

**Adenosine triphosphate (ATP)** - A nucleotide derivative which acts as the 'energy currency' in cells. It consists of a molecule of ribose joined to the nitrogenous base adenine and three phosphate groups.

**Capsid** - The outer protein shell of a virus that encases and protects the viral genome.

**Cell surface membrane** - A phospholipid bilayer studded with proteins that surrounds cells and separates them from their environment.

**Cell wall** - A permeable layer made of polysaccharides that surrounds plant, algal and fungal cells.

**Centrioles** - Cytoplasmic structures made of microtubules that produce the spindle fibres during mitosis.

**Chloroplast** - An organelle found in plants and algae that is the site of photosynthesis.

**Cilia** - Small, hair-like organelles that extend from the surface of eukaryotic cells. They have motile and sensory functions.

**Electron micrograph** - An image of a non-living structure produced by a scanning electron microscope (SEM) or a transmission electron microscope (TEM).

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

**Eyepiece graticule** - A scale bar inside the eyepiece of a light microscope which can be calibrated against a ruler to measure structures.

**Golgi apparatus/ Golgi body/ Golgi complex** - An organelle found in eukaryotic cells that is involved in the modification and packaging of proteins.

**Lysosomes** - Membrane-bound vesicles 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:

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

**Microvilli** - Microscopic finger-like projections from the plasma membrane of some animal cells.

**Mitochondrion (pl mitochondria)** - 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.

**Peptidoglycan** - A polymer consisting of amino acids and sugars that forms a 3D mesh and makes up the cell walls of most bacteria.

**Photomicrograph** - An image produced from a light microscope (also known as an optical microscope).

**Plasmodesmata** - Microscopic channels between plant cell walls that facilitate symplastic transport.

**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 electron 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.

**Stage micrometer** - A scale that may be mounted to the stage of a light microscope and can be used to calibrate an eyepiece graticule.

**Tonoplast** - The lipid bilayer that surrounds a permanent vacuole.

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

**Vacuole (permanent)** - A membrane-bound structure found in plant cells that contains cell sap.

**Virus** - A non-living microorganism that consists of genetic material surrounded by a protein husk.

**Viral envelope**: The outermost layer of many types of viruses that consists of phospholipids. The envelope protects the viral genome and helps the virus to evade recognition by the host immune system.

**Alpha glucose** - A structural isomer of glucose that exists in a ring form where the hydroxyl group on carbon-1 lies below the plane of the ring.

**Amino acids** - The monomers containing an amino group ( $\text{NH}_2$ ), a carboxyl group ( $\text{COOH}$ ) and a variable R group that make up proteins.

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

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

**Benedict's test** - A biochemical test for reducing sugars that produces a different colour based on the amount of reducing sugar present.

**Beta glucose** - A structural isomer of glucose that exists in a ring form where the hydroxyl group on carbon-1 lies above the plane of the ring.

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

**Cellulose** - A polysaccharide made of beta glucose monomers joined by  $\beta$ -1,4 glycosidic bonds that is used as a structural polysaccharide, providing strength to plant cell walls.

**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.

**Disaccharide** - Molecules formed by the condensation of two monosaccharides.

**Disulfide bond** - A covalent bond formed between sulfur-containing cysteine side chains of amino acids.

**Emulsion test** - A biochemical test that produces a cloudy emulsion when performed on lipids.

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

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

**Glycogen** - A highly branched polysaccharide made of alpha glucose monomers that is used as the main storage of energy in humans and animals.

**Glycosidic bond** - A bond between two monosaccharides formed in a condensation reaction.



**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.

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

**Hydrolysis reaction** - A type of reaction involving the use of a water molecule that breaks a chemical bond between two molecules.

**Hydrophobic interaction** - Polar side chains face the cytosol. Non-polar side chains arrange to minimise the surface area in contact with water and often point inwards.

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

**Latent heat of vapourisation** - The amount of energy needed for a substance to change state from a liquid to a gas.

**Macromolecule** - A large molecule formed by condensation reactions between smaller molecules. Polymers are a type of macromolecule, but not all macromolecules are formed from repeating units.

**Monomers** - The smaller units from which larger molecules are made.

**Monosaccharide** - The individual sugar monomers from which larger carbohydrates are made.

**Non-reducing sugar** - A sugar that does not have a free aldehyde or ketone functional group so cannot act as a reducing agent, e.g. sucrose.

**Peptide bond** - The bond between amino acids formed by a condensation reaction between the -H of the amine group on one molecule and the -OH of the carboxylic acid group on the other molecule.

**Phospholipid** - A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group. The two fatty acid chains are the non-polar hydrophobic tails whilst the phosphate group is the polar hydrophilic head.

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

**Polysaccharide** - Molecules formed by the condensation of many monosaccharides.

**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.

**Reducing sugar** - A sugar that has a free aldehyde or ketone functional group so can act as a reducing agent, e.g. maltose, fructose, glucose.

**Secondary structure** - The local interactions of the amino acids in the polypeptide chain resulting in an alpha helix or a beta-pleated sheet.

**Solvent** - A substance which other solutes are dissolved in.

**Specific heat capacity** - The amount of energy needed to raise the temperature of a substance by a specific amount.

**Starch** - A polysaccharide made of alpha glucose monomers that is used as the main storage of energy in plants.

**Sucrose** - A disaccharide formed by condensation of a glucose molecule and a fructose molecule.

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

**Triglyceride** - A type of lipid formed by the condensation of one molecule of glycerol and three molecules of fatty acid.

**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.

**Catalyst** - A substance that increases the rate of reaction, often by offering an alternative reaction pathway with a lower activation energy. It is unchanged at the end of the reaction.

**Colorimeter** - A light-sensitive device that measures the absorbance of transmission of certain wavelengths of light by a solution. A colorimeter can be used to investigate the rate of a reaction that involves colour changes.

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

**Enzyme** - A globular protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions. Some enzymes work intracellularly and others work extracellularly.

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

**Extracellular enzyme** - An enzyme that is secreted by cells and functions outside of cells, e.g. amylase.

**Extracellular reaction** - A reaction that occurs outside of cells e.g. in the tissue fluid.

**Immobilised enzymes** - Enzymes which are attached to an inert, insoluble material over which the substrate passes and the reaction takes place.

**Induced-fit hypothesis** - A model of enzyme action that describes how enzymes undergo subtle conformational changes which exert a strain on bonds in the substrate.

**Intracellular enzyme** - An enzyme that acts within cells, e.g. catalase.

**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.

**Michaelis-Menten constant ( $K_m$ )** - A value which indicates how strong the affinity between an enzyme and its substrate is.

**Non-competitive inhibitor** - An inhibitor which binds to a part of an enzyme which is not the active site (an allosteric site) and prevents the enzyme from functioning.

**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.

**$V_{\max}$**  - The maximum reaction rate.



**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.

**Antigen** - Marker molecule on the cell surface membrane (usually a protein or glycoprotein) that can be detected by antibodies and triggers an immune response.

**Carrier protein** - Protein involved in active transport that uses energy in the form of ATP to change conformation.

**Cell signalling** - Cells release chemicals which bind to complementary receptors on their target and trigger specific responses.

**Cell surface receptor** - A component on the cell membrane which binds to extracellular signals.

**Channel proteins** - Transmembrane proteins for transporting large or charged substances. Some are involved in facilitated diffusion and do not use ATP; others are involved in active transport and do require energy in the form of ATP.

**Cholesterol** - A steroid hormone which adds stability to the lipid bilayer.

**Diffusion** - The passive spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy.

**Endocytosis** - A method of bulk transport into a cell which relies on invagination of the cell membrane and requires energy in the form of ATP.

**Exocytosis** - A method of bulk transport out of a cell which occurs when vesicles fuse with the cell membrane and release their contents. It requires energy in the form of ATP.

**Facilitated diffusion** - The passive 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.

**Glycolipid** - A lipid which is bound to a monosaccharide or oligosaccharide.

**Glycoprotein** - A protein which is bound to a carbohydrate chain.

**Ligand** - An ion or molecule that transmits signals within or between cells. It has a role in cellular signalling and recognition.

**Osmosis** - The passive diffusion of water molecules from a region of high water potential to a region of lower water potential (down a water potential gradient) through a selectively permeable membrane without the use of energy.

**Passive transport** - The movement of substances without the use of energy.



**Phospholipid** - The type of lipid which forms the cell surface membrane bilayer. It is formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group. The two fatty acid chains are the non-polar hydrophobic tails whilst the phosphate group is the polar hydrophilic head.

**Phospholipid bilayer** - A polar membrane made of two layers of phospholipid molecules. It is a selectively permeable barrier to the passage of ions and molecules into and out of cells.

**Surface area to volume ratio** - The volume of an object compared with the amount of area where it contacts its environment. Calculated by dividing the surface area of an object by its volume.

**Visking tubing** - A semipermeable material which can be used to model the cell surface membrane.

**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  $\Psi$ .

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

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

**Bivalent** - A pair of homologous chromosomes.

**Centromere** - A structure on a chromosome that holds the sister chromatids together.

**Chromatid** - One strand of a replicated chromosome.

**Chromosome** - A structure consisting of a long, coiled molecule of DNA and its associated proteins, by which genetic information is passed from generation to generation.

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

**Deoxyribonucleic acid (DNA)** - An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix.

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

**G<sub>1</sub> (Gap 1) phase** - The first growth phase in interphase during which the cell synthesises proteins and RNA, duplicates its organelles and increases in size before DNA replication in S phase.

**G<sub>2</sub> (Gap 2) phase** - The second growth phase of interphase during which the cell continues to increase in size and synthesise biomolecules.

**Histone proteins** - Proteins that, together with DNA, form chromosomes in the nuclei of eukaryotic cells.

**Homologous chromosomes** - Two chromosomes with the same gene loci but different alleles, one inherited from each parent.

**Interphase** - The longest stage of the eukaryotic cell cycle. It consists of G<sub>1</sub> phase, S phase and G<sub>2</sub> phase and occurs before mitosis.

**Metaphase** - The second stage of mitosis in which replicated chromosomes align at the equator of the cell.

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

**Mitotic spindle** - A structure mainly consisting of microtubules that is formed by the cytoskeleton between centrioles. Chromosomes attach to the spindle via the kinetochore at their centrosome.

**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.

**Sister chromatids** - A pair of identical chromatids formed by DNA replication, joined by a centromere.

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

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

**Telomere** - A sequence of repeating nucleotides at each end of a chromosome. During DNA replication, the end of the lagging strand either is not replicated or remains as an RNA-DNA complex. Without telomeres, the chromosome would get shorter with continued replication and some genetic information may be lost.

**Telophase** - The final stage of mitosis in which new nuclear envelopes begin to form around the separated sets of chromosomes.

**Tumour** - An abnormal growth of tissue resulting from uncontrolled mitosis.