CIE AS-level

If your child is studying CIE then we recommend they attend our OCR (A) course. Our course tutor Fariyo says: "CIE is more closely aligned to OCR (A) "

Topic 1: Cell structure

CIE Topic	Equivalent OCR (A) Topic	Covered by OCR (A)	*Not covered by OCR (A)*
1.1 The microscope in cell studies	2.1.1 Cell structure	*- compare the structure of typical animal and plant cells by making temporary preparations of living material and using photomicrographs* *- calculate the linear magnifications of drawings, photomicrographs and electron micrographs* *- use an eyepiece graticule and stage micrometer scale to measure cells and be familiar with units (millimetre, micrometre, nanometre) used in cell studies* *- explain and distinguish between resolution and magnification, with reference to light microscopy and electron microscopy* *- calculate actual sizes of specimens from drawings, photomicrographs and electron micrographs*	

1.2 Cells as the basic units of living organisms	2.1.1 Cell structure	*- describe and interpret electron micrographs and drawings of typical animal and plant cells as seen with the electron microscope* *- recognise the following eukaryotic cell structures and outline their functions:* *• cell surface membrane* *• nucleus, nuclear envelope and nucleolus* *• rough endoplasmic reticulum* *• smooth endoplasmic reticulum* *• Golgi body (Golgi apparatus or Golgi complex)* *• mitochondria (including small circular DNA)* *• ribosomes (80S in the cytoplasm and 70S in chloroplasts and mitochondria)* *• lysosomes* *• centrioles and microtubules* *• chloroplasts (including small circular DNA)* *• cell wall* *- outline key structural features of typical prokaryotic cells as seen in a typical bacterium (including: unicellular, 1–5μm diameter, peptidoglycan cell walls, lack of membrane-bound organelles, naked circular DNA, 70S ribosomes)* *- compare and contrast the structure of typical prokaryotic cells with typical eukaryotic cells (reference to mesosomes should not be included)*	*- recognise the following eukaryotic cell structures and outline their functions:* *• plasmodesmata* *• large permanent vacuole and tonoplast of plant cells* *- state that ATP is produced in mitochondria and chloroplasts and outline the role of ATP in cells* *- outline the key features of viruses as non-cellular structures (limited to protein coat and DNA/RNA)*

Topic 2: Biological molecules			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
2.1 Testing for biological molecules	2.1.2 Biological molecules	*- carry out tests for reducing sugars and non-reducing sugars, the iodine test for starch, the emulsion test for lipids and the biuret test for proteins to identify the contents of solutions* *- carry out a semi-quantitative Benedict's test on a reducing sugar using dilution, standardising the test and using the results (colour standards or time to first colour change) to estimate the concentration*	
2.2 Carbohydrates and lipids	2.1.2 Biological molecules	*- describe the ring forms of α-glucose and β-glucose* *- define the terms monomer, polymer, macromolecule, monosaccharide, disaccharide and polysaccharide* *- describe the formation of a glycosidic bond by condensation, with reference both to polysaccharides and to disaccharides* *- describe the breakage of glycosidic bonds in polysaccharides and disaccharides by hydrolysis* *- describe the molecular structure of polysaccharides including starch (amylose and amylopectin), glycogen and cellulose and relate these structures to their functions in living organisms* *- describe the molecular structure of a triglyceride with reference to the formation of ester bonds and relate the structure of triglycerides to their functions in living organisms* *- describe the structure of a phospholipid and relate the structure of phospholipids to their functions in living organisms*	

2.3 Proteins and water	2.1.2 Biological molecules	*- describe the structure of an amino acid and the formation and breakage of a peptide bond* *- explain the meaning of the terms primary structure, secondary structure, tertiary structure and quaternary structure of proteins and describe the types of bonding (hydrogen, ionic, disulfide and hydrophobic interactions) that hold these molecules in shape* *- describe the molecular structure of haemoglobin as an example of a globular protein, and of collagen as an example of a fibrous protein and relate these structures to their functions* *- explain how hydrogen bonding occurs between water molecules and relate the properties of water to its roles in living organisms (limited to solvent action, specific heat capacity and latent heat of vapourisation)*	

Topic 3: Enzymes			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
3.1 Mode of action of enzymes	2.1.2 Biological molecules 2.1.4 Enzymes	*- explain that enzymes are globular proteins that catalyse metabolic reactions* *- state that enzymes function inside cells (intracellular enzymes) and outside cells (extracellular enzymes)* *- explain the mode of action of enzymes in terms of an active site, enzyme/substrate complex, lowering of activation energy and enzyme specificity (the lock and key hypothesis and the induced fit hypothesis should be included)*	*- investigate the progress of an enzyme-catalysed reaction by measuring rates of formation of products (for example, using catalase) or rates of disappearance of substrate (for example, using amylase)*

3.2 Factors that affect enzyme action	2.1.4 Enzymes	*- investigate and explain the effects of the following factors on the rate of enzyme-catalysed reactions:* *• temperature* *• pH (using buffer solutions)* *• enzyme concentration* *• substrate concentration* *• inhibitor concentration* *- explain the effects of inhibitors, both competitive and non- competitive, on the rate of enzyme activity*	*- explain that the maximum rate of reaction (Vmax) is used to derive the Michaelis-Menten constant (Km) which is used to compare the affinity of different enzymes for their substrates* *- investigate and explain the effect of immobilising an enzyme in alginate on its activity as compared with its activity when free in solution*

Topic 4: Cell membranes and transport

CIE Topic	Equivalent OCR (A) Topic	Covered by OCR (A)	*Not covered by OCR (A)*
4.1 Fluid mosaic membranes	2.1.5 Biological membranes	*- describe and explain the fluid mosaic model of membrane structure, including an outline of the roles of phospholipids, cholesterol, glycolipids, proteins and glycoproteins* *- outline the roles of cell surface membranes including references to carrier proteins, channel proteins, cell surface receptors and cell surface antigens*	*- outline the process of cell signalling involving the release of chemicals that combine with cell surface receptors on target cells, leading to specific responses*
4.2 Movement of substances into and out of cells	2.1.5 Biological membranes	*- describe and explain the processes of diffusion, facilitated diffusion, osmosis, active transport, endocytosis and exocytosis (no calculations involving water potential will be set)* *- investigate the effects of immersing plant tissues in solutions of different water potentials, using the results to estimate the water potential of the tissues* *- explain the movement of water between cells and solutions with different water potentials and explain the different effects on plant and animal cells*	*- investigate diffusion and osmosis using plant tissue and non- living materials, such as Visking tubing and agar* *- calculate surface areas and volumes of simple shapes (including cubes) to illustrate the principle that surface area to volume ratios decrease with increasing size* *- investigate the effect of changing surface area to volume ratio on diffusion using agar blocks of different sizes*

3.2 Factors that affect enzyme action	2.1.4 Enzymes	*- investigate and explain the effects of the following factors on the rate of enzyme-catalysed reactions:* *• temperature* *• pH (using buffer solutions)* *• enzyme concentration* *• substrate concentration* *• inhibitor concentration* *- explain the effects of inhibitors, both competitive and non- competitive, on the rate of enzyme activity*	*- explain that the maximum rate of reaction (Vmax) is used to derive the Michaelis-Menten constant (Km) which is used to compare the affinity of different enzymes for their substrates* *- investigate and explain the effect of immobilising an enzyme in alginate on its activity as compared with its activity when free in solution*

Topic 5: The mitotic cell cycle			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
5.1 Replication and division of nuclei and cells	2.1.6 Cell division, cell diversity and cellular organisation	*- explain the importance of mitosis in the production of genetically identical cells, growth, cell replacement, repair of tissues and asexual reproduction* *- outline the cell cycle, including interphase (growth in G1 and G2 phases and DNA replication in S phase), mitosis and cytokinesis* *- outline the significance of stem cells in cell replacement and tissue repair by mitosis*	*- describe the structure of a chromosome, limited to DNA, histone proteins, chromatids, centromere and telomeres* *- outline the significance of telomeres in permitting continued replication and preventing the loss of genes* *- uncontrolled cell division can result in the formation of a tumour*
5.2 Chromosome behaviour in mitosis	2.1.6 Cell division, cell diversity and cellular organisation	*- describe the behaviour of chromosomes in plant and animal cells during the mitotic cell cycle and the associated behaviour of the nuclear envelope, cell surface membrane and the spindle*	*- observe and draw the mitotic stages visible in temporary root tip squash preparations and in prepared slides of root tips of species such as those of Vicia faba and Allium cepa*

Topic 6: Nucleic acids and protein synthesis			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
6.1 Structure and replication of DNA	2.1.3 Nucleotides and nucleic acids	*- describe the structure of nucleotides, including the phosphorylated nucleotide ATP (structural formulae are not required)* *- describe the structure of RNA and DNA and explain the importance of base pairing and the different hydrogen bonding between bases* *- describe the semi-conservative replication of DNA*	

6.2 Protein synthesis	2.1.3 Nucleotides and nucleic acids	*- state that a polypeptide is coded for by a gene and that a gene is a sequence of nucleotides that forms part of a DNA molecule* *- state that a gene mutation is a change in the sequence of nucleotides that may result in an altered polypeptide* *- describe how the information in DNA is used during transcription and translation to construct polypeptides, including the role of messenger RNA (mRNA), transfer RNA (tRNA) and the ribosomes*	*- describe the way in which the nucleotide sequence codes for the amino acid sequence in a polypeptide with reference to the nucleotide sequence for HbA (normal) and HbS (sickle cell) alleles of the gene for the β-globin polypeptide*

Topic 7: Transport in plants

CIE Topic	Equivalent OCR (A) Topic	Covered by OCR (A)	*Not covered by OCR (A)*
7.1 Structure of transport tissues	3.1.3 Transport in plants	*- draw and label from prepared slides the cells in the different tissues in roots, stems and leaves of herbaceous dicotyledonous plants using transverse and longitudinal sections* *- draw and label from prepared slides the structure of xylem vessel elements, phloem sieve tube elements and companion cells and be able to recognise these using the light microscope* *- relate the structure of xylem vessel elements, phloem sieve tube elements and companion cells to their functions*	*- draw and label from prepared slides plan diagrams of transverse sections of stems, roots and leaves of herbaceous dicotyledonous plants using an eyepiece graticule to show tissues in correct proportions*

7.2 Transport mechanisms	3.1.3 Transport in plants	*- explain the movement of water between plant cells, and between them and their environment, in terms of water potential* *- explain how hydrogen bonding of water molecules is involved with movement in the xylem by cohesion-tension in transpiration pull and adhesion to cell walls* *- describe the pathways and explain the mechanisms by which water and mineral ions are transported from soil to xylem and from roots to leaves (include reference to the symplastic pathway, apoplastic pathway and Casparian strip)* *- define the term transpiration and explain that it is an inevitable consequence of gas exchange in plants* *- investigate experimentally and explain the factors that affect transpiration rate using simple potometers* *- state that assimilates, such as sucrose and amino acids, move between sources (e.g. leaves and storage organs) and sinks (e.g. buds, flowers, fruits, roots and storage organs) in phloem sieve tubes* *- explain how sucrose is loaded into phloem sieve tubes by companion cells using proton pumping and the co-transporter mechanism in their cell surface membranes* *- explain mass flow in phloem sap down a hydrostatic pressure gradient from source to sink*	*- make annotated drawings, using prepared slides of cross-sections, to show how leaves of xerophytic plants are adapted to reduce water loss by transpiration*

Topic 8: Transport in mammals			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
8.1 The circulatory system	3.1.2 Transport in animals	*- state that the mammalian circulatory system is a closed double circulation consisting of a heart, blood vessels and blood* *- explain the relationship between the structure and function of arteries, veins and capillaries* *- state and explain the differences between blood, tissue fluid and lymph* *- describe the role of haemoglobin in carrying oxygen and carbon dioxide with reference to the role of carbonic anhydrase, the formation of haemoglobinic acid and carbaminohaemoglobin* *- describe and explain the significance of the oxygen dissociation curves of adult haemoglobin at different carbon dioxide concentrations (the Bohr effect)*	*- observe and make plan diagrams of the structure of arteries, veins and capillaries using prepared slides and be able to recognise these vessels using the light microscope* *- observe and draw the structure of red blood cells, monocytes, neutrophils and lymphocytes using prepared slides and photomicrographs* *- describe and explain the significance of the higher red blood cell count of humans at high altitude*
8.2 The heart	3.1.2 Transport in animals	*- describe the external and internal structure of the mammalian heart* *- describe the cardiac cycle (including blood pressure changes during systole and diastole)* *- explain how heart action is initiated and controlled (reference should be made to the sinoatrial node, the atrioventricular node and the Purkyne tissue, but not to nervous and hormonal control)*	*- explain the differences in the thickness of the walls of the different chambers in terms of their functions with reference to resistance to flow*

9 Gas exchange and smoking			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
9.1 The gas exchange system	3.1.1 Exchange surfaces	*- describe the gross structure of the human gas exchange system* *- describe the structure and functions of cartilage, cilia, goblet cells, mucous glands, smooth muscle and elastic fibres*	*- observe and draw plan diagrams of the structure of the walls of the trachea, bronchi, bronchioles and alveoli indicating the distribution of cartilage, ciliated epithelium, goblet cells, smooth muscle, squamous epithelium and blood vessels and recognise these cells and tissues in prepared slides* *- describe the process of gas exchange between air in the alveoli and the blood*
9.2 Smoking	Not covered		

Topic 10: Infectious disease			
CIE Topic	**Equivalent OCR (A) Topic**	**Covered by OCR (A)**	***Not covered by OCR (A)***
10.1 Infectious diseases	4.1.1 Communicable diseases, disease prevention and the immune system	*- state the name and type of causative organism (pathogen) of each of the following diseases: tuberculosis (TB) and HIV/AIDS* *- explain how TB and HIV/AIDS are transmitted*	*- define the term disease and explain the difference between an infectious disease and a non-infectious disease (limited to sickle cell anaemia and lung cancer)* *- state the name and type of causative organism (pathogen) of each of the following diseases: cholera, malaria, smallpox and measles* *- explain how cholera, measles and malaria are transmitted* *- discuss the biological, social and economic factors that need to be considered in the prevention and control of cholera, measles, malaria, TB and HIV/AIDS (a detailed study of the life cycle of the malarial parasite is not required)* *- discuss the factors that influence the global patterns of distribution of malaria, TB and HIV/AIDS and assess the importance of these diseases worldwide*
10.2 Antibiotics	4.1.1 Communicable diseases, disease prevention and the immune system	*- explain in outline how bacteria become resistant to antibiotics with reference to mutation and selection* *- discuss the consequences of antibiotic resistance and the steps that can be taken to reduce its impact*	*- outline how penicillin acts on bacteria and why antibiotics do not affect viruses*

Topic 11: Immunity

CIE Topic	Equivalent OCR (A) Topic	Covered by OCR (A)	*Not covered by OCR (A)*
11.1 The immune system	4.1.1 Communicable diseases, disease prevention and the immune system	*- state that phagocytes (macrophages and neutrophils) have their origin in bone marrow and describe their mode of action* *- describe the modes of action of B-lymphocytes and T-lymphocytes* *- explain the meaning of the term immune response* *- explain the role of memory cells in long-term immunity*	*- describe and explain the significance of the increase in white blood cell count in humans with infectious diseases and leukaemias* *- concept of self and non-self* *- explain, with reference to myasthenia gravis, that the immune system sometimes fails to distinguish between self and non- self*
11.2 Antibodies and vaccination	4.1.1 Communicable diseases, disease prevention and the immune system	*- relate the molecular structure of antibodies to their functions* *- distinguish between active and passive, natural and artificial immunity and explain how vaccination can control disease*	*- outline the hybridoma method for the production of monoclonal antibodies* *- outline the use of monoclonal antibodies in the diagnosis of disease and in the treatment of disease* *- discuss the reasons why vaccination programmes have eradicated smallpox, but not measles, tuberculosis (TB), malaria or cholera*

Comparison of CIE Biology A2-level with OCR (A) Biology A2-level

Topic 12: Energy and respiration

CIE Topic	Equivalent OCR (A) Topic	Covered by OCR (A)	*Not covered by OCR (A)*