Progression Model – Year 13 Biology

Module Title: Inheritance, evolution and Energy transfer	**Module Title:** Control of gene expression and Nervous responses	**Module Title:** Gene technology and Homeostasis
Learning Intent for this module: Students will learn life depends on continuous transfers of energy via photosynthesis and respiration. In communities, the biological molecules produced by photosynthesis are consumed by other organisms but the transfer of biomass and its stored chemical energy from one organism to a consumer is also not 100% efficient. Students will learn that the theory of evolution underpins modern Biology and all new species arise from an existing species. They will learn that different species share a common ancestry, which explains similarities between all living organisms. The individuals of a species have different combinations of alleles, which they inherit from their parent or parents leading to variation that allows natural selection. Evolution is due to a change in the allele frequency of a population and isolation can lead to speciation • Succession • Inheritance • Populations • Evolution may lead to speciation • Energy and Ecosystems • Nutrient cycles • Photosynthesis • Respiration	**Learning Intent for this module:** Students will learn that cells are able to control their metabolic activities by regulating the transcription and translation of their genome. In multicellular organisms, this control of translation enables cells to become specialised. There are many factors controlling gene expression and epigenetic regulation of transcription is being increasingly recognised as important. Many common ailments result from a breakdown of these control mechanisms. Students will learn that a stimulus is a change in the internal or external environment detected by receptors. A suitable response is formulated by a coordinator and produced by an effector. In animals, nerve cells pass electrical impulses along their length and release chemical messengers that are specific to a target cell. These impulses produce a response that is usually rapid, short-lived and localised. Plants control their response using hormone-like growth substances. • Alteration of the sequence of bases in DNA can alter the structure of proteins • Gene expression is controlled by a number of features • Using genome projects • Stimuli, both internal and external are detected and lead to a response • Nervous coordination • Gene technologies allow the study and alteration of gene function allowing a better	**Learning Intent for this Module:** Students will learn that recombinant DNA technology involves the transfer of fragments of DNA from one organism, or species, to another. Since the genetic code is universal, the transferred DNA can be translated within cells of the recipient (transgenic) organism. Humans are learning how to control the expression of genes by altering the genomes, epigenomes, and proteomes of organisms. This has many medical and technological Applications, such as the diagnosis and treatment of human diseases. Students will learn that in contrast to nervous responses, mammalian hormones stimulate their target cells via the blood system. They are specific to the tertiary structure of receptors on their target cells and produce responses that are usually slow, long lasting and widespread. • Gene technologies allow the study and alteration of gene function allowing a better understanding of organism function and the design of new industrial and medical processes • Skeletal muscles are stimulated to contract by nerves and act as effectors • Homeostasis is the maintenance of a stable internal environment • Synoptic essay and exam practice

	understanding of organism function and the design of new industrial and medical processes	
Students will learn that ecosystems become colonised and develop over time due to the process of succession. They will learn that individuals of a species vary from each other due to the different alleles of genes that they possess. This genetic information is passed from one generation to the next in predictable Mendelian ratios. Students will investigate inheritance via sex linkage, dihybrid inheritance, epistasis and autosomal linkage. The genetic variation between members of a species allows natural selection to take place. This leads to evolution due to a change in allele frequency in a population caused by an environmental selection pressure. Students will learn how to calculate allele frequency in a population using the Hardy-Weinberg equation. They will learn that if two populations become isolated, different selection pressures and genetic drift may give rise to new species. Students will learn that life depends on continuous transfers of energy via photosynthesis and respiration. In photosynthesis, light is absorbed by chlorophyll and this is linked to the production of ATP. In respiration, various substances are used as respiratory substrates. The hydrolysis of these respiratory substrates is linked to the production of ATP. In both respiration and photosynthesis, ATP production occurs when protons diffuse down an electrochemical gradient through molecules of the enzyme ATP synthase, embedded in the membranes of cellular organelles. In communities, energy is transferred through ecosystems via feeding relationships. This energy transfer is not fully efficient as energy is lost as heat, waste and due to movement. They will learn that Earth is a closed system and so elements such as	Students will learn how the alteration of the sequence of bases in DNA can alter the structure of proteins and may give rise to new alleles of genes or to genetic disorders. They will learn that gene expression is controlled by transcription factors that are often stimulated or inhibited by cell signalling molecules such as oestrogen. Cell differentiation and specialisation is the results of differential gene expression in stem cells. They will learn that control of the expression of tumour suppressor genes and oncogenes is essential to avoid cells becoming cancerous. They will also learn that environmental factors can lead to heritable epigenetic effects such as DNA methylation and histone acetylation affecting gene expression. They will learn how information from DNA sequencing and genome projects has been very useful in the understanding of genes and their expression. Research has also led to the development of gene technologies allowing the study and alteration of gene function allowing a better understanding of organism function. Students will learn that there are receptors in the skin, the eye and blood vessels, which detect specific internal or external stimuli. Responses to stimuli include reflexes, taxes and kineses in animals and tropisms in plants. They will learn how the sympathetic and parasympathetic nervous systems react and control many of the body's essential functions.	Students will learn about some of the key genetic techniques such as in vivo cloning using bacterial plasmids and in vitro DNA cloning using PCR. These technologies allow the study and alteration of gene function allowing a better understanding of organism function. In addition, they provide useful diagnostic tools and allow the design of new industrial processes such as the large-scale production of human insulin and crop improvement. They also may provide medical information leading to the treatment of genetic diseases and the modification of animal organs for xenotransplantation. Students will learn the structure of skeletal muscle and the effect of neurotransmitters at neuromuscular junctions leading to muscle contraction. Students will learn how the maintenance of a stable internal environment via homeostasis is essential for optimal cell function in multicellular organisms. They will look at osmoregulation by the kidney and the action of the hormone ADH from the pituitary and the control of blood glucose due to the hormones insulin and glucagon from the pancreas. Once all of the course content has been covered, students will be given opportunities to develop and practice their synoptic essay skills. They will also improve their exam techniques by practising past paper questions

carbon, nitrogen and phosphorus are continuously recycled between the biotic and abiotic parts of an ecosystem.		
Prior knowledge: **From GCSE** • Each individual has two alleles of every gene • Monohybrid inheritance of recessive and dominant characteristics • Genetic variation within a population allows natural selection to take place • Evolution can lead to new species • Living organisms are interdependent and rely upon each other for food • Energy is transferred through ecosystems in food chains and webs • Carbon cycle • Basic photosynthesis • Basic aerobic and anaerobic respiration	**Prior knowledge:** From GCSE • Genes code for proteins • How mutation can lead to different alleles of genes • Stem cells are undifferentiated cells • Human genome project • The nervous system and reflexes • Genetic engineering	**Prior knowledge:** **From GCSE** • Genetic engineering • Muscles are effectors stimulates by nervous impulses • The basic structure of synapses • Homeostasis • The endocrine system • Control of blood glucose
Key tasks for this module: • Inheritance • Extended writing • Nutrient cycles • Photosynthesis • Mock Exam 1	Key tasks for this module: • DNA, mutations and gene expression • Control of gene expression • Extended writing • Kinesis, taxes and tropisms • Mock exam 2	Formative tasks for this module: • Synoptic essay • Homeostasis • Gene technologies