KS5 Science Subject overview

Subject Rationale (Intent) linked to whole school curriculum mission

In brief (no more than four sentences)

The Science curriculum at St Edmund's is designed to bring science to everyday life, answering questions like 'why do apples fall from trees' or 'how are vaccines developed'? We want learners to be naturally inquisitive, independent and critical in their thinking. This will enable them to develop the substantive and disciplinary knowledge required to understand the world around them. We want to impart a love of the subject and for our students to use science to improve their own lives and the lives of others.

YEAR 12 Biology			
TERM	**Topic sequence** **(What are you teaching?)**	**Topic sequence rationale** **(Why are you teaching this? How does it link to prior learning? Any notable links to St Edmund's curriculum mission** **St Edmund's curriculum mission**	**Main method of assessment?**
Term 1:1	**Basic components of living systems** ● **Microscopy** ● **Magnification and calibration** ● **Eukaryotic cell structure** ● **Plant cell ultrastructure** ● **Prokaryotic cells** **Biological molecules** ● **Structure and bonding** ● **Inorganic ions** ● **Water** ● **Carbohydrates** ● **Lipids** ● **Proteins** ● **Qualitative & quantitative analysis of biological molecules**	**Basic components of living systems** The topic provides an introduction to cells and microscopy techniques. An understanding of the structure and function of the cell is a fundamental concept in the study of biology and essential for most onward routes for biologists. As all living organisms have similar cellular structure and the use of microscopy has revealed cell structure and ultrastructure and improved understanding of the roles of cells and their organelles. Building on student's prior knowledge of cells and their structure developed throughout KS3 & KS4 this unit refines and deepens their understanding. Students will need to use the following mathematical skills in this unit: changing the subject of an equation, converting units and working in standard form **Biological molecules** The biological molecules unit explores the biochemistry needed for the A level course and an understanding of biochemistry provides the foundation for the study of key biological disciplines such as medicine and research. The cells of all living organisms are composed of biological molecules. Students will have already encountered biological molecules and the qualitative chemical tests used to identify them during both KS3 (Year 8 Healthy Lifestyle) and KS4 (Organisation in animals). Studying the chemical composition, structure and bonding in these molecules enables a better understanding of their functions in living organisms.	**Composite task** **End of topic assessment**
Term 1:2	**Nucleotides & nucleic acids** ● **Nucleic acids** ● **DNA replication** ● **Genetic Code** ● **Protein synthesis** ● **ATP**	**Nucleotides & nucleic acids** Nucleic acids are essential to heredity in living organisms and understanding the structure of nucleotides and nucleic acids allows an understanding of their roles in the storage and use of genetic information and cell metabolism. This unit builds directly upon student's understanding of the structure of DNA from the KS4 unit	**Composite task** **End of topic assessment**

	Cell division ● **The cell cycle** ● **Mitosis** ● **Meiosis** ● **Organisation and specialisms of cells** ● **Stem cells** **Enzymes** ● **Models of enzyme action** ● **Factors affecting enzyme activity** ● **Enzyme inhibitors** ● **Cofactor, coenzymes and prosthetic groups**	Inheritance as well as the metabolic reactions students will have encountered throughout the KS4 course. **Cell division and cellular organisation** This unit focuses on the two processes by which cells divide and the subsequent specialisation of cells as well as the potential for the therapeutic use of stem cells. Students will deepen their knowledge from prior study of cell division by both mitosis and meiosis at KS4 by revisiting these two key cell division processes and using the microscope to view cells in different stages of the cell cycle. Understanding the key processes of cell division and how they can go wrong provides a deeper understanding of health and disease asa well as new technologies in genetics and cloning. **Enzymes** Enzymes are vital for many biological processes so an understanding of their structure and how they function is critical in deepening understanding of metabolic processes and cell functioning. Students will have previously encountered enzymes and their role in digestion when studying the organisation of animals at KS4, this unit builds on this knowledge to develop their understanding of this key biological molecule.	
Term 2:1	**Biological Membranes** ● **The structure and function of membranes** ● **Factors affecting membrane structure** ● **Diffusion** ● **Active transport** ● **Osmosis**	**Biological membranes** Plasma membranes control the substances that move in and out of cells, understanding the structure of these membranes is essential in understanding the cellular processes that take place throughout all areas of biology. Students are familiar with the function of a plasma membrane and the transport processes that occur from study at both KS3 and KS4; however, this unit explores these concepts in much greater detail. As well as looking at the detailed structure and ultrastructure of these membranes students will carry out a range of practical activities to explore transport processes and learn about the role of membranes in cell communication and as targets for drug administration. Students will have the opportunity to use mathematical skills when writing up practical activities, particularly those related to constructing graphs and working with negative numbers.	**Composite task** **End of topic assessment**

	Exchange surfaces ● **Specialised exchange surfaces** ● **Mammalian gas exchange system** ● **Measuring lung capacity and breathing rate** ● **Ventilation and gas exchange in other organisms**	**Exchange surfaces** This unit explores the need for specialised exchange surfaces and what makes an effective before moving on to specific examples including the mammalian gas exchange system, and the exchange systems in both bony fish and insects. Although students will have encountered specialised exchange surfaces at KS4 and be familiar with the concept that as animals become larger and more active ventilation and gas exchange systems become essential for them to supply oxygen and remove carbon dioxide they will apply this understanding to new situations and organisms. Students will learn about the relationship between the volume of the lungs and the rate of breathing linking this to clinical applications of measuring ventilation. There are a number of mathematical skills they will need to use in this unit including:recognising and using appropriate units, using expressions in decimal and standard form, using ratios, fractions and percentages as well as estimating results.	
Term 2:2	**Transport in animals** ● **Transport systems in multicellular organisms** ● **Blood vessels** ● **Blood, tissue fluid and lymph** ● **Transport of oxygen and carbon dioxide** ● **The heart** **Transport in plants** ● **Transport systems in dicotyledonous plants** ● **Water transport in plants** ● **Transpiration** ● **Translocation** ● **Plant adaptations to water availability**	**Transport in animals** Following on from the previous unit about specialised exchange surfaces students will deepen their understanding of the transport systems found in animals that supply nutrients and oxygen to cells and remove metabolic waste products. The key roles of the blood, blood vessels and the heart including its electrical control are explored in more depth, building on the foundational knowledge of the cardiovascular system from KS4. Students will have the opportunity to carry out dissections as well as applying their knowledge to medical applications of measuring heart rate and interpreting ECG traces. **Transport in plants** Building on KS4 study of the transport systems in plants as well as their more detailed understanding of cellular ultrastructure, biological molecules and plasma membranes, this unit looks at the key transport systems and processes in plants. As students encountered in animals, as plants become larger and more complex they require transport systems to ensure a supply of nutrients to, and removal of waste products from, individual cells. The supply of nutrients from the soil as well as the movements of the products of photosynthesis is	**Composite task** **End of topic assessment**

	Communicable disease ● **Animal and plant pathogens** ● **Animal and plant diseases** ● **Transmission of communicable diseases**	reliant upon the flow of water through a vascular system. **Communicable disease** Pathogens can be found everywhere and therefore organisms have built defences against them. Whilst students will be familiar with different types of pathogen and some of the defences organisms have against them from KS4, they will deepen their knowledge of the nonspecific and specific responses in both animals and plants. s.	
Term 3:1	**Communicable disease** ● **Plant defences against pathogens** ● **Non-specific animal defences** ● **The specific immune system** ● **Preventing and treating disease** **Biodiversity** ● **Biodiversity** ● **Sampling and sampling techniques** ● **Calculating biodiversity and genetic biodiversity** ● **Factors affecting biodiversity** ● **Maintaining biodiversity** **Classification and evolution** ● **Classification** ● **The five kingdoms** ● **Phylogeny** ● **Evidence for evolution** ● **Variation** ● **Adaptations** ● **Natural selection**	In this unit students will also revisit the medical interventions used to support natural defences in both the prevention and treatment of diseases such as the role of vaccinations and antibiotics . **Biodiversity** This unit directly builds on KS4 study of ecology. Students will learn about the biodiversity of organisms and the ways in which it can be measured as well as gaining an appreciation of the importance of maintaining biodiversity on a local, national and global scale. There are a number of mathematical skills that will be utilised during this unit including statistical tests (standard deviation, Student's *t* test and correlation coefficient) and using formulae (Simpson's index of biodiversity and proportion of polymorphic gene loci). **Classification and Evolution** In this unit learners will study the relationships between organisms considering variation, evolution and phylogeny. They will revisit systems of classification, as taught at KS4, and explore why these systems have changed as our knowledge of the biology of organisms has developed over time. Building on the concepts of variation and evolution that were first introduced at KS3 learners will look at how organisms are adapted for their environment as a result of naturally occurring variation and evolution.	**Composite task** **End of topic assessment**
Term 3:2	**Revision / Exams**	Students will spend this half term reviewing and revising all their AS level work and revision for the 2 mock exam papers, using past	**Composite task** **End of topic**

		examination papers	**assessment**

YEAR 13 Biology			
TERM	**Topic sequence** **(What are you teaching?)**	**Topic sequence rationale** **(Why are you teaching this? How does it link to prior learning? Any notable links to St Edmund's curriculum mission**	**Main method of assessment?**
Term 1:1	**Neuronal communication** ● **Coordination** ● **Neurones** ● **Sensory receptors** ● **Nervous transmission** ● **Synapses** ● **Organisation of the nervous system** ● **Structure and function of the brain** ● **Reflexes** ● **Voluntary and involuntary muscles** ● **Sliding filament model of muscle contraction** **Genetics of living systems** ● **Mutations and variation** ● **Control of gene expression** ● **Body plans** **Patterns of Inheritance** ● **Variation and inheritance** ● **Monogenic inheritance** ● **Dihybrid inheritance** ● **Phenotypic ratios** ● **Evolution** ● **Speciation** ● **Artificial selection**	**Neuronal communication** Students should be familiar with the concept of coordination from KS4 study of the nervous system as well as having an appreciation of the structure and function of the nervous system in coordinating responses to both internal and external stimuli. This unit develops their understanding of how electrical systems are used to monitor and respond to any deviation to the body's steady state. This unit also makes use of their study of the structure and of plasma membranes covered in year 12 as well as introducing concepts that will be explored in more detail in later units related to hormonal communication and plant responses. **Genetics of living systems** Although learners will have encountered the role of genes at KS4, this unit provides a much more in depth look at how genes are involved in cellular control and the effects of mutations. Students will explore how genetic control of metabolic reactions determines an organism's growth, development and function and how gene mutation can have an effect on protein function. They will need to refer back to topics covered in Year 12 as part of biological molecules and cell division. **Patterns of Inheritance** The concept of variation is introduced at KS3 and further explored at KS4 however this unit develops the student's ability to use genetic diagrams to perform genetic crosses and predict outcomes using ratios in a range of situations. They will also need to use more advanced mathematical calculations in order to determine the significance of observed and expected results using statistical analysis by carrying out the Chi-squared test. This unit also links back to classification and evolution covered in Year 12 to explore how	**Composite task** **End of topic assessment**

		genetic variation in a population can lead to such significant changes over prolonged periods of time that new species are formed. The human manipulation of this principle in the form of artificial selection and the ethical issues it raises are also revisited in more depth form KS4.	
Term 1:2	**Hormonal communication** ● **Principles of hormonal communication** ● **Structure and function of the pancreas** ● **Regulation of blood glucose concentration** ● **Diabetes** ● **Coordinated responses** ● **Controlling heart rate** **Manipulating genomes** ● **DNA profiling** ● **DNA sequencing and analysis** ● **Genetic engineering** ● **Gene technology and ethics**	**Hormonal Communication** This unit explores how specific hormones bring about their effects, building directly on student's knowledge from the study of homeostasis at KS4. Focusing on the role of the pancreas in the control of blood glucose and using diabetes as a specific example of a defect in a hormonal control system as well as looking at the role of the liver and kidney in the removal of toxic metabolic by-products allows learners to develop their understanding of the role coordination in allowing organisms to respond to stimuli. Learners will also look at how the control of heart rate has both hormonal and neuronal components which links knowledge and understanding from the previous topics of neuronal communication and transport in animals for Year 12. **Manipulating genomes** The ability to manipulate the genome has many potential benefits such as the treatment of disease, however the ethical implications of genetic techniques are significant The processes of DNA sequencing and DNA profiling are of vital importance in both medicine and forensic science. Students will need to draw on their understanding of a variety of topics from Year 12 related to the application of genetic manipulation.	**Composite task** **End of topic assessment**
Term 2:1	**Homeostasis & Excretion** ● **Principles of homeostasis** ● **Thermoregulation in ectotherms and endotherms** ● **Excretion and the liver** ● **Structure and function of the mammalian kidney**	**Homeostasis and excretion** Homeostasis, the ability to control and maintain internal conditions, is essential to an organism's survival in ever changing environments. Fundamental to achieving homeostasis is communication within the body as studied in the previous units of neuronal and hormonal communication. This unit focuses on the nervous, hormonal and muscular coordination that animals use to respond to their	**Composite task** **End of topic assessment**

	• **Osmoregulation** • **Urinalysis** • **Kidney failure** **Cloning and biotechnology** • **Natural and artificial cloning in plants** • **Cloning in animals** • **Microorganisms and biotechnology, medicines and bioremediation** • **Culturing microorganisms in the laboratory and on an industrial scale** • **Immobilised enzymes**	environment and allows them to control temperature and water balance. Throughout this unit students will make links to previous units from Year 12 including enzymes, biological molecules and specialised exchange surfaces. **Cloning and biotechnology** Humans exploit their ability to manipulate the natural world to their advantage, a characteristic students will have encountered in previous units and at KS4 related to selective breeding and genetic engineering. In this unit they will explore how natural vegetative propagation in plants, cloning in animals and the use of microorganisms in biotechnology is of benefit as well as considering the ethical implications of using these techniques.	
Term 2:2	**Plant responses** • **Plant hormones and growth** • **Plant responses to abiotic stress** • **Plant responses to herbivory** • **Tropisms in plants** • **Commercial use of plant hormones** **Ecosystems** • **Ecosystems** • **Biomass transfer** • **Recycling within ecosystems** • **Succession** • **Measuring distribution and abundance of organisms**	**Plant responses** In contrast to animals, plants rely on hormones to respond to environmental changes. This unit builds on knowledge of the role of hormones in plant responses from KS4 and further develops student's understanding of how plants respond to changes in their environment and further explores how these processes can be exploited commercially. This unit also draws on concepts encountered in Year 12 in the transport in plants and enzymes units. Mathematical skills are needed when comparing data using both standard deviation and Student *t* test. **Ecosystems** In this unit learners will gain an appreciation of the role of microorganisms in recycling materials within the environment and maintaining balance with ecosystems. At KS4 they will have encountered the dynamic nature of ecosystems and the influence of biotic and abiotic factors on the distribution of organisms within an ecosystem. There are many concepts first encountered in the ecology unit at KS4 that will be revisited and developed in this unit.	**Composite task** **End of topic assessment**

Term 3:1	**Energy for biochemical processes** ● **Energy cycles** ● **ATP synthesis** ● **Light dependent and independent stages of photosynthesis** ● **Factors affecting photosynthesis** **Respiration** ● **Glycolysis and the link reaction** ● **The Krebs cycle** ● **Oxidative phosphorylation** ● **Anaerobic respiration** ● **Respiratory substrates** **Populations and Sustainability** ● **Population size** ● **Competition** ● **Predator-prey relationships** ● **Conservation and preservation** ● **Ecosystem management case studies**	**Energy for biochemical processes** Photosynthesis is one of the most important biochemical pathways in biology and ATP is vital as an energy source in biochemical processes including the synthesis of large organic molecules from inorganic molecules. Students are familiar with the photosynthesis reaction from previous study at both KS3 and KS4. This unit explores this reaction in much greater depth as well as the synthesis of ATP building on the foundational knowledge secured in Year 12 units biological molecules, enzymes and transport in plants. **Respiration** As with photosynthesis, respiration is one of the most important biochemical pathways students encounter. Building on prior knowledge of the respiration reaction from both KS3 and KS4, as well as links to Year 12 units eukaryotic cell structure, biological molecules and enzymes, this unit explores the series of enzyme controlled reactions that make up the process of respiration in much greater detail on a biochemical level. Mathematical skills in both graphing to investigate respiration rates and the use of formula to calculate respiratory quotients are utilised in this unit. **Populations and sustainability** As the human population grows the impact on our environment is more and more evident. This unit investigates the factors that determine population size and the economic, social and ethical reasons why ecosystems may need to be managed. Drawing on KS4 study of land use as well as Year 12 study of biodiversity and how to maintain it this unit looks at how biological resources can be used sustainably to support an ever increasing human population.	**Composite task** **End of topic assessment**
Term 3:2	**Revision / Exams**	Students will spend this half term reviewing and revising all their A level work and revision for the 3 final papers using past examination papers.	