AS Level Biology HEAD

3.1 Biological Molecules	**3.1.1 Monomers & polymers** Describe the structure of condensation polymers. Represent the formation & hydrolysis of condensation polymers using equations.	**3.1.2 Carbohydrates** Describe the formation of disaccharides. Describe the formation of polysaccharides. Perform biochemical tests for reducing sugars, non-reducing sugars & starch.	**3.1.3 Lipids** Recognise, from diagrams, saturated & unsaturated fatty acids. Describe how chromatography can be used to separate & identify components of mixtures of amino acids. Explain the different properties of triglycerides & phospholipids. Perform the emulsion test for lipids.	**3.1.4 Proteins** Recall the general structure of an amino acid. Explain how amino acids give rise to protein structure. Perform the biuret test for proteins. Relate the structure of proteins to properties of proteins named throughout the specification.	**3.1.4.2 Many proteins are enzymes** Appreciate how models of enzyme action have changed over time. Appreciate that enzymes catalyse a wide range of reactions. **Required practical 1**: Investigate the effect of a named variable on the rate of an enzyme-controlled reaction.	**3.1.5 Nucleic acids are important information-carrying molecules** Describe the components of RNA & DNA nucleotides. Describe the reaction between two nucleotides. Describe complementary base pairing. Appreciate that the relative simplicity of DNA led many scientists to doubt that it carried the genetic code.	**3.1.5.2 DNA replication** Describe each stage in semi-conservative replication of DNA. Explain the roles of enzymes in DNA replication. Evaluate the work of scientists in validating the Watson–Crick model of DNA replication.	**3.1.6 ATP** Recall the structure & function of ATP. Describe the hydrolysis of ATP. Describe the synthesis of ATP from ADP & P_i.	**3.1.7 Water** Evaluate the link between the water chemistry & its' function in biological systems.	**3.1.8 Inorganic ions** Recognise the role of ions in the following topics: hydrogen ions & pH; iron ions as a component of haemoglobin; sodium ions in the co-transport of glucose & amino acids; & phosphate ions as components of DNA & of ATP.

AS Level Biology HEAD

3.2 Cells	**3.2.1.1 Structure of eukaryotic cells** Apply knowledge of the following cell features to explain the adaptions of eukaryotic cells: cell surface membrane, nucleus, mitochondria, chloroplasts, Golgi apparatus & Golgi vesicles, lysosomes, ribosomes, endoplasmic reticulum, cell wall & cell vacuole.	**3.2.1.2 Structure of prokaryotic cells & of viruses** Describe the features of prokaryotic cells. Describe the structure of virus particles. Compare prokaryotic cell structure to eukaryotic cell structure.	**3.2.1.3 Methods of studying cells** Explain the principles & limitations of optical microscopes, transmission electron microscopes & scanning electron microscopes. Measure the size of an object viewed with an optical microscope. Describe the difference between magnification & resolution. Calculate magnification from microscope images. Describe the principles of cell fractionation & ultracentrifugation to separate cell components.	**3.2.2 All cells arise from other cells** Recognise the stages of the cell cycle: interphase, prophase, metaphase, anaphase & telophase (including cytokinesis). Explain the appearance of cells in each stage of mitosis. Describe the process of binary fission. Required practical 2: Preparation of stained squashes of cells from plant root tips; set-up & use of an optical microscope to identify the stages of mitosis in these stained squashes & calculation of a mitotic index.	**3.2.3 Transport across cell membranes** Describe diffusion, facilitated diffusion, osmosis, active transport & co-transport. Explain the adaptations of specialised cells in relation to the rate of transport across their internal & external membranes. Explain how surface area, number of channel or carrier proteins & differences in gradients of concentration or water potential affect the rate of movement across cell membranes. **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. **Required practical 4**: Investigation into the effect of a named variable on the permeability of cell-surface membranes.	**3.2.4 Cell recognition & the immune system** Define ‘antigen’. Describe phagocytosis. Describe the response of T lymphocytes to a foreign antigen. Describe the response of B lymphocytes to a foreign antigen & the humoral response. Explain the action of vaccines. Explain the differences between active & passive immunity. Recall the structure of HIV, its replication in helper T cells & how HIV causes symptoms of AIDS. Explain why antibiotics are ineffective against viruses. Describe the role of monoclonal antibodies in therapeutics & ELISA testing. Discuss ethical issues associated with the use of vaccines & monoclonal antibodies.

AS Level Biology HEAD

3.3 Organisms exchange substances with their environment	**3.3.1 Surface area to volume ratio** Appreciate and explain the relationship between surface area to volume ratio & metabolic rate.	**3.3.2 Gas exchange** Describe the adaptations of different gas exchange surfaces. Describe the gross structure of the human gas exchange system. Recall the essential features of the alveolar epithelium as a surface over which gas exchange takes place. Describe the mechanism of breathing. 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.	**3.3.3 Digestion & absorption** Describe the role of mammalian enzymes in the digestion of carbohydrates, lipids & proteins. Outline the mechanisms of absorption for the products of digestions by cells lining the ileum of mammals.	**3.3.4 Mass transport** Relate the structure of haemoglobins to their function in animals. Explain the role of haemoglobin and red blood cells in the transport of oxygen taking into account the Bohr effect. Recall the general pattern of blood circulation in a mammal naming the coronary arteries & of the blood vessels entering & leaving the heart, lungs & kidneys. Describe the gross structure of the human heart and how pressure, volume and valve changes occur during the cardiac cycle. Link the structure of arteries, arterioles & veins in relation to their function. Describe the structure of capillaries & the importance of capillary beds as exchange surfaces. Describe the formation of tissue fluid & its return to the circulatory system. **Required practical 5**: Dissection of animal or plant gas exchange system or mass transport system or of organ within such a system.	**3.3.4.2 Mass transport in plants** Explain the role of xylem in the stem & leaves of plants. Describe the cohesion-tension theory of water transport in the xylem. Describe the role of phloem in the transport of organic substances in plants. Describe the mass flow hypothesis for the mechanism of translocation. Appreciate the use of tracers & ringing experiments to investigate transport in plants.

AS Level Biology HEAD

3.4 Genetic information, variation & relationships between organisms	**3.4.1 DNA, genes & chromosomes** Evaluate the differences between DNA molecules in prokaryotes and eukaryotes. Describe what a gene is. Understand the triplet code. Appreciate that much of the nuclear DNA code in eukaryotes does not code for polypeptides.	**3.4.2 DNA & protein synthesis** Recall the structure of molecules of messenger RNA (mRNA) & of transfer RNA (tRNA). Describe transcription as the production of mRNA from DNA in prokaryotes and the production of pre-mRNA in eukaryotes that is the spliced to form mRNA. Outline the role of RNA polymerase in joining mRNA nucleotides. Outline the process of translation as the production of polypeptides from the sequence of codons carried by mRNA. Explain the roles of ribosomes, tRNA & ATP	**3.4.3 Genetic diversity can arise as a result of mutation or during meiosis** Explain how gene mutations can arise. Complete diagrams showing the chromosome content of cells after the first and second meiotic division. Explain the different outcome of mitosis and meiosis. Explain how random fertilisation of haploid gametes further increases genetic variation within a species.	**3.4.4 Genetic diversity & adaptation** Define genetic diversity. Explain the principles of natural selection in the evolution of populations. Explain directional selection, exemplified by antibiotic resistance in bacteria, & stabilising selection, exemplified by human birth weights. **Required practical 6**: Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth.	**3.4.5 Species & taxonomy** Describe the role of courtship behaviour. Understand the use of hierarchy in phylogenetic classification systems. Understand how each species is universally identified by a binomial consisting of the name of its genus & species.	**3.4.6 Biodiversity within a community** Define *'biodiversity'*. Calculate an index of diversity. Evaluate the relationship between farming and biodiversity.	**3.4.7 Investigating diversity** Appreciate that genetic diversity within, or between species, can be made by comparing: the frequency of measurable or observable characteristics; the base sequence of DNA; the base sequence of mRNA; the amino acid sequence of the proteins encoded by DNA & mRNA. Conduct quantitative investigations of variation within a species and interpret data collected.

AS Level Biology HEAD