AD ALTIORA

Year 12 Biology Curriculum Summary

When?	Knowledge	Understanding	Assessment
Cell Structure	• The principles and limitations of optical microscopes, transmission electron microscopes and scanning electron microscopes. • Principles of cell fractionation and ultracentrifugation as used to separate cell components. • The structure of prokaryotic, including the differences between prokaryotic and eukaryotic cells and the additional features of the cell which may be present. • The behaviour of chromosomes during interphase and the stages of mitosis. • Binary fission in prokaryotic cells. • Viruses do not undergo cell division but replicate by injection of their nucleic acid into host cells. • Required practical 2:Preparation of stained squashes of cells from plant root tips; set-up and use of an	• Students should be able to appreciate that there was a considerable period of time during which the scientific community distinguished between artefacts and cell organelles. • Students could use iodine in potassium iodide solution to identify starch grains in plant cells. Students should be able to apply their knowledge of these features in explaining adaptations of eukaryotic cells. • Students should be able to recognise the stages of the cell cycle: interphase, prophase, metaphase, anaphase and telophase (including cytokinesis) • Students should be able to explain the appearance of cells in each stage of mitosis.	**Assessment: Cell Structure and Transport Test**

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	optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index.		
Transport Across Cell Membranes	• The fluid mosaic model of cell membranes, including the arrangement of phospholipids, proteins, glycoproteins and glycolipids. • Required practical 4:Investigation into the effect of a named variable on the permeability of cell-surface membranes. • Movement of molecules and ions against concentration gradients by simple diffusion or facilitated diffusion. • The movement of water across partially permeable membranes by osmosis. • The concepts of water potential and hypotonic, hypertonic and isotonic solutions. • Movement of molecules and	• Students should be able to explain the adaptations of specialised cells in relation to the rate of transport across their internal and external membranes • Students should be able to 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 membranes. • Students plot the data from their investigations in an appropriate format. • Students could determine the water potential of plant tissues using the intercept of a graph of, eg, water potential of solution against gain/loss of mass.	**Assessment:** Transport across a membrane test

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	ions against concentration gradients by active transport. • Movement of molecules and ions against concentration gradients by co-transport. • 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.		
Exchange	• The relationship between the size or structure of an organism and its surface area to volume ratio • Adaptations of gas exchange surfaces in leaves of dicotyledonous plants (mesophyll and stomata). • Adaptations of gas exchange surfaces, shown by gas exchange in single celled organisms and insect tracheal systems. • Structural and functional compromises between gas	• Students should be able to appreciate the relationship between surface area to volume ratio and metabolic rate. • Students could use agar blocks containing indicator to determine the effect of surface area to volume ratio and concentration gradient on the diffusion of an acid or alkali. • Students could be given the dimensions of cells with different shapes from which to calculate the surface area to volume ratios of these cells. • Students should be able to	

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	exchange and the limitation of water loss shown by terrestrial insects. • Adaptations of gas exchange surfaces, shown by gas exchange in fish gills. • The gross structure of the human gas exchange system. • Required practical 5: Dissection of animal or plant respiratory system or mass transport system or of an organ within such a system (could also be met by heart dissection, 3.3.4.1). • Ventilation and the exchange of gases in the lungs. • The essential features of the alveolar epithelium as a gas exchange surface. • Co-transport mechanisms and the role of micelles in the absorption of the products of digestion by cells lining the ileum.	interpret information relating to the effects of lung disease on gas exchange and/or ventilation • Students should be able to interpret data relating to the effects of pollution and smoking on the incidence of lung disease • Students should be able to analyse and interpret data associated with specific risk factors and the incidence of lung disease • Students should be able to evaluate the way in which experimental data led to statutory restrictions on the sources of risk factors • Students should be able to recognise correlations and causal relationships.	**Assessment:** Exchange Test

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Mass Transport	• 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). • The general pattern of blood circulation in a mammal. • The gross structure of the human heart. • Required practical 5: • Dissection of animal or plant respiratory system or mass transport system or of an organ within such a system (could also be met in section 3.3.2 by lung, gill or insect dissection).	• Students should be able to analyse and interpret data relating to pressure and volume changes during the cardiac cycle • Students should be able to analyse and interpret data associated with specific risk factors and the incidence of cardiovascular disease • Students should be able to evaluate conflicting evidence associated with risk factors affecting cardiovascular disease • Students should be able to recognise correlations and causal relationships • Students could design and carry out an investigation into the effect of a named variable on human pulse rate or on the heart rate of an invertebrate, such as Daphnia. • Students could be given values of cardiac output (CO) and one other	**Assessment:** Mass Transport Test

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	• 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. • 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.	measure, requiring them to change the subject of the equation: CO = stroke volume × heart rate • Students should be able to: • recognise correlations and causal relationships • interpret evidence from tracer and ringing experiments and to evaluate the evidence for and against the mass flow hypothesis.	

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Genetic Diversity	• Gene mutations arise spontaneously during DNA replication and include base deletion and base substitution. • 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. • 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). • Directional selection, exemplified by antibiotic resistance in bacteria, and	• Students should be able to complete diagrams showing the chromosome content of cells after the first and second meiotic division, when given the chromosome content of the parent cell • Students should be able to explain the different outcome of mitosis and meiosis • recognise where meiosis occurs when given information about an unfamiliar life cycle • Students should be able to explain how random fertilisation of haploid gametes further increases genetic variation within a species • Students could examine meiosis in prepared slides of suitable plant or animal tissue. • Students could use the expression 2n to calculate the possible number of different combinations of chromosomes following meiosis, without crossing over • Students should be able to derive	**Assessment:** Genetic Diversity Test

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	stabilising selection, exemplified by human birth weights.	a formula from this to calculate the possible number of different combinations of chromosomes following random fertilisation of two gametes, where n is the number of homologous chromosomes pairs.	
Biodiversity	• The concept of a species. • Courtship behaviour as a necessary precursor to successful mating. The role of courtship in species recognition. • The hierarchical nature of classification into taxonomic ranks. • The binomial identification of species based on its genes and species. • The concepts of biodiversity, species richness and index of diversity. • Calculation of the index of diversity (d).	• Students could be given data from which to calculate an index of diversity and interpret the significance of the calculated value of the index. • Students should be able to interpret data relating to similarities and differences in the base sequences of DNA and in the amino acid sequences of proteins to suggest relationships between different organisms within a species and between species • Students should be able to appreciate that gene technology has caused a change in the methods of investigating genetic	**Assessment:** Biodiversity test

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	• 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.
		diversity; inferring DNA differences from measurable or observable characteristics has been replaced by direct investigation of DNA sequences.
		• Students design appropriate methods to ensure random sampling
		• Students should be able to carry out random sampling within a single population • use random samples to investigate the effect of position on the growth of leaves.	