Teaching sequence Y12 single teacher (2023-24)

2.1.1 Cell structure: Ultrastructure of Prokaryotic and Eukaryotic cells
(g) the ultrastructure of eukaryotic cells and the functions of the different cellular components
(h) photomicrographs of cellular components in a range of eukaryotic cells
(i) the interrelationship between the organelles involved in the production and secretion of proteins
(j) the importance of the cytoskeleton
(k) the similarities and differences in the structure and ultrastructure of prokaryotic and eukaryotic cells.
2.1.2 Biological molecules: Water and Carbohydrates
(a) how hydrogen bonding occurs between water molecules, and relate this, and other properties of water, to the roles of water for living organisms
(b) the concept of monomers and polymers and the importance of condensation and hydrolysis reactions in a range of biological molecules
(c) the chemical elements that make up biological molecules
(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
(e) the synthesis and breakdown of a disaccharide and polysaccharide by the formation and breakage of glycosidic bonds
(f) the structure of starch (amylose and amylopectin), glycogen and cellulose molecules
(g) how the structures and properties of glucose, starch, glycogen and cellulose molecules relate to their functions in living organisms
2.1.1 Cell structure: Microscopy
(a) the use of microscopy to observe and investigate different types of cell and cell structure in a range of eukaryotic organisms
(b) the preparation and examination of microscope slides for use in light microscopy
(c) the use of staining in light microscopy
(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 tissue
(e) the use and manipulation of the magnification formula
(f) the difference between magnification and resolution
2.1.2 Biological molecules: Lipids and Proteins
(h) the structure of a triglyceride and a phospholipid as examples of macromolecules
(i) the synthesis and breakdown of triglycerides by the formation and breakage of ester bonds between fatty acids and glycerol
(j) how the properties of triglyceride, phospholipid and cholesterol molecules relate to their functions in living organisms
(k) the general structure of an amino acid
(l) the synthesis and breakdown of dipeptides and polypeptides, by the formation and breakage of peptide bonds
(m) the levels of protein structure
(n) the structure and function of globular proteins including a conjugated protein
(o) the properties and functions of fibrous proteins
(p) the key inorganic ions that are involved in biological processes
(q) how to carry out and interpret the results of the following chemical tests: • biuret test for proteins • Benedict's test for reducing and non-reducing sugars • iodine test for starch • emulsion test for lipids
(r) quantitative methods to determine the concentration of a chemical substance in a solution
(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.

2.1.5 Biological membranes
(a) the roles of membranes within cells and at the surface of cells
(b) the fluid mosaic model of membrane structure and the roles of its components
(c) (i) factors affecting membrane structure and permeability (ii) practical investigations into factors affecting membrane structure and permeability
(d) (i) the movement of molecules across membranes (ii) practical investigations into the factors affecting diffusion rates in model cells
(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 (ii) practical investigations into the effects of solutions of different water potential on plant and animal cells.
2.1.4 Enzymes
(a) the role of enzymes in catalysing reactions that affect metabolism at a cellular and whole organism level
(b) the role of enzymes in catalysing both intracellular and extracellular reactions
(c) the mechanism of enzyme action
(d) (i) the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme activity (ii) practical investigations into the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme activity
(e) the need for coenzymes, cofactors and prosthetic groups in some enzyme-controlled reactions
(f) the effects of inhibitors on the rate of enzyme controlled reactions.
Christmas (approximately here)
2.1.6 Cell division, cell diversity and cellular organisation
(a) the cell cycle
(b) how the cell cycle is regulated
(c) the main stages of mitosis
(d) sections of plant tissue showing the cell cycle and stages of mitosis
(e) the significance of mitosis in life cycles
(f) the significance of meiosis in life cycles
(g) the main stages of meiosis
(h) how cells of multicellular organisms are specialised for particular functions
(i) the organisation of cells into tissues, organs and organ systems
(j) the features and differentiation of stem cell
(k) the production of erythrocytes and neutrophils as examples of distinct, differentiated cells derived from a common stem cell in bone marrow
(l) the production of xylem vessels and phloem sieve tubes as examples of distinct, differentiated outcomes derived from a common stem cell in meristems
(m) the potential uses of stem cells in research and medicine.
6.2.1 Cloning (and biotechnology)
Self study - 6.2.1(a) (i) natural clones in plants and the production of natural clones for use in horticulture (ii) how to take plant cuttings as an example of a simple cloning technique
Self study - 6.2.1(b) (i) the production of artificial clones of plants by micropropagation and tissue culture (ii) the arguments for and against artificial cloning in plants
Self study - 6.2.1(c) natural clones in animal species
Self study - 6.2.1(d) (i) how artificial clones in animals can be produced by artificial embryo twinning or by enucleation and somatic cell nuclear transfer (SCNT) (ii) the arguments for and against artificial cloning in animals
2.1.3 Nucleotides and nucleic acids
(a) the structure of a nucleotide as the monomer from which nucleic acids are made
(b) the synthesis and breakdown of polynucleotides by the formation and breakage of phosphodiester bonds
(c) the structure of ADP and ATP as phosphorylated nucleotides
(d) (i) the structure of DNA (deoxyribonucleic acid) (ii) practical investigations into the purification of DNA by precipitation
(e) semi-conservative DNA replication
(f) the nature of the genetic code
(g) transcription and translation of genes resulting in the synthesis of polypeptides.

3.1.1 Exchange surfaces
(a) the need for specialised exchange surfaces
(b) the features of an efficient exchange surface
(c) the structures and functions of the components of the mammalian gaseous exchange system
(d) the mechanism of ventilation in mammals
(e) the relationship between vital capacity, tidal volume, breathing rate and oxygen uptake
(f) the mechanisms of ventilation and gas exchange in bony fish and insects
(g) the dissection, examination and drawing of the gaseous exchange system of a bony fish and/or insect trachea
(h) the examination of microscope slides to show the histology of exchange surfaces.
3.1.2 Transport in animals
(a) the need for transport systems in multicellular animals
(b) the different types of circulatory systems
(c) the structure and functions of arteries, arterioles, capillaries, venules and veins
(d) the formation of tissue fluid from plasma
(e) (i) the external and internal structure of the mammalian heart (ii) the dissection, examination and drawing of the external and internal structure of the mammalian heart
(f) the cardiac cycle
(g) how heart action is initiated and coordinated
(h) the use and interpretation of electrocardiogram (ECG) traces
(i) the role of haemoglobin in transporting oxygen and carbon dioxide
(j) the oxygen dissociation curve for fetal and adult human haemoglobin.
4.1.1 Communicable diseases, disease prevention and the immune system
(a) the different types of pathogen that can cause communicable diseases in plants and animals
(b) the means of transmission of animal and plant communicable pathogens
(c) plant defences against pathogens
(d) the primary non-specific defences against pathogens in animals
(e) (i) the structure and mode of action of phagocytes (ii) examination and drawing of cells observed in blood smears
(f) the structure, different roles and modes of action of B and T lymphocytes in the specific immune response
(g) the primary and secondary immune responses
(h) the structure and general functions of antibodies
(i) an outline of the action of opsonins, agglutinins and anti-toxins
Easter (approximately here)
(j) the differences between active and passive immunity, and between natural and artificial immunity
(k) autoimmune diseases
(l) the principles of vaccination and the role of vaccination programmes in the prevention of epidemics
(m) possible sources of medicines
(n) the benefits and risks of using antibiotics to manage bacterial infection.
3.1.3 Transport in plants
(a) the need for transport systems in multicellular plants
(b) (i) the structure and function of the vascular system in the roots, stems and leaves of herbaceous dicotyledonous plants (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
(c) (i) the process of transpiration and the environmental factors that affect transpiration rate (ii) practical investigations to estimate transpiration rates
(d) the transport of water into the plant, through the plant and to the air surrounding the leaves
(e) adaptations of plants to the availability of water in their environment
(f) the mechanism of translocation.
Summer study leave

4.2.2 Classification and evolution
(a) the biological classification of species
(b) the binomial system of naming species and the advantage of such a system
(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
(d) the relationship between classification and phylogeny
(e) the evidence for the theory of evolution by natural selection
(f) the different types of variation
(g) the different types of adaptations of organisms to their environment
(h) the mechanism by which natural selection can affect the characteristics of a population over time
(i) how evolution in some species has implications for human populations.
4.2.1 Biodiversity
(a) how biodiversity may be considered at different levels
(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
(c) how to measure species richness and species evenness in a habitat
(d) the use and interpretation of Simpson's Index of Diversity (D) to calculate the biodiversity of a habitat
(e) how genetic biodiversity may be assessed, including calculations
(f) the factors affecting biodiversity
(g) the ecological, economic and aesthetic reasons for maintaining biodiversity
(h) in situ and ex situ methods of maintaining biodiversity
(i) international and local conservation agreements made to protect species and habitats.