ARNOLD LODGE
4 - 18 yrs Co-educational Independent Day School

Key Stage 5: Curriculum Map

AS Level Biology (2022/2023)

A Level Biology Overview (Year 12)

AS Level Biology (Year 12) covers the AS Level only content of the specification where the focus is on topics 1-4. The content is designed to be covered in the first year of A-level. As this is a linear course, the contents of AS subject content are also examined at the end of the two year course. Pupils will support their learning of theory through the completion of a number of required practicals. Pupils will be encouraged to apply their understanding to past exam questions throughout the lessons and their self-study revision.

It is expected that A Level students will complete a minimum of 7 hours extra self-study outside their lesson time. This may be in the form of research, homework or completion of past papers. Teachers will set the pupils adequate homework to help individuals focus their time.

In Biology there will be a minimum of two assessments per half term to identify any gaps in knowledge/understanding that pupils may have and ensure that they are identified and addressed as soon as possible to ensure maximum progression.

Topic of Learning		Half-Termly Overview: Knowledge and Skills	Sample Assessments
HT1	**Biological Molecules** • Monomers and Polymers • Carbohydrates • Lipids • Proteins • Enzymes • Nucleic Acids • DNA replication • ATP • Water • Inorganic Ions	**By the end of the unit, pupils should know or be able to:** • Understand that Monomers are the smaller units from which larger molecules are made and Polymers are molecules made from a large number of monomers joined together. • Monosaccharides, amino acids and nucleotides are examples of monomers. • A condensation reaction joins two molecules together with the formation of a chemical bond and involves the elimination of a molecule of water. • A hydrolysis reaction breaks a chemical bond between two molecules and involves the use of a water molecule. • Explain that carbohydrates consist of monosaccharides and disaccharides formed from condensation and hydrolysis reactions. • Distinguish between the two isomers of glucose – alpha and	**Required practical *1***: Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. End of HT1 assessment – All content to date

		beta • Explain the basic structure and functions of glycogen, starch and cellulose and the relationship of structure to function of these substances in animal cells and plant cells. • Carry out Biochemical tests using Benedict's solution for reducing sugars and non-reducing sugars and iodine/potassium iodide for starch. • Recognise, from diagrams, saturated and unsaturated fatty acids • Explain the different properties of triglycerides and phospholipids. • Explain that Amino acids are the monomers from which proteins are made and draw the general structure of an amino acid where NH_2 represents an amine group, COOH represents a carboxyl group and R represents a side chain. The twenty amino acids that are common in all organisms differ only in their side group. • Describe how condensation reactions between amino acids for proteins and distinguish between structure of primary, secondary, tertiary and quaternary structures. • Relate the structure of proteins to properties of proteins named throughout the specification. • Appreciate how models of enzyme action have changed over time • Appreciate that enzymes catalyse a wide range of intracellular and extracellular reactions that determine structures and functions from cellular to whole-organism level. • Describe Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) as important information-carrying molecules. • Describe how nucleotides are formed and how DNA is formed from these monomers through a condensation reaction to form a phosphodiester bond. • Appreciate that the relative simplicity of DNA led many scientists to doubt that it carried the genetic code. • Explain the process semi-conservative replication of DNA which ensures genetic continuity between generations of cells. • Describe this in terms of unwinding of the double helix, breakage of hydrogen bonds between complementary bases in the polynucleotide strands, the role of DNA helicase in	

		unwinding DNA and breaking its hydrogen bonds, attraction of new DNA nucleotides to exposed bases on template strands and base pairing, and the role of DNA polymerase in the condensation reaction that joins adjacent nucleotides. • Evaluate the work of scientists in validating the Watson–Crick model of DNA replication. • Explain how a single molecule of adenosine triphosphate (ATP) is a nucleotide derivative and is formed from a molecule of ribose, a molecule of adenine and three phosphate groups. • Hydrolysis of ATP to adenosine diphosphate (ADP) and an inorganic phosphate group (P_i) is catalysed by the enzyme ATP hydrolase. • The hydrolysis of ATP can be coupled to energy-requiring reactions within cells. • The inorganic phosphate released during the hydrolysis of ATP can be used to phosphorylate other compounds, often making them more reactive. • ATP is resynthesized by the condensation of ADP and P_i. This reaction is catalysed by the enzyme ATP synthase during photosynthesis, or during respiration. • Water is a major component of cells. It has several properties that are important in Biology – as a metabolite, has a relatively high heat capacity, latent heat of vaporisation, strong cohesion that exists during transport in plants. • Recognise the role of ions in the following topics: hydrogen ions and pH; iron ions as a component of haemoglobin; sodium ions in the co-transport of glucose and amino acids; and phosphate ions as components of DNA and of ATP.	
HT2	**Cells** • Structure of the eukaryotic cells • Structure of Prokaryotic cells and viruses • Microscopy • Cell division – Mitosis • Transport across cell	**By the end of the unit, pupils should know or be able to:** • Describe the structure of eukaryotic cells, restricted to the structure and function of the various organelles: cell membrane, nucleus, nucleoli, mitochondria, chloroplasts, Golgi apparatus and vesicles, lysosomes, ribosomes, RER & SER, cell wall and vacuole. • Recognise that eukaryotic cells become specialised for specific functions which are organised into tissues, tissues into organs and organs into systems.	**Required practical 2:** Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index. **Required practical 3:** Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue.

	membranes • Cell recognition and Immune system	• Apply their knowledge of these features in explaining adaptations of eukaryotic cells. • Describe structure of prokaryotic cells and compare these to eukaryotic cells. • Describe structure of virus cells and compare to both prokaryotic and eukaryotic cells. • Understand the principles and limitations of optical microscopes, transmission electron microscopes and scanning electron microscopes. • Measure the size of an object viewed with an optical microscope. The difference between magnification and resolution. • Use the formula to calculate magnification. • Principles of cell fractionation and ultracentrifugation as used to separate cell components. • recognise the stages of the cell cycle: interphase, prophase, metaphase, anaphase and telophase (including cytokinesis) • explain the appearance of cells in each stage of mitosis. • Explain how uncontrolled cell division can lead to the formation of tumours and of cancers. Many cancer treatments are directed at controlling the rate of cell division. • Explain binary fission in prokaryotic cells • Describe the basic structure of all cell membranes including cell-surface membranes and the membranes around the cell organelles of eukaryotes, is the same. • Explain how the arrangement and any movement of phospholipids, proteins, glycoproteins and glycolipids help in the fluid-mosaic model of membrane structure. Cholesterol may also be present in cell membranes where it restricts the movement of other molecules making up the membrane. • Explain how movement across membranes occurs by the following processes of simple diffusion (involving limitations imposed by the nature of the phospholipid bilayer); facilitated diffusion (involving the roles of carrier proteins and channel proteins); osmosis (explained in terms of water potential); active transport (involving the role of carrier proteins and the importance of the hydrolysis of ATP) and co-transport (illustrated by the absorption of sodium ions and glucose by cells lining the mammalian ileum).	**Required practical 4:** Investigation into the effect of a named variable on the permeability of cell-surface membranes. Mid Term Assessment – Cells End of Term Assessment – Immune system

		• Cells may be adapted for rapid transport across their internal or external membranes by an increase in surface area of, or by an increase in the number of protein channels and carrier molecules in, their membranes. • explain the adaptations of specialised cells in relation to the rate of transport across their internal and external membranes • explain how surface area, number of channel or carrier proteins and differences in gradients of concentration or water potential affect the rate of movement across cell membranes. • Describe how each type of cell has specific molecules on its surface that identify it. These molecules include proteins and enable the immune system to identify pathogens, cells from other organisms of the same species, abnormal body cells, and toxins. • Define an antigen and the effect of antigen variability on disease and disease prevention. • Explain phagocytosis of pathogens and the subsequent destruction of ingested pathogens by lysozymes. • Describe in detail the way the cell responds – specifically • response of T lymphocytes to a foreign antigen (the cellular response). • The role of antigen-presenting cells in the cellular response. • The role of helper T cells (T_H cells) in stimulating cytotoxic T cells (T_C cells), B cells and phagocytes. The role of other T cells is **not** required. • The response of B lymphocytes to a foreign antigen, clonal selection and the release of monoclonal antibodies (the humoral response). • Define an antibody and describe the Antibody structure and how the formation of an antigen-antibody complex, leads to the destruction of the antigen, limited to agglutination and phagocytosis of bacterial cells. • Describe the roles of plasma cells and of memory cells in producing primary and secondary immune responses. • Explain how the use of vaccines provides protection for individuals and populations against disease. The concept of herd immunity. • Explain the differences between active and passive immunity.	

		• Describe the structure of the human immunodeficiency virus (HIV) and its replication in helper T cells. • Explain how HIV causes the symptoms of AIDS. Why antibiotics are ineffective against viruses. • Describe the use of monoclonal antibodies in targeting medication to specific cell types by attaching a therapeutic drug to an antibody and medical diagnosis. • discuss ethical issues associated with the use of vaccines and monoclonal antibodies • evaluate methodology, evidence and data relating to the use of vaccines and monoclonal antibodies.	
HT3	**Organisms exchange substances with their environment** • Surface area to volume ratio • Gas exchange • Digestion and absorption • Mass transport in animals • Mass transport in plants	**By the end of the unit, pupils should know or be able to:** • Appreciate the relationship between surface area to volume ratio and metabolic rate of different sized organisms. • Describe the adaptations of gas exchange surfaces, shown by gas exchange in single celled organisms, insects, fish, and plants. • Explain structural and functional compromises between the opposing needs for efficient gas exchange and the limitation of water loss shown by terrestrial insects and xerophytic plants. • Describe the gross structure of the human gas exchange system limited to the alveoli, bronchioles, bronchi, trachea and lungs. • Describe the essential features of the alveolar epithelium as a surface over which gas exchange takes place. • Explain the ventilation and the exchange of gases in the lungs and the mechanism of breathing to include the role of the diaphragm and the antagonistic interaction between the external and internal intercostal muscles in bringing about pressure changes in the thoracic cavity. • Interpret information relating to the effects of lung disease on gas exchange and/or ventilation • Interpret data relating to the effects of pollution and smoking on the incidence of lung disease • Analyse and interpret data associated with specific risk factors and the incidence of lung disease	**Required practical 5:** Dissection of animal or plant gas exchange system or mass transport system or of organ within such a system. End of HT3 Assessment – Mass transport

		• Evaluate the way in which experimental data led to statutory restrictions on the sources of risk factors • Recognise correlations and causal relationships. • Describe the digestion of carbohydrates, lipids and proteins in mammals. • Explain the mechanisms for the absorption of the products of digestion by cells lining the ileum with focus on co-transport mechanisms and role of micelles in absorption of lipids. • Describe the structure and role of haemoglobin in the transport of oxygen. • Explain the loading, transport and unloading of oxygen in relation to the oxyhaemoglobin dissociation curve. The cooperative nature of oxygen binding to show that the change in shape of haemoglobin caused by binding of the first oxygen makes the binding of further oxygens easier. The effects of carbon dioxide concentration on the dissociation of oxyhaemoglobin (the Bohr effect). • Describe how many animals are adapted to their environment by possessing different types of haemoglobin with different oxygen transport properties. • Identify the general pattern of blood circulation in a mammal. Names are required only of the coronary arteries and of the blood vessels entering and leaving the heart, lungs and kidneys. • Describe the gross structure of the human heart. Pressure and volume changes and associated valve movements during the cardiac cycle that maintain a unidirectional flow of blood. Also describe the structure of arteries, arterioles and veins in relation to their function. • The structure of capillaries and the importance of capillary beds as exchange surfaces. The formation of tissue fluid and its return to the circulatory system. • Analyse and interpret data relating to pressure and volume changes during the cardiac cycle • Analyse and interpret data associated with specific risk factors and the incidence of cardiovascular disease • Evaluate conflicting evidence associated with risk factors affecting cardiovascular disease • Recognise correlations and causal relationships.	

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		• Identify the tissues involved in transport of substances around a plant – the xylem and phloem. • Describe the cohesion-tension theory of water transport • Describe the mass flow hypothesis • Recognise correlations and causal relationships • Interpret evidence from tracer and ringing experiments and to evaluate the evidence for and against the mass flow hypothesis.	
HT4	**Genetic information, variation and relationships between organisms** • DNA, genes and chromosomes • DNA and protein synthesis • Meiosis • Genetic diversity • Genetic diversity and adaptation • Species and taxonomy • Biodiversity within a community • Investigating diversity	**By the end of the unit, pupils should be able to:** • Describe the structure of DNA found in prokaryotic, eukaryotic chloroplast and mitochondrial DNA • Describe a gene and its role in DNA and genetic coding • Explain the concept of the genome as the complete set of genes in a cell and of the proteome as the full range of proteins that a cell is able to produce. • Describe the structure of molecules of messenger RNA (mRNA) and of transfer RNA (tRNA). • Explain transcription as the production of mRNA from DNA and the role of RNA polymerase in joining mRNA nucleotides. • Explain how in prokaryotes, transcription results directly in the production of mRNA from DNA and In eukaryotes, transcription results in the production of pre-mRNA; this is then spliced to form mRNA. • Describe translation as the production of polypeptides from the sequence of codons carried by mRNA. The roles of ribosomes, tRNA and ATP. • Relate the base sequence of nucleic acids to the amino acid sequence of polypeptides, when provided with suitable data about the genetic code • Interpret data from experimental work investigating the role of nucleic acids. • Describe how genetic mutations (different types) arise and lead to genetic diversity • Describe in detail the process of Meiosis to produce daughter cells genetically different to each other. • Complete diagrams showing the chromosome content of cells after the first and second meiotic division, when given the chromosome content of the parent cell	**Required practical 6:** Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth. End of HT4 – Assessment on DNA and Genetic diversity

		• Explain the different outcome of mitosis and meiosis • Recognise where meiosis occurs when given information about an unfamiliar life cycle • Explain how random fertilisation of haploid gametes further increases genetic variation within a species. • Describe genetic diversity • Explore the principles of natural selection • Differentiate between directional and stabilising selection with names examples. • Use unfamiliar information to explain how selection produces changes within a population of a species • Interpret data relating to the effect of selection in producing change within populations • Show understanding that adaptation and selection are major factors in evolution and contribute to the diversity of living organisms. • Describe the role of courtship in species recognition • Use the phylogenetic classification system to organise species based on their evolutionary origins and relationships. • Appreciate that advances in immunology and genome sequencing help to clarify evolutionary relationships between organisms. • Explain how biodiversity can relate to a range of habitats, from a small local habitat to the Earth. • Define species richness as a measure of the number of different species in a community and that An index of diversity describes the relationship between the number of species in a community and the number of individuals in each species. • Calculate an index of diversity ( ) from the formula where = total number of organisms of all species and = total number of organisms of each species. • Describe how farming techniques reduce biodiversity and the balance between conservation and farming. • Interpret data relating to similarities and differences in the base sequences of DNA and in the amino acid sequences of proteins to suggest relationships between different organisms within a species and between species • Appreciate that gene technology has caused a change in the methods of investigating genetic diversity; inferring DNA	

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		differences from measurable or observable characteristics has been replaced by direct investigation of DNA sequences.	
HT5	**Exam Prep/Revision/ Synoptic Essays**	Synoptic essays (Preparation for Paper 3) will be reviewed during this half term where students are required to demonstrate the ability to draw together different areas of knowledge and understanding within one answer. *Revision will be targeted to the needs of the individuals in the class.*	**End of term assessment: AS Biology Mock exam – AS Biology exam.**
HT6	**Examinations**	**Examinations**	External AS Biology Exam