Thomas More Catholic Academy
FAITH | EXCELLENCE | RESPECT

Biology Curriculum Sequence – Key Stage 5

	KS4 prior learning	By the end of the term, students can:	Year 12 Term 1 Section 1 Biological Molecules (Monomers and Polymers)	Year 12 Term 2 Section 2 Cells (Immune System)	Year 12 Term 3 Section 4 Genetic information, variation and relationships between organisms (Biodiversity and Investigating Diversity)	Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Photosynthesis)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Muscular Skeletal System)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)
What we want our students to know and remember	Biology A-level develops the skills needed to make connections and associations with all living things around us. Biology literally means the study of life and if that's not important, what is? Being such a broad topic, students are bound to find a specific area of interest, plus it opens the door to a fantastic range of interesting careers.	Define the key tier 3 **vocabulary**:	Adenosine triphosphate (ATP): A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups. Amino acid: The monomers containing an amino group (NH2), a carboxyl group (COOH) and a variable R group that make up proteins. Benedict's test: A biochemical test used to test for reducing sugars that produces a different colour based on the amount of reducing sugar present. Biuret test: A biochemical test that produces a purple solution in the presence of protein Cellulose: A polysaccharide made of beta glucose monomers that is used as a structural polysaccharide which provides strength to plant cell walls. Condensation reaction: A type of reaction that joins two molecules together with the formation of a chemical bond involving the elimination of a molecule of water Deoxyribonucleic acid (DNA): An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix. Dipeptide: Molecules formed	Active immunity: A form of immunity provided by the immune response of the body upon detection of a pathogen. Active transport: The active movement of substances from a low concentration to a higher concentration (up their concentration gradient) with the use of energy in the form of ATP. Agglutination: The clumping together of cells or particles caused by antibodies which assists phagocytosis. Antibody: A protein found in the blood that is produced by plasma cells which binds to antigens as a part of the immune response. Antigen: Marker molecules that can be detected by antibodies and trigger an immune response. Binary fission: The method of cell division used by prokaryotes involving replication of the circular DNA and plasmids followed by cytoplasmic division. Cell cycle: The series of stages preparing the cell for division consisting of interphase and mitosis. Cell-surface membrane: A phospholipid bilayer studded with proteins that surrounds cells and separates them from their environment.	Adaptation: A feature of an organism that increases its chance of survival in its environment. An adaptation may be anatomical, physiological or behavioural. Arithmetic mean: The average of a set of numbers calculated by dividing the sum of the values by the number of values. Binomial system: A universal system of naming organisms that consists of two parts: the generic name and the specific name, e.g. Homo sapiens. Biodiversity: The variety of genes, species and habitats within a particular area. Classification: The organisation of organisms into groups. There are two types of classification: artificial and phylogenetic. Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. Ecosystem diversity: A measure of the range of different habitats in a particular area. Generic name: Denotes the organism's genus. The first letter is written in upper case, e.g. Homo. Genetic code: The rules by	Adenosine triphosphate (ATP): Universal energy carrier found in all living cells. ATP synthase: An enzyme found embedded in cellular membranes that phosphorylates ADP to form ATP as protons flow through it. Chemiosmotic theory: The synthesis of ATP through the movement of protons down their concentration gradient across a semipermeable membrane, catalysed by ATP synthase. Chlorophyll: A photosynthetic pigment located in the thylakoids of chloroplasts that absorbs light energy and becomes ionised. Coenzymes: Molecules that help enzymes carry out their function e.g. NAD, FAD, NADP. Electron acceptor: Oxygen acts as the final electron acceptor in the electron transfer chain: ½O2 + 2e- + 2H+ ⟶ H2O Electron transfer chain: A series of electron carrier proteins that transfer electrons in a chain of oxidation-reduction reactions. FAD: A carrier molecule that becomes reduced when it takes up protons and electrons during the Krebs cycle,	Acetylcholine: A type of neurotransmitter that is used for communication between neurones. Actin: A type of protein filament found in myofibrils. It forms thin filaments consisting of two long twisted chains. Actinomyosin bridge: The cross-bridge formed when a myosin head attaches to the myosin binding site on an actin filament. Adenylate cyclase: An enzyme that catalyses the conversion of ATP to cAMP. Adrenaline: A hormone that is secreted by the adrenal glands under stressful conditions. It increases blood glucose concentration by activating enzymes involved in glycogenolysis. All-or-nothing: A principle that states that all stimuli above a certain threshold value will generate the same size of action potential, regardless of the strength of the stimulus. Anisotropic (A) bands: The darker bands in a myofibril, which consist of overlapping actin and myosin filaments. Antagonistic muscles: Pairs of muscles that work in opposite directions. Cholinergic synapse: An excitatory or inhibitory synapse formed between	Abiotic factors: The non-living aspects of an ecosystem e.g. temperature, light intensity, moisture, soil pH and oxygen levels. Adaptation: A feature of an organism that increases its chance of survival in its environment. Allele: A version of a gene. Allele frequency: The number of times an allele appears within a population's gene pool. Allopatric speciation: A form of speciation that occurs when two populations become geographically isolated. Autosomal linkage: When two or more genes are positioned on the same autosome. They are unlikely to be separated by crossing over during meiosis so are often inherited together. Autosome: A chromosome that is not an X or Y chromosome. Belt transect: A line along a sampled area, upon which quadrats are placed at certain intervals to determine the abundance and distribution of organisms in an ecosystem. Biodiversity: The variety of genes, species and habitats within a particular area. Biotic factors: The living components of an ecosystem e.g. food availability,

			by the condensation of two amino acids. Disaccharide: Molecules formed by the condensation of two monosaccharides. DNA helicase: An enzyme that breaks the hydrogen bonds between the two DNA strands in the DNA molecule that is going to be replicated. DNA polymerase: An enzyme that catalyses the condensation reactions between the new nucleotides in the synthesis of the new DNA strand. Enzyme: A protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions. Glycogen: A highly branched polysaccharide made of alpha glucose monomers that is used as the main storage of energy in humans and animals. Glycosidic bond: A bond between two monosaccharides formed in a condensation reaction. Heat capacity: The amount of energy needed to raise the temperature of a substance by a specific amount Hydrolysis: Breaking a chemical bond between two molecules involving the use of a water molecule. Induced-fit model: A model of enzyme action that describes how enzymes undergo subtle conformational changes to better fit the substrate. Iodine test: A biochemical test used to test for the presence of starch. Lactose: A disaccharide formed by condensation of a glucose molecule and a galactose molecule. Latent heat: The amount of energy needed for a	Cell vacuole: A membrane bound structure found in plant cells that contains cell sap. Cell wall: A permeable layer that surrounds plant, algae and fungi cells made of polysaccharides which provides strength to the cell. Chloroplast: An organelle found in plants and algae that is the site of photosynthesis. Clonal expansion: The production of many genetically identical daughter cells through cell division of the activated B or T lymphocyte after clonal selection. Clonal selection: The process of matching the antigens on an antigen presenting cells with the antigen receptors on B and T lymphocytes. Co-transport: A method of membrane transport where two substances are both transported across a membrane at the same time either in the same direction or opposite directions. Cytokinesis: Division of the cytoplasm to produce two new cells Facilitated diffusion: The passive movement of substances from a high concentration to a lower concentration (down their concentration gradient) through transport proteins without the use of energy. Flagella: A whip-like structure found on bacterial cells that is used for cell movement. Fluid-mosaic model: A model that describes membrane structure as a sea of mobile phospholipids studded with various proteins. Golgi apparatus: An organelle found in eukaryotic cells that is involved in the modification	which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is degenerate, universal and non-overlapping. Genetic diversity: The number of different alleles in a population. Genetic diversity between organisms can be investigated by comparing observable characteristics, DNA and mRNA base sequences and amino acid sequences. Independent segregation: The random separation of homologous chromosomes in meiosis 1 that produces genetic variation. Index of diversity (d): Describes the relationship between the number of different species and the abundance of individuals in each of these species within a community. It is calculated using the formula: where d is the index of diversity, N is the total number of organisms of all species and n is the total number of organisms of each species. Intron: A non-coding sequence of DNA. Locus: The position of a gene on a chromosome. Mean (normal distribution curve): A measure of the maximum height of a normal distribution curve. Natural selection: The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time. Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates. Species: A group of similar	forming reduced FAD. Glycerate 3-phosphate (GP): A three-carbon molecule which is reduced by reduced NADP in the light-independent stage of photosynthesis to form two molecules of triose phosphate (TP). This requires ATP. Light-dependent reaction: The second stage of photosynthesis that uses light energy to produce ATP, reduced NADP and oxygen (by-product). It takes place in the thylakoids of the chloroplast. Light-independent reaction: The third stage of photosynthesis, also known as the Calvin cycle, in which the products of the light-dependent stage and carbon dioxide are used to form a simple sugar. This stage does not require light energy and takes place in the stroma of the chloroplast. Limiting factor: A variable that limits the rate of a particular reaction. NAD: A carrier molecule that becomes reduced when it takes up protons and electrons during aerobic respiration, forming reduced NAD. NADP: A carrier molecule that becomes reduced when it takes up protons and electrons during the light-dependent stage of photosynthesis, forming reduced NADP. Oxidation: The loss of electrons, gain of oxygen or loss of hydrogen in a substance. Oxidative phosphorylation: The synthesis of ATP from reduced coenzymes and oxygen in the electron transfer chain of aerobic respiration. Photoionisation: The process	neurones or neurones and other effector organs. It uses the neurotransmitter, acetylcholine. Control mechanism: A self-regulating system consisting of five features: optimum point, receptor, coordinator, effector, and feedback mechanism. Coordinator: Coordinates information from the receptors and sends instructions to the effectors. Cyclic AMP (cAMP): A 'second messenger' involved in the action of adrenaline that activates protein kinase. Depolarisation: A sudden, temporary change in the membrane potential of a neurone in response to the transmission of a nerve impulse. The inside of the axon is less negative than the outside. Effector: An organ, tissue, or cell that produces a response to a stimulus. Excitatory synapse: A synapse that produces new action potentials when neurotransmitters bind with receptor proteins on the postsynaptic neurone. Fast-twitch muscle fibres: A type of muscle fibre that contracts more rapidly, with more power, over a shorter period. They are adapted for anaerobic respiration and intense activity. Generator potential: Depolarisation of the membrane of a sensory receptor cell that occurs in response to a stimulus. Glucagon: A hormone that is produced by α cells of the islets of Langerhans. It increases blood glucose concentration by activating enzymes	pathogens and predators. Carrying capacity: The average size of a population that can be supported by an ecosystem over extended periods of time. This varies depending on biotic and abiotic factors. Chi-squared test: A statistical test used to determine whether a pattern of inheritance is statistically significant. Climax community: The stable community of organisms that exists at the final stage of ecological succession. Codominant: When both alleles for a gene in a heterozygous organism equally contribute to the phenotype. Community: All of the populations of different species living together in a habitat. Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. This typically involves the management of succession. Degrees of freedom (X2 test): The number of categories minus one. Dihybrid inheritance: The inheritance of two different genes, that determine two phenotypes, on two different chromosomes. Diploid: Describes a cell with a nucleus containing two sets of chromosomes. Directional selection: A type of selection that favours one extreme phenotype and selects against all other phenotypes. Disruptive selection: A type of selection that favours individuals with extreme phenotypes and selects against those with phenotypes close to the mean.

			substance to change state. Lipid emulsion test: A biochemical test that produces a cloudy emulsion when performed on lipids. Maltose: A disaccharide formed by condensation of two glucose molecules. Metabolite: A molecule formed or used in metabolic reactions. Monomers: The smaller units from which larger molecules are made Monosaccharide: The individual sugar monomers from which larger carbohydrates are made. Phospholipid: A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group Polymers: Molecules made from a large number of monomers joined together. Polypeptide: Molecules formed by the condensation of many amino acids. Polysaccharide: Molecules formed by the condensation of many monosaccharides. Primary structure: The individual sequence of amino acids in a protein. Quaternary structure: A structure only applicable to proteins with multiple polypeptide chains that describes the interactions of the different chains. Ribonucleic acid (RNA): A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds. Secondary structure: The local interactions of the amino acids in the polypeptide chain. Semi conservative replication: The production of two daughter DNA molecules from one	and packaging of proteins. Helper T cell: A type of T cell in the immune system that stimulates cytotoxic T cells, B cells and phagocytes. Herd immunity: A type of disease immunity that occurs when a large proportion of a population are vaccinated against a disease which prevents the spread of the disease to unvaccinated individuals. Human Immunodeficiency Virus (HIV): A virus that attacks T cells in the immune system and can lead to AIDS (acquired immune deficiency syndrome) Lysosomes: Membrane-bound vesicles found in the cytoplasm that contain a hydrolytic enzyme called lysozyme. Magnification: How much bigger an image appears compared to the original object calculated using the following formula: Mitochondrion: An organelle found in eukaryotic cells that is the site of aerobic respiration. Mitosis: The part of the cell cycle in which a eukaryotic cell divides to produce two daughter cells, each with identical copies of DNA. Monoclonal antibodies: Identical antibodies that have been produced by an immune cell that has been cloned from a parent cell. Nucleus: An organelle found in eukaryotic cells that stores the genetic information of the cell as chromosomes and is surrounded by a membrane called the nuclear envelope. Osmosis: The passive diffusion of water molecules from a region of high water potential to a region of lower	organisms that are able to breed with one another to produce living, fertile offspring. Species diversity: A measure of the number of different species and the abundance of individuals in each of these species within a community. Species richness: A measure of the number of different species in a community at a given time. It is a measure of species diversity. Specific name: Denotes the organism's species. It is written in lower case letters, e.g. sapiens. Stabilising selection: A type of selection that favours individuals close to the mean, maintaining the traits of the population. Standard deviation (normal distribution curve): A measure of the width of a normal distribution curve and an indication of the range of values. Taxon: Each group within a phylogenetic classification system. Variation: The differences between individuals due to genes, the environment or a combination of both.	by which a molecule of chlorophyll is ionised. A chlorophyll molecule absorbs light energy causing a pair of electrons within it to become excited, raised to a higher energy level, and leave the molecule. Photolysis: The splitting of a molecule of water in the presence of light that occurs during the light-dependent stage of photosynthesis. This produces protons, electrons and oxygen: $H_2O \rightarrow 2H^+ + 2e^- + \frac{1}{2}O_2$ Photosynthesis: A complex metabolic pathway that consists of three main stages: capturing of light energy, light-dependent reaction, light-independent reaction. Overall, in the presence of light: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ Ribulose bisphosphate (RuBP): A five-carbon compound which reacts with carbon dioxide in the light-independent stage of photosynthesis to form two molecules of glycerate 3-phosphate (GP). Rubisco: An enzyme that catalyses the reaction of RuBP and carbon dioxide in the light-independent stage of photosynthesis. Substrate-level phosphorylation: The synthesis of ATP by the transfer of a phosphate group from a phosphorylated intermediate to ADP. Triose phosphate (TP): A three-carbon compound formed in the light-independent stage of photosynthesis that may be converted into useful organic	involved in gluconeogenesis and the conversion of glycogen to glucose. Gluconeogenesis: The formation of glucose from sources that are not carbohydrate, e.g. amino acids and glycerol. Glycogenesis: The formation of glycogen from glucose in the liver. Glycogenolysis: The breakdown of glycogen into glucose in the liver. Hyperpolarisation: A decrease in the membrane potential of an axon, so that it is even more negative than the resting potential. H-zone: The lighter region in the centre of each A band. Indoleacetic acid (IAA): A plant growth factor that is a type of auxin and controls cell elongation. It stimulates elongation in shoots and inhibits elongation in roots. Inhibitory synapse: A synapse that decreases the likelihood of an action potential in the postsynaptic neurone by causing potassium ions (K^+) to leave the postsynaptic neurone and chloride ions (Cl^-) to enter. This results in hyperpolarisation of the postsynaptic neurone. Isotropic (I) bands: The lighter bands in a myofibril, which consist of non-overlapping actin and myosin filaments. Motor neurone: A neurone that carries nerve impulses from the CNS to the effectors. Myofibrils: Tiny contractile muscle fibres which group together. Numerous myofibril bundles constitute muscles. Myofibrils consist of two protein filaments: actin and myosin. Myosin: A type of protein	Dominant: Describes an allele that is always expressed. Represented by a capital letter. Ecosystem: The community of organisms (biotic) and non-living (abiotic) components of an area and their interactions. It is a dynamic system. Epistasis: Describes a relationship between genes where the allele of one gene affects the expression of a different gene. Evolution: The gradual change in the allele frequencies within a population over time. Occurs due to natural selection. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene pool: All of the different versions of genes (alleles) in the individuals that make up a population. Genetic drift: Variations in allele frequencies in small populations due to chance. Genetic variation: Differences in genotypes between members of a population which may occur due to mutations, meiosis, or random fertilisation. Genotype: An organism's genetic composition. Describes all alleles. Habitat: The region where an organism normally lives. Hardy-Weinberg principle: A model that predicts that the ratio of dominant and recessive alleles in a population will remain constant between generations if the following five conditions are met: no new mutations; no natural selection; no migration; large

			DNA molecule which both contain one original DNA strand and one newly synthesised strand. Solvent: A substance which other solutes are dissolved in. Starch: A polysaccharide made of alpha glucose monomers that is used as the main storage of energy in plants. Sucrose: A disaccharide formed by condensation of a glucose molecule and a fructose molecule. Tertiary structure: The way that the whole protein folds to make a three dimensional structure. Triglyceride: A type of lipid formed by the condensation of one molecule of glycerol and three molecules of fatty acid.. .	water potential (down a water potential gradient) through a selectively permeable membrane without the use of energy. Passive immunity: A form of immunity provided by the introduction of antibodies to a disease into the body Phagocytosis: The process where phagocytes engulf and destroy material. Plasmids: A circular loop of DNA found in the cytoplasm of bacterial cells. Primary immune response: The response produced by the immune system when it encounters a pathogen for the first time. Resolution: The ability to distinguish two different points in a specimen. Ribosomes: Organelles found either free in the cytoplasm or membrane bound that are involved in the synthesis of proteins. Rough endoplasmic reticulum (RER): A membrane-bound organelle that is involved in the synthesis and packaging of proteins. Secondary immune response: The response produced by the immune system when it recognises a pathogen that it has encountered before. Simple diffusion: The passive spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy. Smooth endoplasmic reticulum (SER): A membrane-bound organelle involved in lipid synthesis. Vaccine: The introduction of dead or inactive pathogens to stimulate an immune response and provide long term immunity.		substances or used to regenerate ribulose bisphosphate (RuBP).	filament found in myofibrils. It forms thick filaments, consisting of long tails with bulbous heads, positioned to the side. Myosin binding site: A site on actin that is normally blocked by tropomyosin. During muscle contraction, it becomes exposed, allowing a myosin head to attach. Neuromuscular junction: An excitatory synapse formed between a motor neurone and a muscle fibre that uses the neurotransmitter, acetylcholine. Neurones: Nerve cells adapted to quickly transmit nerve impulses. Neurotransmitters: Chemicals that are used for communication between neurones and their target cells. Neurotransmitters are stored in synaptic vesicles in the presynaptic neurone and released into the synaptic cleft. Phosphocreatine: A compound stored in muscles that serves as a phosphate reserve, enabling ATP regeneration. Polarisation: Describes the condition in which an axon has a membrane potential of -65mV (resting potential). Presynaptic neurone: The neurone before the synapse which releases neurotransmitters from synaptic vesicles into the synaptic cleft. Protein kinase: An enzyme that catalyses the conversion of glycogen to glucose. Sarcomere: Each repeating unit of striations between adjacent Z-lines. Sarcoplasm: The cytoplasm shared by muscle fibres. It consists of a high concentration of mitochondria and	population; and random mating. It provides an equation for calculating the frequencies of alleles: p2+ 2pq + q2 = 1.0 where p is the frequency of the dominant allele, and q is the frequency of the recessive allele. Heterozygous: When someone has two different alleles of a gene e.g. Ff. Homozygous: When someone has two identical alleles of a gene e.g. ff. Interspecific competition: A type of competition that takes place between members of different species. Intraspecific competition: A type of competition that takes place between members of the same species. Locus: The position of a gene on a chromosome. Mark-release-recapture: A method of estimating the population size of motile organisms. It involves capturing a sample of the population, marking them and releasing them. At a later date, another sample is captured and the number of marked individuals recorded. The population size can be estimated using the following equation: Monohybrid inheritance: The inheritance of one gene. Multiple alleles: When a gene has more than two potential alleles. Natural selection: The process by which the frequency of beneficial alleles gradually increases in a population's gene pool over time. This theory was developed by Charles Darwin. Niche: Describes how an organism 'fits' into an

							endoplasmic reticulum. Second messenger model: The mechanism by which a hormone (e.g. adrenaline or glucagon) has an effect inside a cell by triggering the production of a second messenger such as cAMP. Skeletal muscle: A voluntary muscle responsible for movement. It makes up the majority of body muscle and is attached to the skeleton by tendons. Sliding filament theory: The mechanism by which a muscle contracts. During contraction, myosin filaments pull actin filaments to the centre of the sarcomere. The actin filaments slide along the myosin filaments. The sarcomere is shortened and the muscle length is reduced. Slow-twitch muscle fibres: A type of muscle fibre that contracts more slowly, with less power, over a greater period. They are adapted for aerobic respiration and enable endurance. Stretch-mediated sodium channel: A type of sodium channel whose permeability to sodium changes upon distortion (e.g. pressure changes, stretching). They are found in the plasma membrane of the sensory neurone ending at the centre of the Pacinian corpuscle. Tropomyosin: A protein found in muscles that forms a fibrous strand wrapped around an actin filament. Z-line: The line in the centre of each I band.	ecosystem and its role in that environment. Phenotype: An organism's observable characteristics. Due to interactions of the genotype and the environment. Pioneer species: Species that can survive in hostile environments and colonise bare rock or sand e.g. lichens. Population: All organisms of the same species living with one another in a habitat at the same time. Predator: An organism that eats other organisms. Prey: An organism that is eaten by predators. Quadrat: A square grid of a known area used in sampling to determine the abundance of organisms in a habitat. There are two types: point quadrats and frame quadrats. Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates. Recessive: Describes an allele that is only expressed in the absence of a dominant allele. Represented by a small letter. Selection pressures: Environmental factors that drive evolution by natural selection and limit population sizes e.g. competition, predation and disease. Sex-linkage: The presence of a gene on an X or Y chromosome. Speciation: The formation of new species due to the evolution of two reproductively separated populations. Two forms: allopatric and sympatric speciation. Species: A group of similar

								organisms that are able to breed with one another to produce living, fertile offspring. Stabilising selection: A type of selection that favours individuals with phenotypes close to the mean (average) and selects against extreme phenotypes. Succession: Describes changes in the community of organisms occupying a certain area over time. Sustainable: The ability to maintain something for future generations. Sympatric speciation: A form of speciation that occurs when two populations within the same area become reproductively isolated. Systematic sampling: A sampling technique used to determine the abundance and distribution of organisms along an area at periodic intervals e.g. along a belt transect. This is commonly used in ecosystems where some form of gradual change occurs. Variation: The differences between individuals due to genes, the environment or a combination of both
			Year 12 Term 1 Section 1 Biological Molecules (Lipids and Proteins)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Exchange)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Respiration)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Homeostasis)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations in Ecosystems)

			Adenosine triphosphate (ATP): A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups. Amino acid: The monomers containing an amino group (NH2), a carboxyl group (COOH) and a variable R group that make up proteins. Benedict's test: A biochemical test used to test for reducing sugars that produces a different colour based on the amount of reducing sugar present. Biuret test: A biochemical test that produces a purple solution in the presence of protein Cellulose: A polysaccharide made of beta glucose monomers that is used as a structural polysaccharide which provides strength to plant cell walls. Condensation reaction: A type of reaction that joins two molecules together with the formation of a chemical bond involving the elimination of a molecule of water Deoxyribonucleic acid (DNA): An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix. Dipeptide: Molecules formed by the condensation of two amino acids. Disaccharide: Molecules formed by the condensation of two monosaccharides. DNA helicase: An enzyme that breaks the hydrogen bonds between the two DNA strands in the DNA molecule that is going to be replicated. DNA polymerase: An enzyme that catalyses the condensation reactions	Alveoli: Small air sacs found in the lungs at the end of bronchioles which provide a large surface area for gas exchange. Antiporter: A membrane protein involved in the cotransport of molecules in opposite directions. Bronchi: The two airways branching out from the trachea and lead to the smaller bronchioles. Bronchioles: Small airways which branch out from the bronchi and end at the alveoli. Diaphragm: A large sheet of muscle below the lungs used to reduce and increase the lung capacity to create pressure changes necessary for ventilation. External intercostal muscles - A set of muscles found between the ribs on the outside that are involved in forced and quiet inhalation. Gill filaments: Small divisions of the gills in fish that extend off the gill arch. Gill lamellae: Small protrusions on the gill filaments designed to increase the surface area available for gas exchange. Internal intercostal muscles - A set of muscles found between the ribs on the inside that are involved in forced exhalation. Spiracles: Small openings on the surface of insects that allow for the exchange of gases with their environment. Symporter: A membrane protein involved in the cotransport of molecules in the same direction. Tissue fluid: Fluid filtered out from the blood that bathes		Acetyl coenzyme A: A two-carbon molecule formed in the link reaction when acetate reacts with coenzyme A. It is oxidised in the Krebs cycle. Adenosine triphosphate (ATP): Universal energy carrier found in all living cells. Aerobic respiration: A form of cellular respiration that takes place in the presence of oxygen and produces carbon dioxide, water and ATP. It involves four main stages: glycolysis, link reaction, Krebs cycle, and oxidative phosphorylation. Overall: $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$ Anaerobic respiration: A form of cellular respiration that takes place in the absence of oxygen. In animals, lactate is produced. In plants and microorganisms, ethanol and carbon dioxide are produced. Less ATP is formed than in aerobic respiration. ATP synthase: An enzyme found embedded in cellular membranes that phosphorylates ADP to form ATP as protons flow through it. Chemiosmotic theory: The synthesis of ATP through the movement of protons down their concentration gradient across a semipermeable membrane, catalysed by ATP synthase. Coenzymes: Molecules that help enzymes carry out their function e.g. NAD, FAD, NADP. Electron acceptor: Oxygen acts as the final electron acceptor in the electron transfer chain: $\frac{1}{2}O_2 + 2e^- + 2H^+ \longrightarrow H_2O$ Electron transfer chain: A series of electron carrier	Collecting duct: The final region of the nephron that collects urine from the distal convoluted tubules and empties it into the renal pelvis. Its permeability to water is altered by ADH Control mechanism: A self-regulating system consisting of five features: optimum point receptor, coordinator, effector, and feedback mechanism Coordinator: Coordinates information from the receptors and sends instructions to the effectors Descending limb: The limb of the loop of Henle that dips down into the medulla. It is smaller in diameter than the ascending limb. The walls of the descending limb are permeable to water, so the filtrate loses water as it moves down Distal convoluted tubule: The twisted region of the nephron between the loop of Henle and the collecting duct. It controls blood pH by reabsorbing ions and alters the concentration of water and salts reabsorbed. Its permeability to water is altered by ADH Effector: An organ, tissue, or cell that produces a response to a stimulus Feedback mechanism: The mechanism by which the change to a system, brought about by the effector, is detected by the receptor Glomerular filtrate: The fluid produced by ultrafiltration of the blood into the renal capsule It contains water, glucose, mineral ions and urea Glomerulus: A bundle of capillaries located in the renal capsule which are	Abiotic factors: The non-living aspects of an ecosystem e.g. temperature, light intensity, moisture, soil pH and oxygen levels. Adaptation: A feature of an organism that increases its chance of survival in its environment. Allele: A version of a gene. Allele frequency: The number of times an allele appears within a population's gene pool. Allopatric speciation: A form of speciation that occurs when two populations become geographically isolated. Autosomal linkage: When two or more genes are positioned on the same autosome. They are unlikely to be separated by crossing over during meiosis so are often inherited together. Autosome: A chromosome that is not an X or Y chromosome. Belt transect: A line along a sampled area, upon which quadrats are placed at certain intervals to determine the abundance and distribution of organisms in an ecosystem. Biodiversity: The variety of genes, species and habitats within a particular area. Biotic factors: The living components of an ecosystem e.g. food availability, pathogens and predators. Carrying capacity: The average size of a population that can be supported by an ecosystem over extended periods of time. This varies depending on biotic and abiotic factors. Chi-squared test: A statistical test used to determine whether a pattern of inheritance is statistically significant.

			between the new nucleotides in the synthesis of the new DNA strand. Enzyme: A protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions. Glycogen: A highly branched polysaccharide made of alpha glucose monomers that is used as the main storage of energy in humans and animals. Glycosidic bond: A bond between two monosaccharides formed in a condensation reaction. Heat capacity: The amount of energy needed to raise the temperature of a substance by a specific amount Hydrolysis: Breaking a chemical bond between two molecules involving the use of a water molecule. Induced-fit model: A model of enzyme action that describes how enzymes undergo subtle conformational changes to better fit the substrate. Iodine test: A biochemical test used to test for the presence of starch. Lactose: A disaccharide formed by condensation of a glucose molecule and a galactose molecule. Latent heat: The amount of energy needed for a substance to change state. Lipid emulsion test: A biochemical test that produces a cloudy emulsion when performed on lipids. Maltose: A disaccharide formed by condensation of two glucose molecules. Metabolite: A molecule formed or used in metabolic reactions. Monomers: The smaller units from which larger molecules	tissues and provides the cells with substances like food and dissolved gases for exchange. Trachea: The main airway that acts as a passage for air to pass to and from the bronchi. Trachea (mammals): A tube reinforced with cartilage that allows for the movement of air between the larynx and bronchi. Tracheae (insects): Tubes leading from the spiracles to the tracheoles that are part of the gaseous exchange system. Tracheoles: Very small tubes that make up the respiratory system of insects and carry gases from the tracheae to the cells.		proteins that transfer electrons in a chain of oxidation-reduction reactions. FAD: A carrier molecule that becomes reduced when it takes up protons and electrons during the Krebs cycle, forming reduced FAD. Glycerate 3-phosphate (GP): A three-carbon molecule which is reduced by reduced NADP in the light-independent stage of photosynthesis to form two molecules of triose phosphate (TP). This requires ATP. Glycolysis: The first stage of aerobic and anaerobic respiration that takes place in the cytosol of the cell and breaks down glucose into two molecules of pyruvate. Two molecules of ATP and two molecules of reduced NAD are also formed. Krebs cycle: A series of oxidation-reduction reactions in the matrix of the mitochondria in which acetyl coenzyme A is oxidised generating reduced NAD, reduced FAD, ATP and carbon dioxide. Link reaction: The second stage of aerobic respiration that takes place in the mitochondrial matrix and converts pyruvate into acetyl coenzyme A and carbon dioxide. Reduced NAD is also formed. Overall: Pyruvate + NAD + CoA ⟶ acetyl CoA + reduced NAD + CO_2 NAD: A carrier molecule that becomes reduced when it takes up protons and electrons during aerobic respiration, forming reduced NAD. NADP: A carrier molecule that becomes reduced when it takes up protons and	adapted for the filtration of blood. They later merge to form the efferent arteriole Homeostasis: The maintenance of a constant internal environment in the body, despite fluctuations in internal and external conditions Hypothalamus: The region of the brain close to the pituitary gland that serves as the control centre for the autonomic nervous system. It is responsible for the regulation of body temperature and the water potential of body fluids Loop of Henle: A loop consisting of a descending limb (dips into the medulla) and ascending limb (rises into the cortex) surrounded by blood capillaries. It creates a low water potential in the medulla, enabling the reabsorption of water Negative feedback: A feedback mechanism that inhibits the original stimulus and reverses the change in conditions, restoring the optimum point Nephron: The functional unit of the mammalian kidney Optimum point: The point at which a system works most effectively Osmoreceptors: Sensory receptor cells located in the hypothalamus that detect a decrease in water potential Osmoregulation: The regulation of the water potential of the blood by the kidney Positive feedback: A feedback mechanism that enhances the original stimulus and increases the change in conditions, deviating the system further from the optimum point Posterior pituitary gland: The	Climax community: The stable community of organisms that exists at the final stage of ecological succession. Codominant: When both alleles for a gene in a heterozygous organism equally contribute to the phenotype. Community: All of the populations of different species living together in a habitat. Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. This typically involves the management of succession. Degrees of freedom (X2 test): The number of categories minus one. Dihybrid inheritance: The inheritance of two different genes, that determine two phenotypes, on two different chromosomes. Diploid: Describes a cell with a nucleus containing two sets of chromosomes. Directional selection: A type of selection that favours one extreme phenotype and selects against all other phenotypes. Disruptive selection: A type of selection that favours individuals with extreme phenotypes and selects against those with phenotypes close to the mean. Dominant: Describes an allele that is always expressed. Represented by a capital letter. Ecosystem: The community of organisms (biotic) and non-living (abiotic) components of an area and their interactions. It is a dynamic system. Epistasis: Describes a relationship between genes where the allele of one gene affects the

			are made Monosaccharide: The individual sugar monomers from which larger carbohydrates are made. Phospholipid: A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group Polymers: Molecules made from a large number of monomers joined together. Polypeptide: Molecules formed by the condensation of many amino acids. Polysaccharide: Molecules formed by the condensation of many monosaccharides. Primary structure: The individual sequence of amino acids in a protein. Quaternary structure: A structure only applicable to proteins with multiple polypeptide chains that describes the interactions of the different chains. Ribonucleic acid (RNA): A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds. Secondary structure: The local interactions of the amino acids in the polypeptide chain. Semi conservative replication: The production of two daughter DNA molecules from one DNA molecule which both contain one original DNA strand and one newly synthesised strand. Solvent: A substance which other solutes are dissolved in. Starch: A polysaccharide made of alpha glucose monomers that is used as the main storage of energy in plants. Sucrose: A disaccharide			electrons during the light-dependent stage of photosynthesis, forming reduced NADP. Natural fertilisers: Dead and decaying organic matter used to increase the mineral content of soils Oxidation: The loss of electrons, gain of oxygen or loss of hydrogen in a substance. Oxidative phosphorylation: The synthesis of ATP from reduced coenzymes and oxygen in the electron transfer chain of aerobic respiration. Pyruvate: A three-carbon molecule produced in glycolysis. In aerobic respiration, pyruvate is oxidised to acetate in the link reaction. In anaerobic respiration it is converted to lactate (animals) or ethanol and carbon dioxide (plants and microorganisms). Reduction: The gain of electrons, loss of oxygen or gain of hydrogen in a substance. Substrate-level phosphorylation: The synthesis of ATP by the transfer of a phosphate group from a phosphorylated intermediate to ADP. Triose phosphate (TP): A three-carbon compound formed in the light-independent stage of photosynthesis that may be converted into useful organic substances or used to regenerate ribulose bisphosphate (RuBP).	gland responsible for the secretion of ADH into the bloodstream Proximal convoluted tubule: The twisted portion of the nephron between the renal capsule and the loop of Henle. Its walls consist of epithelial cells that are adapted for the reabsorption of glucose and water into the blood Renal (Bowman's) capsule: The cup-like structure at the start of a nephron that surrounds the glomerulus. The inner layer of the capsule, through which filtration of the blood takes place, is composed of podocytes	expression of a different gene. Evolution: The gradual change in the allele frequencies within a population over time. Occurs due to natural selection. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene pool: All of the different versions of genes (alleles) in the individuals that make up a population. Genetic drift: Variations in allele frequencies in small populations due to chance. Genetic variation: Differences in genotypes between members of a population which may occur due to mutations, meiosis, or random fertilisation. Genotype: An organism's genetic composition. Describes all alleles. Habitat: The region where an organism normally lives. Hardy-Weinberg principle: A model that predicts that the ratio of dominant and recessive alleles in a population will remain constant between generations if the following five conditions are met: no new mutations; no natural selection; no migration; large population; and random mating. It provides an equation for calculating the frequencies of alleles: $p2+ 2pq + q2 = 1.0$ where p is the frequency of the dominant allele, and q is the frequency of the recessive allele. Heterozygous: When someone has two different alleles of a gene e.g. Ff. Homozygous: When

			formed by condensation of a glucose molecule and a fructose molecule. Tertiary structure: The way that the whole protein folds to make a three dimensional structure. Triglyceride: A type of lipid formed by the condensation of one molecule of glycerol and three molecules of fatty acid.. .					someone has two identical alleles of a gene e.g. ff. Interspecific competition: A type of competition that takes place between members of different species. Intraspecific competition: A type of competition that takes place between members of the same species. Locus: The position of a gene on a chromosome. Mark-release-recapture: A method of estimating the population size of motile organisms. It involves capturing a sample of the population, marking them and releasing them. At a later date, another sample is captured and the number of marked individuals recorded. The population size can be estimated using the following equation: Monohybrid inheritance: The inheritance of one gene. Multiple alleles: When a gene has more than two potential alleles. Natural selection: The process by which the frequency of beneficial alleles gradually increases in a population's gene pool over time. This theory was developed by Charles Darwin. Niche: Describes how an organism 'fits' into an ecosystem and its role in that environment. Phenotype: An organism's observable characteristics. Due to interactions of the genotype and the environment. Pioneer species: Species that can survive in hostile environments and colonise bare rock or sand e.g. lichens. Population: All organisms of the same species living with

								one another in a habitat at the same time. Predator: An organism that eats other organisms. Prey: An organism that is eaten by predators. Quadrat: A square grid of a known area used in sampling to determine the abundance of organisms in a habitat. There are two types: point quadrats and frame quadrats. Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates. Recessive: Describes an allele that is only expressed in the absence of a dominant allele. Represented by a small letter. Selection pressures: Environmental factors that drive evolution by natural selection and limit population sizes e.g. competition, predation and disease. Sex-linkage: The presence of a gene on an X or Y chromosome. Speciation: The formation of new species due to the evolution of two reproductively separated populations. Two forms: allopatric and sympatric speciation. Species: A group of similar organisms that are able to breed with one another to produce living, fertile offspring. Stabilising selection: A type of selection that favours individuals with phenotypes close to the mean (average) and selects against extreme phenotypes. Succession: Describes changes in the community of organisms occupying a

								certain area over time. Sustainable: The ability to maintain something for future generations. Sympatric speciation: A form of speciation that occurs when two populations within the same area become reproductively isolated. Systematic sampling: A sampling technique used to determine the abundance and distribution of organisms along an area at periodic intervals e.g. along a belt transect. This is commonly used in ecosystems where some form of gradual change occurs. Variation: The differences between individuals due to genes, the environment or a combination of both
			Year 12 Term 1 Section1 Biological Molecules (Enzymes)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Digestion)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Energy in Ecosystems)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Blood Sugar)	Year 13 Term 3 Section 8 The control of gene expression (Gene Expression)

			Adenosine triphosphate (ATP): A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups. Amino acid: The monomers containing an amino group (NH2), a carboxyl group (COOH) and a variable R group that make up proteins. Benedict's test: A biochemical test used to test for reducing sugars that produces a different colour based on the amount of reducing sugar present. Biuret test: A biochemical test that produces a purple solution in the presence of protein Cellulose: A polysaccharide made of beta glucose monomers that is used as a structural polysaccharide which provides strength to plant cell walls. Condensation reaction: A type of reaction that joins two molecules together with the formation of a chemical bond involving the elimination of a molecule of water Deoxyribonucleic acid (DNA): An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix. Dipeptide: Molecules formed by the condensation of two amino acids. Disaccharide: Molecules formed by the condensation of two monosaccharides. DNA helicase: An enzyme that breaks the hydrogen bonds between the two DNA strands in the DNA molecule that is going to be replicated. DNA polymerase: An enzyme that catalyses the condensation reactions	Amylases: A class of enzymes that hydrolyse polysaccharides. Bile salts: Molecules found in the small intestine that assist in the coagulation of lipids, increasing the lipid surface area for breakdown. Co-transport - A type of membrane transport mechanism involving two different molecules moving across a cell membrane. Endopeptidase: A class of enzymes that hydrolyse peptide bonds within polypeptides. Exopeptidases: A class of enzymes that hydrolyse peptide bonds at the end of proteins (e.g. between the penultimate and last amino acid in the polypeptide). Lipase: A class of enzymes that hydrolyse lipids. Membrane-bound dipeptidases: A class of enzymes found within membranes that hydrolyse dipeptides into singular amino acids. Membrane-bound disaccharidases: A class of enzymes found within membranes that hydrolyse disaccharides into monosaccharides. Micelles: An organised group of lipid molecules that aggregate together to provide a hydrophobic capsule for the uptake of lipids. Symporter: A membrane protein involved in the cotransport of molecules in the same direction.		Ammonification: The production of ammonia when saprobiontic microorganisms feed on organic nitrogen-containing compounds. Ammonium ions are formed and added to the soil. Artificial fertilisers: Man-made compounds generally containing nitrogen, phosphorus and potassium that are used to increase the mineral content of soils. Biomass: The total mass of organic material, measured in a specific area over a set time period. This can be calculated in terms of dry mass or mass of carbon per given area. Calorimetry: A technique used to estimate the chemical energy store in dry biomass. Carnivores: Animals that prey on and eat other animals. They can be secondary or tertiary consumers. Consumers: Organisms that feed on other organisms to obtain energy. Denitrification: The conversion of nitrate ions to nitrogen gas by denitrifying bacteria. Denitrifying bacteria: Anaerobic microorganisms found in waterlogged soils responsible for the reduction of nitrate ions to nitrogen gas. Ecosystem: The community of organisms (biotic) and non-living (abiotic) components of an area and their interactions. Efficiency of energy transfer: The efficiency of energy transfer between trophic levels is calculated using: Eutrophication: When a body of water becomes excessively rich with nutrients (often from	Diabetes: A disorder of metabolism in which blood glucose concentration is not regulated properly. There are two forms: Type I and Type II diabetes Feedback mechanism: The mechanism by which the change to a system, brought about by the effector, is detected by the receptor Glucagon: A hormone that is produced by α cells of the islets of Langerhans. It increases blood glucose concentration by activating enzymes involved in gluconeogenesis and the conversion of glycogen to glucose Hormones: Cell signalling molecules produced by endocrine glands and released into the blood. They travel to target cells and bind to specific receptors, initiating a response. The effects of hormones are usually long-lasting Insulin: A hormone that is produced by β cells of the islets of Langerhans. It decreases blood glucose concentration by activating enzymes involved in the conversion of glucose to glycogen and increasing the number of glucose transport channels in the cell surface membranes of target cells Islets of Langerhans: Clusters of hormone-producing cells located in the pancreas. They consist of α-cells that secrete glucagon, and β-cells that secrete insulin Negative feedback: A feedback mechanism that inhibits the original stimulus and reverses the change in conditions, restoring the optimum point Type I diabetes: A form of	Acetylation: The addition of acetyl groups to histones. Acetylation activates the gene by making it more accessible to transcription factors. Addition: A form of gene mutation in which one or more nucleotide bases are inserted into a DNA sequence. This may result in a frameshift to the right. Benign: Describes a tumour that is non-cancerous. Such tumours grow slowly, are enclosed in a capsule and remain at the site of origin. They can usually be removed by surgery. Cancer: A non-communicable disease resulting from tumour cells that metastasise. Cellular proteome: The proteins expressed in a given type of cell. Complementary DNA (cDNA): A single strand of DNA complementary to the mRNA template strand. Complete proteome: All of the proteins coded for by the genome. Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may result in a frameshift to the left. Differentiation: A process in which cells become specialised for function. DNA hybridisation: The process by which a single-stranded segment of DNA is combined with a complementary fragment of DNA or RNA. DNA ligase: An enzyme that joins the sugar-phosphate backbone of two DNA segments. DNA polymerase: An enzyme that synthesises a double-stranded molecule of DNA from a

			between the new nucleotides in the synthesis of the new DNA strand. Enzyme: A protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions. Glycogen: A highly branched polysaccharide made of alpha glucose monomers that is used as the main storage of energy in humans and animals. Glycosidic bond: A bond between two monosaccharides formed in a condensation reaction. Heat capacity: The amount of energy needed to raise the temperature of a substance by a specific amount Hydrolysis: Breaking a chemical bond between two molecules involving the use of a water molecule. Induced-fit model: A model of enzyme action that describes how enzymes undergo subtle conformational changes to better fit the substrate. Iodine test: A biochemical test used to test for the presence of starch. Lactose: A disaccharide formed by condensation of a glucose molecule and a galactose molecule. Latent heat: The amount of energy needed for a substance to change state. Lipid emulsion test: A biochemical test that produces a cloudy emulsion when performed on lipids. Maltose: A disaccharide formed by condensation of two glucose molecules. Metabolite: A molecule formed or used in metabolic reactions. Monomers: The smaller units from which larger molecules		fertilisers). Food chain: Describes the feeding relationships between organisms and the resultant stages of biomass transfer. It takes the form: producer ⟶ primary consumer ⟶ secondary consumer ⟶ tertiary consumer Food web: The interconnection of many different food chains in a habitat. Gross primary production (GPP): The total amount of chemical energy stored in plant biomass in a set area or volume. Herbivores: Animals that eat plants, also known as primary consumers. Leaching: The loss of nutrients from the soil due to rainwater. Limiting factor: A variable that limits the rate of a particular reaction. Mycorrhizae: Mutualistic associations between some species of fungi and the roots of many plants that retain water and minerals around the roots. Natural fertilisers: Dead and decaying organic matter used to increase the mineral content of soils. Net primary productivity (NPP): The chemical energy store that remains when energy losses due to respiration are subtracted from the total energy store. This is used in plant growth or reproduction and is also available to other trophic levels. net primary production (NPP) = gross primary production (GPP) – respiratory losses (R) Net production of consumers (N): Calculated by subtracting the chemical	diabetes (insulin-dependent) in which the body cannot produce insulin. It has an early, rapid onset and is treated using insulin injections. Type II diabetes: A form of diabetes (insulin-independent) in which the body does not respond to insulin due to the loss of or unresponsiveness of glycoprotein receptors. In some cases, the body may not produce enough insulin. It has a late, slow onset and is controlled by managing diet and exercise	single template strand using complementary nucleotides. DNA probe: A short, single-stranded segment of DNA that can be fluorescently or radioactively labelled. DNA probes are used to locate specific alleles of genes. DNA sequencing: Determining the entire DNA nucleotide base sequence of an organism. Duplication: A form of gene mutation in which one or more nucleotide bases are repeated. This may result in a frameshift to the right. Epigenetics: The study of changes in gene expression that are not due to alterations in the nucleotide base sequence of DNA. Frameshift mutation: A form of gene mutation in which the addition or deletion of nucleotide bases alters all subsequent triplet codes in a DNA sequence. This often leads to the production of a non-functional protein. Gel electrophoresis: A technique that separates fragments of DNA by size using electric current. Gene machine: A method of artificially manufacturing genes by feeding the desired sequence of bases into a computer. Gene mutation: A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations occur spontaneously and may result in changes to genotype. Gene therapy: A technique in which a functional gene, cloned from a healthy individual, is inserted into cells that lack the gene. Genetically modified

			are made Monosaccharide: The individual sugar monomers from which larger carbohydrates are made. Phospholipid: A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group Polymers: Molecules made from a large number of monomers joined together. Polypeptide: Molecules formed by the condensation of many amino acids. Polysaccharide: Molecules formed by the condensation of many monosaccharides. Primary structure: The individual sequence of amino acids in a protein. Quaternary structure: A structure only applicable to proteins with multiple polypeptide chains that describes the interactions of the different chains. Ribonucleic acid (RNA): A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds. Secondary structure: The local interactions of the amino acids in the polypeptide chain. Semi conservative replication: The production of two daughter DNA molecules from one DNA molecule which both contain one original DNA strand and one newly synthesised strand. Solvent: A substance which other solutes are dissolved in. Starch: A polysaccharide made of alpha glucose monomers that is used as the main storage of energy in plants. Sucrose: A disaccharide			energy lost due to respiration (R) and as a result of excretion and egestion (F) from the chemical energy stored in food. $N = I - (F + R)$ Nitrification: The conversion of ammonium ions to nitrate ions by nitrifying bacteria. This takes place in two stages: ammonium ions are oxidised to nitrite ions; nitrite ions are oxidised to nitrate ions. Nitrifying bacteria: Aerobic microorganisms found in the soil responsible for the oxidation of ammonium ions to nitrate ions. Nitrogen cycle: The cycle through which nitrogen moves between living organisms and the environment, involving ammonification, nitrification, nitrogen fixation and denitrification. Nitrogen fixation: The conversion of atmospheric nitrogen gas into nitrogen-containing compounds by nitrogen-fixing bacteria in the soil or root nodules of legumes. Nitrogen-fixing bacteria: Microorganisms responsible for the conversion of atmospheric nitrogen gas into nitrogen-containing compounds. They can be free-living or mutualistic. Phosphorus cycle: The cycle through which phosphorus (in the form of phosphate ions) moves between living organisms and the environment. This involves absorption by plants, feeding, digestion and excretion by animals, sedimentation and erosion of rocks and the decay of guano, bones and shells. Photosynthesis: A complex		organism (GMO): An organism that has had its genome altered. Genetic counselling: A service that provides information and advice to people affected by or at risk of genetic diseases. This helps individuals and families to make informed decisions. Genetic fingerprinting: A technique used to genetically identify an organism. It has applications in forensics, paternity testing, diagnostics and the breeding of plants and animals. Genetic screening: Testing individuals for certain faulty alleles. Genome: The complete genetic material of an organism. Hypermethylation: Increased methylation of DNA. This results in the inactivation of tumour suppressor genes and the resulting formation of tumours. Hypomethylation: Reduced methylation of DNA. This results in the activation of oncogenes genes and the resulting formation of tumours. Induced pluripotent stem (iPS) cells: Unipotent cells that have been reprogrammed (using transcriptional factors) to become pluripotent stem cells. iPS cells are capable of self-renewal. Inversion: A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence and reattach in the same position but in the reverse order. In vitro: Describes a procedure that takes place outside of a living organism in a controlled environment e.g. DNA is amplified using PCR in a

			formed by condensation of a glucose molecule and a fructose molecule. Tertiary structure: The way that the whole protein folds to make a three dimensional structure. Triglyceride: A type of lipid formed by the condensation of one molecule of glycerol and three molecules of fatty acid.. .			metabolic pathway that consists of three main stages: capturing of light energy, light-dependent reaction, light-independent reaction. Overall, in the presence of light Primary productivity: The rate of primary production; the energy fixed by photosynthesis in a given area in a given period of time (kJ ha-1 year-1). Producers: Photosynthetic organisms at the start of the food chain that manufacture biomass (using light energy, carbon dioxide, water and mineral ions) for all living things. Saprobionts: Microorganisms that break down dead plant and animal material into simpler organic matter to obtain nutrients. Also known as saprophytes. Secondary productivity: The rate of secondary production; the rate at which animals convert the chemical energy in plants they eat into their own biomass in a given area in a given period of time (kJ ha-1 year-1). Trophic level: The position of an organism in a food chain		thermocycler. In vivo: Describes a procedure that takes place inside of a living organism e.g. fragments of DNA can be transferred to a host cell (using a vector) where they are amplified. Malignant: Describes a tumour that is cancerous. Such tumours grow rapidly, are not enclosed in a capsule and can spread to other regions of the body. Treatment involves radiotherapy, chemotherapy or surgery. Marker genes: An additional gene inserted into a plasmid that is used to aid in the identification of host cells that have taken up the desired gene. Marker genes are easily recognisable e.g. fluoresce or provide antibiotic resistance. Metastasis: The process by which cells break off from a primary tumour and spread to other areas of the body, forming secondary tumours. Methylation: The transfer of methyl groups to cytosine bases of DNA. Methylation inhibits transcription by making the DNA less accessible to transcriptional factors or preventing transcriptional factors from binding. This deactivates the gene. Multipotent cells: Stem cells found in mature mammals that can only differentiate into a limited number of cell types (specific to a tissue). Mutagenic agent: An agent that increases the rate of gene mutations above normal level. Mutation: A random change in DNA which may result in genetic variants. Mutation rate: The frequency of mutations per biological

								unit (e.g. per cell division). Non-coding DNA: DNA that does not code for a protein but instead controls gene expression. Oestrogen: A steroid hormone involved in the initiation of transcription. It joins to a receptor site on a transcriptional factor, activating the DNA binding site and stimulating transcription. Oncogenes: Mutations of proto-oncogenes that are activated continuously. Personalised medicine: A form of medical care that enables doctors to provide healthcare customised to an individual's genotype. Pluripotent cells: Stem cells found in embryos that have the ability to differentiate into almost all types of cell. Polymerase Chain Reaction (PCR): An in vitro technique used to rapidly amplify fragments of DNA. Primers: Short nucleotide sequences, complementary to one end of each of the DNA fragments. Promoter: Region of DNA where RNA polymerase binds during transcription. Proto-oncogenes: Genes that stimulate cell division upon the attachment of growth factors to specific receptor proteins on the cell membrane. Recognition sequences: Specific base sequences of DNA that restriction enzymes cut. Recombinant DNA: A combination of DNA from two different organisms. Recombinant DNA technology: The process by which segments of DNA are transferred from one organism to another.

								Restriction endonucleases: Enzymes that cut DNA molecules at recognition sequences creating sticky ends. Reverse transcriptase: An enzyme that synthesises DNA from RNA. Risk factor: A variable associated with a greater chance of developing a disease or infection. RNA interference (RNAi): A method of controlling gene expression by breaking down target mRNA molecules, preventing translation. Silent mutation: A type of substitution mutation that produces the same amino acid due to the degeneracy of the genetic code. Stem cells: Cells that are unspecialised and retain the ability to differentiate into a range of cell types. Sticky ends: The staggered cut formed by restriction endonucleases in double-stranded DNA. Substitution: A form of gene mutation in which one nucleotide base is exchanged for another. Terminator: Region of DNA where RNA polymerase is released, ending transcription. Thermocycler: A machine controlled by a computer that varies temperatures at predetermined time intervals. Totipotent cells: Stem cells found in early mammalian embryos which have the ability to differentiate into any type of body cell. Transformation: The reinsertion of plasmids back into bacterial cells to form transgenic bacteria. This involves mixing

								the plasmids and bacterial cells in a medium containing calcium ions. Tumour: An abnormal mass of cells formed by uncontrolled cell division. Tumour suppressor genes: Genes that slow cell division, repair DNA and cause the breakdown of cells with damaged DNA by apoptosis. Transcriptional factors: Specific molecules which pass from the cytoplasm of a cell into the nucleus, where they bind to complementary base sequences of DNA and initiate transcription. Transgenic organism: An organism that contains recombinant DNA. Translocation of bases: A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence on one chromosome and are added to the DNA sequence on a different chromosome. Unipotent cells: Stem cells found in mature mammals that arise from multipotent cells and can only differentiate into a single cell type. Variable number tandem repeats (VNTRs): Repeated sequences of non-coding nucleotide bases. It is unlikely that two unrelated individuals will have the same VNTRs. Vector: A carrier used to transfer a gene from one organism to another e.g. plasmid. Whole-genome shotgun (WGS) sequencing: A method of sequencing an organism's entire genome. This involves cutting the DNA into small segments and aligning overlapping sections using computer algorithms.

			Year 12 Term 1 Section 1 Biological Molecules (Nucleic Acids)	Year 12 Term 3 Section 3 Organisms exchange substances with their environment (Mass Transport)		year 13 Term 1 Section 6 Organisms respond to changes to their environments (Response to stimuli)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Water Potential)	Year 13 Term 3 Section 8 The control of gene expression (Genome Projects)
			Adenosine triphosphate (ATP): A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups. Amino acid: The monomers containing an amino group (NH2), a carboxyl group (COOH) and a variable R group that make up proteins. Benedict's test: A biochemical test used to test for reducing sugars that produces a different colour based on the amount of reducing sugar present. Biuret test: A biochemical test that produces a purple solution in the presence of protein Cellulose: A polysaccharide made of beta glucose monomers that is used as a structural polysaccharide which provides strength to plant cell walls. Condensation reaction: A type of reaction that joins two molecules together with the formation of a chemical bond involving the elimination of a molecule of water Deoxyribonucleic acid (DNA): An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix. Dipeptide: Molecules formed by the condensation of two amino acids. Disaccharide: Molecules formed by the condensation of two monosaccharides. DNA helicase: An enzyme that breaks the hydrogen bonds between the two DNA strands in	Aorta: The main artery that carries oxygenated blood away from the heart at high pressure. Arteriole: A smaller type of blood vessel that connects arteries with capillaries. Artery: A type of blood vessel that carries blood away from the heart. Atrium: A type of chamber in the heart which receives blood directly from a vein and passes it on to a ventricle. Capillary: A very small blood vessel with thin walls and a small diameter used for substance exchange in tissues. Capillary bed: A network of many different capillaries that supply the tissues with blood. Coronary artery: The main artery that supplies the heart tissue with blood. Haemoglobin: A protein found in red blood cells that has a quaternary structure and is specialised to carry oxygen to the tissues. Left atrium: The chamber in the heart that receives oxygenated blood from the pulmonary vein and passes it on to the left ventricle. Left ventricle: The chamber in the heart that receives oxygenated blood from the left atrium and pumps it out of the heart to the rest of the body. Phloem: A type of tissue found in plants used to transport organic substances from where they are made to where they are needed. Positive cooperativity: Conformational changes caused by the binding of		Auxins: A class of plant hormones that control cell elongation. . . Control mechanism: A self-regulating system consisting of five features: optimum point, receptor, coordinator, effector, and feedback mechanism. Coordinator: Coordinates information from the receptors and sends instructions to the effectors. Effector: An organ, tissue, or cell that produces a response to a stimulus. . Feedback mechanism: The mechanism by which the change to a system, brought about by the effector, is detected by the receptor.. It contains the greatest concentration of cone cells but no rod cells. . Gravitropism: A plant's growth response to gravity. Homeostasis: The maintenance of a constant internal environment in the body, despite fluctuations in internal and external conditions. Hormones: Cell signalling molecules produced by endocrine glands and released into the blood. They travel to target cells and bind to specific receptors, initiating a response. The effects of hormones are usually long-lasting. . Indoleacetic acid (IAA): A plant growth factor that is a type of auxin and controls cell elongation. It stimulates elongation in shoots and inhibits elongation in roots.. Kinesis: A response to a stimulus that is non-	Collecting duct: The final region of the nephron that collects urine from the distal convoluted tubules and empties it into the renal pelvis. Its permeability to water is altered by ADH Control mechanism: A self-regulating system consisting of five features: optimum point receptor, coordinator, effector, and feedback mechanism Coordinator: Coordinates information from the receptors and sends instructions to the effectors Descending limb: The limb of the loop of Henle that dips down into the medulla. It is smaller in diameter than the ascending limb. The walls of the descending limb are permeable to water, so the filtrate loses water as it moves down Distal convoluted tubule: The twisted region of the nephron between the loop of Henle and the collecting duct. It controls blood pH by reabsorbing ions and alters the concentration of water and salts reabsorbed. Its permeability to water is altered by ADH Effector: An organ, tissue, or cell that produces a response to a stimulus Feedback mechanism: The mechanism by which the change to a system, brought about by the effector, is detected by the receptor Glomerular filtrate: The fluid produced by ultrafiltration of the blood into the renal capsule	Acetylation: The addition of acetyl groups to histones. Acetylation activates the gene by making it more accessible to transcription factors. Addition: A form of gene mutation in which one or more nucleotide bases are inserted into a DNA sequence. This may result in a frameshift to the right. Benign: Describes a tumour that is non-cancerous. Such tumours grow slowly, are enclosed in a capsule and remain at the site of origin. They can usually be removed by surgery. Cancer: A non-communicable disease resulting from tumour cells that metastasise. Cellular proteome: The proteins expressed in a given type of cell. Complementary DNA (cDNA): A single strand of DNA complementary to the mRNA template strand. Complete proteome: All of the proteins coded for by the genome. Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may result in a frameshift to the left. Differentiation: A process in which cells become specialised for function. DNA hybridisation: The process by which a single-stranded segment of DNA is combined with a complementary fragment of DNA or RNA. DNA ligase: An enzyme that joins the sugar-phosphate backbone of two DNA

			the DNA molecule that is going to be replicated. DNA polymerase: An enzyme that catalyses the condensation reactions between the new nucleotides in the synthesis of the new DNA strand. Enzyme: A protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions. Glycogen: A highly branched polysaccharide made of alpha glucose monomers that is used as the main storage of energy in humans and animals. Glycosidic bond: A bond between two monosaccharides formed in a condensation reaction. Heat capacity: The amount of energy needed to raise the temperature of a substance by a specific amount Hydrolysis: Breaking a chemical bond between two molecules involving the use of a water molecule. Induced-fit model: A model of enzyme action that describes how enzymes undergo subtle conformational changes to better fit the substrate. Iodine test: A biochemical test used to test for the presence of starch. Lactose: A disaccharide formed by condensation of a glucose molecule and a galactose molecule. Latent heat: The amount of energy needed for a substance to change state. Lipid emulsion test: A biochemical test that produces a cloudy emulsion when performed on lipids. Maltose: A disaccharide formed by condensation of two glucose molecules.	oxygen to haemoglobin that increase the ability of haemoglobin to bind more oxygen. Pulmonary artery: The main artery that carries deoxygenated blood from the heart to the lungs for reoxygenation. Pulmonary vein: The main vein that carries oxygenated blood away from the lungs and back to the heart. Renal artery: The main artery that carries oxygenated blood to the kidneys from the heart. Renal vein: The main vein that carries deoxygenated blood away from the kidneys back to the heart. Right atrium: The chamber in the heart that receives deoxygenated blood directly from the vena cava and passes it on to the right ventricle. Right ventricle: The chamber in the heart that receives deoxygenated blood from the right atrium and pumps it out of the heart to the lungs for reoxygenation. Spongy mesophyll: A type of loosely packed mesophyll tissue with air pockets found in plant leaves which is specialised for gas exchange. Stomata: Small holes found on leaves that can be opened or closed by guard cells to control the amount of water loss and gas exchange. The Bohr effect: A decrease in the affinity of haemoglobin for oxygen in areas with a high carbon dioxide concentration. Tissue fluid: Fluid filtered out from the blood that bathes tissues and provides the cells with substances like food and dissolved gases for		directional, changing the speed at which an organism moves and the rate at which its direction changes. . Negative feedback: A feedback mechanism that inhibits the original stimulus and reverses the change in conditions, restoring the optimum point. Negative tropism: The growth of a plant away from a stimulus. . . Optimum point: The point at which a system works most effectively. . . Phototropism: A plant's growth response to light. Plant growth factors: Hormone-like substances (e.g. IAA) that control the growth of plants in response to external stimuli). Positive feedback: A feedback mechanism that enhances the original stimulus and increases the change in conditions, deviating the system further from the optimum point. Positive tropism: The growth of a plant towards a stimulus. . Receptor: Specialised structure that detects a specific type of stimuli. Response: A change in an organism as a result of a stimulus. complementary to the shape of a particular hormone. Taxis: A response to a stimulus that is directional, i.e. the movement of an organism towards or away from a stimulus.	It contains water, glucose, mineral ions and urea Glomerulus: A bundle of capillaries located in the renal capsule which are adapted for the filtration of blood. They later merge to form the efferent arteriole Homeostasis: The maintenance of a constant internal environment in the body, despite fluctuations in internal and external conditions Hypothalamus: The region of the brain close to the pituitary gland that serves as the control centre for the autonomic nervous system. It is responsible for the regulation of body temperature and the water potential of body fluids Loop of Henle: A loop consisting of a descending limb (dips into the medulla) and ascending limb (rises into the cortex) surrounded by blood capillaries. It creates a low water potential in the medulla, enabling the reabsorption of water Negative feedback: A feedback mechanism that inhibits the original stimulus and reverses the change in conditions, restoring the optimum point Nephron: The functional unit of the mammalian kidney Optimum point: The point at which a system works most effectively Osmoreceptors: Sensory receptor cells located in the hypothalamus that detect a decrease in water potential Osmoregulation: The regulation of the water potential of the blood by the kidney Positive feedback: A feedback mechanism that enhances the original stimulus and	segments. DNA polymerase: An enzyme that synthesises a double-stranded molecule of DNA from a single template strand using complementary nucleotides. DNA probe: A short, single-stranded segment of DNA that can be fluorescently or radioactively labelled. DNA probes are used to locate specific alleles of genes. DNA sequencing: Determining the entire DNA nucleotide base sequence of an organism. Duplication: A form of gene mutation in which one or more nucleotide bases are repeated. This may result in a frameshift to the right. Epigenetics: The study of changes in gene expression that are not due to alterations in the nucleotide base sequence of DNA. Frameshift mutation: A form of gene mutation in which the addition or deletion of nucleotide bases alters all subsequent triplet codes in a DNA sequence. This often leads to the production of a non-functional protein. Gel electrophoresis: A technique that separates fragments of DNA by size using electric current. Gene machine: A method of artificially manufacturing genes by feeding the desired sequence of bases into a computer. Gene mutation: A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations occur spontaneously and may result in changes to genotype. Gene therapy: A technique in which a functional gene,

			Metabolite: A molecule formed or used in metabolic reactions. Monomers: The smaller units from which larger molecules are made Monosaccharide: The individual sugar monomers from which larger carbohydrates are made. Phospholipid: A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group Polymers: Molecules made from a large number of monomers joined together. Polypeptide: Molecules formed by the condensation of many amino acids. Polysaccharide: Molecules formed by the condensation of many monosaccharides. Primary structure: The individual sequence of amino acids in a protein. Quaternary structure: A structure only applicable to proteins with multiple polypeptide chains that describes the interactions of the different chains. Ribonucleic acid (RNA): A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds. Secondary structure: The local interactions of the amino acids in the polypeptide chain. Semi conservative replication: The production of two daughter DNA molecules from one DNA molecule which both contain one original DNA strand and one newly synthesised strand. Solvent: A substance which other solutes are dissolved in. Starch: A polysaccharide	exchange. Vein: A type of blood vessel that carries blood into the heart from other parts of the body. Vena cava: The main vein that carries deoxygenated blood into the right atrium of the heart. Ventricle: A type of chamber in the heart which receives blood from the atrium above it and pumps it out of the heart. Venule: A smaller type of blood vessel that connects capillaries with veins. Xerophyte: A type of plant that is adapted to survive in places with very little water. Xylem: The tissue that transports water in the stem and leaves of plants.			increases the change in conditions, deviating the system further from the optimum point Posterior pituitary gland: The gland responsible for the secretion of ADH into the bloodstream Proximal convoluted tubule: The twisted portion of the nephron between the renal capsule and the loop of Henle. Its walls consist of epithelial cells that are adapted for the reabsorption of glucose and water into the blood Renal (Bowman's) capsule: The cup-like structure at the start of a nephron that surrounds the glomerulus. The inner layer of the capsule, through which filtration of the blood takes place, is composed of podocytes	cloned from a healthy individual, is inserted into cells that lack the gene. Genetically modified organism (GMO): An organism that has had its genome altered. Genetic counselling: A service that provides information and advice to people affected by or at risk of genetic diseases. This helps individuals and families to make informed decisions. Genetic fingerprinting: A technique used to genetically identify an organism. It has applications in forensics, paternity testing, diagnostics and the breeding of plants and animals. Genetic screening: Testing individuals for certain faulty alleles. Genome: The complete genetic material of an organism. Hypermethylation: Increased methylation of DNA. This results in the inactivation of tumour suppressor genes and the resulting formation of tumours. Hypomethylation: Reduced methylation of DNA. This results in the activation of oncogenes genes and the resulting formation of tumours. Induced pluripotent stem (iPS) cells: Unipotent cells that have been reprogrammed (using transcriptional factors) to become pluripotent stem cells. iPS cells are capable of self-renewal. Inversion: A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence and reattach in the same position but in the reverse order. In vitro: Describes a

			made of alpha glucose monomers that is used as the main storage of energy in plants. Sucrose: A disaccharide formed by condensation of a glucose molecule and a fructose molecule. Tertiary structure: The way that the whole protein folds to make a three dimensional structure. Triglyceride: A type of lipid formed by the condensation of one molecule of glycerol and three molecules of fatty acid.. .					procedure that takes place outside of a living organism in a controlled environment e.g. DNA is amplified using PCR in a thermocycler. In vivo: Describes a procedure that takes place inside of a living organism e.g. fragments of DNA can be transferred to a host cell (using a vector) where they are amplified. Malignant: Describes a tumour that is cancerous. Such tumours grow rapidly, are not enclosed in a capsule and can spread to other regions of the body. Treatment involves radiotherapy, chemotherapy or surgery. Marker genes: An additional gene inserted into a plasmid that is used to aid in the identification of host cells that have taken up the desired gene. Marker genes are easily recognisable e.g. fluoresce or provide antibiotic resistance. Metastasis: The process by which cells break off from a primary tumour and spread to other areas of the body, forming secondary tumours. Methylation: The transfer of methyl groups to cytosine bases of DNA. Methylation inhibits transcription by making the DNA less accessible to transcriptional factors or preventing transcriptional factors from binding. This deactivates the gene. Multipotent cells: Stem cells found in mature mammals that can only differentiate into a limited number of cell types (specific to a tissue). Mutagenic agent: An agent that increases the rate of gene mutations above normal level.

								Mutation: A random change in DNA which may result in genetic variants. Mutation rate: The frequency of mutations per biological unit (e.g. per cell division). Non-coding DNA: DNA that does not code for a protein but instead controls gene expression. Oestrogen: A steroid hormone involved in the initiation of transcription. It joins to a receptor site on a transcriptional factor, activating the DNA binding site and stimulating transcription. Oncogenes: Mutations of proto-oncogenes that are activated continuously. Personalised medicine: A form of medical care that enables doctors to provide healthcare customised to an individual's genotype. Pluripotent cells: Stem cells found in embryos that have the ability to differentiate into almost all types of cell. Polymerase Chain Reaction (PCR): An in vitro technique used to rapidly amplify fragments of DNA. Primers: Short nucleotide sequences, complementary to one end of each of the DNA fragments. Promoter: Region of DNA where RNA polymerase binds during transcription. Proto-oncogenes: Genes that stimulate cell division upon the attachment of growth factors to specific receptor proteins on the cell membrane. Recognition sequences: Specific base sequences of DNA that restriction enzymes cut. Recombinant DNA: A combination of DNA from two different organisms. Recombinant DNA

								technology: The process by which segments of DNA are transferred from one organism to another. Restriction endonucleases: Enzymes that cut DNA molecules at recognition sequences creating sticky ends. Reverse transcriptase: An enzyme that synthesises DNA from RNA. Risk factor: A variable associated with a greater chance of developing a disease or infection. RNA interference (RNAi): A method of controlling gene expression by breaking down target mRNA molecules, preventing translation. Silent mutation: A type of substitution mutation that produces the same amino acid due to the degeneracy of the genetic code. Stem cells: Cells that are unspecialised and retain the ability to differentiate into a range of cell types. Sticky ends: The staggered cut formed by restriction endonucleases in double-stranded DNA. Substitution: A form of gene mutation in which one nucleotide base is exchanged for another. Terminator: Region of DNA where RNA polymerase is released, ending transcription. Thermocycler: A machine controlled by a computer that varies temperatures at predetermined time intervals. Totipotent cells: Stem cells found in early mammalian embryos which have the ability to differentiate into any type of body cell.

								Transformation: The reinsertion of plasmids back into bacterial cells to form transgenic bacteria. This involves mixing the plasmids and bacterial cells in a medium containing calcium ions. Tumour: An abnormal mass of cells formed by uncontrolled cell division. Tumour suppressor genes: Genes that slow cell division, repair DNA and cause the breakdown of cells with damaged DNA by apoptosis. Transcriptional factors: Specific molecules which pass from the cytoplasm of a cell into the nucleus, where they bind to complementary base sequences of DNA and initiate transcription. Transgenic organism: An organism that contains recombinant DNA. Translocation of bases: A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence on one chromosome and are added to the DNA sequence on a different chromosome. Unipotent cells: Stem cells found in mature mammals that arise from multipotent cells and can only differentiate into a single cell type. Variable number tandem repeats (VNTRs): Repeated sequences of non-coding nucleotide bases. It is unlikely that two unrelated individuals will have the same VNTRs. Vector: A carrier used to transfer a gene from one organism to another e.g. plasmid. Whole-genome shotgun (WGS) sequencing: A method of sequencing an organism's entire genome. This involves

								cutting the DNA into small segments and aligning overlapping sections using computer algorithms.
			Year 12 Term 1 Section 1 Biological Molecules (ATP, Water and Inorganic ions)	Year 12 Term 2 Section 4 Genetic Information, variation and relationships between organisms (DNA, Genes and Chromosomes)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Nervous Coordination)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Inheritance)	Year 13 Term 3 Section 8 The control of gene expression (Recombinant DNA technology)
			Adenosine triphosphate (ATP): A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups. Amino acid: The monomers containing an amino group (NH2), a carboxyl group (COOH) and a variable R group that make up proteins. Benedict's test: A biochemical test used to test for reducing sugars that produces a different colour based on the amount of reducing sugar present. Biuret test: A biochemical test that produces a purple solution in the presence of protein Cellulose: A polysaccharide made of beta glucose monomers that is used as a structural polysaccharide which provides strength to plant cell walls. Condensation reaction: A type of reaction that joins two molecules together with the formation of a chemical bond involving the elimination of a molecule of water Deoxyribonucleic acid (DNA): An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix. Dipeptide: Molecules formed by the condensation of two	Allele: A version of a gene. Anticodon: A sequence of three nucleotide bases at one end of a tRNA molecule that is specific to an mRNA codon. Arithmetic mean: The average of a set of numbers calculated by dividing the sum of the values by the number of values. Cellular proteome: The proteins expressed in a given type of cell. Chromatid: One strand of a replicated chromosome. Chromosome: A structure consisting of a long, coiled molecule of DNA and its associated proteins, by which genetic information is passed from generation to generation. Chromosome mutation: A change to the number or structure of chromosomes that can occur spontaneously. Codon: A sequence of three bases on mRNA that codes for a specific amino acid. Crossing over: The process in meiosis 1 in which homologous chromosomes pair up, their chromatids wrap around one another and their alleles are exchanged at equivalent portions of chromatids. This creates genetic variation. Degenerate: A feature of the genetic code; more than one triplet can code for a particular		Acetylcholine: A type of neurotransmitter that is used for communication between neurones. Action potential: The temporary change in electrical potential across the membrane of an axon in response to the transmission of a nerve impulse. Adenylate cyclase: An enzyme that catalyses the conversion of ATP to cAMP. Adrenaline: A hormone that is secreted by the adrenal glands under stressful conditions. It increases blood glucose concentration by activating enzymes involved in glycogenolysis. . All-or-nothing: A principle that states that all stimuli above a certain threshold value will generate the same size of action potential, regardless of the strength of the stimulus. Anisotropic (A) bands: The darker bands in a myofibril, which consist of overlapping actin and myosin filaments. Antagonistic muscles: Pairs of muscles that work in opposite directions. Antidiuretic hormone (ADH): A hormone made by the hypothalamus and secreted by the . Atrioventricular node (AVN): A group of cells located between the atria that slow down the	Allele: A version of a gene. Allele frequency: The number of times an allele appears within a population's gene pool. Autosomal linkage: When two or more genes are positioned on the same autosome. They are unlikely to be separated by crossing over during meiosis so are often inherited together. Autosome: A chromosome that is not an X or Y chromosome. Codominant: When both alleles for a gene in a heterozygous organism equally contribute to the phenotype. Dihybrid inheritance: The inheritance of two different genes, that determine two phenotypes, on two different chromosomes. Diploid: Describes a cell with a nucleus containing two sets of chromosomes. Directional selection: A type of selection that favours one extreme phenotype and selects against all other phenotypes. Disruptive selection: A type of selection that favours individuals with extreme phenotypes and selects against those with phenotypes close to the mean. Dominant: Describes an allele that is always expressed. Represented by a capital letter. Epistasis: Describes a	Acetylation: The addition of acetyl groups to histones. Acetylation activates the gene by making it more accessible to transcription factors. Addition: A form of gene mutation in which one or more nucleotide bases are inserted into a DNA sequence. This may result in a frameshift to the right. Benign: Describes a tumour that is non-cancerous. Such tumours grow slowly, are enclosed in a capsule and remain at the site of origin. They can usually be removed by surgery. Cancer: A non-communicable disease resulting from tumour cells that metastasise. Cellular proteome: The proteins expressed in a given type of cell. Complementary DNA (cDNA): A single strand of DNA complementary to the mRNA template strand. Complete proteome: All of the proteins coded for by the genome. Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may result in a frameshift to the left. Differentiation: A process in which cells become specialised for function. DNA hybridisation: The

			amino acids. Disaccharide: Molecules formed by the condensation of two monosaccharides. DNA helicase: An enzyme that breaks the hydrogen bonds between the two DNA strands in the DNA molecule that is going to be replicated. DNA polymerase: An enzyme that catalyses the condensation reactions between the new nucleotides in the synthesis of the new DNA strand. Enzyme: A protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions. Glycogen: A highly branched polysaccharide made of alpha glucose monomers that is used as the main storage of energy in humans and animals. Glycosidic bond: A bond between two monosaccharides formed in a condensation reaction. Heat capacity: The amount of energy needed to raise the temperature of a substance by a specific amount Hydrolysis: Breaking a chemical bond between two molecules involving the use of a water molecule. Induced-fit model: A model of enzyme action that describes how enzymes undergo subtle conformational changes to better fit the substrate. Iodine test: A biochemical test used to test for the presence of starch. Lactose: A disaccharide formed by condensation of a glucose molecule and a galactose molecule. Latent heat: The amount of energy needed for a substance to change state.	amino acid. Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may change all amino acids in a sequence, rendering the protein non-functional. Eukaryotic DNA: Linear molecules of DNA which, together with histones, form chromosomes. DNA in the mitochondria and chloroplasts of eukaryotic cells is circular and does not have associated proteins. Exon: A sequence of DNA that codes for an amino acid sequence. Fertilisation: The random fusion of haploid gametes during fertilisation to produce a diploid zygote. Genetic information is mixed, creating genetic variation. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene mutation: A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations can occur spontaneously during DNA replication. Generic name: Denotes the organism's genus. The first letter is written in upper case, e.g. Homo. Genetic code: The rules by which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is degenerate, universal and non-overlapping. Genetic diversity: The number of different alleles in a population. Genetic diversity between		wave of excitation and pass it between the ventricles, along the bundle of His. Atrioventricular septum: A layer of non-conductive tissue between the right atrium and left ventricle of the mammalian heart. Autonomic nervous system: A branch of the motor nervous system that carries nerve impulses to muscles and glands. It controls involuntary activities and has two divisions: the sympathetic nervous system and the parasympathetic nervous system.. Axon: A long fibre that conducts nerve impulses away from the cell body. Bundle of His: A collection of Purkyne fibres which run from the AVN down to the apex of the ventricles. Cell body: The region of the neurone that contains the organelles, notably the nucleus and the rough endoplasmic reticulum. Central nervous system (CNS): The brain and spinal cord. Chemoreceptor: A type of receptor found in the walls of the carotid arteries that detects changes in blood pH and transmits nerve impulses to the medulla oblongata. For example, if blood pH decreases, chemoreceptors increase the frequency of nerve impulses to the medulla oblongata. Cholinergic synapse: An excitatory or inhibitory synapse formed between neurones or neurones and other effector organs. It uses the neurotransmitter, acetylcholine. . Cone cells: A type of light	relationship between genes where the allele of one gene affects the expression of a different gene. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene pool: All of the different versions of genes (alleles) in the individuals that make up a population. Genetic drift: Variations in allele frequencies in small populations due to chance. Genetic variation: Differences in genotypes between members of a population which may occur due to mutations, meiosis, or random fertilisation. Genotype: An organism's genetic composition. Describes all alleles. Hardy-Weinberg principle: A model that predicts that the ratio of dominant and recessive alleles in a population will remain constant between generations if the following five conditions are met: no new mutations; no natural selection; no migration; large population; and random mating. It provides an equation for calculating the frequencies of alleles: p2+ 2pq + q2= 1.0 where p is the frequency of the dominant allele, and q is the frequency of the recessive allele. Heterozygous: When someone has two different alleles of a gene e.g. Ff. Homozygous: When someone has two identical alleles of a gene e.g. ff. Locus: The position of a gene on a chromosome. Monohybrid inheritance: The	process by which a single-stranded segment of DNA is combined with a complementary fragment of DNA or RNA. DNA ligase: An enzyme that joins the sugar-phosphate backbone of two DNA segments. DNA polymerase: An enzyme that synthesises a double-stranded molecule of DNA from a single template strand using complementary nucleotides. DNA probe: A short, single-stranded segment of DNA that can be fluorescently or radioactively labelled. DNA probes are used to locate specific alleles of genes. DNA sequencing: Determining the entire DNA nucleotide base sequence of an organism. Duplication: A form of gene mutation in which one or more nucleotide bases are repeated. This may result in a frameshift to the right. Epigenetics: The study of changes in gene expression that are not due to alterations in the nucleotide base sequence of DNA. Frameshift mutation: A form of gene mutation in which the addition or deletion of nucleotide bases alters all subsequent triplet codes in a DNA sequence. This often leads to the production of a non-functional protein. Gel electrophoresis: A technique that separates fragments of DNA by size using electric current. Gene machine: A method of artificially manufacturing genes by feeding the desired sequence of bases into a computer. Gene mutation: A change to at least one nucleotide base

			Lipid emulsion test: A biochemical test that produces a cloudy emulsion when performed on lipids. Maltose: A disaccharide formed by condensation of two glucose molecules. Metabolite: A molecule formed or used in metabolic reactions. Monomers: The smaller units from which larger molecules are made Monosaccharide: The individual sugar monomers from which larger carbohydrates are made. Phospholipid: A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group Polymers: Molecules made from a large number of monomers joined together. Polypeptide: Molecules formed by the condensation of many amino acids. Polysaccharide: Molecules formed by the condensation of many monosaccharides. Primary structure: The individual sequence of amino acids in a protein. Quaternary structure: A structure only applicable to proteins with multiple polypeptide chains that describes the interactions of the different chains. Ribonucleic acid (RNA): A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds. Secondary structure: The local interactions of the amino acids in the polypeptide chain. Semi conservative replication: The production of two daughter DNA molecules from one DNA molecule which both	organisms can be investigated by comparing observable characteristics, DNA and mRNA base sequences and amino acid sequences. Genome: The entire set of genes in a cell. Histones: Proteins that, together with DNA, form chromosomes in the nuclei of eukaryotic cells. Homologous chromosomes: A chromosome pair, one paternal and one maternal, with the same gene loci. Independent segregation: The random separation of homologous chromosomes in meiosis 1 that produces genetic variation. Index of diversity (d): Describes the relationship between the number of different species and the abundance of individuals in each of these species within a community. It is calculated using the formula: where d is the index of diversity, N is the total number of organisms of all species and n is the total number of organisms of each species. Intron: A non-coding sequence of DNA. Locus: The position of a gene on a chromosome. Mean (normal distribution curve): A measure of the maximum height of a normal distribution curve. Meiosis: A type of cell division that produces four genetically different daughter cells (gametes) with a haploid number of chromosomes. It involves two divisions. Messenger RNA (mRNA): A type of RNA that carries genetic information from the nucleus to the ribosomes for protein		receptor cell that transduces light energy into a generator potential. Cone cells are concentrated in the fovea, detect light of high intensity, and lead to colour images. One cone cell forms a synapse with a single bipolar cell, giving high visual acuity. Control mechanism: A self-regulating system consisting of five features: optimum point, receptor, coordinator, effector, and feedback mechanism. Coordinator: Coordinates information from the receptors and sends instructions to the effectors. Cyclic AMP (cAMP): A 'second messenger' involved in the action of adrenaline that activates protein kinase. Dendrites: Short, branched extensions of the cell body that receive nerve impulses from other neurones. Dendrons: Extensions of the cell body which branch into smaller fibres, dendrites. Depolarisation: A sudden, temporary change in the membrane potential of a neurone in response to the transmission of a nerve impulse. The inside of the axon is less negative than the outside. Effector: An organ, tissue, or cell that produces a response to a stimulus. Efferent arteriole: The blood vessel that carries blood away from the glomerulus and sub-divides to form a network of capillaries. Its diameter is smaller than the afferent arteriole, creating a build up of hydrostatic pressure in the glomerulus.	inheritance of one gene. Multiple alleles: When a gene has more than two potential alleles. Phenotype: An organism's observable characteristics. Due to interactions of the genotype and the environment. Recessive: Describes an allele that is only expressed in the absence of a dominant allele. Represented by a small letter. Sex-linkage: The presence of a gene on an X or Y chromosome. Variation: The differences between individuals due to genes, the environment or a combination of both	in DNA or the arrangement of bases. Gene mutations occur spontaneously and may result in changes to genotype. Gene therapy: A technique in which a functional gene, cloned from a healthy individual, is inserted into cells that lack the gene. Genetically modified organism (GMO): An organism that has had its genome altered. Genetic counselling: A service that provides information and advice to people affected by or at risk of genetic diseases. This helps individuals and families to make informed decisions. Genetic fingerprinting: A technique used to genetically identify an organism. It has applications in forensics, paternity testing, diagnostics and the breeding of plants and animals. Genetic screening: Testing individuals for certain faulty alleles. Genome: The complete genetic material of an organism. Hypermethylation: Increased methylation of DNA. This results in the inactivation of tumour suppressor genes and the resulting formation of tumours. Hypomethylation: Reduced methylation of DNA. This results in the activation of oncogenes genes and the resulting formation of tumours. Induced pluripotent stem (iPS) cells: Unipotent cells that have been reprogrammed (using transcriptional factors) to become pluripotent stem cells. iPS cells are capable of self-renewal.

			contain one original DNA strand and one newly synthesised strand. Solvent: A substance which other solutes are dissolved in. Starch: A polysaccharide made of alpha glucose monomers that is used as the main storage of energy in plants. Sucrose: A disaccharide formed by condensation of a glucose molecule and a fructose molecule. Tertiary structure: The way that the whole protein folds to make a three dimensional structure. Triglyceride: A type of lipid formed by the condensation of one molecule of glycerol and three molecules of fatty acid.. .	synthesis. It is a single helix consisting of thousands of mononucleotides. Mitosis: A form of cell division that produces two genetically identical diploid daughter cells. Mutagenic agent: An agent that increases the rate of gene mutations above normal level. Natural selection: The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time. Non-coding sequence: A sequence of DNA that does not code for an amino acid sequence e.g. repeating base sequences and introns. Non-coding sequences make up significant portions of eukaryotic nuclear DNA. Non-disjunction: A change in the number of chromosomes due to the failure of homologous chromosomes to separate during meiosis. This may result in a gamete with one more or one less chromosome. Non-overlapping: A feature of the genetic code; each base in a sequence is read once and is only part of one triplet. Prokaryotic DNA: Circular pieces of DNA that do not have associated proteins. Recombination: When broken-off pieces of chromatid combine with another chromatid on a different chromosome during crossing over. Ribosomes: Sub-cellular structures where protein synthesis takes place. Ribosomes consist of a small subunit and a large subunit. RNA polymerase: An enzyme that moves along the DNA template strand and joins		Excitatory synapse: A synapse that produces new action potentials when neurotransmitters bind with receptor proteins on the postsynaptic neurone. . Feedback mechanism: The mechanism by which the change to a system, brought about by the effector, is detected by the receptor. Fovea: The point on the retina, opposite the pupil, that receives the highest intensity of light. It contains the greatest concentration of cone cells but no rod cells. Generator potential: Depolarisation of the membrane of a sensory receptor cell that occurs in response to a stimulus. Gluconeogenesis: The formation of glucose from sources that are not carbohydrate, e.g. amino acids and glycerol. Glycogenesis: The formation of glycogen from glucose in the liver. Glycogenolysis: The breakdown of glycogen into glucose in the liver. . . Hyperpolarisation: A decrease in the membrane potential of an axon, so that it is even more negative than the resting potential. Hypothalamus: The region of the brain close to the pituitary gland that serves as the control centre for the autonomic nervous system. It is responsible for the regulation of body temperature and the water potential of body fluids. H-zone: The lighter region in the centre of each A band. . Inhibitory synapse: A synapse that decreases the likelihood of an action potential in the postsynaptic neurone by		Inversion: A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence and reattach in the same position but in the reverse order. In vitro: Describes a procedure that takes place outside of a living organism in a controlled environment e.g. DNA is amplified using PCR in a thermocycler. In vivo: Describes a procedure that takes place inside of a living organism e.g. fragments of DNA can be transferred to a host cell (using a vector) where they are amplified. Malignant: Describes a tumour that is cancerous. Such tumours grow rapidly, are not enclosed in a capsule and can spread to other regions of the body. Treatment involves radiotherapy, chemotherapy or surgery. Marker genes: An additional gene inserted into a plasmid that is used to aid in the identification of host cells that have taken up the desired gene. Marker genes are easily recognisable e.g. fluoresce or provide antibiotic resistance. Metastasis: The process by which cells break off from a primary tumour and spread to other areas of the body, forming secondary tumours. Methylation: The transfer of methyl groups to cytosine bases of DNA. Methylation inhibits transcription by making the DNA less accessible to transcriptional factors or preventing transcriptional factors from binding. This deactivates the gene. Multipotent cells: Stem cells found in mature mammals

				adjacent nucleotides to form pre-mRNA. Splicing: The process following transcription in eukaryotic cells in which introns are removed from pre-mRNA and exons are joined together to form mRNA. Substitution: A form of gene mutation in which one nucleotide base is exchanged for another. This may change an amino acid or produce the same amino acid (due to the degeneracy of the genetic code). Transcription: The formation of pre-mRNA in eukaryotes and mRNA in prokaryotes from a section of the template strand of DNA. It is the first stage of protein synthesis. Transfer RNA (tRNA): A form of RNA that carries specific amino acids to the ribosomes. It is single-stranded and takes a clover-leaf shape. One side is longer than the other enabling the attachment of an amino acid. At the opposite end is an anticodon specific to the amino acid. Translation: The second phase of protein synthesis that takes place in the ribosomes. mRNA is used as a template for the attachment of tRNA molecules with complementary anticodons. The amino acids carried on adjacent tRNA molecules are joined to form a polypeptide chain. Triplet: A sequence of three bases that codes for an amino acid. Universal: A feature of the genetic code; the code is the same in almost all organisms. This is evidence for evolution.		causing potassium ions (K+) to leave the postsynaptic neurone and chloride ions (Cl-) to enter. This results in hyperpolarisation of the postsynaptic neurone. . Intermediate neurone: A neurone located in the spinal cord that links the sensory neurone to the motor neurone. Iodopsin: The pigment found in cone cells. . . . Medulla oblongata: The part of the brain that controls heart rate. It is made up of two centres that are linked to the SAN. One centre is linked by the sympathetic nervous system and increases heart rate. The other is linked by the parasympathetic nervous system and decreases heart rate. Motor neurone: A neurone that carries nerve impulses from the CNS to the effectors. . Myogenic: Describes cardiac muscle tissue that initiates its own contraction without outside stimulation from nervous impulses. . Nephron: The functional unit of the mammalian kidney. Nerve impulse: A wave of depolarisation that travels across an axon membrane. It is self-propagating. Neuromuscular junction: An excitatory synapse formed between a motor neurone and a muscle fibre that uses the neurotransmitter, acetylcholine. Neurones: Nerve cells adapted to quickly transmit nerve impulses. Neurotransmitters: Chemicals that are used for communication between neurones and their target cells.		that can only differentiate into a limited number of cell types (specific to a tissue). Mutagenic agent: An agent that increases the rate of gene mutations above normal level. Mutation: A random change in DNA which may result in genetic variants. Mutation rate: The frequency of mutations per biological unit (e.g. per cell division). Non-coding DNA: DNA that does not code for a protein but instead controls gene expression. Oestrogen: A steroid hormone involved in the initiation of transcription. It joins to a receptor site on a transcriptional factor, activating the DNA binding site and stimulating transcription. Oncogenes: Mutations of proto-oncogenes that are activated continuously. Personalised medicine: A form of medical care that enables doctors to provide healthcare customised to an individual's genotype. Pluripotent cells: Stem cells found in embryos that have the ability to differentiate into almost all types of cell. Polymerase Chain Reaction (PCR): An in vitro technique used to rapidly amplify fragments of DNA. Primers: Short nucleotide sequences, complementary to one end of each of the DNA fragments. Promoter: Region of DNA where RNA polymerase binds during transcription. Proto-oncogenes: Genes that stimulate cell division upon the attachment of growth factors to specific receptor proteins on the cell membrane.

				Variation: The differences between individuals due to genes, the environment or a combination of both.		Neurotransmitters are stored in synaptic vesicles in the presynaptic neurone and released into the synaptic cleft. Nodes of Ranvier: Gaps between adjacent Schwann cells in the myelin sheath at which action potentials can occur. Optic nerve: A nerve that carries electrical impulses to the brain from the retina. Optimum point: The point at which a system works most effectively. Osmoreceptors: Sensory receptor cells located in the hypothalamus that detect a decrease in water potential.. Pacinian corpuscle: A sensory receptor that detects changes in mechanical pressure. Parasympathetic nervous system: A branch of the autonomic nervous system that is active under normal, resting conditions. It inhibits effectors, slowing down activity. Peripheral nervous system (PNS): Pairs of nerves that originate from the CNS and carry nerve impulses into and out of the CNS. It is divided into the sensory nervous system and motor nervous system. . Polarisation: Describes the condition in which an axon has a membrane potential of -65mV (resting potential). Postsynaptic neurone: The neurone after the synapse which contains specific receptor proteins on its membrane, complementary to the neurotransmitter. Pressure receptors: A type of receptor found in the walls of the carotid arteries and aorta which detects changes in blood pressure and transmits		Recognition sequences: Specific base sequences of DNA that restriction enzymes cut. Recombinant DNA: A combination of DNA from two different organisms. Recombinant DNA technology: The process by which segments of DNA are transferred from one organism to another. Restriction endonucleases: Enzymes that cut DNA molecules at recognition sequences creating sticky ends. Reverse transcriptase: An enzyme that synthesises DNA from RNA. Risk factor: A variable associated with a greater chance of developing a disease or infection. RNA interference (RNAi): A method of controlling gene expression by breaking down target mRNA molecules, preventing translation. Silent mutation: A type of substitution mutation that produces the same amino acid due to the degeneracy of the genetic code. Stem cells: Cells that are unspecialised and retain the ability to differentiate into a range of cell types. Sticky ends: The staggered cut formed by restriction endonucleases in double-stranded DNA. Substitution: A form of gene mutation in which one nucleotide base is exchanged for another. Terminator: Region of DNA where RNA polymerase is released, ending transcription. Thermocycler: A machine controlled by a computer

						nerve impulses to the medulla oblongata. For example, if blood pressure increases, pressure receptors increase the frequency of nerve impulses to the medulla oblongata. Presynaptic neurone: The neurone before the synapse which releases neurotransmitters from synaptic vesicles into the synaptic cleft. . Purkyne tissue: Specialised cardiac muscle fibres which conduct the wave of excitation from the AVN down to the apex of the ventricles. Receptor: Specialised structure that detects a specific type of stimulus. Reflex: A rapid, automatic response to a sensory stimulus by the body. It serves as a protective mechanism. Reflex arc: The pathway of neurones involved in a reflex action: Refractory period: The time period after an action potential during which further action potentials are prevented. This ensures that action potentials can only be propagated in one direction. It limits the frequency of action potentials and ensures nervous impulses are discrete. Repolarisation: The re-establishment of the resting potential (-65mV). Response: A change in an organism as a result of a stimulus. Resting potential: An electrical potential difference of -65 mV across the membrane of an axon. The inside of the axon is more negative than the outside. The membrane is described as polarised.		that varies temperatures at predetermined time intervals. Totipotent cells: Stem cells found in early mammalian embryos which have the ability to differentiate into any type of body cell. Transformation: The reinsertion of plasmids back into bacterial cells to form transgenic bacteria. This involves mixing the plasmids and bacterial cells in a medium containing calcium ions. Tumour: An abnormal mass of cells formed by uncontrolled cell division. Tumour suppressor genes: Genes that slow cell division, repair DNA and cause the breakdown of cells with damaged DNA by apoptosis. Transcriptional factors: Specific molecules which pass from the cytoplasm of a cell into the nucleus, where they bind to complementary base sequences of DNA and initiate transcription. Transgenic organism: An organism that contains recombinant DNA. Translocation of bases: A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence on one chromosome and are added to the DNA sequence on a different chromosome. Unipotent cells: Stem cells found in mature mammals that arise from multipotent cells and can only differentiate into a single cell type. Variable number tandem repeats (VNTRs): Repeated sequences of non-coding nucleotide bases. It is unlikely that two unrelated individuals will have the same VNTRs. Vector: A carrier used to

						Retina: The inner layer of the mammalian eye. It consists of light receptor cells that act as transducers, converting light energy into electrical energy. Rhodopsin: The pigment found in rod cells which is broken down to create a generator potential. Rod cells: A type of light receptor cell that transduces light energy into a generator potential. They are located at the periphery of the retina, detect light of low intensity and lead to black and white images. Many rod cells form a synapse with a single bipolar cell, giving low visual acuity. Saltatory conduction: The process by which a nerve impulse is propagated along a myelinated neurone. Depolarisation occurs at the nodes of Ranvier and action potentials jump from node to node, speeding up transmission. . Sensory neurone: A neurone that carries nerve impulses from the receptors to the CNS. Sinoatrial node (SAN): A group of cells in the wall of the right atrium that generate electrical activity. The SAN is often referred to as the heart's pacemaker. . . Sodium-potassium pump: A carrier protein found in the plasma membrane of an axon. It actively transports three sodium ions (Na+) out of the axon for every two potassium ions (K+) that it pumps into the axon. Spatial summation: A type of summation involving the release of neurotransmitters from multiple presynaptic		transfer a gene from one organism to another e.g. plasmid. Whole-genome shotgun (WGS) sequencing: A method of sequencing an organism's entire genome. This involves cutting the DNA into small segments and aligning overlapping sections using computer algorithms.

							neurones. The concentration of neurotransmitter exceeds the threshold value and triggers an action potential in the postsynaptic neurone. Stimulus: A change in an organism's internal or external environment that can be detected. Stretch-mediated sodium channel: A type of sodium channel whose permeability to sodium changes upon distortion (e.g. pressure changes, stretching). They are found in the plasma membrane of the sensory neurone ending at the centre of the Pacinian corpuscle. Summation: The build-up of neurotransmitters in the synaptic cleft, allowing low-frequency action potentials to trigger a new action potential in the postsynaptic neurone. There are two forms of summation: spatial and temporal. Sympathetic nervous system: A branch of the autonomic nervous system that is active under stressful conditions. It stimulates effectors, speeding up activity. Synaptic cleft: A small gap between neurones across which a nerve impulse is transmitted via neurotransmitters. Synaptic vesicles: Secretory vesicles located in the presynaptic neurone that store neurotransmitters. Upon fusion with the presynaptic membrane, their contents are released into the synaptic cleft. . Temporal summation: A type of summation involving the release of neurotransmitters from a single presynaptic neurone at a high frequency. The concentration of		

						neurotransmitter exceeds the threshold value and triggers an action potential in the postsynaptic neurone. Threshold value: A certain size of stimulus that is required to generate an action potential. Transducer cells: Cells that convert one form of energy into an electrical signal. . cases, the body may not produce enough insulin. It has a late, slow onset and is controlled by managing diet and exercise. Unidirectionality: Describes synaptic transmission; synapses can only transmit information in a single direction, from the presynaptic neurone to the postsynaptic neurone. Visual acuity: The clarity of vision.		
			Year 12 Term 1 Section 2 Cells (Cell Structure)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Protein Synthesis and Genetic Diversity)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Synaptic Transmission)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Genetic Crosses)	

Active immunity: A form of immunity provided by the immune response of the body upon detection of a pathogen.
Active transport: The active movement of substances from a low concentration to a higher concentration (up their concentration gradient) with the use of energy in the form of ATP.
Agglutination: The clumping together of cells or particles caused by antibodies which assists phagocytosis.
Antibody: A protein found in the blood that is produced by plasma cells which binds to antigens as a part of the immune response.
Antigen: Marker molecules that can be detected by antibodies and trigger an immune response.
Binary fission: The method of cell division used by prokaryotes involving replication of the circular DNA and plasmids followed by cytoplasmic division.
Cell cycle: The series of stages preparing the cell for division consisting of interphase and mitosis.
Cell-surface membrane: A phospholipid bilayer studded with proteins that surrounds cells and separates them from their environment.
Cell vacuole: A membrane bound structure found in plant cells that contains cell sap.
Cell wall: A permeable layer that surrounds plant, algae and fungi cells made of polysaccharides which provides strength to the cell.
Chloroplast: An organelle found in plants and algae that is the site of photosynthesis.
Clonal expansion: The

Adaptation: A feature of an organism that increases its chance of survival in its environment. An adaptation may be anatomical, physiological or behavioural.
Allele: A version of a gene.
Anticodon: A sequence of three nucleotide bases at one end of a tRNA molecule that is specific to an mRNA codon.
Arithmetic mean: The average of a set of numbers calculated by dividing the sum of the values by the number of values.
Artificial classification: A type of classification that divides organisms into groups based on analogous characteristics such as leaf shape, number of legs and type of wing.
Binomial system: A universal system of naming organisms that consists of two parts: the generic name and the specific name, e.g. Homo sapiens.
Biodiversity: The variety of genes, species and habitats within a particular area.
Cellular proteome: The proteins expressed in a given type of cell.
Chromatid: One strand of a replicated chromosome.
Chromosome: A structure consisting of a long, coiled molecule of DNA and its associated proteins, by which genetic information is passed from generation to generation.
Chromosome mutation: A change to the number or structure of chromosomes that can occur spontaneously.
Classification: The organisation of organisms into groups. There are two types of classification: artificial and phylogenetic.

Acetylcholine: A type of neurotransmitter that is used for communication between neurones.
Action potential: The temporary change in electrical potential across the membrane of an axon in response to the transmission of a nerve impulse.
Axon: A long fibre that conducts nerve impulses away from the cell body.
Cholinergic synapse: An excitatory or inhibitory synapse formed between neurones or neurones and other effector organs. It uses the neurotransmitter, acetylcholine.
Dendrites: Short, branched extensions of the cell body that receive nerve impulses from other neurones.
Dendrons: Extensions of the cell body which branch into smaller fibres, dendrites.
Depolarisation: A sudden, temporary change in the membrane potential of a neurone in response to the transmission of a nerve impulse. The inside of the axon is less negative than the outside.
Excitatory synapse: A synapse that produces new action potentials when neurotransmitters bind with receptor proteins on the postsynaptic neurone.
Generator potential: Depolarisation of the membrane of a sensory receptor cell that occurs in response to a stimulus.
Hyperpolarisation: A decrease in the membrane potential of an axon, so that it is even more negative than the resting potential.
Inhibitory synapse: A synapse that decreases the likelihood of an action

Allele: A version of a gene.
Allele frequency: The number of times an allele appears within a population's gene pool.
Autosomal linkage: When two or more genes are positioned on the same autosome. They are unlikely to be separated by crossing over during meiosis so are often inherited together.
Autosome: A chromosome that is not an X or Y chromosome.
Codominant: When both alleles for a gene in a heterozygous organism equally contribute to the phenotype.
Dihybrid inheritance: The inheritance of two different genes, that determine two phenotypes, on two different chromosomes.
Diploid: Describes a cell with a nucleus containing two sets of chromosomes.
Directional selection: A type of selection that favours one extreme phenotype and selects against all other phenotypes.
Disruptive selection: A type of selection that favours individuals with extreme phenotypes and selects against those with phenotypes close to the mean.
Dominant: Describes an allele that is always expressed. Represented by a capital letter.
Epistasis: Describes a relationship between genes where the allele of one gene affects the expression of a different gene.
Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA.
Gene pool: All of the different versions of genes

			production of many genetically identical daughter cells through cell division of the activated B or T lymphocyte after clonal selection. Clonal selection: The process of matching the antigens on an antigen presenting cells with the antigen receptors on B and T lymphocytes. Co-transport: A method of membrane transport where two substances are both transported across a membrane at the same time either in the same direction or opposite directions. Cytokinesis: Division of the cytoplasm to produce two new cells Facilitated diffusion: The passive movement of substances from a high concentration to a lower concentration (down their concentration gradient) through transport proteins without the use of energy. Flagella: A whip-like structure found on bacterial cells that is used for cell movement. Fluid-mosaic model: A model that describes membrane structure as a sea of mobile phospholipids studded with various proteins. Golgi apparatus: An organelle found in eukaryotic cells that is involved in the modification and packaging of proteins. Helper T cell: A type of T cell in the immune system that stimulates cytotoxic T cells, B cells and phagocytes. Herd immunity: A type of disease immunity that occurs when a large proportion of a population are vaccinated against a disease which prevents the spread of the disease to unvaccinated individuals.	Codon: A sequence of three bases on mRNA that codes for a specific amino acid. Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. Courtship: The behaviour by which members of a species select reproductive partners. It enables organisms to recognise their own species, identify a mate with a capacity to breed, form a pair bond, synchronise mating and become able to breed themselves. Crossing over: The process in meiosis 1 in which homologous chromosomes pair up, their chromatids wrap around one another and their alleles are exchanged at equivalent portions of chromatids. This creates genetic variation. Degenerate: A feature of the genetic code; more than one triplet can code for a particular amino acid. Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may change all amino acids in a sequence, rendering the protein non-functional. Directional selection: A type of selection that favours individuals that differ in one direction (fall to the left or the right) from the population mean. This changes the traits of the population. Ecosystem diversity: A measure of the range of different habitats in a particular area. Eukaryotic DNA: Linear molecules of DNA which,		potential in the postsynaptic neurone by causing potassium ions (K+) to leave the postsynaptic neurone and chloride ions (Cl-) to enter. This results in hyperpolarisation of the postsynaptic neurone. Intermediate neurone: A neurone located in the spinal cord that links the sensory neurone to the motor neurone. Nerve impulse: A wave of depolarisation that travels across an axon membrane. It is self-propagating. Neuromuscular junction: An excitatory synapse formed between a motor neurone and a muscle fibre that uses the neurotransmitter, acetylcholine. Neurones: Nerve cells adapted to quickly transmit nerve impulses. Neurotransmitters: Chemicals that are used for communication between neurones and their target cells. Neurotransmitters are stored in synaptic vesicles in the presynaptic neurone and released into the synaptic cleft. Nodes of Ranvier: Gaps between adjacent Schwann cells in the myelin sheath at which action potentials can occur. Polarisation: Describes the condition in which an axon has a membrane potential of -65mV (resting potential). Postsynaptic neurone: The neurone after the synapse which contains specific receptor proteins on its membrane, complementary to the neurotransmitter. Presynaptic neurone: The neurone before the synapse which releases	(alleles) in the individuals that make up a population. Genetic drift: Variations in allele frequencies in small populations due to chance. Genetic variation: Differences in genotypes between members of a population which may occur due to mutations, meiosis, or random fertilisation. Genotype: An organism's genetic composition. Describes all alleles. Hardy-Weinberg principle: A model that predicts that the ratio of dominant and recessive alleles in a population will remain constant between generations if the following five conditions are met: no new mutations; no natural selection; no migration; large population; and random mating. It provides an equation for calculating the frequencies of alleles: $p2+ 2pq + q2= 1.0$ where p is the frequency of the dominant allele, and q is the frequency of the recessive allele. Heterozygous: When someone has two different alleles of a gene e.g. Ff. Homozygous: When someone has two identical alleles of a gene e.g. ff. Locus: The position of a gene on a chromosome. Monohybrid inheritance: The inheritance of one gene. Multiple alleles: When a gene has more than two potential alleles. Phenotype: An organism's observable characteristics. Due to interactions of the genotype and the environment. Recessive: Describes an allele that is only expressed in the absence of a dominant allele.	

			Human Immunodeficiency Virus (HIV): A virus that attacks T cells in the immune system and can lead to AIDS (acquired immune deficiency syndrome) Lysosomes: Membrane-bound vesicles found in the cytoplasm that contain a hydrolytic enzyme called lysozyme. Magnification: How much bigger an image appears compared to the original object calculated using the following formula: Mitochondrion: An organelle found in eukaryotic cells that is the site of aerobic respiration. Mitosis: The part of the cell cycle in which a eukaryotic cell divides to produce two daughter cells, each with identical copies of DNA. Monoclonal antibodies: Identical antibodies that have been produced by an immune cell that has been cloned from a parent cell. Nucleus: An organelle found in eukaryotic cells that stores the genetic information of the cell as chromosomes and is surrounded by a membrane called the nuclear envelope. Osmosis: The passive diffusion of water molecules from a region of high water potential to a region of lower water potential (down a water potential gradient) through a selectively permeable membrane without the use of energy. Passive immunity: A form of immunity provided by the introduction of antibodies to a disease into the body Phagocytosis: The process where phagocytes engulf and destroy material. Plasmids: A circular loop of	together with histones, form chromosomes. DNA in the mitochondria and chloroplasts of eukaryotic cells is circular and does not have associated proteins. Exon: A sequence of DNA that codes for an amino acid sequence. Fertilisation: The random fusion of haploid gametes during fertilisation to produce a diploid zygote. Genetic information is mixed, creating genetic variation. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene mutation: A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations can occur spontaneously during DNA replication. Generic name: Denotes the organism's genus. The first letter is written in upper case, e.g. Homo. Genetic code: The rules by which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is degenerate, universal and non-overlapping. Genetic diversity: The number of different alleles in a population. Genetic diversity between organisms can be investigated by comparing observable characteristics, DNA and mRNA base sequences and amino acid sequences. Genome: The entire set of genes in a cell. Histones: Proteins that, together with DNA, form chromosomes in the nuclei of eukaryotic		neurotransmitters from synaptic vesicles into the synaptic cleft. Repolarisation: The re-establishment of the resting potential (-65mV). Resting potential: An electrical potential difference of -65 mV across the membrane of an axon. The inside of the axon is more negative than the outside. The membrane is described as polarised. Spatial summation: A type of summation involving the release of neurotransmitters from multiple presynaptic neurones. The concentration of neurotransmitter exceeds the threshold value and triggers an action potential in the postsynaptic neurone. Summation: The build-up of neurotransmitters in the synaptic cleft, allowing low-frequency action potentials to trigger a new action potential in the postsynaptic neurone. There are two forms of summation: spatial and temporal. Synaptic cleft: A small gap between neurones across which a nerve impulse is transmitted via neurotransmitters. Synaptic vesicles: Secretory vesicles located in the presynaptic neurone that store neurotransmitters. Upon fusion with the presynaptic membrane, their contents are released into the synaptic cleft. Temporal summation: A type of summation involving the release of neurotransmitters from a single presynaptic neurone at a high frequency. The concentration of neurotransmitter exceeds the threshold value	Represented by a small letter. Sex-linkage: The presence of a gene on an X or Y chromosome. Variation: The differences between individuals due to genes, the environment or a combination of both	

			DNA found in the cytoplasm of bacterial cells. Primary immune response: The response produced by the immune system when it encounters a pathogen for the first time. Resolution: The ability to distinguish two different points in a specimen. Ribosomes: Organelles found either free in the cytoplasm or membrane bound that are involved in the synthesis of proteins. Rough endoplasmic reticulum (RER): A membrane-bound organelle that is involved in the synthesis and packaging of proteins. Secondary immune response: The response produced by the immune system when it recognises a pathogen that it has encountered before. Simple diffusion: The passive spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy. Smooth endoplasmic reticulum (SER): A membrane-bound organelle involved in lipid synthesis. Vaccine: The introduction of dead or inactive pathogens to stimulate an immune response and provide long term immunity. . .	cells. Homologous chromosomes: A chromosome pair, one paternal and one maternal, with the same gene loci. Independent segregation: The random separation of homologous chromosomes in meiosis 1 that produces genetic variation. Index of diversity (d): Describes the relationship between the number of different species and the abundance of individuals in each of these species within a community. It is calculated using the formula: where d is the index of diversity, N is the total number of organisms of all species and n is the total number of organisms of each species. Intron: A non-coding sequence of DNA. Locus: The position of a gene on a chromosome. Mean (normal distribution curve): A measure of the maximum height of a normal distribution curve. Meiosis: A type of cell division that produces four genetically different daughter cells (gametes) with a haploid number of chromosomes. It involves two divisions. Messenger RNA (mRNA): A type of RNA that carries genetic information from the nucleus to the ribosomes for protein synthesis. It is a single helix consisting of thousands of mononucleotides. Mitosis: A form of cell division that produces two genetically identical diploid daughter cells. Mutagenic agent: An agent that increases the rate of gene mutations above normal level. Natural selection: The		and triggers an action potential in the postsynaptic neurone. Threshold value: A certain size of stimulus that is required to generate an action potential. Unidirectionality: Describes synaptic transmission; synapses can only transmit information in a single direction, from the presynaptic neurone to the postsynaptic neurone.		

				process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time. Non-coding sequence: A sequence of DNA that does not code for an amino acid sequence e.g. repeating base sequences and introns. Non-coding sequences make up significant portions of eukaryotic nuclear DNA. Non-disjunction: A change in the number of chromosomes due to the failure of homologous chromosomes to separate during meiosis. This may result in a gamete with one more or one less chromosome. Non-overlapping: A feature of the genetic code; each base in a sequence is read once and is only part of one triplet. Phylogenetic classification: A type of classification that divides organisms into groups based on evolutionary relationships and homologous characteristics. It uses a hierarchy in which smaller groups are contained within larger groups, with no group overlap. Phylogeny: The evolutionary relationships between individuals or groups of organisms. Prokaryotic DNA: Circular pieces of DNA that do not have associated proteins. Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates. Recombination: When broken-off pieces of chromatid combine with another chromatid on a different chromosome during				

				crossing over. Ribosomes: Sub-cellular structures where protein synthesis takes place. Ribosomes consist of a small subunit and a large subunit. RNA polymerase: An enzyme that moves along the DNA template strand and joins adjacent nucleotides to form pre-mRNA. Species: A group of similar organisms that are able to breed with one another to produce living, fertile offspring. Species diversity: A measure of the number of different species and the abundance of individuals in each of these species within a community. Species richness: A measure of the number of different species in a community at a given time. It is a measure of species diversity. Specific name: Denotes the organism's species. It is written in lower case letters, e.g. sapiens. Splicing: The process following transcription in eukaryotic cells in which introns are removed from pre-mRNA and exons are joined together to form mRNA. Stabilising selection: A type of selection that favours individuals close to the mean, maintaining the traits of the population. Standard deviation (normal distribution curve): A measure of the width of a normal distribution curve and an indication of the range of values. Substitution: A form of gene mutation in which one nucleotide base is exchanged for				

				another. This may change an amino acid or produce the same amino acid (due to the degeneracy of the genetic code). Taxon: Each group within a phylogenetic classification system. Transcription: The formation of pre-mRNA in eukaryotes and mRNA in prokaryotes from a section of the template strand of DNA. It is the first stage of protein synthesis. Transfer RNA (tRNA): A form of RNA that carries specific amino acids to the ribosomes. It is single-stranded and takes a clover-leaf shape. One side is longer than the other enabling the attachment of an amino acid. At the opposite end is an anticodon specific to the amino acid. Translation: The second phase of protein synthesis that takes place in the ribosomes. mRNA is used as a template for the attachment of tRNA molecules with complementary anticodons. The amino acids carried on adjacent tRNA molecules are joined to form a polypeptide chain. Triplet: A sequence of three bases that codes for an amino acid. Universal: A feature of the genetic code; the code is the same in almost all organisms. This is evidence for evolution. Variation: The differences between individuals due to genes, the environment or a combination of both.				
			Year 12 Term 1 Section 2 Cells (Cell Division)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Genetic Diversity and adaptation, Species and Taxonomy)			Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)		

			Active immunity: A form of immunity provided by the immune response of the body upon detection of a pathogen. Active transport: The active movement of substances from a low concentration to a higher concentration (up their concentration gradient) with the use of energy in the form of ATP. Agglutination: The clumping together of cells or particles caused by antibodies which assists phagocytosis. Antibody: A protein found in the blood that is produced by plasma cells which binds to antigens as a part of the immune response. Antigen: Marker molecules that can be detected by antibodies and trigger an immune response. Binary fission: The method of cell division used by prokaryotes involving replication of the circular DNA and plasmids followed by cytoplasmic division. Cell cycle: The series of stages preparing the cell for division consisting of interphase and mitosis. Cell-surface membrane: A phospholipid bilayer studded with proteins that surrounds cells and separates them from their environment. Cell vacuole: A membrane bound structure found in plant cells that contains cell sap. Cell wall: A permeable layer that surrounds plant, algae and fungi cells made of polysaccharides which provides strength to the cell. Chloroplast: An organelle found in plants and algae that is the site of photosynthesis. Clonal expansion: The	Adaptation: A feature of an organism that increases its chance of survival in its environment. An adaptation may be anatomical, physiological or behavioural. Allele: A version of a gene. Arithmetic mean: The average of a set of numbers calculated by dividing the sum of the values by the number of values. Artificial classification: A type of classification that divides organisms into groups based on analogous characteristics such as leaf shape, number of legs and type of wing. Binomial system: A universal system of naming organisms that consists of two parts: the generic name and the specific name, e.g. Homo sapiens. Biodiversity: The variety of genes, species and habitats within a particular area. Cellular proteome: The proteins expressed in a given type of cell. Chromatid: One strand of a replicated chromosome. Chromosome: A structure consisting of a long, coiled molecule of DNA and its associated proteins, by which genetic information is passed from generation to generation. Chromosome mutation: A change to the number or structure of chromosomes that can occur spontaneously. Classification: The organisation of organisms into groups. There are two types of classification: artificial and phylogenetic. Codon: A sequence of three bases on mRNA that codes for a specific amino acid. Conservation: The maintenance of ecosystems			Abiotic factors: The non-living aspects of an ecosystem e.g. temperature, light intensity, moisture, soil pH and oxygen levels. Adaptation: A feature of an organism that increases its chance of survival in its environment. Allele: A version of a gene. Allele frequency: The number of times an allele appears within a population's gene pool. Allopatric speciation: A form of speciation that occurs when two populations become geographically isolated. Autosomal linkage: When two or more genes are positioned on the same autosome. They are unlikely to be separated by crossing over during meiosis so are often inherited together. Autosome: A chromosome that is not an X or Y chromosome. Belt transect: A line along a sampled area, upon which quadrats are placed at certain intervals to determine the abundance and distribution of organisms in an ecosystem. Biodiversity: The variety of genes, species and habitats within a particular area. Biotic factors: The living components of an ecosystem e.g. food availability, pathogens and predators. Carrying capacity: The average size of a population that can be supported by an ecosystem over extended periods of time. This varies depending on biotic and abiotic factors. Chi-squared test: A statistical test used to determine whether a pattern of inheritance is statistically significant.	

			production of many genetically identical daughter cells through cell division of the activated B or T lymphocyte after clonal selection. Clonal selection: The process of matching the antigens on an antigen presenting cells with the antigen receptors on B and T lymphocytes. Co-transport: A method of membrane transport where two substances are both transported across a membrane at the same time either in the same direction or opposite directions. Cytokinesis: Division of the cytoplasm to produce two new cells Facilitated diffusion: The passive movement of substances from a high concentration to a lower concentration (down their concentration gradient) through transport proteins without the use of energy. Flagella: A whip-like structure found on bacterial cells that is used for cell movement. Fluid-mosaic model: A model that describes membrane structure as a sea of mobile phospholipids studded with various proteins. Golgi apparatus: An organelle found in eukaryotic cells that is involved in the modification and packaging of proteins. Helper T cell: A type of T cell in the immune system that stimulates cytotoxic T cells, B cells and phagocytes. Herd immunity: A type of disease immunity that occurs when a large proportion of a population are vaccinated against a disease which prevents the spread of the disease to unvaccinated individuals.	and biodiversity by humans in order to preserve the Earth's resources. Courtship: The behaviour by which members of a species select reproductive partners. It enables organisms to recognise their own species, identify a mate with a capacity to breed, form a pair bond, synchronise mating and become able to breed themselves. Crossing over: The process in meiosis 1 in which homologous chromosomes pair up, their chromatids wrap around one another and their alleles are exchanged at equivalent portions of chromatids. This creates genetic variation. Degenerate: A feature of the genetic code; more than one triplet can code for a particular amino acid. Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may change all amino acids in a sequence, rendering the protein non-functional. Directional selection: A type of selection that favours individuals that differ in one direction (fall to the left or the right) from the population mean. This changes the traits of the population. Ecosystem diversity: A measure of the range of different habitats in a particular area. Eukaryotic DNA: Linear molecules of DNA which, together with histones, form chromosomes. DNA in the mitochondria and chloroplasts of eukaryotic cells is circular and			Climax community: The stable community of organisms that exists at the final stage of ecological succession. Codominant: When both alleles for a gene in a heterozygous organism equally contribute to the phenotype. Community: All of the populations of different species living together in a habitat. Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. This typically involves the management of succession. Degrees of freedom (X2 test): The number of categories minus one. Dihybrid inheritance: The inheritance of two different genes, that determine two phenotypes, on two different chromosomes. Diploid: Describes a cell with a nucleus containing two sets of chromosomes. Directional selection: A type of selection that favours one extreme phenotype and selects against all other phenotypes. Disruptive selection: A type of selection that favours individuals with extreme phenotypes and selects against those with phenotypes close to the mean. Dominant: Describes an allele that is always expressed. Represented by a capital letter. Ecosystem: The community of organisms (biotic) and non-living (abiotic) components of an area and their interactions. It is a dynamic system. Epistasis: Describes a relationship between genes where the allele of one gene affects the	

			Human Immunodeficiency Virus (HIV): A virus that attacks T cells in the immune system and can lead to AIDS (acquired immune deficiency syndrome) Lysosomes: Membrane-bound vesicles found in the cytoplasm that contain a hydrolytic enzyme called lysozyme. Magnification: How much bigger an image appears compared to the original object calculated using the following formula: Mitochondrion: An organelle found in eukaryotic cells that is the site of aerobic respiration. Mitosis: The part of the cell cycle in which a eukaryotic cell divides to produce two daughter cells, each with identical copies of DNA. Monoclonal antibodies: Identical antibodies that have been produced by an immune cell that has been cloned from a parent cell. Nucleus: An organelle found in eukaryotic cells that stores the genetic information of the cell as chromosomes and is surrounded by a membrane called the nuclear envelope. Osmosis: The passive diffusion of water molecules from a region of high water potential to a region of lower water potential (down a water potential gradient) through a selectively permeable membrane without the use of energy. Passive immunity: A form of immunity provided by the introduction of antibodies to a disease into the body Phagocytosis: The process where phagocytes engulf and destroy material. Plasmids: A circular loop of	does not have associated proteins. Exon: A sequence of DNA that codes for an amino acid sequence. Fertilisation: The random fusion of haploid gametes during fertilisation to produce a diploid zygote. Genetic information is mixed, creating genetic variation. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene mutation: A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations can occur spontaneously during DNA replication. Generic name: Denotes the organism's genus. The first letter is written in upper case, e.g. Homo. Genetic code: The rules by which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is degenerate, universal and non-overlapping. Genetic diversity: The number of different alleles in a population. Genetic diversity between organisms can be investigated by comparing observable characteristics, DNA and mRNA base sequences and amino acid sequences. Genome: The entire set of genes in a cell. Histones: Proteins that, together with DNA, form chromosomes in the nuclei of eukaryotic cells. Homologous chromosomes: A chromosome pair, one paternal and one maternal, with the			expression of a different gene. Evolution: The gradual change in the allele frequencies within a population over time. Occurs due to natural selection. Gene: A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA. Gene pool: All of the different versions of genes (alleles) in the individuals that make up a population. Genetic drift: Variations in allele frequencies in small populations due to chance. Genetic variation: Differences in genotypes between members of a population which may occur due to mutations, meiosis, or random fertilisation. Genotype: An organism's genetic composition. Describes all alleles. Habitat: The region where an organism normally lives. Hardy-Weinberg principle: A model that predicts that the ratio of dominant and recessive alleles in a population will remain constant between generations if the following five conditions are met: no new mutations; no natural selection; no migration; large population; and random mating. It provides an equation for calculating the frequencies of alleles: $p2+ 2pq + q2 = 1.0$ where p is the frequency of the dominant allele, and q is the frequency of the recessive allele. Heterozygous: When someone has two different alleles of a gene e.g. Ff. Homozygous: When	

			DNA found in the cytoplasm of bacterial cells. Primary immune response: The response produced by the immune system when it encounters a pathogen for the first time. Resolution: The ability to distinguish two different points in a specimen. Ribosomes: Organelles found either free in the cytoplasm or membrane bound that are involved in the synthesis of proteins. Rough endoplasmic reticulum (RER): A membrane-bound organelle that is involved in the synthesis and packaging of proteins. Secondary immune response: The response produced by the immune system when it recognises a pathogen that it has encountered before. Simple diffusion: The passive spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy. Smooth endoplasmic reticulum (SER): A membrane-bound organelle involved in lipid synthesis. Vaccine: The introduction of dead or inactive pathogens to stimulate an immune response and provide long term immunity. . .	same gene loci. Independent segregation: The random separation of homologous chromosomes in meiosis 1 that produces genetic variation. Index of diversity (d): Describes the relationship between the number of different species and the abundance of individuals in each of these species within a community. It is calculated using the formula: where d is the index of diversity, N is the total number of organisms of all species and n is the total number of organisms of each species. Intron: A non-coding sequence of DNA. Locus: The position of a gene on a chromosome. Mean (normal distribution curve): A measure of the maximum height of a normal distribution curve. Meiosis: A type of cell division that produces four genetically different daughter cells (gametes) with a haploid number of chromosomes. It involves two divisions. Messenger RNA (mRNA): A type of RNA that carries genetic information from the nucleus to the ribosomes for protein synthesis. It is a single helix consisting of thousands of mononucleotides. Mitosis: A form of cell division that produces two genetically identical diploid daughter cells. Mutagenic agent: An agent that increases the rate of gene mutations above normal level. Natural selection: The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time.			someone has two identical alleles of a gene e.g. ff. Interspecific competition: A type of competition that takes place between members of different species. Intraspecific competition: A type of competition that takes place between members of the same species. Locus: The position of a gene on a chromosome. Mark-release-recapture: A method of estimating the population size of motile organisms. It involves capturing a sample of the population, marking them and releasing them. At a later date, another sample is captured and the number of marked individuals recorded. The population size can be estimated using the following equation: Monohybrid inheritance: The inheritance of one gene. Multiple alleles: When a gene has more than two potential alleles. Natural selection: The process by which the frequency of beneficial alleles gradually increases in a population's gene pool over time. This theory was developed by Charles Darwin. Niche: Describes how an organism 'fits' into an ecosystem and its role in that environment. Phenotype: An organism's observable characteristics. Due to interactions of the genotype and the environment. Pioneer species: Species that can survive in hostile environments and colonise bare rock or sand e.g. lichens. Population: All organisms of the same species living with	

				Non-coding sequence: A sequence of DNA that does not code for an amino acid sequence e.g. repeating base sequences and introns. Non-coding sequences make up significant portions of eukaryotic nuclear DNA. Non-disjunction: A change in the number of chromosomes due to the failure of homologous chromosomes to separate during meiosis. This may result in a gamete with one more or one less chromosome. Non-overlapping: A feature of the genetic code; each base in a sequence is read once and is only part of one triplet. Phylogenetic classification: A type of classification that divides organisms into groups based on evolutionary relationships and homologous characteristics. It uses a hierarchy in which smaller groups are contained within larger groups, with no group overlap. Phylogeny: The evolutionary relationships between individuals or groups of organisms. Prokaryotic DNA: Circular pieces of DNA that do not have associated proteins. Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates. Recombination: When broken-off pieces of chromatid combine with another chromatid on a different chromosome during crossing over. Ribosomes: Sub-cellular structures where protein synthesis takes place. Ribosomes consist			one another in a habitat at the same time. Predator: An organism that eats other organisms. Prey: An organism that is eaten by predators. Quadrat: A square grid of a known area used in sampling to determine the abundance of organisms in a habitat. There are two types: point quadrats and frame quadrats. Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates. Recessive: Describes an allele that is only expressed in the absence of a dominant allele. Represented by a small letter. Selection pressures: Environmental factors that drive evolution by natural selection and limit population sizes e.g. competition, predation and disease. Sex-linkage: The presence of a gene on an X or Y chromosome. Speciation: The formation of new species due to the evolution of two reproductively separated populations. Two forms: allopatric and sympatric speciation. Species: A group of similar organisms that are able to breed with one another to produce living, fertile offspring. Stabilising selection: A type of selection that favours individuals with phenotypes close to the mean (average) and selects against extreme phenotypes. Succession: Describes changes in the community of organisms occupying a	

				of a small subunit and a large subunit. RNA polymerase: An enzyme that moves along the DNA template strand and joins adjacent nucleotides to form pre-mRNA. Species: A group of similar organisms that are able to breed with one another to produce living, fertile offspring. Species diversity: A measure of the number of different species and the abundance of individuals in each of these species within a community. Species richness: A measure of the number of different species in a community at a given time. It is a measure of species diversity. Specific name: Denotes the organism's species. It is written in lower case letters, e.g. sapiens. Splicing: The process following transcription in eukaryotic cells in which introns are removed from pre-mRNA and exons are joined together to form mRNA. Stabilising selection: A type of selection that favours individuals close to the mean, maintaining the traits of the population. Standard deviation (normal distribution curve): A measure of the width of a normal distribution curve and an indication of the range of values. Substitution: A form of gene mutation in which one nucleotide base is exchanged for another. This may change an amino acid or produce the same amino acid (due to the degeneracy of the genetic code).			certain area over time. Sustainable: The ability to maintain something for future generations. Sympatric speciation: A form of speciation that occurs when two populations within the same area become reproductively isolated. Systematic sampling: A sampling technique used to determine the abundance and distribution of organisms along an area at periodic intervals e.g. along a belt transect. This is commonly used in ecosystems where some form of gradual change occurs. Variation: The differences between individuals due to genes, the environment or a combination of both	

				Taxon: Each group within a phylogenetic classification system. Transcription: The formation of pre-mRNA in eukaryotes and mRNA in prokaryotes from a section of the template strand of DNA. It is the first stage of protein synthesis. Transfer RNA (tRNA): A form of RNA that carries specific amino acids to the ribosomes. It is single-stranded and takes a clover-leaf shape. One side is longer than the other enabling the attachment of an amino acid. At the opposite end is an anticodon specific to the amino acid. Translation: The second phase of protein synthesis that takes place in the ribosomes. mRNA is used as a template for the attachment of tRNA molecules with complementary anticodons. The amino acids carried on adjacent tRNA molecules are joined to form a polypeptide chain. Triplet: A sequence of three bases that codes for an amino acid. Universal: A feature of the genetic code; the code is the same in almost all organisms. This is evidence for evolution. Variation: The differences between individuals due to genes, the environment or a combination of both.				

			Year 12 Term 1 Section 2 Cells (Transport)					
			Active immunity: A form of immunity provided by the immune response of the body upon detection of a pathogen. Active transport: The active movement of substances from a low concentration to a higher concentration (up their concentration gradient) with the use of energy in the form of ATP. Agglutination: The clumping together of cells or particles caused by antibodies which assists phagocytosis. Antibody: A protein found in the blood that is produced by plasma cells which binds to antigens as a part of the immune response. Antigen: Marker molecules that can be detected by antibodies and trigger an immune response. Binary fission: The method of cell division used by prokaryotes involving replication of the circular DNA and plasmids followed by cytoplasmic division. Cell cycle: The series of stages preparing the cell for division consisting of interphase and mitosis. Cell-surface membrane: A phospholipid bilayer studded with proteins that surrounds cells and separates them from their environment. Cell vacuole: A membrane bound structure found in plant cells that contains cell sap. Cell wall: A permeable layer that surrounds plant, algae and fungi cells made of polysaccharides which provides strength to the cell. Chloroplast: An organelle found in plants and algae					

			that is the site of photosynthesis. Clonal expansion: The production of many genetically identical daughter cells through cell division of the activated B or T lymphocyte after clonal selection. Clonal selection: The process of matching the antigens on an antigen presenting cells with the antigen receptors on B and T lymphocytes. Co-transport: A method of membrane transport where two substances are both transported across a membrane at the same time either in the same direction or opposite directions. Cytokinesis: Division of the cytoplasm to produce two new cells Facilitated diffusion: The passive movement of substances from a high concentration to a lower concentration (down their concentration gradient) through transport proteins without the use of energy. Flagella: A whip-like structure found on bacterial cells that is used for cell movement. Fluid-mosaic model: A model that describes membrane structure as a sea of mobile phospholipids studded with various proteins. Golgi apparatus: An organelle found in eukaryotic cells that is involved in the modification and packaging of proteins. Helper T cell: A type of T cell in the immune system that stimulates cytotoxic T cells, B cells and phagocytes. Herd immunity: A type of disease immunity that occurs when a large proportion of a population are vaccinated against a disease which					

			prevents the spread of the disease to unvaccinated individuals. Human Immunodeficiency Virus (HIV): A virus that attacks T cells in the immune system and can lead to AIDS (acquired immune deficiency syndrome) Lysosomes: Membrane-bound vesicles found in the cytoplasm that contain a hydrolytic enzyme called lysozyme. Magnification: How much bigger an image appears compared to the original object calculated using the following formula: Mitochondrion: An organelle found in eukaryotic cells that is the site of aerobic respiration. Mitosis: The part of the cell cycle in which a eukaryotic cell divides to produce two daughter cells, each with identical copies of DNA. Monoclonal antibodies: Identical antibodies that have been produced by an immune cell that has been cloned from a parent cell. Nucleus: An organelle found in eukaryotic cells that stores the genetic information of the cell as chromosomes and is surrounded by a membrane called the nuclear envelope. Osmosis: The passive diffusion of water molecules from a region of high water potential to a region of lower water potential (down a water potential gradient) through a selectively permeable membrane without the use of energy. Passive immunity: A form of immunity provided by the introduction of antibodies to a disease into the body Phagocytosis: The process					

			where phagocytes engulf and destroy material. Plasmids: A circular loop of DNA found in the cytoplasm of bacterial cells. Primary immune response: The response produced by the immune system when it encounters a pathogen for the first time. Resolution: The ability to distinguish two different points in a specimen. Ribosomes: Organelles found either free in the cytoplasm or membrane bound that are involved in the synthesis of proteins. Rough endoplasmic reticulum (RER): A membrane-bound organelle that is involved in the synthesis and packaging of proteins. Secondary immune response: The response produced by the immune system when it recognises a pathogen that it has encountered before. Simple diffusion: The passive spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy. Smooth endoplasmic reticulum (SER): A membrane-bound organelle involved in lipid synthesis. Vaccine: The introduction of dead or inactive pathogens to stimulate an immune response and provide long term immunity. . .					
	KS4 prior learning	**By the end of the term, students can:**	Year 12 Term 1 Section 1 Biological Molecules (Monomers and Polymers)	Year 12 Term 2 Section 2 Cells (Immune System)	Year 12 Term 3 Section 4 Genetic information, variation and relationships between organisms (Biodiversity and Investigating Diversity)	Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Photosynthesis)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Muscular Skeletal System)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)

		Recall the **knowledge**:	Monomers are the smaller units from which larger molecules are made 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 Monosaccharides, including glucose, galactose and fructose, are monomers from which larger carbohydrates are made. Condensation reactions produce disaccharides through the formation of glycosidic bonds. These include maltose, sucrose and lactose. Glycogen and starch are polysaccharides formed by condensation of α-glucose Identify the biochemical tests for reducing sugars, non-reducing sugars and starch Glucose has two isomers, α-glucose and β–glucose. Polysaccharides are formed by the condensation of many glucose units. Glycogen and starch are formed by the condensation of α- glucose. Cellulose is formed by the condensation of β-glucose.	The definition of an antigen. These molecules allow the immune system to identify pathogens, cells from other individuals, abnormal body cells and toxins. Phagocytosis of pathogens. The subsequent destruction of ingested pathogens by lysozymes. The 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 (TH cells) in stimulating cytotoxic T cells (TCcells), B cells and phagocytes. The definition of an antibody. The structure of an antibody. The formation of antigen-antibody complexes and the subsequent destruction of pathogens. The response of B lymphocytes to a foreign antigen, clonal selection and the release of monoclonal antibodies (the humoral response). The roles of plasma cells and of memory cells in producing primary and secondary immune responses. The effect of antigen variability on disease and disease prevention. The differences between active and passive immunity. The use of vaccines to provide protection for individuals and populations against disease. The concept of herd immunity. Ethical issues associated with the use of vaccines. Structure of the human immunodeficiency virus (HIV) and its replication in helper T cells. How HIV causes the symptoms of AIDS. Why antibiotics are ineffective against viruses. The use of monoclonal	The concepts of biodiversity, species richness and index of diversity. Calculation of the index of diversity (d). Farming techniques reduce biodiversity. The balance between conservation and farming. Genetic diversity within, or between species, can be made by comparing the frequency of characteristics, the base sequences of DNA or mRNA, or the amino acid sequences of proteins. Quantitative investigations of variation within a species involve: • collecting data from random samples • calculating a mean value of the collected data and the standard deviation of that mean • interpreting mean values and their standard deviations.	Life depends on continuous transfers of energy. 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. The process of photosynthesis is common in all photoautotrophic organisms and the process of respiration is common in all organisms, providing indirect evidence for evolution.	Muscles act in antagonistic pairs against an incompressible skeleton. Gross and microscopic structure of skeletal muscle. The ultrastructure of a myofibril. The roles of actin, myosin, calcium ions and ATP in myofibril contraction. The roles of calcium ions and tropomyosin in the cycle of actinomyosin bridge formation. The roles of ATP and phosphocreatine in muscle contraction. The structure, location and general properties of slow and fast skeletal muscle fibres	Individuals within a population may show a wide range of variation in phenotype. This is due to genetic and environmental factors. The primary source of genetic variation is mutation. Meiosis and the random fertilisation of gametes during sexual reproduction produce further genetic variation. Predation, disease and competition for the means of survival result in differential survival and reproduction, i.e. natural selection. Those organisms with phenotypes providing selective advantages are likely to produce more offspring and pass on their favourable alleles to the next generation. Predation, disease and competition for the means of survival result in differential survival and reproduction, i.e. natural selection. Those organisms with phenotypes providing selective advantages are likely to produce more offspring and pass on their favourable alleles to the next generation. The effect of differential reproductive success on the allele frequencies within a gene pool. The effects of stabilising, directional and disruptive selection. Reproductive separation of two populations can result in the accumulation of difference in their gene pools. New species arise when these genetic differences lead to an inability of members of the populations to interbreed and produce fertile offspring, The importance of genetic drift in causing changes in allele frequency in small populations. resulting in

				antibodies in: targeting medication at particular cell types, medical diagnosis and ELISA. Ethical issues associated with the use of monoclonal antibodies. Required practical 6: Use of aseptic techniques to investigate the effect of anti-microbial substances on microbial growth.				speciation. Allopatric speciation and sympatric speciation.
			Year 12 Term 1 Section 1 Biological Molecules (Lipids and Proteins)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Exchange)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Respiration)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Homeostasis)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations in Ecosystems)
			The emulsion test for lipids Triglycerides and phospholipids are two groups of lipid. Triglycerides are formed by the condensation of one molecule of glycerol and three molecules of fatty acid (RCOOH) through the formation of ester bonds/three ester bonds. The R-group of a fatty acid may be saturated or unsaturated The structure of phospholipids and how this structure relates to their properties The general structure of amino acids and how the only difference between amino acids is their side group. The roles played by proteins The biuret test for proteins The formation of dipeptides and polypeptides through condensation of amino acids. The relationship between primary, secondary, tertiary and quaternary structure and protein function. The role of hydrogen bonds, ionic bonds and disulfide bridges in the structure of proteins...	The relationship between the size or structure of an organism and its surface area to volume ratio. Changes to body shape and the development of systems as adaptations that facilitate exchange as this ratio reduces. Adaptations of gas exchange surfaces in leaves of dicotyledonous plants (mesophyll and stomata). Structural and functional compromises between gas exchange and the limitation of water loss shown by xerophytic plants. Adaptations of gas exchange surfaces, shown by gas exchange in single-celled organisms, insect tracheal systems and fish gills. Structural and functional compromises between gas exchange and the limitation of water loss shown by terrestrial insects. The gross structure of the human gas exchange system. Ventilation and the exchange of gases in the lungs. The mechanism of breathing. The essential features of the alveolar epithelium as a gas exchange surface. Lung diseases and the risk factors associated with them.		Respiration produces ATP. Aerobic respiration involves: · glycolysis · active transport of pyruvate into the mitochondrial matrix · oxidation of pyruvate to acetate · production of acetyl CoA · the Krebs cycle · oxidative phosphorylation, associated with electron transfer and chemiosmosis, to synthesise ATP. Glycolysis is the first stage of anaerobic and aerobic respiration. If respiration is only anaerobic, pyruvate can be converted to ethanol or lactate using reduced NAD. The oxidised NAD produced in this way can be used in further glycolysis. Other respiratory substrates include the breakdown products of lipids and amino acids, which enter the Krebs cycle.	Homeostasis in mammals involves physiological control systems that maintain the internal environment within restricted limits. The importance of maintaining a stable core temperature and stable blood pH in relation to enzyme activity. The importance of maintaining a stable blood glucose concentration in terms of availability of respiratory substrate and of the water potential of blood. Negative feedback restores systems to their original level. The possession of separate mechanisms involving negative feedback, controls departures in different directions from the original state, giving a greater degree of control.	Populations of different species form a community. Within a habitat, a species occupies a niche governed by adaptation to both abiotic and biotic conditions. An ecosystem supports a certain size of population of a species, called the carrying capacity. This population size can vary as a result of: · the effect of abiotic factors · interactions between organisms: interspecific and intraspecific competition and predation. The size of a population can be estimated using randomly placed quadrats, or quadrats along a belt transect, for slow-moving or non-motile organisms. The size of a population can be estimated using the mark-release- recapture method for motile organisms. The assumptions made when using the mark-release-recapture method. Required practical 12: Investigation into the effect of a named environmental factor on the distribution of a given species. Primary succession from pioneer species to climax community. At each stage, certain species may be recognised which change the

								environment so that it becomes more suitable for other species. The new species may change the environment in such a way that it becomes less suitable for the previous species. Changes that organisms produce in their abiotic environment can result in a less hostile environment and change biodiversity. Conservation of habitats frequently involves management of succession.
			Year 12 Term 1 Section1 Biological Molecules (Enzymes)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Digestion)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Energy in Ecosystems)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Blood Sugar)	Year 13 Term 3 Section 8 The control of gene expression (Gene Expression)
			Enzyme catalysis and activation energy. The induced-fit model of enzyme action. Enzyme specificity linked to active site structure The properties of an enzyme relate to the tertiary structure of its active site in the formation of an enzyme-substrate complex. The effects of the following factors on the rate of enzyme- controlled reactions – enzyme concentration, substrate concentration, concentration of competitive an of non- competitive inhibitors, pH and temperature. Calculate rate Required practical 1 – Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. Could include: design a valid experiment, using the work of others as a starting point, to investigate and solve a problem in a scientific context Identify variables including those that must be controlled Calculate initial rate Plot and interpret graphs	The purpose of digestion. Digestion in mammals of: carbohydrates by amylases and disaccharidases lipids by lipase proteins by endopeptidases, exopeptidases and dipeptidases. The role of bile salts. Co-transport mechanisms and the role of micelles in the absorption of the products of digestion by cells lining the ileum.		Plants synthesise organic compounds from carbon dioxide. Most of the sugars are used as respiratory substrates. The rest are used to make other biological molecules, which form the biomass of the plants. Biomass can be measured in terms of mass of carbon or dry mass of tissue per given area per given time. The chemical energy stored in dry biomass can be estimated using calorimetry. The concept of gross primary production and net primary production and their mathematical relationship i.e. NPP = GPP – R. The net production of consumers, such as animals, can be calculated as: N = I – (F + R). Nutrients are recycled within natural ecosystems, exemplified by the nitrogen cycle, to include: the role of bacteria in the nitrogen cycle in the processes of saprobiotic nutrition, ammonification, nitrification, nitrogen fixation and denitrification. The use of natural and artificial fertilisers to replace	The factors that influence blood glucose concentration. The action of insulin by: · attaching to receptors on the surfaces of target cells · controlling the uptake of glucose by regulating the inclusion of channel proteins in the surface membranes of target cells · activating enzymes involved in the conversion of glucose to glycogen. The role of the liver in glycogenesis. The action of glucagon by: · attaching to receptors on the surfaces of target cells · activating enzymes involved in the conversion of glycogen to glucose · activating enzymes involved in the conversion of glycerol and amino acids into glucose. The role of the liver in glycogenolysis and gluconeogenesis. The role of adrenaline by: · attaching to receptors on the surfaces of target cells. - activating enzymes involved in the conversion of glycogen to glucose. The second messenger model of adrenaline and glucagon action, involving	Gene mutations might arise spontaneously during DNA replication. They include addition, deletion, substitution, inversion, duplication and translocation of bases. The mutation rate is increased by mutagenic agents. Mutations affecting one triplet and those which cause frame shift. The characteristics and source of totipotent, pluripotent, multipotent and unipotent stem cells. The production of specialised cells from totipotent cells requires only part of the cell's DNA to be translated. Unipotent cells exemplified by formation of cardiomyocytes. Pluripotent cells and their use in treating human disorders. The production of Induced pluripotent cells (IPS cells). In eukaryotes, transcription of target genes can be stimulated or inhibited when specific transcriptional factors move from the cytoplasm into the nucleus. The role of the steroid

			Evaluate findings to draw meaningful conclusions.			the nitrates and phosphates lost by harvesting plants and removing livestock. The environmental issues arising from the use of fertilisers including leaching and eutrophication.	adenylate cyclase, cAMP and protein kinase. The causes of types I and II diabetes and their control by insulin and/or manipulation of the diet. Required practical 11: Production of a dilution series of a glucose solution and use of colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown 'urine' sample.	hormone, oestrogen, in initiating transcription. Epigenetic control of gene expression in eukaryotes. Epigenetics involves heritable changes in gene function, caused by changes in the environment that inhibit transcription by: · increased methylation of the DNA · decreased acetylation of associated histones. The relevance of epigenetics on the development and treatment of disease, especially cancer. In eukaryotes and some prokaryotes, translation of the mRNA produced from target genes can be inhibited by RNA interference (RNAi). The main characteristics of benign and malignant tumours. The role of the following in the development of tumours: · tumour suppressor genes and oncogenes · abnormal methylation of tumour suppressor genes and oncogenes · increased oestrogen concentrations in the development of some breast cancers.
			Year 12 Term 1 Section 1 Biological Molecules (Nucleic Acids)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Mass Transport)		year 13 Term 1 Section 6 Organisms respond to changes to their environments (Response to stimuli)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Water Potential)	Year 13 Term 3 Section 8 The control of gene expression (Genome Projects)
			Deoxyribonucleic acid is important in all living cells, as it carries genetic information. DNA is a polymer of nucleotides formed by condensation, with phosphodiester bonds between nucleotides. Each nucleotide is formed from a deoxyribose, a nitrogen- containing organic base and a phosphate group. DNA is a double helix with two polynucleotide chains, held together by hydrogen bonds between	The general pattern of blood circulation in a mammal. The quaternary structure of haemoglobins. The role of haemoglobin in the loading, transport and unloading of oxygen. The cooperative nature of oxygen binding, with the binding of the first oxygen molecule making the binding of subsequent oxygen molecules easier. The effects of carbon dioxide concentration on oxygen dissociation (Bohr effect). Many animals are adapted to		A stimulus is a change in the internal or external environment. A receptor detects a stimulus. A coordinator formulates a suitable response to a stimulus. An effector produces a response. Receptors are specific to one type of stimulus. Plants control their response using hormone-like growth substances.	The structure of the nephron and its role in: · the formation of glomerular filtrate · reabsorption of glucose and water by the proximal convoluted tubule · maintaining a gradient of sodium ions in the medulla by the loop of Henle · reabsorption of water by the distal convoluted tubule and collecting ducts. Osmoregulation as control of the water potential of the blood. The roles of the	Sequencing projects have read the genomes of a wide range of organisms. Determining the genome of simpler organisms allows the proteome to be determined. This may have many applications, including the identification of potential antigens for use in vaccine production. In more complex organisms, the presence of non-coding DNA and of regulatory genes means that knowledge of the genome cannot easily be translated into the proteome.

			complementary bases Ribonucleic acid is important in all living cells, as it transfers genetic information from DNA to ribosomes. RNA is a polymer of nucleotides formed by condensation, with phosphodiester bonds between nucleotides. Each nucleotide is formed from a ribose, a nitrogen-containing organic base and a phosphate group. An RNA molecule is a relatively short polynucleotide chain. Ribosomes are made of RNA and proteins The semi-conservative replication of DNA ensures genetic continuity between generations of cells. The process of semi-conservative replication of DNA, including the role of helicase and DNA polymerase...	their environment by possessing different types of haemoglobin with different oxygen transport properties. Required practical 5: Dissection of animal or plant respiratory system or mass transport system or of an organ within such a system. 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. 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. Cardiovascular disease (CVD) and associated risk factors. Xylem as the tissue that transports water in the stem and leaves of plants. The cohesion-tension theory of water transport in the xylem. Phloem as the tissue that transports organic substances in plants. The mass flow hypothesis for the mechanism of translocation. Investigating transport in plants using tracers and ringing experiments.			hypothalamus, posterior pituitary and ADH in osmoregulation.	Sequencing methods are continuously updated and have become automated. Recombinant DNA technology involves the transfer of fragments of DNA from one organism, or species, to another, resulting in translation within the recipient (transgenic organism) due to the universal nature of the genetic code. Fragments of DNA can be produced by several methods, including: · conversion of mRNA to cDNA, using reverse transcriptase · using restriction enzymes to cut a fragment containing the desired gene from DNA · creating the gene in a 'gene machine'. The principles of the polymerase chain reaction (PCR) as an in vitro method to amplify DNA fragments. The culture of transformed host cells as an in vivo method to amplify DNA fragments, involving: · the addition of promoter and terminator regions to the fragments of DNA · the use of restriction endonucleases and ligases to insert fragments of DNA into vectors · transformation of host cells using these vectors. The applications and implications of recombinant DNA technology. Relate recombinant DNA technology to gene therapy.
			Year 12 Term 1 Section 1 Biological Molecules (ATP, Water and Inorganic ions)	Year 12 Term 2 Section 4 Genetic Information, variation and relationships between organisms (DNA, Genes and Chromosomes)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Nervous Coordination)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Inheritance)	Year 13 Term 3 Section 8 The control of gene expression (Recombinant DNA technology)
			A single molecule of ATP is a nucleotide derivative, formed from a molecule of ribose, a molecule of adenine and three phosphate groups. Hydrolysis of ATP to ADP and Pi is catalysed by the enzyme	Eukaryotic cells have chromosomes of linear DNA associated with histones. Prokaryotic cells contain short, circular DNA that is not associated with histones. Mitochondria and		Nerve cells pass electrical impulses along their length. A nerve impulse is specific to a target cell only because it releases a chemical messenger directly onto it, producing a response that is	The genotype is the genetic constitution of an organism. The phenotype is the expression of this genetic constitution and its interaction with the environment.	The use of labelled DNA probes and DNA hybridisation to locate specific alleles of genes. The use of labelled DNA probes that can be used to screen patients for heritable

			ATP hydrolase and can be used to phosphorylate compounds often making them more reactive, or provide energy to energy-requiring cellular reactions. ATP is resynthesised from ADP and Pi by the enzyme ATP synthase during photosynthesis or respiration Water is a major component of cells. It has several properties that are important in biology. In particular, water: is a metabolite, is a solvent, has a high heat capacity, has a large latent heat of vaporisation and has strong cohesion between molecules Inorganic ions occur in solution in the cytoplasm and body fluids of organisms, some in high concentrations and others in very low concentrations. Each type of ion has a specific role, depending on its properties. 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.	chloroplasts contain DNA like that of prokaryotes. A gene is a base sequence of DNA that codes for the amino acid sequence of a polypeptide or a functional RNA. DNA has a triplet code which is universal, non-overlapping and degenerate. Much of eukaryotic DNA does not code for polypeptides. There are non-coding regions of multiple base repeats between genes. There are also introns within genes which separate coding sequences (exons).		usually rapid, short-lived and localised. In contrast, 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.	There may be many alleles of a single gene. In a diploid organism, the alleles at a specific locus may be either homozygous or heterozygous. Alleles may be dominant or recessive. The use of fully labelled genetic diagrams to interpret, or predict, the results of monohybrid crosses involving dominant and recessive alleles. Use of the chi- squared ($\chi 2$) test to compare the goodness of fit of observed phenotypic ratios with expected ratios. Alleles may also be codominant. The use of fully labelled genetic diagrams to interpret, or predict, the results of monohybrid crosses involving codominant alleles.	conditions, drug responses or health risks. The use of this information in genetic counselling and personalised medicine. An organism's genome contains many variable number tandem repeats (VNTRs). The probability of two individuals having the same VNTRs is very low. The technique of genetic fingerprinting in analysing DNA fragments that have been cloned by PCR, and its use in determining genetic relationships and in determining the genetic variability within a population.
			Year 12 Term 1 Section 2 Cells (Cell Structure)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Protein Synthesis and Genetic Diversity)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Synaptic Transmission)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Genetic Crosses)	
			The structure of eukaryotic cell Eukaryotic cells have adaptations to their function The structure of prokaryotic cells, including the differences between prokaryotic and eukaryotic cells and the additional features of the cell which may be present. The structure of virus particles to include genetic material, capsid and attachment protein	The concept of the genome and the proteome. The structure of molecules of mRNA. The process of transcription in prokaryotes to produce mRNA. The process of transcription in eukaryotes to produce pre-mRNA which is subsequently spliced. The process of translation. The roles of ribosomes, tRNA and ATP. The structure of molecules of		The detailed structure of a synapse. The sequence of events involved in transmission across a cholinergic synapse in sufficient detail to explain: · unidirectionality · temporal and spatial summation · inhibition by inhibitory synapses. The effects of specific drugs on a synapse. NB recall of names and modes of action of individual drugs are no	The use of fully labelled genetic diagrams to interpret, or predict, the results of crosses involving sex linkage. The use of fully labelled genetic diagrams to interpret, or predict, the results of dihybrid crosses involving dominant, recessive and codominant alleles. The use of fully labelled genetic diagrams to interpret, or predict, the results of crosses involving	

			The principles and limitations of optical microscopes, transmission electron microscopes and scanning electron microscopes. The difference between magnification and resolution. Measuring the size of an object viewed with an optical microscope and calculation of magnification. Principles of cell fractionation and ultracentrifugation as used to separate cell components.	tRNA. Gene mutations arise spontaneously during DNA replication and include base deletion and base substitution. The degeneracy of the genetic code means that not all base substitutions cause a change in the amino acid sequence. Mutagenic agents can increase the risk of gene mutation. Meiosis produces genetically unique daughter cells. The process of meiosis involves two nuclear divisions and forms four haploid daughter cells. Independent segregation and crossing over result in genetically different daughter cells. Mutations in the number of chromosomes can arise spontaneously by chromosome non-disjunction during meiosis.		expected. The detailed structure of a neuromuscular junction. A comparison of transmission across a cholinergic synapse and across a neuromuscular junction.	autosomal linkage. The use of fully labelled genetic diagrams to interpret, or predict, the results of crosses involving epistasis.	
			Year 12 Term 1 Section 2 Cells (Cell Division)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Genetic Diversity and adaptation, Species and Taxonomy)			Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)	
			Not all cells in multicellular organisms retain the ability to divide. The cell cycle involves DNA replication followed by mitosis The behaviour of chromosomes during interphase and the stages of mitosis. The role of spindle fibres 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. Measurement of cells and calculation of their actual size Uncontrolled cell division can	The concept of genetic diversity. The principles of natural selection in the evolution of populations (including random mutation, reproductive success, inheritance of the beneficial allele and increasing allele frequency in the next generation). Natural selection results in species that are better adapted to their environment. This included anatomical, physiological or behavioural adaptations. Directional selection, exemplified by antibiotic resistance in bacteria and stabilising selection, exemplified by human birth weights. The concept of a species.			Species exist as one or more populations. A population as a group of organisms of the same species occupying a particular space at a particular time that can potentially interbreed. The concepts of gene pool and allele frequency. The Hardy-Weinberg principle provides a mathematical model, which predicts that allele frequencies will not change from generation to generation. The conditions under which the principle applies. The frequency of alleles, genotypes and phenotypes in a population can be calculated using the Hardy-	

			lead to the formation of tumours and of cancers. Many cancer treatments are directed at controlling the rate of cell division Binary fission in prokaryotic cells Viruses do not undergo cell division. Following injection of their nucleic acid, the infected host cell replicates the virus particles....	Courtship behaviour as a necessary precursor to successful mating. The role of courtship in species recognition. Phylogenetic classification is based on evolutionary origins and relationships. The hierarchical nature of classification into taxonomic ranks. The binomial identification of species based on its genes and species. Advances in immunology and genome sequencing help to clarify evolutionary relationships between organisms.			Weinberg equation: p2 + 2pq + q2 = 1	
			Year 12 Term 1 Section 2 Cells (Transport)					
			The fluid mosaic model of cell membranes, including the arrangement of phospholipids, proteins, glycoproteins and glycolipids. The role of cholesterol Required practical 4: Investigation into the effect of a named variable on the permeability of cell- surface membranes The movement of water across partially permeable membranes by osmosis. The concept of water potential 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. Movement of molecules and ions down concentration gradients by simple diffusion or facilitated diffusion. Movement of molecules and ions against concentration gradients by active transport. The adaptations of cells for rapid transport across internal and external membranes. Movement of molecules and ions against concentration gradients by co-transport.					

	KS4 prior learning	By the end of the term, students can:	Year 12 Term 1 Section 1 Biological Molecules (Monomers and Polymers)	Year 12 Term 2 Section 2 Cells (Immune System)	Year 12 Term 3 Section 4 Genetic information, variation and relationships between organisms (Biodiversity and Investigating Diversity)	Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Photosynthesis)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Muscular Skeletal System)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)
What we want our students to do	Biology, like all sciences, is a practical subject. Throughout the course students will carry out practical activities including: using microscopes to see cell division, dissection of animal or plant systems, aseptic technique to study microbial growth, investigating activity within cells, investigating animal behaviours and investigating distributions of species in the environment These practicals will give students the skills and confidence needed to investigate the way living things behave and work. It will also ensure that if students choose to study a Biology-based subject at university, they will have the practical skills needed to carry out successful experiments in your degree	Demonstrate excellence in these **skills**:	Explain what a monomer and polymer are. Identify some biological polymers and the monomer from which they are made. Explain the concept of condensation and hydrolysis reactions in forming/breaking down polymers Identify common monosaccharides. Describe the monosaccharides from which lactose, maltose and sucrose are made. Explain what is meant by a glycosidic bond and how they form through condensation. Describe how polymerisation of α-glucose can form starch or glycogen Represent the structure of α -glucose and β –glucose diagrammatically. Explain that glycosidic bonds between α–glucose form starch or glycogen and how this relates to their function and properties. Explain that glycosidic bonds between β–glucose form cellulose and how this relates to its function and properties. Describe the tests for starch, a reducing and non-reducing sugar in detail. Explain what is meant by qualitative testing.	Explain what is meant by an antigen and the types of molecules which can act as antigens. Explain why antigen recognition is important for the immune system. Identify cells which the immune system would launch an immune response against. Describe the process of phagocytosis. Explain the role of lysozymes in the destruction of pathogens. Explain the role of antigen presentation following destruction. Explain what is meant by the specific immune response. Explain the cell-mediated (cellular) immune response. Explain the roles played by helper T cells. Relating previous knowledge of protein structure, describe the structure of antibodies. Explain the specificity of an antibody to a particular antigen. Explain how antibodies lead to the destruction of pathogens. Explain the humoral (antibody-mediated) immune response. Explain what is meant by a monoclonal antibody. Explain the roles of plasma cells in producing a primary response and memory cells in producing a secondary response. Explain that antigen variability can lead to some diseases being caught more than once. Explain how mutations can cause antigen variability and how this can cause new strains of pathogen.	Explain what is meant by the terms biodiversity, species richness and index of diversity. Calculate the index of diversity when supplied with relevant information. Interpret information and draw conclusions from the index of diversity for different habitats. Explain how farming techniques impact on biodiversity and the reason why these techniques are used Evaluate conservation techniques and why these must be balanced with farming. Explain how the results of DNA hybridisation and biochemical analysis can be used to suggest relationships between different organisms within/between species. Interpret data obtained from DNA hybridisation or biochemical analysis. Explain how gene technology has changed the way in which relationships between organisms are worked out. Evaluate direct DNA/protein sequencing against methods of measuring the frequency of characteristics. Explain how random samples can be obtained. Explain what standard deviation is and how it is calculated. Represent raw and processed data clearly using tables and graphs. Interpret data in terms of means and the overlap of standard deviation bars. Apply knowledge of, to draw and explain conclusions. Evaluate the quality of	Explain how to extract photosynthetic pigments from leaves and separate them using chromatography. Identify photosynthetic pigments found in leaves of different plants. Required practical 7: Use of chromatography to investigate the pigments isolated from leaves of different plants, e.g. leaves from shade-tolerant and shade-intolerant plants or leaves of different colours. Describe the structure of chloroplasts. Explain where, specifically, the light-dependent reaction occurs. Explain the role of light in photolysis and photoionisation. Explain how photoexcited electrons move along the electron transfer chain, and how ATP and reduced NADP are produced. Explain chemiosmosis and the role of ATP synthase in producing ATP. Explain where the light-independent reaction occurs. Describe the Calvin cycle. Explain the roles of reduced NADP and ATP. Interpret experimental data about the light independent reaction. Required practical 8: Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts. Explain what is meant by limiting factors and how Farmers seek to overcome limiting factors in order to increase productivity.	Explain the role of skeletal muscle, linked to the role of tendons and joints. Explain how muscles which move bones that form part of a joint work as antagonistic pairs. To produce movement as they contract, muscles work against/are attached to an incompressible skeleton/bones. Describe the gross structure of skeletal muscles. Explain what is meant by a myofibril. Describe the microscopic structure of skeletal muscle. Explain what is meant by a sarcomere. Explain how actin and myosin are arranged within a myofibril to produce contraction of a sarcomere. Interpret diagrams to identify I bands, A bands, the H zone and the Z line on a diagram. Recall how the release of acetylcholine across neuromuscular junctions, triggers the release of calcium ions. Explain the importance of the release of calcium ions leading to a conformational change in tropomyosin. Explain the sliding theory filament of myofibril contraction. Explain the roles of key molecules myosin, actin, calcium and ATP in causing myofibril contraction. Explain the role of phosphocreatine in muscle fibres. Describe the locations of slow and fast skeletal muscle fibres. Describe differences in the structure of slow and fast skeletal muscle fibres.	Explain why individuals within a population of a species may show a wide range of variation in phenotype. Describe variation based on trends in graphs and link this to the causes of variation. Explain what is meant by selection. Explain how natural selection is linked to inheritance of alleles by the next generation and adaptation. Explain the concept of differential reproductive success. Apply your knowledge to explain data. Recall what is meant by allele frequency. · Explain what is meant by stabilising, directional and disruptive selection in the context of the effect that each has on phenotypes and allele frequencies. Explain what is meant by allopatric and sympatric speciation. Explain how natural selection and isolation may result in change in the allele and phenotype frequency and lead to the formation of a new species by allopatric speciation and sympatric speciation. Explain possible mechanisms for sympatric speciation. Apply knowledge to unfamiliar contexts. Explain how evolutionary change over a long period of time has resulted in a great diversity of species. Explain the process of genetic drift and its impact on allele frequencies. Explain how genetic drift differs from natural selection. Explain why genetic drift is

				Explain the consequences of antigen variability on the incidence of disease and the development of therapies against that disease. Compare and contrast active and passive immunity and apply knowledge to given examples. Describe how antigens can be used to produce a vaccine. Explain why vaccination is able to protect against diseases caused by particular pathogens. Explain what is meant by herd immunity and why it is able to protect unvaccinated individuals in a population Discuss ethical issues associated with the use of vaccines Evaluate methodology, evidence and data relating to the use of vaccines. Describe the structure of a HIV particle Explain how the structure of a HIV particle enables it to infect and replicate within a helper T cell Explain the distinction between being HIV positive and developing AIDS Explain how HIV causes the symptoms of AIDS Explain why antibiotics are ineffective against viruses (link to cell structure). Explain how the specificity of monoclonal antibodies can be used in medical diagnosis and targeting of medication at particular cell types. Explain the use of monoclonal antibodies in the ELISA technique. Interpret information to explain the accuracy and results of tests which use the ELISA technique. Discuss ethical issues associated with the use of monoclonal antibodies Evaluate methodology, evidence and data relating to the use of monoclonal antibodies.	results and reliability of conclusions.		Explain differences in the properties of slow and fast skeletal muscle fibres.	important only in small populations.

			Year 12 Term 1 Section 1 Biological Molecules (Lipids and Proteins)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Exchange)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Respiration)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Homeostasis)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations in Ecosystems)
			Describe the stages of the emulsion test. Describe the structure of triglycerides. Explain how triglycerides form. Recognise, from diagrams, saturated and unsaturated fatty acids. Describe the structure of phospholipids. Explain the properties of phospholipids related to their structure. Contrast the different properties of triglycerides and phospholipids. Explain how dipeptides and polypeptides form. Explain the hierarchical organisation of protein structure. Describe the types of bond involved in protein structure and the weakness of hydrogen bonds. · Relate the structure of proteins to properties of proteins (this is required for proteins named throughout the specification). Describe the general structure of an amino acid. Describe the biuret test and how it can be interpreted. Explain the variety of functions that proteins have and why they are so important to the body. Interpret the results of the emulsion test.	Explain how the size of an organism affects its surface area to volume ratio and why this is important. Apply your knowledge of surface area to volume ratio, to explain adaptations to body shape or the development of exchange systems. Describe and explain the relationship between surface area to volume ratio and metabolic rate. Calculate surface area to volume ratios when supplied with cell/organism dimensions. Describe the internal structure of a leaf. Explain how the structure is an adaptation allowing efficient gas exchange. Explain what a xerophytic plant is Explain the adaptations that xerophytic plants have and how these balance the needs for gas exchange whilst minimising water loss. Explain the adaptations of single-celled organisms for efficient gas exchange. Describe the structure of insect tracheal systems. Explain how the tracheal system is adapted to allow efficient gas exchange. Explain how tracheal systems balance the needs for gas exchange whilst minimising water loss. Describe the structure of fish gills. Explain how fish gills are adapted to maximise gas exchange, including counter current flow. Describe the structure of the human gas exchange system. Explain the roles of cartilage		Describe the process of anaerobic respiration in animals and some microorganisms. Explain the advantage of producing ethanol or lactate using reduced NAD. Compare and contrast aerobic and anaerobic respiration. Interpret information/data about anaerobic respiration and apply knowledge. Required practical 9: Investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms.	Define what homeostasis is. Explain why it is important that core temperature, blood pH, blood glucose concentration and blood water potential are maintained within restricted limits and the consequences of not doing so. Explain what is meant by negative and positive feedback. Explain the general stages involved in negative feedback, and why these are used in homeostatic mechanisms. Explain the benefit of having separate mechanisms for different departures from the original level. Interpret information relating to examples of negative and positive feedback.	Define the terms community, biotic, abiotic, ecosystem and niche. Explain what is meant by the carrying capacity of a population, and the biotic and abiotic factors which determine population size. Explain how some common abiotic factors could be measured. Explain why no two species have exactly the same niche. Describe and explain the techniques of sampling at random using quadrats, and systematic sampling using transects. Explain when it would be appropriate to use each technique. Describe the different measures of abundance that can be measured. Explain how sampling at random can be done to avoid bias. Explain how to ensure that estimates and conclusions are reliable. Explain the technique of mark-release-recapture and when it would be appropriate to use this technique. Use given data to calculate the size of a population estimated using the mark-release-recapture method. Explain why careful consideration must be given to the method used to mark animals. Explain the assumptions which must be made during mark-release-recapture. Propose a null hypothesis to test. Design an experiment to investigate the effect of a named factor on the distribution of a given species, taking into account

				in the trachea and bronchi. Explain the role of ventilation in terms of maintaining diffusion gradients. Explain the mechanism of breathing in terms of the action of the diaphragm muscle and the antagonistic action of the external and internal intercostal muscles and the pressure changes which they cause in the thoracic cavity. Explain the process of gas exchange, related to blood circulation and ventilation. Describe the features of the squamous epithelium. Explain how the squamous epithelium is adapted to maximising gas exchange. 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. Recognise correlations and causal relationships.				the need for data to be reliable. Suggest what you will do for variables which cannot be controlled. Represent raw and processed data clearly using tables and graphs. Select and use an appropriate statistical test and interpret the P value that results in terms of probability and chance. Apply knowledge to draw and explain conclusions. Explain what succession is. Explain how succession causes changes to ecosystems over time. Explain the impact of environmental changes on biodiversity. Apply knowledge to unfamiliar contexts. Use their knowledge and understanding to present scientific arguments and ideas relating to the conservation of species and habitats. Evaluate evidence and data concerning issues relating to the conservation of species and habitats and consider conflicting evidence. Know that management of succession can involve preventing succession occurring to maintain a desired community.
			Year 12 Term 1 Section1 Biological Molecules (Enzymes)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Digestion)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Energy in Ecosystems)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Blood Sugar)	Year 13 Term 3 Section 8 The control of gene expression (Gene Expression)
			Interpret energy level diagrams and identify the activation energy. Explain the induced-fit model of enzyme action. Explain how temperature, pH, substrate concentration, enzyme concentration and the presence of inhibitors affect enzyme catalysis. Describe and explain trends within graphs, relating this	Explain the general roles of organs within the digestive system and where key events in digestion happen. Explain the purpose of digestion. Explain the role of different enzymes in the digestive process and relate the specificity of enzymes back to protein structure. Explain how endopeptidases		Explain the concepts of gross primary production and net primary production. Understand the mathematical relationship between the two and use it to calculate values when supplied with data. Explain the reduction in energy/biomass along a food chain. Explain the concept of net production in consumers,	Explain the factors which can influence blood glucose concentration. Explain how hormones work to bring about a response. Explain the role of the pancreas, specifically the α and β cells of the Islets of Langerhans, in regulating blood glucose concentration. Explain what is meant by the terms glycogenesis,	Describe what happens in substitution, addition, deletion, inversion, duplication and translocation mutations. Explain how mutations can arise spontaneously, and the effect that mutagenic agents have on the rate of mutation. Relate the nature of a gene mutation to its effect on the encoded polypeptide.

			back to the tertiary structure of active sites and the effect of these variables. Calculate rate of reaction from graphs and raw data and explain the advantage of using initial rate. Interpret graphs of enzyme-controlled reactions and apply Explain the features of good experimental design. Process data to calculate rates. Represent raw and processed data clearly using tables and graphs. Evaluate the results and conclusions. Apply knowledge to draw and explain conclusions. Apply knowledge of tertiary structure to explain enzyme specificity and the formation of enzyme-substrate complexes.	and exopeptidases increase protein digestion. Explain the role of bile salts. Explain the features of good experimental design. Evaluate risk. Research and adapt methodology as the basis for designing an experiment. Process data to calculate rates. Represent raw and processed data clearly using tables and graphs. Apply knowledge to draw and explain conclusions. Evaluate the quality of results and reliability of conclusions. Recall the adaptations of intestinal epithelial cells to exchange. Explain the absorption of amino acids and glucose against a concentration gradient by co-transport. Explain the role of micelles in the absorption of lipids.		linked to how energy losses occur along food chains. Apply knowledge to the context of exam questions. Explain the ways in which production is affected by simplifying food webs. Explain the ways in which farmers are reducing respiratory losses within a human food chain. Interpret and calculate data on efficiency when provided with appropriate information. Evaluate the ethics of some of these farming practices. Describe the stages of the phosphorus cycle, and the ions at each stage. Explain the role of saprobionts and mycorrhizae in the phosphorus cycle. Interpret information/data about the phosphorus cycle and apply knowledge. Describe the stages of the nitrogen cycle, and the ions/ molecules at each stage. Explain the processes of saprobiotic nutrition, ammonification, nitrification, nitrogen fixation and denitrification within the nitrogen cycle. Explain the role of saprobionts and mycorrhizae in the nitrogen cycle. Interpret information/data about the nitrogen cycle and apply knowledge. Explain why farmers utilise natural and artificial fertilisers. Explain how eutrophication is caused, and what the impact is on the ecosystem in which it happens. Interpret information/data about eutrophication and apply knowledge.	glycogenolysis and gluconeogenesis. Apply knowledge to explain the stages involved in negative feedback in response to changes in blood glucose concentration. Explain what triggers the release of insulin. Explain how insulin acts at the cellular level to lower blood glucose concentration. Explain the role of the liver in glycogenesis. Explain what triggers the release of glucagon. Explain how glucagon acts at the cellular level to raise blood glucose concentration Explain the role of the liver in glycogenolysis and gluconeogenesis. Explain what triggers the release of adrenaline. Explain how adrenaline acts at the cellular level to control blood glucose concentration. Explain the second messenger model related to adrenaline and glucagon action. Describe the role of adenylate cyclase, cyclic AMP and protein kinase in the second message model. Explain the causes of type I and II diabetes. Explain how type 1 and type 2 diabetes can be controlled. Apply knowledge of blood sugar regulation and diabetes to interpret data. Evaluate the positions of health advisers and the food industry in relation to the increased incidence of type II diabetes. Apply knowledge of diabetes and biochemical tests, to design an experiment to identify the concentration of glucose in a 'urine' sample. Explain how to use colorimetry of known concentrations, alongside calibration curves to identify unknown concentrations.	Define what a stem cell is. Explain the characteristics of totipotent, pluripotent, multipotent and unipotent stem cells, and the sources of each type. Explain how induced pluripotent cells can be produced and why they are of interest. Evaluate the use of stem cells in treating human disorders. Explain what a transcription factor is. Describe the role of transcription factors in gene expression. Describe the mechanism by which oestrogen is able to initiate transcription. Interpret data provided from investigations into gene expression. Explain what epigenetics is, and what happens to the DNA or histone to modify gene expression. Interpret data provided from investigations into gene expression. Evaluate appropriate data for the relative influences of genetic and environmental factors on phenotype. Explain how epigenetic control can cause disease, and how it could be used to treat diseases such as cancer. Explain how gene expression can be inhibited by RNA interference of translation. Explain how siRNA interferes with translation. Interpret data provided from investigations into gene expression. Describe the characteristics of benign and malignant tumours. Explain the role of oncogenes/tumour suppressor genes, abnormal methylation and increased oestrogen concentrations in the development of cancer. Evaluate evidence showing correlations between genetic

								and environmental factors and various forms of cancer. Interpret information relating to the way in which an understanding of the roles of oncogenes and tumour suppressor genes could be used in the prevention, treatment and cure of cancer.
			Year 12 Term 1 Section 1 Biological Molecules (Nucleic Acids)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Mass Transport)		year 13 Term 1 Section 6 Organisms respond to changes to their environments (Response to stimuli)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Water Potential)	Year 13 Term 3 Section 8 The control of gene expression (Genome Projects)
			Explain the significance of DNA to organisms. Describe the structure of DNA and identify structural components from diagrams. Apply knowledge of complementary base pairing rules to work out the frequency of certain bases, when provided with information about the frequency the other bases. Explain why many scientists initially doubted that DNA was the genetic code Explain the role of RNA in transferring genetic information and as a component of ribosome Describe the structure of RNA and identify structural components of an RNA nucleotide from diagrams. Compare and contrast the similarities and differences between DNA and RNA Describe the process of DNA replication. Explain the significance of DNA replication. Evaluate the work of scientists in validating the Watson-Crick model of DNA replication. Apply your knowledge to explain experimental results from the work of these scientists.	Describe the structure of the circulatory system, with particular reference to the blood vessels entering/leaving the heart, lungs and kidneys. Link the structure of the circulatory system to its role in exchanging and transporting materials. Relate knowledge of protein structure to the structure of haemoglobin. Explain what is meant by the term "partial pressure". Explain how the binding of one oxygen molecule changes the shape of haemoglobin and how this affects the binding of further oxygen molecules. Relate knowledge to explain the shape of an oxyhaemoglobin dissociation curve. Explain the effect of carbon dioxide concentration on oxygen dissociation. Relate this knowledge to explain oxygen loading and unloading in different tissues. Explain differences between the oxyhaemoglobin dissociation curves of different species. Relate these differences to the environment in which the organisms with to explain how these adaptations allow organisms to survive. Describe and label the structure of the heart.		Explain what is meant by phototropism and gravitropism, and by positive and negative tropisms. Describe where IAA is produced. Describe the effect of different IAA concentrations on root/shoot growth. Apply knowledge of IAA to interpret results and draw conclusions. Explain how taxes and kineses aid survival. Required Practical 10. Represent raw and processed data clearly using tables. Calculate an appropriate statistical test and interpret values in terms of probability and chance. Apply knowledge of kineses to draw and explain conclusions. Explain the role of reflexes and why they are important. Explain the role of sensory, intermediate and motor neurones in a reflex arc. For a given context, explain the sequence of events which brings about a reflex action (from stimulus to response). Explain the features of sensory reception which are common to all receptors. Describe the structure of a Pacinian corpuscle. Explain the stimulus which Pacinian corpuscles respond to.	Describe the structure of a nephron. Explain the process of ultrafiltration and where it occurs. Explain the process of selective reabsorption, where it occurs along a nephron and the transport processes involved. Explain the adaptations of cells of the proximal convoluted tubule. Explain the importance of maintaining a sodium ion gradient in the medulla, and how this is achieved. Explain the reabsorption of water from the distal convoluted tubule and collecting ducts. Explain the role of the hypothalamus and posterior pituitary gland in osmoregulation. Explain the responses which are brought about by the release of ADH. Apply knowledge to explain the stages involved in negative feedback in response to changes in blood water potential.	Explain the principles of gel electrophoresis in separating DNA fragments. Explain how sequencing techniques have become automated and faster. Explain why it is harder to translate genomic sequences into the proteome for complex organisms than for simpler organisms. Explain what is meant by a restriction endonuclease and how they work to leave sticky ends. Describe the process of PCR in amplifying DNA fragments. Explain the role of primers and Taq polymerase in PCR. Explain the processes of strand separation, primer annealing, and strand synthesis. Evaluate the pros and cons of using PCR to clone DNA fragments over in vivo methods. Explain what gene cloning is and why it is important in a range of applications. Describe the stages involved in in vivo gene cloning. Explain the importance of the addition of promoter and terminator regions. Explain the importance of the use of restriction enzymes and sticky ends. Explain the methods used for transformation. Explain the use of marker genes and replica plating.

				Explain differences in the thickness of cardiac muscle between the atria and ventricles and between different sides of the heart. Explain the role of the atrio-ventricular and semilunar valves. Explain the role of the coronary artery. Explain the cardiac cycle. Explain the opening and closing of AV and semi-lunar valves in terms of differences in pressure at different stages of the cardiac cycle. Analyse and interpret data relating to pressure and volume changes during the cardiac cycle. Describe the structure of arteries, arterioles, veins and capillaries. Relate the structure of arteries, arterioles, veins and capillaries to their functions. Compare and contrast the structure and function of different blood vessels. Explain what tissue fluid is and which substances it contains. Explain the formation of tissue fluid in terms of hydrostatic pressure. Explain the reabsorption of some tissue fluid back into the capillaries, in terms of hydrostatic pressure and water potential Explain the role of the lymph system. Analyse and interpret data associated with specific risk factors and the incidence of cardiovascular disease. Recognise correlations and causal relationships. Explain the role of the xylem in plants. Explain how water transport in the xylem is linked to transpiration in the leaves. Explain the cohesion-tension theory of water transport. Explain the factors which affect transpiration. Explain the role of the phloem in plants.		Explain how a Pacinian corpuscle produces a generator potential in response to a specific stimulus. Identify the pigments in rod and cone cells. Explain how rod cells' visual acuity, sensitivity to light and sensitivity to colour are accounted for by the presence of rhodopsin and connections to the optic nerve. Explain how cone cells' visual acuity, sensitivity to light and sensitivity to colour are accounted for by the presence of different forms of iodopsin and connections to the optic nerve. Explain the events which take place during the cardiac cycle to produce and transmit a wave of electrical activity to make the heart beat Explain the roles of the SAN, AVN and bundle of His. Describe the location of, and the role played by, chemoreceptors and pressure receptors involved in detecting changes which lead to changes in heart rate. · Explain what is meant by the sympathetic and parasympathetic nervous system. Explain the role of the autonomic nervous system (sympathetic and parasympathetic) in controlling heart rate. Explain the role of the medulla oblongata.		Interpret information provided in exam questions, to interpret which colonies have been successfully transformed with recombinant DNA. Interpret information relating to the use of recombinant DNA technology. Evaluate the ethical, financial and social issues associated with the use and ownership of recombinant DNA technology in agriculture, in industry and in medicine. · Balance the humanitarian aspects of recombinant DNA technology with the opposition from environmentalists and anti-globalisation activists. Explain the principles of gene therapy. Explain the use of liposomes and viruses in delivering genes into cells. Explain the difference between somatic and germ line therapy, and why germ line therapy is prohibited. Evaluate the effectiveness and risks of gene therapy.

				Explain what is meant by translocation. Explain the mass flow hypothesis as a mechanism for translocation. Recognise correlations and causal relationships. Interpret evidence from tracer and ringing experiments and evaluate the evidence for and against the mass flow hypothesis.				
			Year 12 Term 1 Section 1 Biological Molecules (ATP, Water and Inorganic ions)	Year 12 Term 2 Section 4 Genetic Information, variation and relationships between organisms (DNA, Genes and Chromosomes)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Nervous Coordination)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Inheritance)	Year 13 Term 3 Section 8 The control of gene expression (Recombinant DNA technology)
			Describe the structure of ATP. Explain the role of enzymes in hydrolysing and synthesising ATP. Explain the significance of ATP in numerous processes within organisms, as a supplier of energy or phosphate Describe the properties that are important in water. Explain the properties of water linked to the polar nature of the molecule. Explain the significance of these properties to living organisms and processes Explain what is meant by the term inorganic ions and where they occur in the body. Explain the specific role of hydrogen ions, iron ions, sodium ions and phosphate ions. Relate the role of each of these ions to their properties.	Explain what is meant by the terms chromosome and gene. Compare and contrast DNA in eukaryotes with that in prokaryotes, mitochondria and chloroplasts. Explain what a gene could code for. Explain how the DNA base sequence is able to code for the primary structure of a polypeptide. Explain the terms degenerate, universal and non-overlapping. Explain why much of eukaryotic DNA can be considered as non-coding. Explain what is meant by an intron and an exon.		Describe and explain the structure of a myelinated motor neurone. Explain what is meant by a resting and an action potential. Explain the events in establishing a resting potential. Explain the events in generating an action potential. Explain how action potentials pass along unmyelinated neurones. Describe what nodes of Ranvier are. Describe how action potentials pass along myelinated neurones by saltatory conduction.	Explain the meaning of the key terms: · gene · allele · genotype · phenotype · homozygous · heterozygous. Define what is meant by dominant and recessive alleles and describe how to represent these. Draw genetic diagrams of dominant/recessive monohybrid crosses to predict offspring genotypes and phenotypes. Apply knowledge to calculate the predicted ratios of genotypes and phenotype of offspring when supplied with appropriate information. Explain what the chi-squared test is used for. Set a null hypothesis. Use the chi-squared test to compared observed values against those predicted from genetic crosses. Interpret chi-squared tests in terms of probability and chance. Define what is meant by codominant alleles, and describe how to represent these. Draw genetic diagrams of codominant monohybrid crosses to predict offspring genotypes and phenotypes.	Explain how DNA probes and hybridisation are used to locate specific alleles. Explain the benefits of screening for genetic diseases. Explain some of the issues raised by screening, and the role of genetic counsellors. Evaluate information relating to screening individuals for genetically determined conditions and drug responses. Describe the methodology involved in producing a genetic fingerprint. Explain what variable number tandem repeats are, and how these allow the production of a virtually unique genetic fingerprint. Explain the applications of genetic fingerprinting. Interpret genetic fingerprint patterns and draw conclusions.

								Apply knowledge to calculate the predicted ratios of genotypes and phenotype of offspring, using fully labelled diagrams, when supplied with appropriate information. Use the chi-squared test to compare observed values against those predicted from genetic crosses. Interpret P values from chi-squared tests in terms of probability and chance.	
			Year 12 Term 1 Section 2 Cells (Cell Structure)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Protein Synthesis and Genetic Diversity)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Synaptic Transmission)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Genetic Crosses)		
			Explain what is meant by a eukaryotic cell and the defining characteristics of a eukaryotic cell. Explain the roles of different components and organelles within eukaryotic cells. Interpret pictures, diagrams and electron micrographs to identify cell organelles Identify examples of specialised eukaryotic cells. Explain common adaptations that cells have to particular functions. Apply knowledge of eukaryotic cells features in suggesting the role of cells based on their adaptations Describe the structure of virus particles. Describe the role of the capsid and attachment protein. Relate the structure of a virus to its replication within cells. Describe the structural differences between prokaryotic and eukaryotic cells. Explain the role of plasmids, capsules and flagella Describe how an optical microscope and an electron microscope work. Explain the concepts of magnification and resolution and how they differ.	Explain what the terms genome and proteome mean. Describe the structure of mRNA and how it is related to its function. Explain the process of transcription in prokaryotes. Explain the process of transcription and splicing in eukaryotes, linking this to knowledge of introns. Interpret data from experimental work investigating the role of nucleic acids. Explain the process of translation. Explain the specific roles of ribosomes, ATP and tRNA in translation. Describe the structure of tRNA and how it is related to its function. Relate the base sequence of nucleic acids to the amino acid sequence of polypeptides, when provided with suitable data about the genetic code. Explain what a gene mutation is and how it arises. Explain what is meant by a deletion and substitution mutation and the potential consequences of each (linked to primary protein structure). Interpret base sequences to identify gene mutations and		Explain the functions of synapses. Describe the detailed structure of a synapse. Explain the sequence of events involved in transmission of an action potential from one neurone to another. Explain why synaptic transmission is unidirectional. Explain temporal, spatial summation, and inhibition by inhibitory synapses. Use information provided to predict and explain the effects of specific drugs on a synapse. Explain what a neuromuscular junction is. Describe and explain the detailed structure of a neuromuscular junction. Explain transmission across a neuromuscular junction by release of acetylcholine and compare this to synaptic transmission. Explain how muscle fibres stimulated to contract by one motor neurone act as a motor unit.	Explain what is meant by sex-linked genes, and describe how to represent these. Draw genetic diagrams of sex-linked crosses to predict offspring genotypes and phenotypes. Apply knowledge to calculate the predicted ratios of genotypes and phenotype of offspring, using fully labelled diagrams, when supplied with appropriate information. Use the chi-squared test to compared observed values against those predicted from genetic crosses. Interpret P values from chi-squared tests in terms of probability and chance. Draw genetic diagrams of dihybrid crosses to predict offspring genotypes and phenotypes. Apply knowledge to calculate the predicted ratios of genotypes and phenotype of offspring, using fully labelled diagrams, when supplied with appropriate information. Use the chi-squared test to compare observed values against those predicted from genetic crosses. Interpret P values from chi-squared tests in terms of probability and chance. Apply knowledge to calculate	

			Compare and contrast optical and electron microscopes. Explain why, for a considerable period of time, the scientific community distinguished between artefacts and cell organelles. Explain the use of an eyepiece graticule. Calculate the actual size of cells based on measured size and magnification. Describe the processes of cell fractionation and ultracentrifugation. Explain why the separation of cell components is important in studying cells and their components. Explain the use of low temperatures and buffers during cell fractionation. Explain the principles of separation by ultracentrifugation.	their impact. Describe what a mutagenic agent is and identify some possible mutagenic agents. Explain the different outcome of mitosis and meiosis. Explain how meiosis results in variation. Complete diagrams showing the chromosome content of cells after the first and second meiotic division, when given the chromosome content of the parent cell. 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. Explain what a non-disjunction event is and how it occurs. Compare and contrast gene and chromosomal mutations.			the predicted frequencies of genotypes and phenotype of offspring, using fully labelled diagrams, when supplied with appropriate information. Use the chi-squared test to compared observed values against those predicted from genetic crosses. Interpret P values from chi-squared tests in terms of probability and chance. Apply knowledge to calculate the predicted ratios of genotypes and phenotype of offspring, using fully labelled diagrams, when supplied with appropriate information. Use the chi-squared test to compare observed values against those predicted from genetic crosses. Interpret P values from chi-squared tests in terms of probability and chance.	
			Year 12 Term 1 Section 2 Cells (Cell Division)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Genetic Diversity and adaptation, Species and Taxonomy)			Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)	
			Explain what the cell cycle is and why it does not occur in some cells from multicellular organisms. 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., Describe the stages of the cell cycle. Apply knowledge of mitosis and the cell cycle, to identify cells in different stages of mitosis. · Use measured values to calculate the actual size of cells. · Explain what the mitotic index is and calculate the mitotic index from observed values Explain the events involved	Explain what is meant by genetic diversity and allele frequency. Explain the concept of reproductive success. Explain the principles of natural selection and how selection and adaptation are major factors in evolution and contributing to species diversity. Apply knowledge to unfamiliar information to explain how selection produces changes within a population of a species. Explain what is meant by directional and stabilising selection. Identify types of selection from distribution curves. Interpret data relating to the effect of selection in producing change within			Define what is meant by the term ‘population’. Explain what is meant when we refer to allele frequencies and a gene pool. Explain why some genotypes cannot be determined by looking at phenotypes. Explain what the Hardy-Weinberg principle predicts. Explain the conditions under which Hardy-Weinberg principle is valid. Describe and explain the mathematical equations used to express allele and genotype frequencies. Apply knowledge of the Hardy-Weinberg equation to the data given in a question to calculate the frequency of an allele or genotype.	

			in the formation of tumours and cancers and why this is damaging to the body. · Identify the processes within the cell cycle which are disrupted and which lead to cancer. · State that cancer treatments often work to inhibit stages of the cell cycle. · Interpret data relating to cancer treatments and their effects on the rate of cell division Explain what binary fission is and the organisms which carry out binary fission. · Describe the process of binary fission... Explain why viruses are not classified as being living organisms. · Describe the sequence of events by which viruses replicate. · Explain why viruses are so difficult to treat and develop medicines against.	populations. Apply knowledge of types of selection to explain antibiotic resistance and human birth weights. Explain what a species is. Appreciate the difficulties in defining the term species. Explain the role of courtship and why it is necessary. Interpret information and data relating to courtship displays. Explain the hierarchical taxonomic ranks used in the classification of species. Interpret phylogenetic trees. Apply knowledge to identify different taxonomic ranks from information provided. Appreciate the difficulties in constructing valid phylogenetic classifications. Explain how the results of genetic sequencing and immunological analysis can help us to update our understanding of evolutionary relationships. Interpret results from genetic and immunological analysis, to draw valid conclusions as to evolutionary relationships between organisms.					
			Year 12 Term 1 Section 2 Cells (Transport)					
			Describe the arrangement of proteins, glycoproteins, glycolipids, phospholipids and cholesterol in the fluid mosaic model of membrane. Explain the roles/importance of the constituent parts of the membrane. Relate the structure of the membrane to its role around/inside cells Identify key variables which affect membrane permeability. Represent raw and processed data clearly using tables and graphs. Apply knowledge of the fluid mosaic model to suggest how temperature/ alcohol affects membrane permeability.					

			Evaluate the quality of results and reliability of conclusions Define osmosis in terms of water potential. Explain the movement of water due to osmosis into or out of cells. Explain the effect of osmosis on plant and animal cells Explain what a dilution series is and produce one from stock solutions. Apply knowledge to explain how the water potential of a plant tissue can be experimentally determined. Represent raw and processed data clearly using tables and graphs. Process data to calculate percentage gain/loss. Apply knowledge to explain trends in graphs in relation to osmosis, water potential and mass change. Explain the usefulness of calibration curves or standards. Evaluate the results and conclusions. Define what is meant by diffusion and facilitated diffusion. Explain the process of facilitated diffusion. Identify which substances rely on facilitated diffusion and why they cannot enter/leave cells by diffusion. Interpret data to identify when a substance is moving by facilitated diffusion or diffusion. Define what is meant by active transport. Explain the process of active transport. Compare and contrast active transport and facilitated diffusion. Interpret data to identify when a substance is being actively transported. Explain the adaptations of specialised cells maximising the rate of transport across their internal and external membranes (could be linked						

			to Fick's law). 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 membrane. Describe the adaptations of small intestine epithelial cells for absorption. Define what is meant by co-transport. Explain the process of co-transport in the context of absorption of glucose (and amino acids).					
	KS4 prior learning	**By the end of the term, students can:**	Year 12 Term 1 Section 1 Biological Molecules (Monomers and Polymers)	Year 12 Term 2 Section 2 Cells (Immune System)	Year 12 Term 3 Section 4 Genetic information, variation and relationships between organisms (Biodiversity and Investigating Diversity)	Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Photosynthesis)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Muscular Skeletal System)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)
Key assessment questions:			During which process/group of processes are polymers hydrolysed in the body into monomers? What catalyses hydrolysis in the body If a glucose and a fructose (both with the formula C6H12O6) joined together in a condensation reaction, what would be the disaccharide which formed and what would its molecular formula be? Provide the structures of two monosaccharides and ask students to draw the structure of the disaccharide which would result from condensation Why does the structure of starch, cellulose and glycogen mean that starch and glycogen are good molecules for storage, whilst cellulose is a good structural molecule in cell walls	Define what an antigen is. Explain why the surface molecules of some cells act as antigens. Describe the process of phagocytosis from start to finish. Evaluate the statement "Phagocytes eat the pathogen". Why is the cell-mediated response able to destroy body cells that have turned cancerous? Define what an antibody is. Explain the importance of the variable region of antibodies. Explain the structure of antibodies in terms of the hierarchy of protein structure. Would the humoral response be used during a viral infection? Explain your answer. Why does the secondary immune response mean that pathogens are destroyed before they are able to make you ill? Suggest why we can suffer from some diseases multiple times, but we get others only once and are then immune. Why is it so difficult to	Define what we mean by the terms: biodiversity; species richness; and index of diversity. Why is the index of diversity a more useful measure than counting the number of species in an area? Explain some of the ways in which farming causes a reduction in biodiversity.	What is chromatography used for? What role does reduced NADP play in this process? · What role does ATP play in this process? · How many carbon atoms do RuBP, GP and TP have? · How is the chloroplast adapted to maximising the rate of photosynthesis in the stroma?	What are the three types of muscle in the body and what are their roles? Muscles can pull as they contract, but they cannot push. What would happen to a bone if muscles did not work in antagonistic pairs? Evaluate this statement: 'in an antagonistic pair of muscles, one muscle contracts whilst the other relaxes'. What is a myofibril? In which bands/zone would you find: a) Myosin? b) Actin? How would you work out the length of one sarcomere? Explain the presence of large amounts of mitochondria and endoplasmic reticulum in the sarcoplasm. Evaluate this statement: 'during contraction of a muscle, actin and myosin filaments contract and get shorter'. Explain the roles of tropomyosin, ATP and Ca2+ ions in muscle contraction.	What do we mean by continuous and discontinuous variation? What causes discontinuous and continuous variation? Explain why siblings are so varied, even though they have the same parents. What kind of selection is shown in the example of Biston betularia? Justify your answer. Explain what happens to cause speciation. How do the mechanisms of reproductive separation differ in allopatric and sympatric speciation? How is genetic drift fundamentally different to natural selection? Why does genetic drift only have noticeable effects in small populations?

				develop a vaccine against the common cold or HIV? Why have many animal flu viruses e.g. bird flu, made the news so often in recent years? During recent flu outbreaks, the government invested in Tamiflu drugs to protect the population in the event of a pandemic. Was this a wise decision? Evaluate the relative data and methodology of Wakefield and Honda in their studies of MMR and autism. Which is the most convincing study and why? Why are so few anti-viral drugs licensed for human use compared with the number against other types of pathogen? What is the difference between being HIV positive and having AIDS? What property of monoclonal antibodies makes them so useful in diagnostic testing?				
			Year 12 Term 1 Section 1 Biological Molecules (Lipids and Proteins)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Exchange)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Respiration)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Homeostasis)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations in Ecosystems)

			Describe how you would conduct an emulsion test for lipids. Are triglycerides (and phospholipids) polymers? Explain your answer. Why is the degree of saturation of the fatty acid chains important Where might the hydrophobic nature of lipids be useful within a cell and why Describe the biuret test A student took a sample of 100% pure starch and added the enzyme amylase to it. After 1 hour, they tested the solution using the Benedict's, iodine, emulsion and biuret tests. Which tests would be positive and why Show some bonds between functional groups covered so far and ask students to identify them as ester, peptide or glycosidic Provide the structures of two amino acids and ask students to draw the structure of the dipeptide· Is the emulsion test quantitative or qualitative? Explain your answer.	Explain the ways in which the structure of a leaf is adapted for gas exchange Explain the adaptations present in xerophytic plants that reduce water loss. Explain the adaptations present in fish gills and insect tracheal systems. Compare and contrast the human gas exchange system with that of an insect or a fish. The trachea and bronchi have C-shaped rings of cartilage, but the bronchioles do not. Suggest the advantages of this. What is risk? Why does correlation not prove causation?		How do aerobic and anaerobic respiration differ? Reduced NAD is used to produce lactate or ethanol from pyruvate. What is the advantage of this?	Explain how blood pH might fall and how the body would rectify this. Explain the consequence to enzymes of a) a fall in body temperature b) a rise in body temperature. Suggest the effect on cells if blood sugar concentration were to rise, resulting in a fall in the water potential. How do the principles of positive and negative feedback differ? What is the benefit of having separate negative feedback mechanisms controlling departures in different direction from the original state?	Why do no two species have exactly the same niche? What happens when niches overlap? Why is it incorrect to say that no two organisms have the same niche? Why might it be inappropriate to put a brightly coloured mark on an animal? Predict the effect on the accuracy of your estimate if: a) some marks were to rub off prior to recapture b) the second sample is conducted within an hour of release. Assuming that the technique is done correctly, why might all individuals still not be equally catchable? Could mark-release-recapture be used to sample humans? Explain your answer. Why does succession begin with a pioneer species? What is conservation? Why does conservation often involve managing succession?

			Year 12 Term 1 Section1 Biological Molecules (Enzymes)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Digestion)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Energy in Ecosystems)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Blood Sugar)	Year 13 Term 3 Section 8 The control of gene expression (Gene Expression)
			What aspects of enzyme catalysis cannot be explained using lock and key? Evaluate the statements: · "temperature denatures enzymes" · "acidic and alkaline pHs denature enzymes". Why is induced-fit a more refined model of enzyme catalysis than lock and key?	Why do vitamins and minerals not require digestion? Explain the mechanisms by which each of the products of digestion is absorbed.		What do the arrows in food chains represent? Why do humans tend to rear herbivores as their source of meat? How is energy lost along a food chain? How could farmers improve efficiency? Evaluate the advantages and disadvantages of using these methods. Explain how eutrophication occurs. Suggest steps that could be taken to reduce eutrophication from farmland. Explain the significance of nitrogen to living things. Write an equation for the conversions which occur during: ammonification; nitrogen fixation; denitrification; nitrification. Explain how eutrophication occurs. Suggest steps that could be taken to reduce eutrophication from farmland. What are the key features/principles of good experimental design?	What roles do the α cells of the Islets of Langerhans play in regulating blood glucose concentration? What roles do the β cells of the Islets of Langerhans play in regulating blood glucose concentration? What factors influence blood glucose concentration and how do they influence it? How do the hormones involved in bringing about adjustments to blood glucose concentration travel to their target organ? Which cells produce insulin? What are the three actions which insulin binding to insulin receptors brings about? Which cells are especially affected in terms of increasing the rate of glucose absorption? What role does the liver play? When is glucagon released? Which cells produce glucagon? Which cells are the only cells that have glucagon receptors? When is adrenaline released? Suggest how the binding of glucagon and adrenaline to liver cell surface receptors is able to activate enzymes inside the cells of the liver. Explain the causes of types I and II diabetes. Why do diabetics have to manage their carbohydrate intake? Why do diabetics have to be mindful about how much exercise they do? What are the arguments for and against the banning of advertising for certain types of food and drink in order to lower the incidence of type II diabetes? Why can glucose	What is meant by a frame shift mutation? Explain why some types of mutation might not result in a change to the structure of the polypeptide that is produced. How do plants and mammals differ in relation to differentiation? Why is only a small proportion of a cell's DNA translated when it specialises? Why is oestrogen able to directly enter the cell? What is a transcriptional factor? How does oestrogen stimulate/activate transcription factors? Suggest why oestrogen only has an effect in certain tissues? Why is studying twins so useful when investigating the environmental effects on epigenetics? What effect does DNA methylation have on gene expression? Why? What effect does histone acetylation have on gene expression. Why? Why is RNA interference specific to mRNA from a particular gene? How is RNAi different from inhibition of gene expression by transcription factors?

							concentration in urine be used as a means of diagnosing diabetes?	
			Year 12 Term 1 Section 1 Biological Molecules (Nucleic Acids)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Mass Transport)		year 13 Term 1 Section 6 Organisms respond to changes to their environments (Response to stimuli)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Water Potential)	Year 13 Term 3 Section 8 The control of gene expression (Genome Projects)
			Why can we not work out the frequency of bases in RNA when provided with data about the frequency of some of the other bases? How does the short, single-stranded structure of RNA suit its role in transferring genetic information to the ribosomes Describe the process of semi-conservative DNA replication, including the role of key enzymes Why did the Meselson–Stahl experiment prove the mechanism of DNA replication? What would the Meselson–Stahl experiment results have looked like if conservative replication was the mechanism for DNA replication??	Why do humans need a double circulatory system? Describe the journey of a red blood cell around one circuit of the body, naming the main blood vessels and the chambers of the heart. Why does haemoglobin have a quaternary structure? What effect does the first oxygen binding have on the structure of haemoglobin? What are haemoglobin's two seemingly conflicting roles (in the lungs and respiring tissues)? How are both roles achieved? Explain the S shape of the oxyhaemoglobin dissociation curve. Provide examples of organisms and the conditions in which they live e.g. birds. Then show oxyhaemoglobin dissociation curves and ask students to relate them to the environmental conditions. What are the risk factors associated with CVD? Explain why a strong correlation is not proof that a factor causes CVD. How are big trees, like giant redwood trees, able to move water against gravity to the leaves at the top?		Describe the differences in how plant growth factors are produced and act, compared to hormones in animals. Explain phototropism in stems. Explain gravitropism in roots. Explain how a taxis and a kinesis differ. How might each manifest itself in the movement of the animal? Provide examples of taxes and kineses for student to categorise as positive/negative taxes or kineses. Why are reflex actions much quicker than voluntary responses? Why are rods able to respond to low light intensity? Why do we see in greater detail when the image is focussed on the fovea? What is the advantage to having cells which can respond to low and high light intensity? What is meant by the term 'myogenic'? What is the role of the SAN, AVN and bundle of His? What would happen if the ring of non-conducting tissue was not present? What is the difference between the sympathetic and parasympathetic nervous system?	Explain what causes some molecules to be filtered into the filtrate and others not. Which molecules are selective reabsorbed? By which processes does this occur? Explain the counter current multiplier mechanism and why it is important for water reabsorption. Where are osmoreceptors located? Where is ADH released from? What effect does ADH have on the distal convoluted tubule and collecting duct (in the medulla)? What happens as a consequence of this?	What is cDNA? Why would it be inappropriate to produce cDNA of the human insulin gene by trying to find mRNA in a small intestine epithelial cell? What is meant by the term palindromic recognition sequence? What is the purpose of adding DNA primers? Why is Taq polymerase used in the PCR? How many fragments would you have after 20 cycles of PCR? Why is the percentage of cells successfully transformed with recombinant DNA so low? What are the potential benefits to mankind of transgenic/GM organisms? What are the valid objections that some people have to using recombinant DNA technology? Would your viewpoint depend on your circumstances? Should companies be allowed to patent genes? Why has the UK not approved widespread commercial growing of GM crops? Why are viruses used in some forms of gene therapy? Why does gene therapy become less effective with successive treatments? Describe a risk of using viruses? What further challenges would be faced in using gene therapy to cure genetic diseases caused by mutations in multiple genes?

			Year 12 Term 1 Section 1 Biological Molecules (ATP, Water and Inorganic ions)	Year 12 Term 2 Section 4 Genetic Information, variation and relationships between organisms (DNA, Genes and Chromosomes)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Nervous Coordination)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Inheritance)	Year 13 Term 3 Section 8 The control of gene expression (Recombinant DNA technology)
			Explain why ATP is such an important molecule Evaluate the statement "when ATP is hydrolysed, it makes energy for cellular processes to occur".· Explain the role of: · hydrogen ions · iron ions · sodium ions · phosphate ions Using GCSE knowledge, explain how we gain and lose inorganic ions and why homeostatic control of inorganic ions in the body is so important.	A textbook stated that "The bacterial chromosome is found in the cytoplasm of the cell". Evaluate this statement. What is meant by the terms: degenerate? non-overlapping? universal? A polypeptide is made of 24 amino acids. What is the minimum number of bases that the gene coding for it must have had?		What could act as a stimulus to change the heart rate? · Where are chemoreceptors and pressure receptors located? · How does the medulla oblongata increase/reduce heart rate? How is a resting potential established? · How is the membrane potential reversed during an action potential? · What is the all or nothing principle? What are nodes of Ranvier? · Why is conduction along myelinated neurones quicker than along unmyelinated ones? Give three reasons why the refractory period is important. · Why are nerve impulses unidirectional?	What is wrong with this statement: "he had two blue eyed genes which meant he had blue eyes"? Define what is meant by dominant and recessive alleles. Why is it not correct to think of a cell ignoring the recessive allele if a dominant one is present? Two heterozygous parents who can roll their tongue have 3 children. All 3 offspring can roll their tongue. They then fall pregnant with a 4th child. Does this mean that this one will be unable to roll their tongue? Why should you use chi-squared for inheritance investigations? What is the null hypothesis for this? How many degrees of freedom? Interpret your results in terms of chance and probability. Ask students to interpret or predict the offspring when provided with parental genotypes for examples involving multiple alleles e.g. ABO blood groups, coat colour in rabbits.	Explain how a radioactive DNA probe would be used in screening? What is the value of genetic screening? Why are some people concerned about having screening for a wide range of genetic diseases and predispositions? What can genetic counsellors provide advice on, and what can they not advise on? Why might PCR be used with DNA fingerprinting? Why are forensics officers so careful to avoid contaminating a crime scene? What proportion of bands would you expect to match between a child and its father.
			Year 12 Term 1 Section 2 Cells (Cell Structure)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Protein Synthesis and Genetic Diversity)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Synaptic Transmission)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Genetic Crosses)	

			Evaluate the statement "Mitochondria produce energy during respiration When provided with new cells, e.g. B lymphocytes, identify their adaptations and suggest a role, e.g. large numbers of mitochondria and rough E.R. indicative of large amounts of protein synthesis to produce antibodies Compare and contrast prokaryotic and eukaryotic cells Why are viruses described as particles rather than cells Optical microscopes were invented hundreds of years ago, whilst electron microscopes were invented in the 1930s. Suggest why some parts of the cell like rough endoplasmic reticulum were not discovered until the 1940s and 1950s whilst others like mitochondria were discovered much earlier. Put the cell organelles in order of sedimentation as the speed of the centrifuge is increased Why are fractionated cells kept in a solution that is ice cold, buffered and the same water potential?	What are the advantages of mRNA being used to carry the genetic code to the ribosomes, rather than DNA? Explain how mRNA is adapted to its function. What is the difference between mRNA and pre-mRNA? Provide students with a DNA code, identify the sense strand and ask students to transcribe it (assuming there are no introns). Evaluate the statement "DNA is a triplet code which instructs the ribosomes how to make amino acids". Explain how the structure of tRNA is adapted for its function. Provide students with an mRNA code and ask them to translate it into an amino acid sequence (when provided with appropriate information). Evaluate this statement: "Sunbathing exposes your body to UV light which causes mutations to occur". Which type of gene mutation is likely to be the most damaging and why? A student wrote that UV light increased the likelihood of mutations in the protein that the cell made. Why is this not correct? Compare and contrast the similarities and differences between mitosis and meiosis.		Explain how the synapse structure and events involved in synaptic transmission allow for unidirectionality, spatial and temporal summation and inhibition by inhibitory synapses. Why is it important that acetylcholinesterase hydrolyse acetylcholine? Explain the role played by ATP after synaptic transmission. How does an action potential arriving at a neuromuscular junction, trigger the release of acetylcholine? What effect does acetylcholine have on the postsynaptic membrane? In what ways is the transmission across a neuromuscular junction similar to transmission across a (excitatory) cholinergic synapse?	Interpret or predict the offspring when provided with parental genotypes for examples involving sex linkage e.g. Duchenne muscular dystrophy, Haemophilia, Red/green colour blindness. Interpret or predict the offspring when provided with parental genotypes for examples involving dihyrbid inheritance e.g. coat colour and hair length in guinea pigs, wing size and body colour in Drosophila. Interpret or predict the offspring when provided with parental genotypes for examples involving autosomal linkage e.g. linkage in flower colour and type of pollen in sweet peas, linkage of wing and eye colour. Interpret or predict the offspring when provided with parental genotypes for examples involving epistasis e.g. coat colour in rodent, fruit colour in summer squashes, flower colour in sweet peas, comb shape in chickens.	
			Year 12 Term 1 Section 2 Cells (Cell Division)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Genetic Diversity and adaptation, Species and Taxonomy)			Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)	

			Why would scientists investigating mitosis choose to study bone marrow cells over neurones Evaluate the statement "Mitosis consists of Interphase, Prophase, Metaphase, Anaphase and Telophase". Provide students with pictures of each stage of mitosis and ask them to describe what the chromosomes are doing and which stage of mitosis the cell is at Binary fission can happen every 20 minutes for some species, under ideal conditions. Suggest one example where this trait would be useful to humans Why do scientists disagree about whether viruses should be classified as living? Why do viruses make you ill?	How would selective breeding of animals and plants by humans affect genetic diversity? Fossils indicate that crocodiles and sharks have remained relatively unchanged for millions of years. Does this indicate that they are no longer subject to natural selection? Define what a species is. What is the difficulty in applying this definition to species such as bacteria? If a mutation were to affect the ability of a group of individuals to perform elements of a courtship display correctly, suggest what this would mean for them and why it might be significant in terms of speciation? Explain why determining the similarity of DNA sequences for common genes is a valid way of determining evolutionary relationships. Explain why immunological comparisons are a valid way of determining evolutionary relationships. Explain why these techniques allow us to classify more accurately than comparing anatomical features.			Is the dominant allele more common in a population than the recessive allele? Explain your answer. Is it possible to work out the genotypes of everyone in a population for a particular feature? Explain your answer. What assumptions does the Hardy-Weinberg principle make? Do these principles apply in practice? Why must both equations be equal to 1?	
			Year 12 Term 1 Section 2 Cells (Transport)					

			Explain how the structure of the membrane relates to its role as being partially permeable Present diagrammatic representation of cells with numerical water potentials. Students to represent the net movement of water with arrows between cells. Why do poisons that inhibit respiration, result in active transport stopping? Suggest why overwatering of plants can kill the plants. what does Fick's law state? what common adaptations do cells of exchange surfaces have? Describe the process of co-transport. How does co-transport differ from direct active transport?					
	KS4 prior learning	**By the end of the term, students can:**	Year 12 Term 1 Section 1 Biological Molecules (Monomers and Polymers)	Year 12 Term 2 Section 2 Cells (Immune System)	Year 12 Term 3 Section 4 Genetic information, variation and relationships between organisms (Biodiversity and Investigating Diversity)	Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Photosynthesis)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Muscular Skeletal System)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)

Disciplinary Rigour		What makes your subject different to other subjects? What are the expectations for students in your subject area in the KS5 qualification specification?	AO1 – Demonstration of knowledge of scientific ideas AT f – interpret the results of qualitative tests. Interpret experimental techniques for biochemical tests independently · 8.4.2.3 – risk assessment of dangers and appropriate control measures, using hazcards AO1 – demonstration of knowledge of techniques AT b and c /8.4.2.3 – production of a dilution series from a stock glucose concentration Use colorimetric techniques to produce a calibration curve · Maths Skills 0.2 – convert concentrations between standard and ordinary form · Maths Skills – plot a calibration curve and read off an unknown concentration from the graph AO2 – application of knowledge in a practical context AO3 – interpret evidence to make judgements and reach conclusions from Benedict's test	AO1 – Development of knowledge and understanding of antigens and their importance. AO1 – development of knowledge and understanding of phagocytosis AO1 – development of knowledge and understanding of the cell mediated response. AO1 – development of knowledge and understanding of the antibody structure and how antibodies lead to the destruction of pathogens. AO1 – development of knowledge and understanding of the humoral response AO2 – application of knowledge on the humoral response to explain data on antibody concentrations during the primary and secondary immune responses. AO1 – development of knowledge and understanding of antigen variability and its consequences AO2 – application of knowledge of antigen variability to the context of recent outbreaks of influenza (and other diseases). AO1 – development of knowledge of vaccines AO3 – evaluate scientific evidence. AO1 – development of knowledge of HIV and AIDS and the replication of HIV AO2/AO3 – interpret scientific data (graphs) and apply knowledge to explain them. AO1 – development of knowledge of monoclonal antibodies and their uses AO2 – application of knowledge of monoclonal antibodies to the contexts given in exam questions.	AO1 – development of knowledge and understanding of biodiversity and the impact of farming AO2 – application of knowledge to the context of question to calculate correctly the index of diversity. Maths Skills 1.3 – Interpret tabular data relating to amino acid sequences or DNA hybridisation of different organisms and draw conclusions about the evolutionary relationships between the organisms.	AO1 – development of knowledge of a scientific technique AO2 /AO3 – apply knowledge of scientific techniques and draw conclusions as to the pigments present AT g and b · Maths Skills 1.9 – use an appropriate statistical test (e.g. to compare mean distances moved) AO1/AO2 – development of understanding of the light dependent reactions of photosynthesis and application of knowledge to the context of exam questions AO3 – interpret scientific ideas and information from energy level diagrams. AO2 /AO3 – apply knowledge of scientific techniques and interpret data to draw conclusions AT g and b · Maths Skills 1.9 – select (and use) an appropriate statistical test Maths Skills 3.1 and Maths Skills 3.2 – transfer information between tables and graphs, and plot 2 variables on a graph Maths Skills 3.5/MS 3.6 – calculate rate or work out rate from the slope of a tangent to a curve Practical Skills 1.2 – apply scientific knowledge to practical contexts Practical Skills 2.4 – consider key variables Practical Skills 2.2/Practical Skills 3.1/Maths Skills 3.2/Maths Skills 1.3 – plot the experimental data in an appropriate format Practical Skills 2.3/Maths Skills 3.3 – evaluate data for errors and uncertainties, and consider margins of accuracy	AO1 – development of knowledge of synapses and synaptic transmission AO2 – application of knowledge to explain features of synapses. AO1 – development of understanding that recreational and medicinal drugs often affect synapses AO2/AO3 – interpret information and experimental data, and apply knowledge to explain the specific effects of drugs on a synapse. AO1 – development of knowledge of neuromuscular junctions and transmission across neuromuscular junctions. AO1 – development of knowledge of antagonistic pairs of muscles. AO1 – development of knowledge and understanding of the structure of skeletal muscle, and the ultrastructure of myofibrils. AO2 – application of knowledge to the context given in exam questions. AO1 – development of knowledge and understanding of the mechanism of myofibril contraction. AO1 – development of knowledge relating to the structure, location and properties of slow and fast skeletal muscle AO2 – application of knowledge to exam questions.	Maths Skills 1.10 – understand and calculate standard deviation and range. AO1 – development of knowledge of variation and its causes AO2/AO3 – application of knowledge to identify types of variation and causes from experimentally derived data Maths Skills 1.6 – calculate mean, median and mode for measured values. AO1/AO2/AO3 – development of knowledge of natural selection and selection pressures, and application to data AO1 – development of understanding relating to forms of natural selection and their effect on allele frequencies AO2/AO3 – application of knowledge to experimentally derived data (in exam questions). AO1 – development of understanding relating to forms of natural selection and their effect on allele frequencies and species diversity AO2 – application of knowledge to unfamiliar contexts in exam questions. AO1 – development of understanding of genetic drift AO2/AO3 – application of knowledge to explain unfamiliar examples. Maths Skills 1.5 – apply knowledge of sampling to the concept of genetic drift

			Year 12 Term 1 Section 1 Biological Molecules (Lipids and Proteins)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Exchange)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Respiration)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Homeostasis)	Year 13 Term 3 Section 7 Genetics, populations, evolution and ecosystems (Populations in Ecosystems)
			AT f – interpret the results of the emulsion test for lipids. Independently follow instructions for the emulsion test to test samples for lipids AO1 – demonstration of knowledge of scientific technique AO1 – demonstration of knowledge of scientific idea. AT f – use and interpret the results of a biuret test for proteins · 8.4.2.1/8.4.2.2 – independently follow instructions for the biuret test AO1 – demonstration of knowledge of scientific idea/technique AO3 – interpret evidence to make judgements and reach conclusions from Biuret test. AO1 and AO2 – demonstration and application of knowledge of scientific idea· AO3 – make judgements as to the presence of lipids.	Maths Skills 0.3/Maths Skills 4.1 – calculate the surface area to volume ratios of different shaped object/cells/organisms when supplied with their dimensions AO1 – development of knowledge of why larger organisms have specialised surfaces and mass transport systems, or particular body shapes. Maths Skills 1.9 – students could select and use an appropriate statistical test to find the significance of differences in the number of stomata on the upper and lower surfaces of leaves of a single plant species or on the lower surfaces of leaves of different plant species AO1 – development of knowledge of leaf structure and the adaptations present in xerophytes AO2 – application of earlier learning on features that increase the rate of exchange, to explain features that reduce water loss in xerophytic plants. AO1 – development of knowledge of mechanism of breathing and associated measurements and the techniques associated with spirometers and respirometers. Maths Skills 0.3 – calculate and understand the use of percentages or values per 100 000 when looking at data within populations AO3 – analyse, interpret and evaluate scientific information and evidence to assess the validity of conclusions and the strength of correlations.		AO1/AO2 – development of understanding of aerobic respiration AO2/AO3 – application of knowledge to exam questions. AO1/AO2 – development of understanding of anaerobic respiration AO2/AO3 – application of knowledge to exam questions. ATb – use a redox indicator to investigate dehydrogenase activity Maths Skills 3.2/Maths Skills 1.3 – plot the experimental data in an appropriate format Maths Skills 3.3 – evaluate data for errors and uncertainties and consider margins of accuracy AO1/AO2 – application of knowledge to explain trends AO3 – develop and refine practical design Maths Skills 1.9 – use an appropriate statistical test Maths Skills 1.4 – understand simple probability	AO1 – development of knowledge relating to homeostasis and some of the key factors which the body maintains within restricted limits AO2/AO3 – application of knowledge to explain trends in data. AO1 – development of knowledge relating to positive and negative feedback and the use of negative feedback in homeostatic processes AO2 – application of knowledge of positive and negative feedback to unfamiliar examples, when presented with appropriate information.	AO1 – development of understanding relating to forms of natural selection and their effect on allele frequencies AO2/AO3 – application of knowledge to experimentally derived data (in exam questions) Maths Skills 0.1 – recognise and use appropriate units for abiotic measurements. AO1/PS 4.1 – development of understanding relating to sampling using quadrats and transects AO2/AO3 – application of knowledge to experimentally derived data (in exam questions) AT k – investigate the distribution of organisms in a named habitat using randomly placed frame quadrats, or a belt transect AT k/Maths Skills 0.3 – use both percentage cover and frequency as measures of abundance of a sessile species. Maths Skills 0.4 – make estimates of percentage cover Maths Skills 1.6 – calculate mean, median and mode for measured values from sampling Maths Skills 1.5 – understand the principles of sampling Maths Skills 1.7 – use a scatter diagram to identify a correlation between two measured values from a belt transect e.g. light intensity and percentage cover of Dog's mercury Maths Skills 1.9 – select and use an appropriate statistical test Practical Skills 1.2/2.1 – understand how to design experiments to avoid bias and ensure a large enough sample size.a) prior to

								recapture b) the second sample is conducted within an hour of release. AT a and k – use appropriate apparatus and sampling techniques in fieldwork Practical Skills 1.1/1.2/2.4 – apply scientific knowledge to design a sampling investigation, identifying key variables Practical Skills 2.2/PS 3.1/ Maths Skills 1.7 – plot the experimental data on a scatter graph AO1/AO2 – application of knowledge to explain trends AO2/AO3 – application of knowledge to unfamiliar contexts and experimentally derived data Maths Skills 2.5 – students could use logarithmic scale in representing the growth of a population of microorganisms · extended exam answers. AO1 – development of understanding relating to conservation and succession management AO2/AO3 – application of knowledge to, and interpretation of, scientific data and evidence to form reasoned arguments.
			Year 12 Term 1 Section1 Biological Molecules (Enzymes)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Digestion)		Year 13 Term 1 Section 5 Energy Transfer in and between organisms (Energy in Ecosystems)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Blood Sugar)	Year 13 Term 3 Section 8 The control of gene expression (Gene Expression)

			Maths Skills 1.3 – interpret graphs of energy changes during reactions, to identify activation energy · AO1 and AO2 – demonstration and application of knowledge of scientific idea · AT a/AT l – use apparatus, including data loggers, to record measurements e.g. pH, temperature Maths Skills 0.1 – work out and use appropriate units for rate Maths Skills 0.5 – calculate pH from data about hydrogen ion concentration, using the formula: pH = −log10 [H+] AO2/AO3 and PS1.2 – apply knowledge to practical contexts Maths Skills 3.2/3.3 – plot two variables on graphs. Sketch the shape of a graph with a linear relationship using the formula y = mx +c e.g. the effect of substrate concentration in the presence of excess enzyme AO3 – interpret scientific information and ideas to make judgements in the context of activation energy and the strength of enzyme catalysis models Practical Skills 2.2/Maths Skills 1.3/Maths Skills 3.1/MS 3.2 – present experimental data using tables and graphs Practical Skills 3.2/Maths Skills 2.4/Maths Skills 3.6 – calculate/work out initial rates of reaction from data and from slopes of a tangent Practical Skills 2.3 and PS3.3 – evaluate results for errors Maths Skills 0.1/Maths Skills 0.2 – use and convert units for concentration Maths Skills 1.9 – select (and use) an appropriate statistical test AO1/AO2 – application of knowledge to explain trends AO3 – develop and refine practical design.	AO1 – development of knowledge and understanding of digestion AO2/AO3 – application of knowledge to explain exam questions/data showing the reduction in pH when lipase and bile are added to milk AO2 – apply knowledge in a practical context AO3 – analyse, interpret and evaluate scientific information and evidence to make judgements, reach conclusions and develop/refine practical design and procedures. AO1 – development of knowledge and understanding of absorption AO3 – evaluation of scientific information in other people's presentations.		Maths Skills 0.2 – convert and carry out calculations of energy transfer using numbers in standard and ordinary form Maths Skills 0.3 – calculation of percentage efficiency and percentage yield Maths Skills 2.3/Maths Skills 2.4 – substitute numerical values into, and solve, algebraic equations using appropriate units. AO1 – development of knowledge and understanding of the nitrogen cycle AO2 – application of knowledge to the context set in exam questions Maths Skills 1.9 – select an appropriate statistical test Practical Skills 1.1/1.2 – solve problems set in, and apply scientific knowledge to, practical contexts.	AO1 – development of knowledge relating to negative feedback in the context of blood glucose regulation. AO1 – development of knowledge relating to the mechanisms of action by insulin, and how it results in a decrease in blood glucose concentration. AO1 – development of knowledge relating to the mechanisms of action by glucagon, and how it results in an increase in blood glucose concentration. AO1 – development of knowledge relating to the mechanism of action by adrenaline and the second messenger model AO2 – application of knowledge to think-pair-share tasks. AO1 – development of knowledge relating to types I and II diabetes, in terms of causes and control AO2/AO3 – interpretation of experimentally derived data in exam questions and from the glucose tolerance test, and application of knowledge to explain/evaluate the data and evaluate societal arguments around particular types of food/drink · MS 1.10 – understand standard deviation in the context of diabetes studies contained within suggested exam questions. AO2 – application of knowledge of biochemical tests, colorimetry and calibration curves AT b and c – production of a dilution series from a stock glucose concentration. Use colorimetric techniques to produce a calibration curve Practical Skills 4.1 – use colorimetry/calibration curves Practical Skills 3.1/Maths Skills 1.3/3.2 – plot a calibration curve and read off an unknown concentration.	AO1 – development of knowledge understanding of types of mutation and its consequences AO2 – application of knowledge to information/context of exam questions. AO1 – development of understanding of how transcription factors can stimulate or inhibit transcription AO2/AO3 – application of knowledge to, and interpretation of, scientific data from investigations into gene expression. AO1 – development of understanding relating to the properties and uses of different types of stem cells AO2/AO3 – application of knowledge and interpretation of, scientific data and evidence to evaluate the use of stem cells · 8.4.2.5 – Research IPS cells. AO1 – development of understanding of how RNA interference can inhibit gene expression AO2/AO3 – application of knowledge to, and interpretation of, scientific data from investigations into gene expression. AO1 – development of understanding of tumours, and the possible reasons for developing tumours AO2 – application of knowledge to exam questions AO3/AT I – evaluation of scientific data showing correlations and comparison of data against bioinformatics database · essay-writing skills.

			Year 12 Term 1 Section 1 Biological Molecules (Nucleic Acids)	Year 12 Term 2 Section 3 Organisms exchange substances with their environment (Mass Transport)		year 13 Term 1 Section 6 Organisms respond to changes to their environments (Response to stimuli)	Year 13 Term 2 Section 6 Organisms respond to changes in their environments (Control of Water Potential)	Year 13 Term 3 Section 8 The control of gene expression (Genome Projects)
			Maths Skills 0.3 – use incomplete information about the frequency of bases on DNA strands to find the frequency of other bases AO1 – knowledge and understanding of scientific ideas AO2/AO3 – analysing data on base frequency and applying knowledge of base pairing, to work out frequency of other bases Practical Skills 1.2/AO2 – apply knowledge of semi-conservative DNA replication to the results of Meselson and Stahl, to explain how this experiment proved semi-conservative replication over other theories e.g. conservative or dispersive replication AO3 – interpret and explain the results of the Meselson–Stahl experiment. AO2/AO3 – interpreting DNA sequence and applying knowledge to work out complementary mRNA code..	AO1 – development of knowledge and understanding or circulation and the key blood vessels entering and leaving the kidneys, lungs and heart. AO1 – development of knowledge on oxygen loading, transport and unloading AO2 – application of knowledge to explain the Bohr effect on an oxyhaemoglobin dissociation curve Maths Skills 1.3/AO3 – interpret data from graphs showing oxyhaemoglobin dissociation curves AO3 – apply knowledge of oxygen dissociation and adaptations of organisms, to experimental data showing oxygen dissociation at different partial pressures AO3/Maths Skills 1.3 – interpret data from graphs showing oxyhaemoglobin dissociation curves Maths Skills 3.1 – translate data between a number of different formats e.g. graphical and tabular forms AO1 – development of knowledge on oxygen loading, transport and unloading AO2 – application of knowledge to suggest how organisms have haemoglobin with different transport properties. AO1 – development of knowledge on the structure of the heart. AO1 – development of knowledge of the cardiac cycle, the pressure and volume changes within it and how this causes valves to open and close AO2/AO3/Maths Skills 1.3 – interpret data from graphs/tables showing		AO1 – development of knowledge relating to IAA and tropisms in plants. AO2/AO3 – interpret scientific data and apply knowledge of the effects of IAA to explain it · MS 0.2 – use/conversion of IAA concentrations in ordinary and standard form · MS 0.3 – calculation of percentage inhibition/stimulation · MS 2.3 – plot 2 variables from experimental data · AT h – carry out investigations into the effect of IAA on root growth in seedlings AO1 – development of knowledge and understanding of kineses and taxes · AO2 – application of knowledge to explain observations from activity circus · AT h – carry out investigations into taxes and kineses using living organisms.AO2 – application of knowledge of kinesis and stats tests to explain and interpret observations · AT h – investigation of kineses in organisms · MS 1.9 – use an appropriate statistical test. AO1 – development of knowledge and understanding of how Pacinian corpuscles work. AO1 – development of understanding of the roles of the SAN, AVN and Purkinje fibres in generating and transmitting electrical activity to cause a heartbeat. AO1 – development of knowledge and understanding of how heart rate is controlled.	AO1 – development of knowledge/understanding relating to the structure of a nephron, and the events which occur at different points along the nephron AO2/AO3 – interpretation of data and application of knowledge to explain it. AO1 – development of knowledge relating to negative feedback in the context of osmoregulation and the role of ADH. AO2/AO3 – interpretation of data and application of knowledge to think-pair-share tasks. Maths Skills 1.3 – interpret pie charts.	AO1 – development of understanding relating DNA sequencing techniques and genome projects AO2/AO3 – application of knowledge to, interpret sequences from gel patterns. AO1 – development of understanding relating to recombinant DNA technology and production of DNA fragments AO2 – application of knowledge of restriction endonuclease recognition sites to work out sticky ends produced. AO1 – development of understanding of the process of PCR and its applications AO2/AO3 – application of knowledge to, and interpretation of, scientific data and evidence to form reasoned arguments AO1 – development of understanding relating to the process of in vivo gene cloning AO2/AO3 – interpretation of information in exam questions and application of knowledge about in vivo gene cloning Maths Skills 0.3 – use percentages when discussing/working out the proportion of cells which are successfully transformed. AO1 – development of understanding of how recombinant DNA technology is used AO2/AO3 – application of knowledge to, and interpretation/evaluation of, scientific data and case studies to form reasoned arguments. AO1 – development of understanding relating to gene therapy, its effectiveness and its risks AO2 – application of

				pressure/volume changes within the cardiac cycle and apply knowledge to explain the data AO1 – development of knowledge of the structure and function of different blood vessels AO2 – application of knowledge of structure to the function of each blood vessels. AO3 – analyse, interpret and evaluate scientific information and evidence to assess the validity of conclusions and the strength of correlations. AO1 – development of understanding of cohesion-tension theory and water movement AO1/PS 4.1 – understand the principles of using and reading values from a potometer. AO1 – development of knowledge and understanding of translocation by mass flow Practical Skills 1.2/AO2 – apply knowledge of translocation to traces and ringing experiments AO3 – evaluate scientific evidence in supporting scientific ideas.				knowledge to evaluate gene therapy
			Year 12 Term 1 Section 1 Biological Molecules (ATP, Water and Inorganic ions)	Year 12 Term 2 Section 4 Genetic Information, variation and relationships between organisms (DNA, Genes and Chromosomes)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Nervous Coordination)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Inheritance)	Year 13 Term 3 Section 8 The control of gene expression (Recombinant DNA technology)

			Maths Skills 2.4 – calculation of specific heat capacity of water from data AO1 and AO2 – development and application of knowledge and understanding about properties of water related to their significance to life AO1 – development of knowledge and understanding of scientific ideas and processes AO1 and AO2 – development and application of knowledge and understanding about inorganic ions, their properties and their roles. AO3 – interpreting activity circus and drawing conclusions.	AO1 – development of knowledge and understanding of the arrangement of DNA in eukaryotes and prokaryotes and the relationship between DNA, genes and chromosomes. Maths Skills 0.3 – calculate the percentage of human DNA which does code for polypeptides, when supplied with data about the number of coding bases and the total number of bases Maths Skills 0.5 – work out the possible number of combinations that a triplet code can have (i.e. 43) to highlight the idea of degeneracy AO1 – development of knowledge and understanding of the triplet code and non-coding sections of it.		AO1 – development of understanding of motor neurone structure, resting potentials and action potentials AO2/AO3 – interpret scientific data and apply knowledge of the resting and action potentials to explain the data. AO1 – development of understanding of how action potentials pass along myelinated and unmyelinated neurones. AO1 – development of understanding of the refractory period and its importance AO2/AO3 – interpret scientific data and apply knowledge about refractory period in limiting the frequency of action potentials.	AO1 – development of knowledge and understanding of key terms and concepts relating to inheritance. ATh – ethical and safe use of organisms. AO1 – development of understanding of dominant and recessive alleles, and their inheritance AO2 – application of knowledge to unfamiliar contexts Maths Skills 0.3 – use information to represent phenotypic ratios in monohybrid crosses Maths Skills 1.4 – understand simple probability associated with inheritance. AO1 – development of knowledge and understanding of the chi-squared test and how it is used AO2 – application of knowledge to interpret chi-squared outcomes Maths Skills 1.9 – use the χ2 test to investigate the significance of differences between expected and observed phenotypic ratios. AO1 – development of understanding of multiple alleles and their inheritance AO2 – application of knowledge to unfamiliar contexts Maths Skills 0.3 – use information to represent phenotypic ratios in monohybrid crosses Maths Skills 1.4 – understand simple probability associated with inheritance Maths Skills 1.9 – use the χ2 test to investigate the significance of differences between expected and observed phenotypic ratios.	AO1 – development of understanding relating to genetic screening and counselling AO2 – application of knowledge to form reasoned arguments. AO1 – development of understanding relating to genetic fingerprinting and its applications AO2/AO3 – interpretation of genetic fingerprints to draw valid conclusions Maths Skills 1.4 – consider the probability of two people (not identical twins) having the same VNTRs · essay-writing skills.
			Year 12 Term 1 Section 2 Cells (Cell Structure)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Protein Synthesis and Genetic Diversity)		Year 13 Term 1 Section 6 Organisms respond to changes in their environments (Synaptic Transmission)	Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Genetic Crosses)	

			Maths Skills 0.1 – convert between units e.g. mm and µm Maths Skills 0.2 – understand standard form when applied to the size of organelles AO1 – development of knowledge of cell structure AT d/AT e – use optical microscopes to observe and draw pre-prepared microscope slides of specialised eukaryotic cells. Maths Skills 0.2 – understand standard form when applied to the size of bacteria AO1 – development of knowledge of prokaryotes AO2 – application of knowledge to micrographs. AO2 – application of knowledge to micrographs Maths Skills 0.2 – understand standard form when applied to the size of viruses AO1 – development of knowledge of virus structure Maths Skills 0.2 – understand and convert numbers from standard to ordinary form when applied to magnification AO1 – development of knowledge and understanding of microscopy techniques... Maths Skills 1.8/Maths Skills 2.2 – use and manipulate the magnification formula AO1 – knowledge of the procedure of using a micrometer and graticule AO2 – application of knowledge to data given to calculate magnification, object size or image size. AO1 – development of knowledge and understanding of cell fractionation procedures and the reasoning behind stages AO2 – application of cell structure to suggest or explain the sedimentation at different centrifuge speeds.	Practical Skills 1.2 - apply knowledge of transcription and nucleic acids to explain experimental data from investigations into the role of nucleic acids AO1 – development of knowledge around transcription and the structure and role of mRNA AO2 – application of knowledge to transcribe a DNA sequence into mRNA. AO1 – development of knowledge around translation and the structure and role of tRNA AO2 – application of knowledge to translate a mRNA sequence into a sequence of amino acids. AO1 – development of knowledge around gene mutations and their possible consequences AO2 – application of knowledge of mutation to a model of protein synthesis model to suggest possible effects of gene mutation on the structure of the protein produced. Maths Skills 0.5 – use the expression 2n to calculate the possible number of different combinations of chromosomes Maths Skills 0.5 – derive a formula from this to calculate the possible number of different combinations of chromosomes following random fertilisation AO1 – development of knowledge of meiosis AO2 – application of knowledge to unknown life cycles. AO1 – development of knowledge and understanding of non-disjunction events during meiosis leading to chromosomal mutations.		AO1 – development of knowledge of synapses and synaptic transmission AO2 – application of knowledge to explain features of synapses. AO1 – development of understanding that recreational and medicinal drugs often affect synapses AO2/AO3 – interpret information and experimental data, and apply knowledge to explain the specific effects of drugs on a synapse. AO1 – development of knowledge of neuromuscular junctions and transmission across neuromuscular junctions.	AO1 – development of understanding of co-dominant alleles, and their inheritance AO2 – application of knowledge to unfamiliar contexts Maths Skills 0.3 – use information to represent phenotypic ratios in monohybrid crosses Maths Skills 1.4 – understand simple probability associated with inheritance Maths Skills 1.9 – use the $\chi 2$ test to investigate the significance of differences between expected and observed phenotypic ratios. AO1 – development of understanding of dihybrid crosses AO2 – application of knowledge to unfamiliar contexts Maths Skills 0.3 – use information to represent phenotypic ratios in dihybrid crosses Maths Skills 1.4 – understand simple probability associated with inheritance Maths Skills 1.9 – use the $\chi 2$ test to investigate the significance of differences between expected and observed phenotypic ratios. AO1 – development of understanding of epistasis AO2 – application of knowledge to unfamiliar contexts Maths Skills 0.3 – use information to represent phenotypic ratios in crosses involving epistasis Maths Skills 1.4 – understand simple probability associated with inheritance Maths Skills 1.9 – use the $\chi 2$ test. AO1 – development of understanding of epistasis AO2 – application of knowledge to unfamiliar contexts Maths Skills 0.3 – use information to represent phenotypic ratios in crosses	

							involving epistasis Maths Skills 1.4 – understand simple probability associated with inheritance.	
			Year 12 Term 1 Section 2 Cells (Cell Division)	Year 12 Term 2 Section 4 Genetic information, variation and relationships between organisms (Genetic Diversity and adaptation, Species and Taxonomy)			Year 13 Term 2 Section 7 Genetics, populations, evolution and ecosystems (Populations and evolution)	
			AO1 – Knowledge and understanding of stages of mitosis. AO2/AO3 – Interpretation of images of cells in mitosis and identification of stages. A03 – Application of knowledge to explain scientific data about the amount of DNA within a cell. AO1 – development of knowledge and understanding of the cell cycle AO3 – analysis of data relating to the length of time at each stage. AO1 – knowledge and understanding the techniques and procedures for staining chromosomes and using microscopes AO2 – application of knowledge to use these AO1 – knowledge and understanding of cancer and its treatment AO2/AO3 – interpretation of exam question data and application of knowledge of the impact of some treatments on mitosis and the cell cycle AO1 – knowledge and understanding of binary fission. AO1 – Knowledge and understanding of viral replication.	AO1 – development of knowledge around natural selection and adaptation, the principles involved in selection and how this is linked to evolution AO2 – application of knowledge to explain the evolution of a species in an unknown context (using the information provided). AO3/Maths Skills 1.3 – interpret data from graphs showing selection AO1 – development of knowledge around and understanding of directional and stabilising selection AO2 – application of knowledge to explain changes/lack of changes in the distribution curves/features of a population. AO1 – development of knowledge and understanding of what a species is and the importance of courtship behaviours AO2/AO3 – application of knowledge to interpret information and data about courtship behaviours. AO1 – development of knowledge and understanding of classification AO2 – application of knowledge to the context of particular species, based on binomial name, to identify genus and species. AO1 – development of knowledge and understanding of how the results genomic sequencing			AO1 – development of understanding of population and gene pools AO2/AO3 – analyse information and apply knowledge to work out allele frequencies Maths Skills 0.3 – use percentages and decimals. AO1 – development of understanding of Hardy–Weinberg principle AO2 – application of knowledge to unfamiliar contexts Maths Skills 2.4 – students should be able to calculate allele, genotype and phenotype frequencies from appropriate data using the Hardy–Weinberg equation Maths Skills 3.1 – translate information between numerical and algebraic forms AT k – collect data about the frequency of observable phenotypes within a single population	

				and immunological techniques can be used to refine our understanding of evolutionary relationships AO2/AO3 – application of knowledge to interpret data and draw conclusions on evolutionary relationships.				
			Year 12 Term 1 Section 2 Cells (Transport)					
			AO1/AO2 – application of knowledge and understanding from Section 3.1.3 to understand the structure and function of plasma membranes AO1/AO2 – application of knowledge to explain trends and to understand the technique of colorimetry AO3 – develop and refine practical design.. AO1/AO2 – application of knowledge to explain trends and to understand serial dilutions AO3 – develop and refine practical design and analyse data to draw conclusions.· AO1 – development of knowledge of osmosis and water potential AO2 – application of knowledge and understanding of osmosis AO1 – development of knowledge and understanding of facilitated diffusion Maths Skills 1.3/AO3 – interpret data from a variety of tables and graphs AO2/AO3/Practical Skills 1.2 – apply knowledge of diffusion to explain trends in experimentally derived data on the movement of molecules and ions. AO1 – development of knowledge and understanding of facilitated diffusion AO3/Maths Skills 1.3 – interpret data about active transport from a variety of tables and graphs AO2/Practical Skills 1.2 – apply knowledge of active				

			transport to explain trends in experimentally derived data on the movement of molecules and ions. AO1 – development of knowledge and understanding of co-transport AO2/PS 1.2 – apply knowledge of transport processes to explain data and identify the transport process being used					