Year 12 Curriculum Overview

Week	Statements Teacher 1	Statements Teacher 2
1	**Biological Molecules** **2.1.2(a)** how hydrogen bonding occurs between water molecules, and relate this, and other properties of water, to the roles of water for living **organisms; transport, solvent,** transport medium, **coolant** and as a **habitat**	**Cell Structure** **2.1.1(a)** the use of microscopy to observe and investigate different types of cell and cell structure in a range of eukaryotic organisms to include: images produced by a range of microscopes; **light**, **transmission electron**, **scanning electron** and **laser scanning confocal** microscopes
	2.1.2(b) the concept of **monomers** and **polymers** and the importance of **condensation** and **hydrolysis** reactions in a range of biological molecules	**2.1.1(b)** the preparation and examination of microscope slides for use in light microscopy Including the use of an eyepiece graticule and stage micrometre
2	**2.1.2(c)** the chemical elements that make up biological molecules **2.1.2(d)** the ring structure and properties of **glucose** as an example of a **hexose monosaccharide** and the structure of **ribose** as an example of a **pentose monosaccharide**	**2.1.1(c)** the use of staining in light microscopy to include the use of differential staining to identify different cellular components and cell types
	2.1.2(e) the synthesis and breakdown of a disaccharide and polysaccharide by the formation and breakage of **glycosidic bonds**; **sucrose, lactose**, **maltose**	**2.1.1(d)** the representation of cell structure as seen under the light microscope using drawings and annotated diagrams of whole cells or cells in sections of tissues
3	**2.1.2(f)** the structure of starch **(amylose** and **amylopectin**), **glycogen** and **cellulose** molecules	**2.1.1(e)** the use and manipulation of the magnification formula *magnification = image size object size* *M0.2 Recognise and use expressions in decimal and standard form*
	2.1.2(g) how the structures and properties of glucose, starch, glycogen and cellulose molecules relate to their **functions** in living organisms	**2.1.1(f)** the difference between magnification and resolution achieved by a light, a transmission electron and a scanning electron microscope.

4	**2.1.2 (q)** **PAG 9** **Benedict's** test for reducing and non reducing sugars	**2.1.1(g)** the ultrastructure of eukaryotic cells and the functions of the different cellular components to include: nucleus, nucleolus, nuclear envelope, rough and smooth endoplasmic reticulum (ER), Golgi apparatus, ribosomes, mitochondria, lysosomes, chloroplasts, plasma membrane, centrioles, cell wall, flagella and cilia
	2.1.2 (q) **PAG 9** The **iodine** test for starch Reagent test strips for reducing sugars	**2.1.1(g)** the ultrastructure of eukaryotic cells and the functions of the different cellular components to include: nucleus, nucleolus, nuclear envelope, rough and smooth endoplasmic reticulum (ER), Golgi apparatus, ribosomes, mitochondria, lysosomes, chloroplasts, plasma membrane, centrioles, cell wall, flagella and cilia
5	**2.1.2(h)** the structure of a **triglyceride** and a **phospholipid** as examples of macromolecules; saturated and unsaturated fatty acids	**2.1.1(h)** photomicrographs of cellular components in a range of eukaryotic cells to include interpretation of transmission and scanning electron microscope images
	2.1.2(i) the synthesis and breakdown of triglycerides by the formation (**esterification**) and breakage of ester bonds between fatty acids and glycerol	**2.1.1(i)** the interrelationship between the organelles involved in the production and secretion of proteins **2.1.1(j)** the importance of the cytoskeleton provide mechanical strength to cells, aiding transport within cells and enabling cell movement
6	**2.1.2(j)** how the properties of triglyceride, phospholipid and cholesterol molecules relate to their functions in living organisms to include **hydrophobic** and **hydrophilic** regions and **energy content** AND illustrated using examples of prokaryotes and eukaryotes	**2.1.1(k)** the similarities and differences in the structure and ultrastructure of prokaryotic and eukaryotic cells
	2.1.2 (q) **PAG 9** **emulsion** test for lipids	**PAG 1** Microscopy
7	**2.1.2(k)** the general structure of an amino acid	**Biological Membranes**

	2.1.2(l) the synthesis and breakdown of **dipeptides** and polypeptides, by the formation and breakage of **peptide bonds**	**2.1.5(a)** the roles of membranes within cells and at the surface of cells **2.1.5(b)** the fluid mosaic model of membrane structure and the roles of its components: partially permeable barriers between the cell and its environment, between organelles and the cytoplasm and within organelles, sites of chemical reactions and cell communication (cell signalling).
	2.1.2(m) the levels of protein structure to include **primary**, **secondary**, **tertiary** and **quaternary** structure AND **hydrogen bonding**, **hydrophobic** and **hydrophilic** interactions, **disulfide** bonds and **ionic** bonds	**2.1.5(c)** (i) factors affecting membrane structure and permeability to include solvents and temperature (ii) practical investigations into factors affecting membrane structure and permeability **PAG 5** - The effect of temperature on membrane permeability (beetroot) using a colorimeter
8	**2.1.2(n**) the structure and function of globular proteins including a conjugated protein to include **haemoglobin** as an example of a conjugated protein (globular protein with a prosthetic group), a named enzyme and insulin	**PAG 5** - The effect of temperature on membrane permeability (beetroot) using a colorimeter
	2.1.2(o) the properties and functions of fibrous proteins to include **collagen**, **keratin** and **elastin** (no details of structure are required)	**2.1.5(d)** (i) the movement of molecules across membranes (ii) practical investigations into the factors affecting diffusion rates in model cells
9	**2.1.2 (q)** **PAG 9** **biuret** test for proteins	**2.1.5(e)** (i) the movement of water across membranes by osmosis and the effects that solutions of different water potential can have on plant and animal cells
	2.1.2(p) the key inorganic ions that are involved in biological processes to include the correct chemical symbols for the following; **cations**: calcium ions (Ca2+), sodium ions (Na+), potassium ions (K+), hydrogen ions (H+), ammonium ions (NH4 +) **anions**: nitrate (NO3 –), hydrogencarbonate (HCO3 –), chloride (Cl –), phosphate (PO4 3–), hydroxide, (OH–)	(ii) practical investigations into the effects of solutions of different water potential on plant and animal cells **PAG 8** **An investigation into the water potential of potato**

10	**2.1.2(r)** quantitative methods to determine the concentration of a chemical substance in a solution **PAG 5** To Include the **colorimetry** on serial dilutions	(ii) practical investigations into the effects of solutions of different water potential on plant and animal cells **PAG 8 An investigation into the water potential of potato**
	2.1.2(s) (i) the principles and uses of paper and thin layer chromatography to separate biological molecules / compounds (ii) practical investigations to analyse biological solutions using paper or thin layer chromatography **PAG 6** Identification of amino acids using paper and TLC - to include calculation of retention (**Rf**) values.	**Enzymes** **2.1.4(a)** the role of enzymes in catalysing reactions that affect metabolism at a cellular and whole organism level **2.1.4(b)** the role of enzymes in catalysing both intracellular and extracellular reactions eg catalase - intracellular, amylase and trypsin catalyse extracellular reactions
11	**Nucleotides and Nucleic Acids** **2.1.3(a)** the structure of a nucleotide as the monomer from which nucleic acids are made to include the differences between **RNA** and **DNA** nucleotides, the identification of the **purines** and **pyrimidines** and the type of pentose sugar	**2.1.4(c)** the mechanism of enzyme action to include the tertiary structure, specificity, active site, lock and key hypothesis, induced-fit hypothesis, enzyme-substrate complex, enzyme product complex, product formation and lowering of activation energy
	2.1.3(b) the synthesis and breakdown of polynucleotides by the formation and breakage of phosphodiester bonds	**2.1.4(c)** the mechanism of enzyme action to include the tertiary structure, specificity, active site, lock and key hypothesis, induced-fit hypothesis, enzyme-substrate complex, enzyme product complex, product formation and lowering of activation energy
12	**2.1.3(c)** the structure of **ADP** and **ATP** as phosphorylated nucleotides **2.1.3(d**) (i) the structure of **DNA** (deoxyribonucleic acid) to include how **hydrogen** bonding between complementary base pairs (A to T, G to C) on two **antiparallel** DNA polynucleotides leads to the formation of a DNA molecule, and how the twisting of DNA produces its '**double-helix**' shape	**2.1.4(d)** (i) the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme activity To include reference to the temperature coefficient (Q10)
	(ii) practical investigations into the purification of DNA by precipitation	**2.1.4(d)** (i) the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme activity

		To include reference to the temperature coefficient (Q10)
13	**PAG 10** RasMol used to investigate DNA structure	(ii) practical investigations into the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme activity **PAG 4** Rates of enzyme controlled reactions
	2.1.3(e) semi-conservative DNA replication to include the roles of the enzymes **helicase** and **DNA polymerase**, the importance of replication in **conserving** genetic information with accuracy and the occurrence of **random**, **spontaneous** mutations	**PAG 4** Rates of enzyme controlled reactions **M3.6** Draw and use the slope of a tangent to a curve as a measure of rate of change **M3.5** Calculate rate of change from a graph showing a linear relationship
14	**2.1.3(f)** the nature of the genetic code to include the **triplet**, **non-overlapping**, **degenerate** and **universal** nature of the code and how a gene determines the sequence of amino acids in a polypeptide (the primary structure of a protein)	**2.1.4(e)** the need for coenzymes, cofactors and prosthetic groups in some enzyme-controlled reactions to include Cl – as a cofactor for amylase, Zn2+ as a prosthetic group for carbonic anhydrase and vitamins as a source of coenzymes.
	2.1.3(g) transcription and translation of genes resulting in the synthesis of polypeptides to include, the roles of **RNA polymerase**, **messenger (m)RNA, transfer (t)RNA**, **ribosomal (r)RNA**	**2.1.4(f)** the effects of inhibitors on the rate of enzyme controlled reactions to include competitive and non-competitive and reversible and non-reversible inhibitors with reference to the action of metabolic poisons and some medicinal drugs, and the role of product inhibition
15	**Cell Division, Cell Diversity and Cellular Organisation** **2.1.6(a)** the cell cycle to include the processes taking place during interphase (G1, S and G2), mitosis and cytokinesis, leading to genetically identical cells	**2.1.4(f)** the effects of inhibitors on the rate of enzyme controlled reactions to include competitive and non-competitive and reversible and non-reversible inhibitors with reference to the action of metabolic poisons and some medicinal drugs, and the role of product inhibition
	2.1.6(b) how the cell cycle is regulated to include an outline of the use of checkpoints to control the cycle	Enzyme summary

16	**2.1.6(c)** the main stages of mitosis to include the changes in the nuclear envelope, chromosomes, chromatids, centromere, centrioles, spindle fibres and cell membrane	**Exchange Surfaces** **3.1.1(a)** the need for specialised exchange surfaces to include surface area to volume ratio (SA:V), metabolic activity, single-celled and multicellular organisms. Ratio = Volume/Surface Area
	2.1.6(d) sections of plant tissue showing the cell cycle and stages of mitosis **PAG 1** Using a light microscope to study mitosis in garlic root tips	**M4.1** Calculate the circumferences, surface areas and volumes of regular shapes eg. cubes, spheres and cylinders
17	**2.1.6(e)** the significance of mitosis in life cycles ie growth, repair, asexual rpeoduction	**3.1.1(b)** the features of an efficient exchange surface to include: • increased surface area – root hair cells • thin layer – alveoli • good blood supply/ventilation to maintain gradient – gills/alveolus
	2.1.6(f) the significance of meiosis in life cycles ie haploid cells, genetic variation by crossing over and independent assortment **2.1.6 (g)** the main stages involved; prophase, metaphase, anaphase, telophase 1and 2, term homologous	**3.1.1(b)** the features of an efficient exchange surface to include: • increased surface area – root hair cells • thin layer – alveoli • good blood supply/ventilation to maintain gradient – gills/alveolus
18	**2.1.6(h)** how cells of multicellular organisms are specialised for particular functions **2.1.6(i)** the organisation of cells into tissues, organs and organ systems	**3.1.1(c)** the structures and functions of the components of the mammalian gaseous exchange system to include the distribution and functions of cartilage, ciliated epithelium, goblet cells, smooth muscle and elastic fibres in the trachea, bronchi, bronchioles and alveoli
	PAG 1 Using a light microscope to study squamous and epithelial cells, sperm cells, palisade cells, root hair cells and guard cells	**PAG 1** Mammalian lung tissue

19	**2.1.6(j)** the features and differentiation of stem cell to include stem cells as a renewing source of undifferentiated cells **2.1.6(k)** the production of erythrocytes and neutrophils derived from stem cells in bone marrow **2.1.6(l)** the production of xylem vessels and phloem sieve tubes from meristems	**3.1.1(d)** the mechanism of ventilation in mammals, rib cage, intercostal muscles (internal external) amd diaphragm
	2.1.6(m) the potential uses of stem cells in research and medicine to include; neurological conditions such as Alzheimer's, Parkinson's and research into Developmental Biology	**3.1.1(e)** the relationship between vital capacity, tidal volume, breathing rate and oxygen uptake eg from a spirometer
20	**Communicable Disease, Prevention and the Immune System** **4.1.1(a)** the different types of pathogen that can cause communicable diseases in plants and animals bacteria – tuberculosis (TB), bacterial meningitis, ring rot (potatoes, tomatoes) • viruses – HIV/AIDS (human), influenza (animals), Tobacco Mosaic Virus (plants) • protoctista – malaria, potato/tomato late blight • fungi – black sigatoka (bananas), ringworm (castle), athlete's foot (humans)	**3.1.1(f)** the mechanisms of ventilation and gas exchange in bony fish and insects • bony fsh – changes in volume of the buccal cavity and the functions of the operculum, gill filaments and gill lamellae (gill plates); countercurrent flow • insects – spiracles, trachea, thoracic and abdominal movement to change body volume, exchange with tracheal fluid.
	4.1.1(b) the means of transmission of animal and plant communicable pathogens to include direct and indirect transmission, reference to vectors, spores and living conditions – e.g. climate, social factors (no detail of the symptoms of specific diseases is required)	**3.1.1(f)** the mechanisms of ventilation and gas exchange in bony fish and insects • bony fsh – changes in volume of the buccal cavity and the functions of the operculum, gill filaments and gill lamellae (gill plates); countercurrent flow • insects – spiracles, trachea, thoracic and abdominal movement to change body volume, exchange with tracheal fluid.
21	**4.1.1(c)** plant defences against pathogens to include production of chemicals AND plant responses that limit the spread of the pathogen (e.g. callose deposition)	**3.1.1(h)** the examination of microscope slides to show the histology of exchange surfaces such as fish gills, cross section of arteries and veins as well as insect tracheoles

	4.1.1(d) the primary non-specific defences against pathogens in animals to include skin, blood clotting, wound repair, inflammation, expulsive reflexes and mucous membranes (no detail of skin structure or all the steps involved in the clotting cascade are required)	**Transport in Animals** **3.1.2(a)** the need for transport systems in multicellular animals to include an appreciation of size, **metabolic rate** and surface area to volume ratio (SA:V) **3.1.2(b)** the different types of circulatory systems to include single, double, open and closed circulatory systems in insects, fish and mammals
22	**4.1.1(e) (i)** the structure and mode of action of phagocytes	**3.1.2(c)** the structure and functions of arteries, arterioles, capillaries, venules and veins to include the **distribution** of different tissues within the vessel walls such as cartilage and muscle
	PAG 1 Using a light microscope to to examine and draw cells in a blood smear	**3.1.2(d)** the formation of tissue fluid from plasma, hydrostatic pressure, oncotic pressure and compositions of blood, tissue fluid and lymph
23	**4.1.1(f)** the structure, different roles and modes of action of B and T lymphocytes in the specific immune response; cell signalling, clonal selection, clonal expansion, plasma cells, T helper, T killer and T regulatory cells	**3.1.2(e)** (i) the external and internal structure of the mammalian heart
	4.1.1(g) the primary and secondary immune responses; B and T memory cells	**PAG 2** (ii) the dissection, examination and drawing of the external and internal structure of the mammalian heart
24	**4.1.1(h)** the structure and general functions of antibodies **4.1.1(i)** an outline of the action of opsonins, agglutinins and anti-toxins	**3.1.2(f)** the cardiac cycle to include the role of the **valves** and the **pressure changes** occurring in the heart and associated vessels cardiac output = heart rate X stroke volume
	4.1.1(j) the differences between active and passive immunity, and between natural and artificial immunity	**3.1.2(f)** the cardiac cycle to include the role of the **valves** and the **pressure changes** occurring in the heart and associated vessels cardiac output = heart rate X stroke volume

25	**4.1.1(k)** autoimmune diseases eg. arthritis and lupus	**3.1.2(g)** how heart action is initiated and coordinated to include the roles of the sino-atrial node (SAN), atrio-ventricular node (AVN), purkyne tissue and the myogenic nature of cardiac muscle
	4.1.1(l) the principles of vaccination and the role of vaccination programmes in the prevention of epidemics	**3.1.2(h)** the use and interpretation of electrocardiogram (ECG) traces to include normal and abnormal heart activity e.g. tachycardia, bradycardia, fibrillation and ectopic heartbeat
26	**4.1.1(m)** possible sources of medicines to include microorganisms and plants as well as personalised medicine	**3.1.2(i)** the role of haemoglobin in transporting oxygen and carbon dioxide to include the reversible binding of oxygen molecules, carbonic anhydrase, haemoglobinic acid, HCO3 – and the chloride shift
	4.1.1(n) the benefits and risks of using antibiotics to manage bacterial infection; discovery of penicillin against antibiotic resistance (examples to include Clostridium difficile and MRSA)	**3.1.2(j)** the oxygen dissociation curve for fetal and adult human haemoglobin to include the significance of the different affinities for oxygen AND the changes to the dissociation curve at different carbon dioxide concentrations (the Bohr effect)
27	**Classification and Evolution** **4.2.2(a)** the biological classification of species to include the taxonomic hierarchy of kingdom, phylum, class, order, family, genus and species AND domain. **4.2.2(b)** the binomial system of naming species and the advantage of such a system	**3.1.2(j)** the oxygen dissociation curve for fetal and adult human haemoglobin to include the significance of the different affinities for oxygen AND the changes to the dissociation curve at different carbon dioxide concentrations (the Bohr effect)
	4.2.2(c) (i) the features used to classify organisms into the five kingdoms: Prokaryotae, Protoctista, Fungi, Plantae, Animalia **(ii)** the evidence that has led to new classification systems, such as the three domains of life, which clarifies relationships	**Transport in Plants** **3.1.3(a)** the need for transport systems in multicellular plants to include an appreciation of size, metabolic rate and surface area to volume ratio (SA:V) **3.1.3(b)** (i) the structure and function of the vascular system in the **roots**, **stems** and **leaves** of herbaceous dicotyledonous plants
28	**4.2.2(d**) the relationship between classification and phylogeny	**PAG 2** Dissection of a plant tissue

	4.2.2(e) the evidence for the theory of evolution by natural selection to include the contributions of Darwin and Wallace in formulating the theory of evolution by natural selection	(ii) the examination and drawing of stained sections of plant tissue to show the distribution of xylem and phloem (iii) the dissection of stems, both longitudinally and transversely, and their examination to demonstrate the position and structure of xylem vessels
	4.2.2(f) the different types of variation to include intraspecific and interspecific variation AND the differences between continuous and discontinuous variation, using examples of a range of characteristics found in plants, animals and microorganisms AND both genetic and environmental causes of variation	**PAG 2** Dissection of a plant tissue (ii) the examination and drawing of stained sections of plant tissue to show the distribution of **xylem** and **phloem** (iii) the dissection of stems, both **longitudinally** and **transversely**, and their examination to demonstrate the position and structure of xylem vessels
29	**M1.2** Find arithmetic means **M1.10** Understand measures of dispersion, including **Standard Deviation** and range M1.3 Construct and interpret frequency tables and diagrams, bar charts and histograms	**3.1.3(c)** (i) the process of transpiration and the environmental factors that affect transpiration rate to include an appreciation that transpiration is a consequence of gaseous exchange
	the **Spearman's Rank** correlation coefficient to consider the relationship of the data (t-test covered in Year 13)	**3.1.3(c)** (i) the process of transpiration and the environmental factors that affect transpiration rate to include an appreciation that transpiration is a consequence of gaseous exchange
30	**4.2.2(g)** the different types of adaptations of organisms to their environment: anatomical, physiological and behavioural adaptations AND why organisms from different taxonomic groups may show similar anatomical features, including the marsupial mole and placental mole	(ii) practical investigations to estimate transpiration rates **PAG 5** use of appropriate measurements to record quantitative measurements such a potometer
	4.2.2(h) the mechanism by which natural selection can affect the characteristics of a population over time **4.2.2(i)** how evolution in some species has implications for human populations; pesticide resistance in insects and drug resistance in microorganisms	(ii) practical investigations to estimate transpiration rates **PAG 5** use of appropriate measurements to record quantitative measurements such a potometer

31	**Biodiversity** **4.2.1(a)** how biodiversity may be considered at different levels **4.2.1(c)** how to measure species richness and species evenness in a habitat	**3.1.3(d)** the transport of water into the plant, through the plant and to the air surrounding the leaves to include details of the pathways taken by water AND the mechanisms of movement, in terms of **water potential**, **adhesion**, **cohesion** and the **transpiration stream**
	4.2.1(d) the use and interpretation of **Simpson's Index of Diversity (D)** to calculate the biodiversity of a habitat **4.2.1(b**) (i) how sampling is used in measuring the biodiversity of a habitat and the importance of sampling (ii) practical investigations collecting random and non-random samples in the field	**3.1.3(e)** adaptations of plants to the availability of water in their environment to include xerophytes (cactus and marram grass) and hydrophytes (water lilies)
32	**PAG 3.1** Simpson's Index of Diversity on the school field	**3.1.3(f)** the mechanism of translocation to include translocation as an energy-requiring process transports assimilates, especially sucrose, in the phloem between **sources** (e.g. leaves) and **sinks** (e.g. roots, meristem) AND details of active loading at the source and removal at the sink
	4.2.1(e) how genetic biodiversity may be assessed, including calculations; the proportion of polymorphic gene loci = the number of polymorphic/total number of loci	Summary and recap on plants
33	**4.2.1(f)** the factors affecting biodiversity; human population growth,agriculture and climate change	
	4.2.1(g) the ecological, economic and aesthetic reasons for maintaining biodiversity **4.2.1(h)** in situ and ex situ methods of maintaining biodiversity	
34	**4.2.1(i)** international and local conservation agreements made to protect species and habitats	