Progression Model – Year 12 Biology

Module Title: Biological Molecules and Cells	**Module Title:** Genetic information and Gas exchange	**Module Title:** Variation and Mass transport
Learning Intent for this module: Students will learn how all life on Earth shares common molecules providing indirect evidence for evolution. The cells of all organisms contain carbohydrates, lipids, proteins and nucleic acids. In particular, proteins carry out many essential biological roles while nucleic acids carry the genetic code for the production of proteins. Students will learn that all life on Earth exists as cells, which have basic features in common providing indirect evidence for evolution. All cells arise from other cells, by a process of cell division and have a cell-surface membrane with the same basic structure. This membrane enables control of the passage of substances across exchange surfaces by passive or active transport. • Monomers and polymers • Carbohydrates • Lipids • Proteins • (Digestion and absorption) • Nucleic acids • ATP • Water • Inorganic ions • Cell structure • All cells arise from other cells • Transport across cell membranes	**Learning Intent for this module:** Students will learn how cell-surface membranes contain embedded proteins some of which act as antigens, allowing recognition of 'self' and 'foreign' cells by the immune system. The internal environment of a cell or organism is different from its external environment. Exchange of substances between the internal and external environments takes place at exchange surfaces. Students will learn how a gene is a section of DNA located at a particular locus on a chromosome, which carries the coded genetic information determining the sequence of amino acids during protein synthesis. Genetic diversity within a species can be caused by mutation or random factors associated with meiosis and fertilisation. This genetic diversity allows natural selection to occur, resulting in species becoming better adapted to their environment. • DNA, genes and chromosomes • Protein synthesis • Mutation and meiosis • Genetic diversity and adaptation • Transport across cell membranes • Cell recognition and the immune system • Surface area to volume ratio • Gas exchange	**Learning Intent for this Module:** Students will learn that biodiversity is reflected in the vast number of species of organisms, which differ due to genetic differences. Variation between species is measured by comparing DNA or protein sequences. Populations of different species live in communities and biodiversity within a community can be measured using species richness and an index of diversity. Competition occurs within and between these populations for the means of survival and populations are affected by the biotic and abiotic factors, in their environment. Students will learn that in large multicellular organisms, cells are in contact with tissue fluid. Their exchange surfaces are associated with mass transport systems, which carry substances between the exchange surfaces and the rest of the body. Mass transport maintains the final diffusion gradients of tissue fluid that bring substances to and from the cell membranes of individual cells. • Species and taxonomy • Biodiversity within a community • Populations in ecosystems • Gas exchange • (Digestion and absorption) • Mass transport in animals • Mass transport in plants

Key Content to be learned: Students will learn that essential biological molecules are polymers made by condensation reactions between monomers. These polymers include carbohydrates, lipids and proteins that can be broken back down into their monomers using hydrolysis reactions. Students will learn the structure of carbohydrates, lipids and proteins and how they hydrolysis by enzymes in the digestive system allows absorption of the monomers needed by cells. The nucleic acids are information-carrying molecules that are essential in determining protein structure, which is critical for the functions they carry out in living organisms. Students will also learn how important ATP is as the energy currency of cells, the role of inorganic ions in cells and the essential role of water for life. Students will learn that cell theory is a unifying concept in biology and will compare the structure of eukaryote and prokaryote cells with viruses. They will learn how technological progress has allowed the development of improved methods to study cells and sub-cellular structures. Students will learn that all cells arise from other cells by a process of binary fission or mitosis and that the cell cycle is strictly controlled.	**Key Content to be learned:** Students will learn how a gene is a section of DNA located at a particular locus on a chromosome, which carries the coded genetic information determining the sequence of amino acids during protein synthesis. They will learn that genetic diversity within a species can be caused by mutation or random factors associated with meiosis and fertilisation. This genetic diversity between individuals of the same species allows natural selection to occur due to selection pressures in the environment. Natural selection results in species becoming better adapted to their environment over time. Students will learn how substances are transported across cell membranes by diffusion, facilitated diffusion, osmosis and active transport. They will learn that cell-surface membranes contain embedded proteins some of which act as antigens, allowing recognition of 'self' and 'foreign' cells by the immune system. Students will learn that the internal environment of a cell or organism is different from its external environment, which enables exchange of substances. The surface area to volume ratio of a cell or organ influences the speed of exchange between its internal and external environment. They will learn the importance of gas exchange in all organisms as a requirement for respiration and in plants for photosynthesis.	**Key Content to be learned:** Students will learn that biodiversity is reflected in the vast number of species of organisms, which show genetic differences. They will learn that we can classify organisms into hierarchical taxonomic ranks, based upon the evolutionary relationships between species. Variation between species can be measured by comparing DNA or protein molecules allowing for accurate classification. Populations of different species live in communities and biodiversity within a community can be measured using species richness and an index of diversity. Competition occurs within and between these populations for the means of survival and populations are influenced by the biotic and abiotic factors, in their environment. Students will learn that in large multicellular organisms, cells are in contact with tissue fluid. Their exchange surfaces are associated with mass transport systems, which carry substances between the exchange surfaces and the rest of the body. Mass transport maintains the final diffusion gradients of tissue fluid that bring substances to and from the cell membranes of individual cells. They will learn about the role of the heart, blood vessels and blood in animal mass transport and the role of the xylem, phloem and stomata in plant mass transport.
Prior knowledge: **From GCSE** • The basic components of carbohydrates, fats and proteins • Basic structure of DNA and how the DNA is arranged in the nucleus • Genes code for proteins • Basic cell structure and • The cell cycle and mitosis • Transport in and out of cells by diffusion, osmosis and active transport	**Prior knowledge:** From GCSE • DNA, genes and chromosomes • Genes code for proteins • Enzymes are important proteins in biology • How mutation can lead to different alleles of genes • Meiosis is cell division that creates gametes • Natural selection allows adaptation of species to their environment • Antigens are proteins on the cell surface	**Prior knowledge:** **From GCSE** • Classification • Populations and communities in ecosystems • Sampling, abiotic and biotic factors • Transport in and out of cells by diffusion • Structure of the human gas exchange system • The human digestive system • The heart and circulatory system • Plant tissues and organs and transport in the xylem and phloem • Factors affecting transpiration rate in plants

	• White blood cells of the immune system can react to foreign antigens by producing antibodies leading to immunity • Surface area is an important adaptation for exchange of materials • Adaptations of animals and plants for gas exchange to enable respiration	
Key tasks for this module: • Cell Structure • Carbohydrates and lipids • Extended writing • Cell division • Proteins	Key tasks for this module: • DNA and Protein synthesis • Cell transport • Extended writing • Immunity • Mutation, meiosis and adaptation	Key tasks for this module: • Adaptation and taxonomy • Gas exchange • Extended writing • Biodiversity • Year 12 Mock exam