Intermediate Biology Olympiad

Core topics consistent with AQA, OCR, Edexcel AS/A-level syllabus

1. Biological Molecules

- Concepts of monomers, polymers, condensation & hydrolysis reactions
- Monosaccharides, e.g. α and β glucose, galactose, fructose, ribose
- Di-/polysaccharides, e.g. sucrose, maltose, lactose, cellulose, starch (amylose, amylopectin)
- Quantitative Benedict's test, iodine test for starch
- Glycerol, fatty acids (saturated and unsaturated), triglycerides, ester bond formation, phospholipids, emulsion test
- Amino acids, levels of protein structure (including types of non-covalent bonds involved), peptide bond formation, Biuret test
- Haemoglobin and collagen as examples of globular and fibrous proteins (detailed structure of collagen often omitted)
- DNA and RNA structure and formation of phosphodiester bonds between nucleotides
- Semi-conservative replication of DNA
- Structure of ATP and basic role in cells
- Enzymes: lock and key and induced fit models of action; effect of pH, temperature, enzyme/substrate concentration, inhibitors (competitive and non-competitive) (cofactors/coenzymes sometimes included)
- Role of inorganic ions
- Biologically important properties of water

2. Cell Structure

- Structure of eukaryotic cells, including:
    - cell-surface membrane
    - nucleus (containing chromosomes, consisting of protein-bound, linear DNA, and one or more nucleoli)
    - mitochondria
    - chloroplasts
    - Golgi apparatus and Golgi vesicles
    - lysosomes
    - ribosomes
    - rough endoplasmic reticulum and smooth endoplasmic reticulum
    - cell wall
    - cell vacuole
- Structure of prokaryotic cells
- Cytoskeleton sometimes included – usually just actin and tubulin
- Manipulating magnification for light and electron micrographs (usually including use of graticules)
- Use of stains in light microscopy
- Characteristics of light and electron microscopes
- Cell cycle – the main stages of mitosis and meiosis
- Structure of the cell membrane, including phospholipids, glycoproteins, glycolipids, membrane proteins, cholesterol in the fluid mosaic model
- Membrane transport: active transport, facilitated diffusion, carrier and channel proteins, diffusion, osmosis (using water potential terminology)

3. Immune System

- Definition of antigen and structure and function of antibodies
- Phagocytosis

- Antigen presentation, stimulation of B cells, clonal selection and expansion, plasma cells
- Role of T cells (normally highly simplified and restricted to helper T cells and cytotoxic T cells
- Primary and secondary immune responses
- Passive and active immunity
- HIV as an example of a pathogen (other syllabuses may include other diseases such as cholera, measles, TB, flu)
- Uses of monoclonal antibodies

4. a. Exchange Surfaces

- SA:Vol relationships for cells and organisms, features of exchange surfaces and the need for circulatory systems
- Examples of gas exchange systems: human always included, often fish gills or insect trachea
- Gas exchange in plants
- Mechanism of ventilation in humans and structure of trachea epithelium
- COPD and smoking

4. b. Circulatory Systems

- Structure of single and double circulatory systems (sometimes also open/closed)
- Structure and function of haemoglobin, including Bohr effect and transport of CO_2 (sometimes also fetal haemoglobin and myoglobin)
- Structure of arteries, veins, capillaries
- Structure of the mammalian heart, including valves
- Electrical activity of the heart and role of AVN, SAN (sometimes ECG included)
- Formation and composition of tissue fluid
- CHD is on most syllabuses

4. c. Plant Transport

- Structure of xylem
- Cohesion-tension theory
- Structure of phloem
- Mass flow hypothesis

5. Molecular Genetics

- Structure of chromosomes, DNA and genes
- Role and structure of mRNA, tRNA and ribosomes
- The genetic code, transcription and translation
- Exons and introns and splicing of pre-mRNA
- Mutations and the effect on proteins
- Mutations as a source of genetic variation for natural selection

6. Biodiversity

- Hierarchical nature of taxonomic systems
- Three domains versus 5 kingdom classifications
- Idea of a phylogenetic classification
- Random and systematic sampling
- Simpson’s diversity index