scientific skills that are transferrable in a competitive employment market.
  - Encouraging students to aspire to study A-level sciences leading to STEM careers.

Curriculum Offer : KS3

	Year 7	Year 8	Year 9
Term 1	Introduction to Science – This topic introduces lab safety, hazard symbols and equipment. Cells – Cells is the fundamental concept in biology and this topic focuses on the structure of cells, the function of organelles and using microscopes to observe cells. Materials – This topic introduces the properties of materials and their uses.	This topic focuses on the vital processes of photosynthesis and respiration without which life would not be possible, introducing word and symbol equations and key practicals investigating factors that affect the rate of photosynthesis. This links directly with the B4 Bioenergetics topic. KO6.2 Internal Energy – This topic builds on ideas developed in the KO3.2 States of Matter and Separating Mixtures topic with a specific focus on the energy changes involved and introduces the ideas of specific heat capacity and latent heat to calculate the energy changes. This links directly to the P3 Particle model of matter topic.	KO3.4 Materials – This topic follows on from the ideas developed in KO3.1 Atomic Structure topic introducing the idea of ionic, covalent and metallic bonding and the properties of materials with these types of bonding. KO4.4 Earth, Atmosphere and Resources – This topic looks at the structure of the Earth and the rock cycle and the production of fuels and the composition of the atmosphere and the effects of humans on the atmosphere including the carbon cycle with strong links to C7 Organic Chemistry, C9 Chemistry of the Atmosphere and C10 Using Resources topics. KO2.2 Ecology – This topic develops an understanding of the interdependence of organism in an ecosystem and sampling species in their habitat. This links directly to the B7 Ecology topic.
Term 2	Forces – This topic focuses on the fundamental idea of forces building on ideas developed at primary school which are extended through GCSE and A-level Physics. A focus on Newton's laws of motion provides the key rules when considering the motion of an object.	KO6.3 Electricity – Electricity is a key idea in physics which is widely used in our everyday lives. This topic develops the ideas of current, potential difference, resistance and power to explain how electrical circuits work and introduces equations to calculate these quantities. This directly links to the P2 Electricity topic.	KO2.3 Genetics - Following on from the variation and inheritance topic this topic introduces genetic crosses to consider how genes are passed on from parents to offspring and the structure of DNA in preparation for the B6 Inheritance, variation and evolution topic.

	Organ Systems – This topic follows on to cells to introduce transport of substances into and out of cells, define levels of organisation and consider different organ systems.	KO2.1 Variation and Inheritance – This topic focuses on the differences between organisms, how they are adapted, how they compete and how they evolved. Moral and ethical considerations of selective breeding links directly to SMSC. This topic links directly to the B6 Inheritance, variation and evolution topic.	KO5.4 Earth, Sea and Space – This topic applies the ideas developed in KO5 Forces to turning forces, pressure and gas pressure and develops an understanding of our place in the Universe with links to P3 Particle Model and P5 Forces.
Term 3	States of Matter – This topic focuses of on particle theory changes of state which are fundamental ideas in chemistry and links to many GCSE topics. Mixtures – This topic focuses of on the key practical skills of separating mixture by filtration, evaporation, distillation and chromatography which links to many GCSE topics. Light and Sound – This topic focuses on the properties of waves, with a specific focus on sound and light in preparation for the P6 waves topic at GCSE.	KO3.3 Periodic Table – This topic develops and understanding of the structure of the atom and the periodic table which forms the basis of our understanding of Chemistry. KO1.3 Digestion – Digestion is a vital process in the human body and this topic develops an understanding of the organs involved, introducing the role of enzymes in digestion. Key practicals develop understanding of the methods to test foods for different nutrients. An understanding of the function of different nutrients allows students to make informed choices about a healthy diet linking to SMSC.	B1 Cell Biology – This topic builds on ideas from the KS3 Cells topic looking in more detail at the cell structure of prokaryotes and eukaryotes, cell transport and the cell cycle. Moral/ethical considerations of the use of stem cells links to SMSC and higher tier students especially 7+ students are expected to be able to complete calculations of microscope magnification. P1 Energy – This topic builds on ideas from the KS3 Energy topic with a focus on using equations to calculate energy in different stores, measure specific heat capacity and calculate power and efficiency and evaluate the use of different energy resources. Higher tier students, especially 7+ students should be able to complete complex calculations including converting units and rearranging equations.
Term 4	Heredity and Variation – This topic focuses on the differences between organisms, how they are adapted, how they compete and how they evolved. Moral and ethical considerations of selective breeding links	KO4.3 Metals – Building on ideas from the chemical reactions topic this topic investigates the reactions of metals with oxygen, water and acids including the reactivity of metals and how metals are	C8 Chemical Analysis – This topic focuses on using chromatography, melting point and testing for gases to identify different substances.

	directly to SMSC. This topic links directly to the B6 Inheritance, variation and evolution topic.	extracted. This links to the C4 Chemical changes topic and other GCSE chemistry topics.	P2 Electricity – This topic builds on ideas developed in the KS3 Electrical circuits topic to include combinations of resistors in series and parallel, IV characteristics of components, the use of LDRs and thermistors in control circuits and how electricity is distributed through the National Grid. 7+ students should be able to combine equations to solve complex calculations.
Term 5	Elements and Compounds – This topic develops and understanding of the structure of the atom and the periodic table which forms the basis of our understanding of Chemistry. Solar System – This topic applies the ideas developed in KO5 Forces to turning forces, pressure and gas pressure and develops an understanding of our place in the Universe with links to P3 Particle Model and P5 Forces.	KO2.4 Disease and Drugs – This topic develops and understanding of how the body defends against diseases and the effects of drugs, alcohol and smoking on the body with strong links to SMSC and the B3 Infection and response topic.	C7 Organic Chemistry – This topic focuses on how hydrocarbons and extracted from crude oil and their properties and uses. Higher tier students especially 7+ students should be able to compare supply and demand for different fractions and explain how high demand can be met.
Term 6	Health and Disease – This topic develops an understanding of how the body defends against diseases and the effects of drugs, alcohol and smoking on the body with strong links to SMSC and the B3 Infection and response topic. Lifecycles and growth – This topic develops an understanding of reproduction with	KO5.3 Motion – Following on from the forces topic we investigate the effect of forces on the motion of an object considering speed/velocity, acceleration and resistive forces. Interpreting motion graphs is a key maths skill that is developed. This topic links directly with the P5 Forces topic at GCSE.	C9 Chemistry of the Atmosphere – This topic uses ideas from a range of biology and chemistry topics to explain how the atmosphere has evolved including the greenhouse effect and global warming and the effect of atmospheric pollutants with strong links to SMSC. Higher tier students especially 7+ students should be able to complete word and symbol equations for the reactions involving pollutants.

	strong links to SMSC e.g. changes during puberty.		C10 Using Resources – This topic considers sustainable development and the life cycle assessment for a product to consider the environmental impact of a product and how water is treated and tested.

Curriculum Offer : KS4

	Year 10	Year 11
Term 1	B4 Bioenergetics – This topic builds on ideas in the KS3 Photosynthesis and respiration topic to investigate limiting factors of photosynthesis and compare aerobic and anaerobic respiration. P3 Particle Model – This topic follows on from the KS3 States of matter and Internal energy topics to explain changes of state including calculations of latent heat and specific heat capacity and the practical skills to measure specific heat capacity and density. C6 Rate and Extent of Chemical Reactions – This topic builds on ideas developed in the KS3 Rates topic to determine the rate of reaction using calculations or graphs, explain rate of reaction using collision theory and investigate the factors that affect rate of reaction. Students learn about reversible reactions and 7+ students should be able to use le Chatelier's principle to explain the effect of changing conditions on equilibrium.	B6 Inheritance, Variation and Evolution – This topic follows on from the KS3 Variation and inheritance and Genetics topics develop ideas about sexual and asexual reproduction, the structure of DNA, genetic diagrams to explain inheritance and evolution by natural selection. Moral and ethical considerations of genetic engineering and selective breeding links directly to SMSC. C2 Structure and Bonding – This topic builds on ideas about atomic structure to explain how atoms form ionic, covalent and metallic bonds and the properties of structures with these bonds. Higher tier students should be able to apply their understanding to a range of substances.

Term 2	B2 Organisation – This topic follows on from the KS3 Body systems and reproduction and Digestion topics developing an understanding of the role of enzymes in digestions, testing foods for different nutrients and the structure of the circulatory and respiratory systems and factors that affect coronary heart disease with strong links to SMSC. This topic also covers plant structure and transport. P4 Atomic Structure – This follows on from the KS3 Atomic Structure topic develops an understanding of nuclear radiation and their dangers and uses. Higher tier students especially 7+ students should be able to complete calculations involving half-life and complete decay equations.	C3 Quantitative Chemistry – This topic focuses on calculations of mass, number of moles and concentration of substances involved in a range of chemical reactions. Higher tier students especially 7+ students should be able to calculate the theoretical yield of a product in a reaction and convert units for concentration. P6 Waves – Building on ideas from the KS3 waves topic, this topic extends ideas about light and sound waves to the electromagnetic spectrum and the properties, uses and dangers of each part. C4 Chemical Changes – This topic builds on ideas from KS3 chemistry to consider and range of chemical reactions using word and symbol equations including extracting metals by reduction and electrolysis. Higher tier students especially 7+ students should be able to identify the products at each electrode during electrolysis and complete ionic half equations.
Term 3	B3 Infection and Response - This topic follows on from the KS3 Disease and drugs topic to explain how white blood cells fight disease, how vaccinations work and how drugs are developed for use in medicine including the issue of antibiotic resistance as well as an understanding of plant diseases and defence. C1 Atomic Structure and Periodic Table – This topic builds on the KS3 Atomic structure and periodic table topic developing an understanding of the structure of an atom, how the structure of the atom was discovered, how the periodic table was developed. 7+ students should be able to make links between the structure of the atom and the arrangement of the periodic table and explain reactivity in terms of electron structure.	**Mock Exams** P7 Magnetism and Electromagnetism – This topic build on ideas from P2 Electricity and KS3 Forces at a distance topics to describe the magnetic field around a bar magnet, straight current-carrying wire and a solenoid leading to an understanding of how motors work. Higher tier students especially 7+ students should be able to calculate the force on a wire in a magnetic field.
Term 4	B5 Homeostasis and Response – This topic develops and understanding of how the body maintains the internal environmental conditions through the nervous and endocrine systems. An understanding of the menstrual cycle, contraception and IVF provides strong links to SMSC. Higher tier students especially 7+ students should be able to explain how negative feedback is used to control a range of conditions in the body.	B7 Ecology – This topic builds on ideas developed in the KS3 Ecology topic to consider the classification of organisms, the effect of abiotic and biotic factors on the distribution of organisms and the effects of humans on ecosystems including land use and waste management, deforestation, destruction of peat bogs and the importance of maintaining biodiversity.

	P5 Forces – This topic builds on ideas from the KS3 Forces topics to explain the motion of objects including calculating velocity, acceleration, resultant force and momentum. 7+ students should be able to combine equations to complete complex calculations including converting units.	
Term 5	P5 Forces – This topic builds on ideas from the KS3 Forces topics to explain the motion of objects including calculating velocity, acceleration, resultant force and momentum. 7+ students should be able to combine equations to complete complex calculations including converting units. C2 Structure and Bonding – This topic builds on ideas about atomic structure to explain how atoms form ionic, covalent and metallic bonds and the properties of structures with these bonds. Higher tier students should be able to apply their understanding to a range of substances.	Revision and exams
Term 6	C3 Quantitative Chemistry – This topic focuses on calculations of mass, number of moles and concentration of substances involved in a range of chemical reactions. Higher tier students especially 7+ students should be able to calculate the theoretical yield of a product in a reaction and convert units for concentration.	Revision and exams

Curriculum Offer : KS5 (Sixth Form) Biology

	Year 12 – Teacher 1 (3 lessons)	Year 12 – Teacher 2 (2 lessons)	Year 13 – Teacher 1 (2 lessons)	Year 13 – Teacher 2 (2 lessons)

Term 1	Module 1 – Practical Skills Practical skills are taught through-out the course during PAGs (Practical Assessment Groups). Module 2 – Foundations in Biology <u>2.1.1 Cell structure</u> The topic builds on cell organelle structure and function at KS4 to include a cellular ultrastructure with additional organelles and also a description of the organelles, which they need to able to identify on photomicrographs. How organelles work together to make proteins for export from the cell is studied. Prokaryotic and eukaryotic cell structure is compared. Microscopy includes the KS4 knowledge of the magnification equation and definitions of magnification and resolution. Students build on their knowledge of the advantages and disadvantages light and electron microscopes, and consider uses, resolution and magnification of light, laser scanning confocal microscopes, transmission electron microscopes and scanning electron microscopes. The use of differential staining, eyepiece graticules and stage micrometres is also taught, and students practise this in an additional centre-based PAG (1.4) in which they calibrate their microscopes, using stains, and draw both high and low power biological drawings. <u>2.1.5 Plasma membranes</u> Building on students KS5 knowledge of the structure and physical properties of proteins and lipids they learn about structure and function of the components in the fluid mosaic model of the plasma (cell surface) membranes. Differentiation between cell surface and internal cellular membranes is required. Students consider factors that affect membrane permeability and use this knowledge to explain the effects of	Module 1 – Practical Skills Practical skills are taught through-out the course during PAGs (Practical Assessment Groups). Module 2 – Foundations in Biology <u>2.1.2 Biological molecules</u> This topic builds on KS4 knowledge of food groups and chemical formula of glucose to consider the structure and function of the key groups of macromolecules (carbohydrates, proteins, lipids), water and inorganic ions. Hydrolytic catabolic reactions and catabolic anabolic reactions are considered and the names and formation of bonds between monomers. For carbohydrates the knowledge of the structure of alpha and beta glucose is required and students need to be able to describe the differences between ribose and deoxyribose sugars. Students learn about monosaccharides, disaccharides and the polysaccharides starch (amylose and amylopectin), glycogen and cellulose. The basic structure of an amino acid is required as is the hierarchy of protein structure. The structure of a triglyceride and phospholipid macromolecules are considered. The practicals (PAG 9.1, 9.2 and 9.3) build on KS4 food tests, while the tests are the same students are required to measure reagents and also learn how to differentiate between reducing and a non-reducing sugar. Quantitative tests to determine glucose concentration enable students to use a colorimeter (PAG 5.2); while PAG 6.1 enables students to separate a mixture of amino acids by chromatography which build on their KS4 Chemistry knowledge of paper chromatography and Rf values.	Module 1 – Practical Skills Practical skills are taught through-out the course during PAGs (Practical Assessment Groups). Module 5 Communication and Homeostasis <u>5.1.2 Excretion</u> At GCSE students only consider the liver as an organ that converts glucose to glycogen but do not consider the liver as part of the excretory system. GCSE Biology students have some understanding of the structure and function of the kidney as an excretory organ. A level requires students to learn the structure and functions the liver and the kidney. Examination, dissection and drawing of these organs are required and offer practical opportunities in PAG 1 (microscopy) and PAG 2 (dissection). How water potential of the blood is regulated and monitored, and the effects of kidney failure and treatment are taught. GCSE Biology students know how monoclonal antibodies are produced and can build on this knowledge to learn how excretory products (urine) can be used in medical diagnosis. <u>5.1.3 Neuronal communication</u> Students already know the structure of the neurone and the different types of neurone that are involved in both conscious responses and reflex actions. A level requires students to look at the differences between the three types of neurone and to compare the structure and function of myelinated and non-myelinated neurones. Students to consider how sensory receptors respond to stimuli and act as transducers resulting in the generation and transmission of electrical impulses. The structure	Module 1 – Practical Skills Practical skills are taught through-out the course during PAGs (Practical Assessment Groups). Module 6 Genetics, Evolution and Ecosystems <u>6.1.1 Cellular control</u> Students know from GCSE that a mutation is a change in DNA which results in a different protein being produced. Types of gene mutation are taught in this topic which builds on AS knowledge DNA structure, protein production and hierarchy and the nature of the genetic code. At GCSE students are taught that mutations are either beneficial, neutral or harmful; their A level knowledge enable them to explain why this is the case. In module 2 students are taught about transcription and translation. Here they learn about he regulatory mechanism that control gene expression at the pre-transcriptional, post-transcriptional, pre-translational and post-translational levels. The lac-operon is used as an example. The genetic control of the development of body plans in different organisms is discussed with respect to Hox genes and homeobox gene sequences. These are highly conserved and a link can be made here to students AS knowledge of evolution and natural selection. Students recap their AS knowledge of mitosis and the cell cycle and use this to consider the importance of mitosis and apoptosis and mechanism for controlling the development of body form.

	temperature on the release of betalain from beetroot tissue (PAG 5.1) and once again use a colorimeter, which can also used in PAG 8.3 when students investigate the effect of detergents on membrane solubility and apply their knowledge to explain the results in terms of the properties of membrane components. Like KS4 students consider diffusion, osmosis and active transport as cellular transport methods. The nature of molecules dictates whether a substance is transported by simple diffusion or facilitated diffusion. Osmosis is now defined in terms of water potential, although the effects of how animal and plant cells respond to being put into hypotonic, isotonic and hypertonic solutions is the same as GCSE with the exception of these terms. Active transport considers the use of carrier proteins changing shape and additionally students look at exocytosis, endocytosis and pinocytosis. Practical skills extend on GCSE required practicals of osmosis in a potato cell whereby students need to convert graph intercepts of concentration to a water potential, using a look up table (PAG 8.1). Students also make their own serial dilutions in this investigation. Students can investigate osmosis using an artificial cell (PAG 8.2).		and roles of synapses in neurotransmission builds on students knowledge from GCSE. .	<u>6.1.2 Patterns of inheritance – genetic crosses</u> Learners build on their KS4 knowledge that both genes and the environment are contributory factors to variation. Etiolation and chlorosis in plants are included as examples of phenotypic variation due to environmental factors. Types of variation are also linked to monogenic and polygenic phenotypes. AS knowledge of meiosis is recapped and how sexual reproduction leads to genetic variation within a species is discussed. KS4 Punnett squares are recapped together with genetic terms learnt at this phase. The KS4 monogenetic crosses are extended to include multiple alleles, codominance and sex-linkage. Dihybrid crosses are also taught, as are the use of phenotypic ratios to identify autosomal and sex linkage and epistasis. Chi squared tests are used as a statistical basis to determine whether or no there is a significance difference between observed and expected resulted of genetic crosses.

Term 2	Module 2 – Foundations in Biology 2.1.6 Cell division, cell diversity and cellular organisation The structure of the chromosome is cause to include chromatids and centromeres. KS5 knowledge of cellular components such as the centrioles, cytoskeleton and nuclear envelope are necessary to teach cell division. The three stages of the cell cycle is extended from GCSE to include all the phases of mitosis, together with the use of checkpoints for cell cycle regulation. Students need to know the subtle differences of cytokinesis in plant and animal cells. PAG 1.1 requires students to use their knowledge of microscopy to observe and draw roots cells undergoing mitosis and to calculate the mitotic index. Building on the phases of mitosis, the phases of meiosis are taught, which enables students to compare the two processes, as well as explaining how meiosis results in variation. Students then consider the significance of both mitosis and meiosis in life cycles. The ultrastructure of a generic animal cell and plant cell are taught at the start of AS. As with GCSE the division of labour is taught in which different cells become specialised to perform different functions within animals and plants. The process of differentiation of stem cells in animals and meristem tissues in plants is considered. is considered how different types of cells are specialised for their function. A centre based PAG could also be introduced for students to practice their biological drawings of preprepared slides of specialised animal and plant cells. The use of stems cells in research and medicine extends students KS4 knowledge of embryonic and adult stem cells to include totipotent and pluripotent embryonic stem cells of the and multipotent and unipotent adult stem cells. Ethical considerations of stem cell research	Module 2 – Foundations in Biology 2.1.3 Nucleotides and nucleic acids The KS3 and KS4 knowledge of DNA being a polymer and a double helix is built on as students learn about the structure and function of nucleotides and an ability to differentiate between purine and pyrimidine. Students consider how DNA is duplicated in semiconservative replication and how both transcription in the nucleus and translation at ribosomes occur. Features of the genetic code is required knowledge as is the ability to compare the structure of DNA, mRNA and tRNA, and so build on their KS5 knowledge of sugars to identify different types of pentose sugars (ribose and deoxyribose) that are found in different nucleotides. PAG 10.1 (if completed) provides students with the opportunity to use computer modelling to investigate DNA structure. 2.1.4 Enzymes At KS4 required students to know that enzymes were proteins with a specific (complementary) active site and to explain the effect of both temperature and pH on the rate of enzyme action. Required practicals were limited to the effect of pH on the rate of starch digestion. At KS5 students use their knowledge of tertiary protein structure to explain the specific 3D shape of a protein. They also need to include the terms enzyme-substrate complex and enzyme product complex in their explanations of enzyme action. Models include the KS4 lock and key theory and look at the later scientific theory of the induced fit model of enzyme action. Enzyme action also considers the use of coenzymes and cofactors and how binding with an enzyme's allosteric site alters the	Module 5 Communication and Homeostasis 5.1.4 Hormonal communication At GCSE students learn about endocrine glands and target organs, and controlling blood glucose and regulating the menstrual cycle. A level requires students to consider the structure and function of the adrenal glands in more detail. The histology of the pancreas is required, which provides opportunity for a microscopy PAG 1. The control of blood glucose is considered in greater depth and insulin secretion is taught with reference to potassium and calcium channel proteins, which builds on AS knowledge. The causes of diabetes type 1 and type 2 are in the remit of GCSE. The symptoms of diabetes mellitus Type 1 and type 2 are considered at A level and treatments extend beyond insulin injections at this level.	Module 6 Genetics, Evolution and Ecosystems 6.1.2 Patterns of inheritance – evolution Students build on their AS knowledge of the theory of evolution that explains how, over a prolonged period of time, organisms have changed and some have become extinct, to consider how different factors such as stabilising selection, genetic drift, genetic bottlenecks and the founder effect can affect the evolution of a species. They are also taught about the role of isolating mechanisms (geographical and reproductive) can lead to the accumulation of different genetic information in populations, potentially leading to new species (allopatric and sympatric speciation). Students application the Hardy-Weinberg principles to calculate allele frequences in a population, which requires them to recall different genotypes of alleles taught at KS4 and AS. Artificial selection, which was called selective breeding at KS4, is taught, as are uses beyond improved milk, and meat yield and animal docility. Students need an appreciation of the importance of maintaining wild breeds as a genetic resource for selective breeding. As at GCSE the effects of inbreeding are considered, which is extended at A level to include ethical considerations. 6.1.3 Manipulating genomes Students have learnt much about DNA, genetic crosses and the regulation of gene expression. They now learn about the principles of gene sequencing and the development of such techniques over time led to high-throughput sequencing and the human genome project. The impact of gene sequencing has allowed genome-wide comparisons, prediction of

	provides an opportunity to teach ethics and character virtue of respect. Module 4 – Biodiversity, evolution and disease <u>4.1.1 Communicable diseases, disease prevention and the immune system</u> Learners gain an understanding of a variety of organisms that are pathogenic to animals and plants. This includes the KS4 Trilogy knowledge or viral HIV and TMV and protoctista malarial infections. Students who studied GCSE Biology will have a basic understanding of plant defences. Modes of transmission are discussed to include social factors, however unlike KS4 no detail of symptoms of specific diseases are required. The defence response of plants is new to students. Primary non-specific defences in animals overlap with GCSE, while at A-level secondary defences are split into the primary response (humoral immunity) and secondary responses (cell-mediated immunity) and builds on the knowledge of different types of blood cells that students learnt about in Module 2. The microscopy PAG 1.2 requires the examination and drawing of cells observed in blood smears. Students use their knowledge of tertiary and quaternary protein structure to describe the structure of an antibody molecule and need to describe the different ways in which antibodies function. The distinction between active and passive immunity is required with examples, as is an appreciation of the term 'autoimmune disease', and again with examples. What are vaccinations and how vaccinations work was considered at GCSE. At A level this is extended to consider different vaccination programmes such as routine vaccinations and reasons for changes to vaccinations and vaccination programmes. Students also build on their GCSE knowledge with respect to the sources of different medicines. At A level in addition to	shape of the active site. The factors that affect the rate of enzyme action include temperature and pH and are additionally extended to substrate concentration, competitive and non-competitive inhibitors. Students need to be able to explain these graphs with respect to limiting factors (a topic touched upon in GCSE Biology). Practical opportunities (PAG 4.1, 4.2 and/or 4.3) enable students to collect their own data and explain the results using A level enzyme theory.		amino-acids in polypeptide sequences, which builds of students AS knowledge of these topics. The growth of the fields of bioinformatics and computational biology and has allowed for biological research into genotype-phenotype relationships, epidemiology and the development of synthetic biology too. The principles of polymerase chain reaction and electrophoresis are taught and the applications of these in DNA profiling for forensics and analysis of disease risk. PAG 6.2 enables students to develop the practical skills required to conduct electrophoresis and to analysis the results. The principles and techniques used for genetic engineering extend students GCSE knowledge (which is greater if GCSE Biology was studied compared to just GCSE combined science). GCSE knowledge of bacterial resistance is extended to include, for example, insect resistance to genetically modified soya. The ethical considerations of genetic manipulation are considered, as issues relating to patenting and technology transfer between communities. The principles of, and the potential for, somatic cell and germline cell gene therapy in medicine is then taught.

	using microbes and plants as a source of a drug personalised medicine and the scope of synthetic biology is considered. The discovery, benefits and risks of antibiotics are taught, as is the increase in bacterial resistance (which builds on KS4 knowledge)			

Term 3	Module 4 – Biodiversity, evolution and disease 4.2.1 Biodiversity Biodiversity refers to the variety and complexity of life. At KS4 students considered a simple definition for biodiversity, while at A level (habitat, species and genetic biodiversity). Biodiversity is considered at three different levels I. Species diversity is considered to include both species richness and species evenness and students consider the use of statistical tests including Simpson's Index of Diversity. Random and non-random ecosystem sampling techniques at GCSE are extended to include opportunistic, stratified and systematic sampling and students also need to know the importance of ecological sampling. Assessing genetic diversity builds on KS4 knowledge of alleles and students extend their knowledge of threats to biodiversity to include monocultures as an agricultural practice. At A level the reasons for maintaining biodiversity are categorised as ecological , economic and aesthetic. Students distinguish consider conservation that is sub-divided into *in-situ* and *ex-situ* methods. The impact of international and local conservation agreements are discussed and evaluated.	Module 3 – Exchange and Transport 3.1.1 Exchange surfaces Students know from GCSE that larger organisms have a smaller surface area and therefore cannot rely on diffusion alone to obtain the materials to materials to meet their metabolic needs. At GCSE (Trilogy) students consider the structure and function of the human gas exchange system and the features of an efficient exchange surface. This is extend upon at A level to include Fick's diffusion coefficient and students look at the tissues that make up the organ of the mammalian gas exchange system. PAG 1.3 provides an opportunity for microscopy and biological drawings of lung tissue and the histology of exchange surfaces.. The mechanism of ventilation includes both internal and external intercostal muscles and considers pressure gradients. Students need to understand how a spirometer works and need to be able to analysis and interpret a spirograph. The gas exchange systems of bony fish and insects are considered. Students studying GCSE Biology would have previously looked at the structure of gills but students studying GCSE combined science would not have done so. PAG 2 allows students to dissect and draw the gas exchange system of a bony fish and / or insect trachea.	Module 5 Communication and Homeostasis 5.1.5 Plant and animal responses Only GCSE Biology students are taught about plant tropisms so this topic is new to GCSE combined science students. The hormonal control of plant responses to environmental changes includes a range of tropisms and other effects, and practical investigations into phototropism and geotropism in PAG 11. Students consider experimental evidence for both the role of auxin and gibberellins as well as the commercial uses of plant hormones, for which there is a link back to commercial cloning of plants. Students basic GCSE knowledge of central and peripheral nervous systems is deepened and extended to include the organisation of the somatic and autonomic nervous systems. The structure and function of the brain builds on GCSE Biology syllabus; however GCSE combined science students will only have heard of the pituitary gland. The coordination and responses by the nervous system and endocrine system links to cell signalling and the diffusion of lipid soluble hormones through the phospholipid bilayer, taught at AS. The effects of hormones and nervous mechanisms on heart rate allows students to monitor the physiological functions during and after exercise. PAGs provide an opportunity for them to use AS knowledge of standard deviation and student t-tests. GCSE knowledge of muscle structure is extremely basic, while at A level students need to be able to know the structural and functional differences between skeletal ,involuntary and	Module 6 Genetics, Evolution and Ecosystems 6.2.1 Cloning and biotechnology While GCSE Biology covers the basics of cloning all students learn at in combined science is that asexual reproduction produces clones by mitosis, and AS looks at the stages of mitosis and of the importance of mitosis in lifecycles.. Different types of natural plant clones are taught at AS as well as how to take plant cuttings. This provides an opportunity for a centre based PAG to clone cauliflowers and to dissect a selection of plant material to produce cuttings (PAG2). Micropropagation and tissue culture and an evaluation of there use in horticulture and agriculture is considered to support the arguments for and against cloning. Natural clones in animals species is taught and artificial cloning methods include embryo twinning and somatic cell nuclear transfer. Uses, and arguments for and against cloning of animals is considered. In GCSE combined science students learn about the uses of anaerobic respiration (fermentation) of yeast and plants in the brewing and baking industries. This is extending at A level to include the uses of microorganisms in biotechnological processes such as brewing, baking, cheese and yoghurt, and bioremediation. The production of penicillin and insulin link to the population growth curve of microbes and the different phases in which primary and secondary metabolites are made in continuous and batch processes respectively.

			cardiac muscle. The last of which builds on the myogenic nature of cardiac muscle studied in AS. The sliding filament mechanism of muscle contraction and the role of ATP is taught, which provides an opportunity for students to recap the structure of Practical opportunities involve PAG1 (microscopy) and the examination of photomicrographs.	Aseptic techniques and agar plating are considered in GCSE Biology but not combined science. At A level students are taught how to culture organisms effectively using the aseptic technique. PAG 7 provides practical opportunities in microbiology.

Term 4	Module 4 – Biodiversity, evolution and disease <u>4.2.2 Classification and evolution</u> Students were taught about the taxonomic hierarchies of Linnaeus and Wose at GCSE. This is extended at A-level to compare the domain and kingdom classification systems and to consider the reasons for the introduced of domains and the biological molecules that were used as evidence. Students also need to be able to describe the features used to classify organisms into the five kingdoms and three domains. Students consider the relationship between classification and phylogeny and will use, for example, their understanding of DNA structure and primary protein structure as a means for assessing how closely related species are on a phylogenetic tree. Fossil evidence (planetology) is considered as evidence for evolution at KS4, as it is at KS5, together with comparative anatomy and comparative biochemistry (which utilises students KS5 biomolecule knowledge). In addition to the evidence for evolution by natural selection provided by Darwin, at A level students also consider the contribution provided by Wallace in formulating and giving further credence this theory. Variation drives evolution, as without intraspecific variation no organism would be better adapted to survive. The causes of variation are therefore taught which builds on KS4 knowledge to include the reasons that meiosis causes variation, which was taught in Module 2. Types of variation are taught and students consider the spread of variation by learning ab out normal distribution curves and standard deviation. Students learn about null and alternative hypotheses and other statistical tests, including Student's t-test to compare means and Spearman's rank correlation coefficient to compare two sets of data. An	Module 3 – Exchange and Transport <u>3.1.2 Transport in animals</u> Students need to be able to calculate the surface area to volume ratio f regular shaped objects and explain the need to transport systems in multicellular objects. Double circulatory systems are defined at GCSE. At A level students need to consider the advantages and disadvantages of single, double, open and closed circulatory systems found in insects, fish and mammals. Students will know about arteries, veins and capillaries as blood vessels, at A level they learn about venules and arterioles too and need to know about the distribution of different tissues within the vessel walls. The formation of tissue fluid from plasma is a new concept involving changing hydrostatic and oncotic pressures. Students build on their knowledge of the composition of the blood to be able to compare blood composition to the composition of tissue fluid and lymph. The structure of the heart is the same as GCSE except for the naming of the valves. PAG 2.1 is a heart dissection in which students practice their biological drawings of both the internal and external structures of the heart, and compare the thickness of the walls of the left and right ventricles. Students should know where the pace-maker is situated and they extend this knowledge to describe the myogenic nature of the heart and explain how heart action is initiated and coordinates the cardiac cycle, for which they need to be able to describe changes in pressure in different heart changes and explain how this causes heart valves to open and close.	Module 5 Communication and Homeostasis 5.2.2 Respiration Students build on GCSE knowledge of what organisms need energy for, aerobic and anaerobic respiration, and their AS knowledge of active transport and the structure of mitochondria. The need for cellular respiration includes and outline of metabolic reactions and students learn of the role of different parts of the mitochondrion in respiration. Knowledge of the biochemical sequences of glycolysis, the link reaction, the Krebs cycle and oxidation phosphorylation are required. Knowledge of chemiosmotic theory includes electron transport chains, proton gradients and the role of ATP synthase in oxidative phosphorylation and photophosphorylation. Students need to explain the important of coenzymes in cellular respiration are needed. Carbohydrates, lipids and proteins can all be used as respiratory substrates and students should be able to compare the difference in relative energy values for each of the these groups of biomolecule they studied at AS. Knowledge of the biochemical chains of reaction for anaerobic respiration in eukaryotes enables students to compare different types of respiration and to explain why anaerobic respiration produces a lower yield of ATP. Mathematical requirements are the use and interpretation of the respiratory quotient. While practical investigations include respiration rates in yeast under aerobic and anaerobic conditions and practical investigation into the effect of factors that affect he rate of respiration. This gives students the opportunity to use sensors and data loggers to process data, and the use of standard deviation and Students	Module 5 Communication and Homeostasis 5.2.1 Photosynthesis Students build on GCSE knowledge of photosynthesis and structure of the leaf, and their AS knowledge of the structure of a chloroplast. They now consider the role of different parts of the chloroplast in the two main stages of photosynthesis and the importance of photosynthetic pigments as light harvesting systems and photosystems. PAG 6.3 enables students to separate different photosynthetic pigments by chromatography and to identify them using Rf value calculations. The biochemical sequences of the light-dependent states and the difference between cyclic and non-cyclic photophosphorylation is required knowledge. Students should be able to describe the fixation of carbon dioxide and the light independent stage of photosynthesis which describes how the products of the light dependent stages are used in the Calvin cycle to produce Triose phosphate; knowledge of the uses of this biomolecule are required. Limiting factors of photosynthesis were taught at GCSE. At A level students need to be able to explain how carbon dioxide, light intensity, temperatures and water stress act as limiting factors with respect to the light dependent and light independent stages of photosynthesis. Several PAG opportunities exist. PAG 12 requires students to research (with Harvard referencing), plan, conduct and analysis their own investigation into the factors that affect photosynthesis. An understanding of the relationship between photosynthesis and respiration builds on students GCSE knowledge and AS knowledge of the carbon cycle and the bioenergetics topics.

	opportunity exist here to do a centre based PAG, for example looking at width and length of ivy leaves or the number of prickles on holly leaves at different heights from the ground. The categorisation of GCSE adaptations of structural, behavioural, and functional is reclassified as anatomical, behavioural and physiological at A level. Anatomical adaptations provide evidence for both convergent and divergent evolution.	The use and interpretation of electrocardiogram traces includes both normal and abnormal heart activity and requires students to analyse traces to diagnose different heart conditions. Students recall their Module 2 knowledge of the structure of haemoglobin to describe the biochemical reactions and the role of haemoglobin in transporting both oxygen from the lungs and carbon dioxide to the lungs. The different affinities of different tissues for oxygen is with changing carbon dioxide concentrations is explained by the Bohr effect. Oxygen dissociation curves for fetal and adult human haemoglobin are also considered and explained.	T test to compares the means of the results. PAG 12 enables research and planning.	

Term 5	Module 6 Genetics, Evolution and Ecosystems 6.3.1 Ecosystems Students learnt definitions of ecosystems, communities, populations, species, habitats and the influences of biotic and abiotic factors at GCSE. The dynamic nature of ecosystems and the influence of biotic and abiotic factors is considered in greater details at A level. Students also extend their knowledge of energy transfer through food chains to consider biomass transfer through ecosystems. (Students who studied GCSE Biology rather than GCSE Combined Science will come to these lessons with greater prior knowledge). The carbon cycle at GCSE is extended at A level to consider physical and chemical effects of recycling of carbon. The nitrogen cycle is new to students who are taught at GCSE that nitrates combine with glucose to make amino acids and proteins for growth, and students will know that the amine group, containing Nitrogen, is part of an amino acid. The genus names of decomposers and microbes are needed and students use GCSE chemistry knowledge to recognise reactions as either reduction or oxidation (in terms of oxygen loss or gain). Succession is a new concept in which students learn about pioneer species through to climax communities and deflected succession, which links to recycling of nutrients and how changing abiotic factors affect flora and fauna in an area. How the distribution and abundance of organisms is measured recaps previous AS knowledge and the opportunity for another PAG 3 on ecological sampling can be included at this stage.	Module 3 – Exchange and Transport 3.1.3 Transport in plants The need from transport systems in pants build on students KS5 appreciation of size, metabolic rate and surface area to volume ratio of organisms. Students also learnt about the structure of xylem and phloem in Module 2 and extend their knowledge by describing and explaining the distribution of vascular bundles in roots, stems and leaves. PAG 2.2 allows students to practice their skills of dissection, differential staining, microscopy and biological drawings while doing a stem dissection. Alternatively an additional microscopy PAG 1 can be conducted with ready-made slides. The transpiration stream builds on students' knowledge of the physical properties of water (learnt in Module 2) and their GCSE knowledge. Students need an appreciation of the different pathways of water through the root. In PAG 5.3 students use a potometer to investigate and estimate transpiration rates. Students consider the adaptations of xerophytic and hydrophytic plants to the availability of water in their environment. A centre based PAG 1 is available for students do use microscopes to make biological drawing of such plants. The method of translocation of assimilates in phloem uses students' A level knowledge of water potential, active transport, simple and facilitated diffusion and mass flow.	Revision programme A revision programme is put in place, which changes slightly year to year depending on the strengths and areas for development of our cohort.	Revision programme A revision programme is put in place, which changes slightly year to year depending on the strengths and areas for development of our cohort.

Term 6	Module 6 Genetics, Evolution and Ecosystems <u>6.3.2 Populations and sustainability</u> At GCSE students learnt the definition of a population and learnt about predator-prey cycles. There are however many factors that determine the size of a population and it's maximum carrying capacity. Students need to understand these and their impact on population size. The influence of predator-prey populations is again discussed at KS5 and students also consider the impact of interspecific and intraspecific competition on population size. Building on AS knowledge of economic, social and ethical reasons for maintaining biodiversity students learn about the ecosystems as biological resources. The reasons for, and the difference between, conservation and preservation methods are taught and students consider how ecosystems can be managed in a sustainable way, for example to provide fish and timber. The obvious conflict between human needs and conservator and preservation is discussed with respect to the management of environmental recourse and the effects of human activities on animal and plant populations and how such activities are controlled in environmentally sensitive ecosystems.	Module 5 Communication and Homeostasis <u>5.1.1 Communication and Homeostasis</u> Students learn the basics of chemical and electrical systems to monitor and respond to changes in the environment at GCSE. This knowledge is consolidated and extended at KS5 with an extended definition of homeostasis and deepened understanding of the principles of homeostasis, which incorporates AS knowledge of the communication between cells by cell signalling. Students studying GCSE Combined Science knowledge is limited to the fact that body temperature is maintained by homeostasis to provide optimum conditions for enzyme action. GCSE Biology students will have looked at how body temperature is monitored and controlled by the thermoregulatory centre in the brain and how the body responds to high and low temperatures and how thermoregulatory mechanisms transfer energy to the body or the environment. At A level students learn about the physiological and behaviour responses involved in temperature control in both ectotherms and endotherms. An additional centre-based PAG 11 could provide an opportunity to monitor physiological functions in ectotherms and/or endotherms.	<u>Revision programme</u> A revision programme is put in place, which changes slightly year to year depending on the strengths and areas for development of our cohort.	<u>Revision programme</u> A revision programme is put in place, which changes slightly year to year depending on the strengths and areas for development of our cohort.

Curriculum Offer : KS5 (Sixth Form) Chemistry

	Year 12		Year 13	
	Physical and inorganic	**Organic**	**Physical and inorganic**	**Organic**
TERM 1	**2.1 Atoms ions, compounds and bonding (2.1 and 2.4) [6 lessons]** Builds upon fundamental concepts developed in C1 and C2 and addresses potential misconceptions while laying the foundation of A Level standard definitions and understanding of the atom, electron structure and bonding. Fundamental to most units that follow in the course. **2.2 Amount of substance [6 lessons]** Take the concept of the mole and reacting quantities introduced in C3 and develops student confidence and competence in working with reacting masses, volumes and concentrations. Techniques developed here can be and are applied in almost all future parts of this course. PAG 1.1 PAG 1.2	**2.5 Shapes and intermolecular forces [4 lessons]** Introduces students to the underlying reasons for the intermolecular forces described in GCSE unit C2. Considers the shapes of molecules and the reasons for their shapes. Prepares students to discuss charge distribution in molecules, dipoles and the significance of lone pairs of electrons. Has application throughout the course but especially significant for understanding of reactivity and mechanisms of reaction in organic chemistry. **3.1 Periodicity [4 lessons]** Builds upon the reactions of group 1 and group 7 elements from GCSE and ideas of periodic trends from C1. Sets the basis for describing trends in reactivity in 3.2 Group 2 and the Halogens. Ideas of atomic radius, shielding and nuclear charge find use throughout the organic chemistry in the course. PAG 1.3 PAG 2.2	**5.2 Acids, alkalis and buffers [8 lessons]** Builds upon ideas from 2.3. Predominant analysis based on equilibria from 5.2. PAG 11.3	**6.2 Carbonyl compounds (6.2 and 6.3) [8 lessons]** Extends ideas from 4.1, 4.2 and 4.3 to carbonyl compounds. Reinforces ideas of reaction mechanisms. Builds to support 6.6 Organic synthesis. PAG 7.2 **6.4 Nitrogen compounds, optical isomers and polymers (6.4 and 6.5) [6 lessons]** Extends ideas from 4.1, 4.2 and 4.3 to nitrogen compounds. Develops ideas of isomerism to optical isomers. Builds to support 6.6 Organic synthesis. Idea of optical isomers in 5.5 Transition metals.

TERM 2	**2.3 Acids and redox [6 lessons]** Builds upon concepts of acids, bases and neutralisation from C4. Introduces the idea of oxidation numbers as a way of tracking redox reactions. Introduces students to titration as a quantitative technique. Sets the basis for 5.2 Acids, alkalis and buffers and fundamental to making sense of 5.4 Redox and electrode potentials next year. **3.2 Group 2 and the Halogens (3.2 and 3.3) [6 lessons**] Builds upon and applies the ideas developed in 3.1 Periodicity and students' knowledge of the reactions of group 1 and group 7 elements from GCSE. PAG 4.3	**4.1 Introduction to organic chemistry (4.1 and 4.2) [10 lessons]** Takes ideas introduced briefly in C7 organic chemistry. Introduces the key ideas of systematic naming and structural formulae for alkanes and akenes and the concept of functional group. Introduces reaction mechanisms and the idea of stereoisomerism. Students meet many of the ideas developed and reinforced in the organic chemistry modules to come. Ideas of isomerism recur in 6.4 and 5.5. PAG 5.2	**5.3 Enthalpy and entropy [5 lessons]** Develops the ideas introduced in 3.4. Extended to Born-Haber cycles to determine Lattice enthalpy and enthalpy of solution. PAG **5.4 Redox and electrode potentials [6 lessons]** Introduces the concept of electrode potentials building on ideas of oxidation and reduction from 2.3. Extends to electrochemical cells and feasibility of reactions. Fundamental to understanding of redox titrations in 5.5 Transition metals. PAG 8.1	**6.6 Organic synthesis [6 lessons]** Brings together knowledge from 4.1, 4.2, 4.3, 6.1, 6.2 and 6.4. Links with 4.4, 6.7 and 5.5 for synoptic questions in organic chemistry. PAG 6.2 PAG 7.1

TERM 3	**3.5 Reaction rates and equilibrium [4 lessons]** Revisits ideas about rate of reaction and reversible reactions first encountered in C6. Reinforces techniques for measuring and calculating rates of reaction. Revisits the ideas of equilibrium and Le Chatelier's principle. Establishes the fundamental ideas developed numerically in 5.1 Reaction rates and 5.2 Equilibrium. **5.1 Reaction rates [8 lessons]** Extends ideas of rate of reaction established in 3.5 to rate equations and orders of rate. PAG 9.3 PAG 10.3	**4.3 Mechanisms, alcohols and haloalkanes** Builds upon 4.1 and introduces curly arrow mechanisms. Uses ideas from 2.5. Sets the foundation for organic mechanisms in 6.1, 6.2 and 6.4 and organic synthesis 6.6. PAG 5.1	**Mock Exams** **5.5 Transition elements [6 lessons]** Introduces transition element chemistry. Builds on ideas of electron structure in 2.1 and periodicity in 3.2. Complex ions uses ideas of molecular shape from 2.5 and stereoisomerism from 6.4. Redox titrations use ideas of oxidation numbers from 2.3 and electrochemistry 5.4. A synoptic unit bringing together ideas from across the course and pointing forward to further study in chemistry. PAG 12.1	**Mock Exams (Paper 1)** **6.7 Chromatography and NMR** Develops ideas of spectral analysis introduced in 4.4. Builds on ideas from 2.1. Supports questions in 6.6 Organic synthesis.
TERM 4	**3..4 Enthalpy changes [6 lessons]** Builds on ideas introduced in C5. Introduces standard enthalpies and Hess's law and practical methods of determining enthalpy changes. Introduces the key ideas developed later in 5.3 Enthalpy and entropy. PAG 3.1	**4.4 Analytical techniques [6 lessons]** Takes ideas and techniques from C8 Chemical Analysis. Introduces spectral analysis. Sets the foundation for 6.7. Key to problem solving throughout organic chemistry.	Revision and exam question practice	Revision and exam question practice

TERM 5	**Revision and examination** Summative assessment of progress in year 1.	**Revision and examination**	**External Examinations** H338/01 H338/02 H338/03 Unified	
TERM 6	**5.2 Equilibrium part 2 [4 lessons]** Builds on idea of equilibrium in 3.5. Introduces idea of rate constant. Rate equations and rate constant are the foundation of the study of acids, alkalis and buffers in 5.2.	**6.1 Aromatic compounds [8 lessons]** Develops and reinforces ideas introduced in 4.1 and 4.3 in the context or aromatic organic compounds. Supports 6.6 Organic synthesis. PAG 6.1 PAG11.1		

Curriculum Offer : KS5 (Sixth Form) Physics

	Year 12	Year 13
TERM 1	**Module 2: Foundations of Physics** This topic covers the fundamental concepts of base units, prefixes, measurements and uncertainties which is required for all the A-level Physics topics. **Module 2.2 Scalars and Vectors** This topic builds on the difference between scalars and vectors introduced in the GCSE P5 Forces topic and includes vector addition and resolving vectors which is required for many A-level Physic topics but especially the motion topic. **Module 3.1 Motion** This topic builds on the key concept of forces and their effect on motion introduced in KS2, and revisited throughout KS3 and KS4. The equations of motion are introduced and used to consider projectile motion in two dimensions. These equations are then useful in the electric fields and electromagnetism topics. **Module 4.1 Charge, Current and Drift Velocity** This topic builds on the ideas about electricity introduced in KS2 and revisited in the electricity topics in KS3 and KS4. The relationship between charge and current are recalled leads to how to calculate drift velocity. **Module 3.2 Forces in action** This topic follows on from 3.1 motion and considers the forces acting on an object and their effect on the motion of an object in one and two dimensions, including moments, density and pressure. **Module 4.2 Energy, Power and Resistance** This topic builds on the ideas about electricity introduced in KS2 and revisited in the electricity topics in KS3 and KS4. It explores the relationship current, potential difference, resistance and power for different components.	**Module v5.3 Oscillations** This topic builds on ideas developed in the forces, waves and energy topics to consider the simple harmonic motion of pendulums including damping and resonance. **Module 6.3 Electromagnetism** This topic follows on from the electric fields topic and builds on ideas introduced in the KS4 Magnetism and Electromagnetism topic. It recalls ideas about magnetic fields around bar magnets, a long, straight current-carrying wire and a solenoid and the force on a current-carrying wire in a magnetic field and develops ideas about the motion of charged particles in a uniform magnetic field, electromagnetic induction including Faraday's and Lenz's Laws, motors and generators and transformers. **Module 5.2 Circular Motion** This module builds on the forces and oscillations topics to consider the kinematics of circular motion and centripetal force. **Module 6.4a Particle Physics and Radioactivity** This topic builds on ideas developed in the KS4 Atomic Structure topic and develops ideas about the fundamental particles including quarks and neutrinos and considers the changes that occur during radioactive decay in terms of nuclei, nucleons and quarks, half-life and activity and decay equations. The history of the development of the atomic structure is included to promote an understanding of how science works and character.

TERM 2	**Module 3.3 Work, Energy and Power** This topic builds on ideas about Energy introduced in KS2 and revisited in the energy topics in KS3 and KS4. It recalls the law of conservation of energy and focuses on energy transfers between gravitational potential energy, kinetic energy and thermal energy, including power and efficiency. **Module 4.3 Electrical circuits** This topic follows on from the previous electricity topics with a focus on how current, potential difference a resistance are related in series and parallel circuits including Kirchoff's First and Second Laws, the potential divider and internal resistance.	**Module 5.4 Gravitational Fields** This topic follows on from the circular motion topic and relates to the electric fields topic to consider Newton's Law of Gravitation, Kepler's Laws of the motion of objects in orbit, gravitational potential and gravitational potential energy. **Module 6.4b Nuclear Physics** This topic considers the changes that occur to nuclei during nuclear fission and nuclear fusion including calculations of mass defect and binding energy using Einstein's energy-matter equivalence equation $E=mc^2$.
TERM 3	**Module 3.4 Materials** This topic builds on ideas introduced in the forces topics in KS3 and KS4 including Hooke's Law. It then extends to the measurement of the Young modulus of a material and categorising materials based on their properties and relationship between stress and strain. **Module 4.4 Waves** This topic builds on ideas about light and sound introduced in KS2 and developed in the waves topics in KS3 and KS4. It explores the properties of waves from wavelength, amplitude, wave speed and frequency to polarisation, diffraction and interference including two-slit interference and stationary waves.	**Module 5.5 Astrophysics** This topic builds on ideas introduced in KS2 and KS3 space topics to consider the structure of the Universe, the formation and evolution of stars, emission and absorption spectra, Wien's Displacement Law and Stefan's Law, measurement of astronomical distances, doppler effect and red shift and cosmic microwave background radiation as evidence for the Big Bang and the evolution of the Universe. **Module 6.5 Medical Physics** This topic applies many ideas from A-level Physics to use in medical physics including X-rays and CAT scans, the gamma camera and PET scans, ultrasound and the doppler effect. A discussion of how MRI scans work is included for interest.
TERM 4	**Module 3.5 Newton's Laws of Motion** This topic builds on ideas about Newton's Laws introduced in the forces topics in KS3 and KS4. It explores the concept of momentum including conservation of momentum in collisions in two dimensions, impulse and elastic and inelastic collisions. **Module 4.5 Quantum Physics** This topic introduces the ideas about the photon, and the photoelectric effect as evidence for the particle nature of light leading to the concept of wave-particle duality.	**Review of modules** Revision activities and exam questions are used to consolidate knowledge and understanding of all the A-level Physics modules including applying this to a range of questions including the synoptic questions used in the Unified Physics paper.

TERM 5	**End of Year 12 Assessments** **Module 5.1 Thermal Physics** This topic builds on the ideas about the particle model of matter introduced in the states of matter and internal energy topics in KS3 and KS4. It develops ideas about the Brownian motion of smoke particles, specific heat capacity and specific latent heat, amount of substance, kinetic theory of gases and the ideal gas equation. **Module 6.1 Capacitance** This module builds on ideas developed in the electricity topics to consider how charge and energy are stored in capacitors including qualitative analysis of charging and discharging capacitors.	**Revision and Final Exams**
TERM 6	**Module 6.2 Electric Fields** This topic follows on from the capacitance topic to consider the electric field around charged particles including Coulomb's Law, uniform electric fields and electric potential and electric potential energy.	

Careers

Science is required or beneficial for a wide range of careers including:

- Medicine and healthcare
- Engineering and technology
- Environmental science
- Research and development
- Science media and publishing

- Education