

Definitions and Concepts for OCR (A) Biology A-Level

Topic 2 - Foundations in Biology

Topic 2.1: Cell structure

Centrioles: Structures found in the cytoplasm made of microtubules that produce the spindle fibres during mitosis.

Chloroplasts: Organelles found in plants and algae that are the site of photosynthesis.

Cilia: Small hair-like structures that project from the surface of cells.

Confocal microscopy: A type of microscopy that uses lasers to scan a specimen point by point to produce an image.

Cytoskeleton: A mesh of protein fibres found in the cytoplasm of eukaryotic cells used for structural support and intracellular transport.

Differential staining: Using multiple different stains to distinguish different parts of a specimen.

Eukaryotic cell: A type of cell that contains a nucleus along with membrane bound organelles.

Flagella: A whip-like structure found on bacterial cells that is used for cell movement.

Golgi apparatus: An organelle found in eukaryotic cells that is involved in the modification and packaging of proteins.

Light microscope: A type of microscope that uses a series of lenses to magnify the visible light reflecting off a specimen.

Lysosomes: Membrane-bound vesicles found in the cytoplasm that contain a hydrolytic enzyme called lysozyme.

Magnification: How much bigger an image appears compared to the original object calculated using the following formula:

$$\text{Image size} = \text{Actual size} \times \text{Magnification}$$

Mitochondrion: An organelle found in eukaryotic cells that is the site of aerobic respiration.

Nuclear envelope: A double membrane that surrounds the nucleus.



Nucleolus: A structure found inside the nucleus that contains proteins and RNA and is involved in synthesizing new ribosomes.

Nucleus: An organelle found in eukaryotic cells that stores the genetic information of the cell as chromosomes and is surrounded by a membrane called the nuclear envelope.

Plasma membrane: A semipermeable lipid bilayer studded with proteins that surrounds the cell and many organelles.

Prokaryotic cell: A type of cell that does not contain any membrane bound organelles or a nucleus.

Resolution: The ability to distinguish two different points in a specimen.

Ribosomes: Organelles found either free in the cytoplasm or membrane bound that are involved in the synthesis of proteins.

Rough endoplasmic reticulum (RER): A membrane-bound organelle that is involved in the synthesis and packaging of proteins.

Scanning electron microscope (SEM): A type of microscope that passes a beam of electrons over the surface of a specimen to produce an image.

Smooth endoplasmic reticulum (SER): A membrane-bound organelle involved in lipid synthesis.

Transmission electron microscope (TEM): A type of microscope that passes a beam of electrons through a sample to produce an image.

Topic 2.2: Biological molecules

Adhesion: A property of water molecules that creates an attraction between them and surfaces that they are in contact with.

Amino acid: The monomers containing an amino group (NH_2), a carboxyl group (COOH) and a variable R group that make up proteins.

Amylopectin: A branched polysaccharide made up of alpha glucose monomers joined by α -1,6 glycosidic bonds that makes up starch along with amylose.

Amylose: An unbranched polysaccharide made up of alpha glucose monomers joined by α -1,4 glycosidic bonds that makes up starch along with amylopectin.

Anions: An ion with a negative charge.



Benedict's test: A biochemical test used to detect the presence of a reducing sugar in a solution and distinguish between solutions of different reducing sugar concentrations.

Biuret test: A biochemical test that produces a purple colour when it is added to a solution containing protein.

Cations: An ion with a positive charge.

Cellulose: A linear polysaccharide that is the main component of the cell wall in plants and is made up of many beta glucose molecules joined by β -1,4 glycosidic bonds.

Chromatography: A technique used to separate different molecules in a solution by their different properties.

Cohesion: A property of water molecules that creates an attraction between them which causes them to stick together.

Collagen: A type of fibrous protein that provides strength to many different cell types and makes up connective tissues.

Condensation reaction: A type of reaction that joins two molecules together with the formation of a chemical bond involving the elimination of a molecule of water.

Conjugated protein: A protein with a prosthetic group bound to it.

Elastin: A type of fibrous protein that allows tissues and structures like blood vessels to stretch and return to their original shape.

Fibrous protein: A class of long chain proteins that are generally insoluble in water and typically have structural roles.

Globular protein: A class of spherical shaped proteins that are generally water soluble and typically have metabolic roles.

Glucose: A hexose monosaccharide that is the main respiratory substrate in eukaryotes.

Glycogen: A highly branched polysaccharide that is used as the main energy storage molecule in animals and is made up of alpha glucose monomers joined by α -1,4 glycosidic bonds.

Haemoglobin: A type of conjugated globular protein used to transport oxygen that is made up of four polypeptide chains each containing a haem prosthetic group.

Hexose monosaccharide: A simple sugar that contains 6 carbon atoms.

Hydrogen bond: A type of weak bond formed between an electropositive hydrogen and an electronegative atom like oxygen or nitrogen.



Hydrolysis: Breaking a chemical bond between two molecules involving the use of a water molecule.

Insulin: A globular protein hormone that is made in the pancreas in response to detection of high glucose levels in the blood.

Iodine test: A biochemical test that produces a blue/black colour when it is added to a solution containing starch.

Keratin: A type of fibrous protein that provides strength to hair and nails.

Lactose: A disaccharide made of a molecule glucose and galactose joined by a glycosidic bond.

Lipid emulsion test: A biochemical test that produces a cloudy emulsion when performed on lipids.

Maltose: A disaccharide made of two molecules of glucose joined by a glycosidic bond.

Monomer: An individual unit that can be bonded to other identical monomers to make a polymer.

Monomers: The smaller units from which larger molecules are made.

Pentose monosaccharide: A simple sugar that contains 5 carbon atoms.

Phospholipid: A type of amphipathic lipid made from a molecule of glycerol bonded to two fatty acid molecules and a phosphate group.

Polymer: A molecule made from many repeating monomers joined together.

Polymers: Molecules made from a large number of monomers joined together.

Primary structure: The individual sequence of amino acids in a protein.

Quaternary structure: A structure only applicable to proteins with multiple polypeptide chains that describes the interactions of the different chains.

Ribose: A pentose monosaccharide which composes the backbone of RNA.

Saturated fatty acid: A type of fatty acid molecule containing only single bonds between the carbon atoms.

Secondary structure: The local interactions of the amino acids in the polypeptide chain.

Solvent: A liquid that solutes can dissolve in to form a solution.



Starch: A polysaccharide used for energy storage in plants that is made up of alpha glucose joined together in the forms of amylose and amylopectin.

Sucrose: A disaccharide made of a molecule glucose and fructose joined by a glycosidic bond.

Tertiary structure: The way that the whole protein folds to make a three dimensional structure.

Triglyceride: A type of lipid formed from a molecule of glycerol joined by ester bonds to three fatty acid molecules.

Unsaturated fatty acid: A type of fatty acid molecule containing at least one double bond in the carbon chain.

Topic 2.3: Nucleotides and nucleic acids

Adenosine triphosphate (ATP): A nucleotide consisting of a molecule of ribose joined to the nitrogenous base adenine and three phosphate groups.

Degenerate (genetic code): A term used to describe the fact that some amino acids can be coded for by multiple different codons.

Deoxyribonucleic acid (DNA): A double stranded polynucleotide that contains the genetic material of an organism and is made up of deoxyribonucleotide monomers joined together by phosphodiester bonds.

DNA nucleotide: The monomer that makes up DNA and consists of deoxyribose, a nitrogenous base and a phosphate group.

DNA polymerase: An enzyme that catalyses the formation of phosphodiester bonds between nucleotides during the synthesis of a new DNA strand.

RNA polymerase: An enzyme that catalyses the formation of phosphodiester bonds between nucleotides during the synthesis of a new RNA strand.

Helicase: An enzyme that catalyses the unwinding and unzipping of DNA in many processes like replication and transcription.

Messenger RNA (mRNA): A type of RNA that carries genetic information from the DNA in the nucleus to the ribosomes for translation.

Non-overlapping (genetic code): A term used to describe the fact that each base is only part of one codon and that each codon is read one at a time in order.



Nucleotide: The monomer from which nucleic acids are made that consists of a pentose sugar, nitrogenous base and phosphate group.

Phosphodiester bond: A type of bond that joins nucleotides together to create polynucleotides.

Purines: A class of nitrogenous bases which are made up of two rings that adenine and guanine are members of.

Pyrimidines: A class of nitrogenous bases which are made up of a single ring that cytosine, thymine and uracil are members of.

Ribosomal RNA (rRNA): A type of RNA that makes up ribosomes.

RNA nucleotide: The monomer that makes up RNA and consists of ribose, a nitrogenous base and a phosphate group.

Semi-conservative replication: The replication of DNA to produce two new DNA molecules which both contain one new strand and one old strand from the original DNA molecule.

Transcription: The process of synthesising a new mRNA strand from a molecule of DNA.

Transfer RNA (tRNA): A type of RNA that has three hairpin loops, an anticodon for attachment to the mRNA codon and an amino acid binding site and is used to carry amino acids to the ribosome.

Translation: The process of protein synthesis where complementary tRNAs carrying amino acids are brought to each codon in an mRNA molecule as it moves through a ribosome.

Triplet (genetic code): A term used to describe the fact that DNA is grouped into three base long codons that are read together and code for an amino acid.

Universal (genetic code): A term used to describe the fact that the same codons code for the same amino acids in all organisms.

Topic 2.4: Enzymes

Activation energy: The amount of energy needed for a reaction to happen.

Active site: A specific region on an enzyme where the substrate binds and the reaction takes place.

Amylase: An enzyme that catalyses the extracellular breakdown of starch.



Catalase: An enzyme that catalyses the intracellular breakdown of hydrogen peroxide into oxygen and water.

Coenzyme: A type of cofactor that is bound loosely to an enzyme with weak interactions.

Cofactors: A non-protein molecule that is needed for the effective functioning of an enzyme.

Competitive inhibitor: A molecule which binds to the active site of an enzyme and prevents the substrate from binding.

Cyanide (CN⁻): A metabolic poison which acts as an irreversible inhibitor of cytochrome oxidase and hence preventing respiration.

End-product inhibition: A method of enzyme inhibition where the product of an enzyme controlled reaction can bind to the enzyme and prevent it from working.

Enzyme: A biological catalyst used to speed up the rate of biochemical reactions without being used up or permanently altered.

Enzyme-product complex: The temporary complex formed after the enzyme has catalysed the reaction but before the products have left the active site of the enzyme.

Enzyme-substrate complex: The temporary complex formed when the substrate binds to the active site of the enzyme.

Extracellular reaction: A reaction that occurs outside of cells.

Inactive precursor: An inactive form of an enzyme that cannot carry out its function until it is activated.

Induced fit hypothesis: A model of enzyme action that describes how once a specific substrate binds to the active site, the enzyme undergoes subtle conformational changes to fit the substrate better.

Intracellular reaction: A reaction that occurs within cells.

Lock and key hypothesis: A model of enzyme action that describes how the enzyme will only fit a substrate that has the correct complementary shape to the active site.

Metabolism: The sum of all the chemical reactions taking place in a cell.

Non-competitive inhibitor: An inhibitor which binds to a different part of an enzyme known as the allosteric site and prevents the enzyme from functioning.

Prosthetic group: A type of cofactor that is bound tightly to an enzyme with strong interactions.



Substrate specificity: The ability of an enzyme to catalyse only a specific reaction or set of reactions which have substrates complementary to the active site of the enzyme.

Temperature coefficient (Q_{10}): A method of calculating an increase in reaction rate after a 10°C temperature increase - calculated using the following equation:

$$Q_{10} = \frac{R_2}{R_1}$$

Trypsin: An enzyme that catalyses the extracellular breakdown of proteins.

Topic 2.5: Biological membranes

Active transport: The active movement of substances from a low concentration to a higher concentration (up their concentration gradient) with the use of energy in the form of ATP.

Amphipathic: A molecule with both hydrophobic and hydrophilic parts.

Cell lysis: The bursting of a cell, particularly after the uptake of too much water into an animal cell through osmosis.

Cholesterol: A mostly hydrophobic molecule that sits in the hydrophobic portion of the membrane and regulates membrane fluidity.

Crenation: The shrinking of a cell when placed in a hypertonic solution due to large amounts of water moving out of the cell through osmosis.

Endocytosis: The bulk uptake of substances into a cell by invagination of the membrane to form a vesicle trapping the substances inside the cell with the use of energy in the form of ATP.

Exocytosis: The bulk transport of substances out of a cell using a vesicle that fuses with the plasma membrane using energy in the form of ATP.

Facilitated diffusion: The net movement of substances from a high concentration to a lower concentration (down their concentration gradient) through transport proteins without the use of energy.

Fluid mosaic model: A model that describes membrane structure as a sea of mobile phospholipids studded with various proteins.

Hydrophilic: A molecule which is attracted to water.

Hydrophobic: A molecule which repels water.



Integral membrane protein: A type of protein bound to the membrane with strong interactions.

Osmosis: The net movement of water molecules across a partially permeable membrane from a region of high water potential to a region of lower water potential without the use of energy.

Peripheral membrane protein: A type of protein that is weakly bound to the surface of the membrane.

Phagocytosis: The ingestion of solid material (particularly pathogens and foreign material) by phagocytic cells.

Phospholipid: A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group.

Pinocytosis: The bulk uptake of liquids into the cell using energy in the form of ATP.

Plasmolysis: The effect produced by placing plant cells in a hypertonic solution causing the cell to shrivel from water loss, resulting in the membrane pulling away from the rigid cell wall.

Simple diffusion: The spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy.

Turgid: A term used to describe a cell that is swollen due to large amounts of fluid uptake

Water potential: A measure of the tendency of water molecules to move from one area to another measured in kilopascals (kPa) and given the symbol Ψ .

Topic 2.6: Cell division, cell diversity and cellular organisation

Acrosome: An organelle found in the head of sperm cells which is specialised to digest the outer coating of an egg cell during fertilisation.

Anaphase: The third stage in mitosis where the chromosomes are pulled apart to the poles of the cell by the spindle fibres.

Anaphase 1: The third stage of meiosis where the chromosomes that make up the bivalent are pulled apart to the poles of the cell by the spindle fibres.

Anaphase 2: The seventh stage of meiosis where the chromatids are pulled apart to opposite poles of the cell.

Anucleate: A type of cell which does not have a nucleus.



Asexual reproduction: The production of genetically identical offspring from one parent through the process of mitosis.

Bivalent: A pair of homologous chromosomes.

Ciliated epithelium: A type of epithelium which has many fine protrusions known as cilia and is specialised for sweeping dirt and debris out of the body.

Crossing over: The exchange of genetic material between two chromosomes in a bivalent.

Cytokinesis: The division of the cytoplasm at the end of mitosis to produce two new daughter cells.

Differentiation: The process where a cell develops certain features so that it is specialised to carry out a certain function.

Diploid: Cells with two copies of each chromosome.

Erythrocyte: An anucleate cell specialised to carry oxygen from the lungs around the body (commonly referred to as a red blood cell).

G₁ (gap 1) checkpoint: The first checkpoint in the cell cycle which occurs just before the end of G₁ phase and commits the cell to division under favourable conditions.

G₁ (Gap 1) phase: The first growth phase in interphase where the cell synthesises proteins and RNA, duplicates its organelles and increases in size before DNA replication in S phase.

G₂ (gap 2) checkpoint: The second checkpoint in the cell cycle which occurs at the end of G₂ phase and checks that the DNA was correctly replicated during S phase before the cell enters mitosis.

G₂ (Gap 2) phase: The second growth phase of interphase where the cell continues to increase in size and synthesize biomolecules.

Gametes: Sex cells that have a haploid nucleus and are produced through meiosis.

Gene loci: The location of a gene on a chromosome.

Guard cells: A type of cell usually found in pairs that is specialised to control the opening and closing of stomata.

Haploid: Cells with only one copy of each chromosome.

Homologous chromosomes: Two chromosomes with similar gene loci but different alleles, one inherited from each parent.



Independent assortment: A source of variation in meiosis where the bivalent chromosomes can line up either way around on the metaphase plate.

Interphase: The largest part of the cell cycle where cells spend most of their time growing, synthesising biomolecules and preparing for mitosis.

M (Metaphase) checkpoint: The checkpoint occurring at the end of metaphase during mitosis which ensures all of the chromosomes have correctly attached to the spindle fibres and aligned at the metaphase plate.

Meiosis: A type of cell division used to produce gametes that produces four genetically different haploid daughter cells from one parent cell.

Meristematic tissue: A type of plant tissue which contains stem cells and is usually found in the growing regions of the plant.

Metaphase: The second stage in mitosis where the chromosomes attach to the spindle fibres and align in the centre of the cell along the metaphase plate.

Metaphase 1: The second stage of meiosis where the bivalent chromosomes align along the metaphase plate and independent assortment occurs.

Metaphase 2: The sixth stage of meiosis where the recombinant chromosomes align on the metaphase plate.

Mitosis: The division of a cell to produce two genetically identical daughter cells.

Multipotent: A type of stem cell which has the ability to differentiate into any cell type within a certain tissue in the body.

Neutrophil: A type of white blood cell with a multi-lobed nucleus which is specialised to engulf and destroy pathogens.

Organ: A group of specialised tissues working together to carry out a specific function.

Organ system: A group of specialised organs working together to carry out a specific function.

Palisade cell: A type of cell found in the leaves of plants which contains many chloroplasts and is specialised to carry out photosynthesis.

Phloem: A tissue found in plants which is specialised for the transport of assimilates from their site of production to different parts of the plant where they are needed.



Pluripotent stem cell: A type of stem cell which has the ability to differentiate into any cell type in the body.

Prophase: The first stage in mitosis where the nuclear envelope breaks down, the centrosomes move to opposite poles of the cell, the mitotic spindle begins to form and the chromosomes condense.

Prophase 1: The first stage of meiosis where the nuclear envelope breaks down, the spindle fibres form and the chromosomes condense and form bivalents. This is the stage of meiosis where crossing over occurs.

Prophase 2: The fifth stage of meiosis where the nuclear envelope breaks down, the spindle fibres form and the chromosomes condense.

Recombinant chromosomes: The chromosomes produced by the crossing over and exchange of genes during metaphase 1.

Root hair cell: A type of cell that is found in the roots of plants which has a large surface area and is specialised for the uptake of water and ions from the soil.

S (synthesis) phase: The second phase in the cell cycle where the DNA in the cell is replicated.

Somatic cells: Any cells that make up an organism excluding sex cells (sperm and egg cells).

Sperm cell: The male gamete which contains a long tail, an acrosome and lots of mitochondria and is specialised to fertilise an egg cell.

Squamous epithelium: A type of epithelium which is only one cell thick and is specialised for rapid diffusion.

Stem cell: A type of undifferentiated cell which has the ability to divide many times and differentiate into many different cell types.

Stomata: Small openings in the leaves or stem of a plant that can be opened or closed by guard cells in response to varying conditions.

Telophase: The final stage of mitosis where new nuclear envelopes begin to form around the separated sets of chromosomes.

Telophase 1: The fourth stage of meiosis where the nuclear envelopes reform around the separated chromosomes and they uncoil.

Telophase 2: The final stage in meiosis where the nuclear envelopes reform around the separated chromatids (now called chromosomes) and they uncoil.



Tissue: A group of specialised cells working together to carry out a specific function.

Totipotent stem cell: A type of stem cell which has the ability to differentiate into any type of cell in the body or in the placenta.

Xylem: A tissue found in plants which is specialised for the transport of water and dissolved minerals up the plant.

