

Year 11 Biology — What do I need to know?

UNIT 1 — CELLS AND MULTICELLULAR ORGANISMS

TOPIC	WHAT DO I NEED TO KNOW?	MEMORY TRIGGER / BRIEF ANSWER	Revised once?	Revised again for luck?	Have you got this?
Topic 1: Cells as the basis of life	Recognise the differences between prokaryotic and eukaryotic cells.	Prokaryotes have no nucleus or membrane-bound organelles; eukaryotes have a nucleus and membrane-bound organelles.			
	Recognise the key organelles and state their functions: nucleus, mitochondria, rough ER, ribosomes, smooth ER, Golgi apparatus, lysosomes, vacuoles and chloroplasts.	Nucleus — DNA/control; mitochondria — aerobic respiration/ATP; RER — protein synthesis/transport; ribosomes — protein synthesis; SER — lipid synthesis/detoxification; Golgi — modifies, sorts and packages; lysosomes — intracellular digestion; vacuoles — storage; chloroplasts — photosynthesis.			
	Recognise organelles from cell diagrams and electron micrographs.	Use shape and structure as clues: double membranes, cristae, stacked membranes, cisternae, vesicles and so on.			
	Explain how the structure of an organelle relates to its function.	Structure determines function: e.g. cristae increase inner mitochondrial membrane area for ATP production.			
	Understand the hierarchical organisation of cells, tissues, organs and systems.	Cells form tissues; tissues form organs; organs work together in organ systems.			
	Explain how specialised cells and tissues allow multicellular organisms to obtain nutrients, exchange gases and remove wastes.	Specialised structures divide labour and provide efficient exchange and transport between cells and the environment.			
	Explain how the size and shape of cells, including surface area-to-volume ratio, are related to their function.	Small/thin cells have a larger SA:V and shorter diffusion distances, supporting faster exchange.			
	Explain why a large surface area-to-volume ratio allows more efficient exchange of materials.	More membrane area is available per unit volume, so materials can enter/leave more rapidly.			
	Interpret data from experiments investigating surface area-to-volume ratio and rate of diffusion.	As SA:V increases, diffusion is generally faster; use data to identify trends and support conclusions.			
	Describe how stem cells originate through mitosis and differentiate into specialised cells to form tissues.	Stem cells divide by mitosis, then differentiate by expressing different genes to become specialised cells.			
	Describe the process of mitosis.	Interphase replicates DNA; prophase condenses chromosomes and forms the spindle; metaphase lines chromosomes up at the equator; anaphase separates sister chromatids; telophase reforms two nuclei; cytokinesis divides the cytoplasm to form two genetically identical daughter cells.			
	Distinguish between unipotent, multipotent, pluripotent and totipotent stem cells.	Unipotent — one cell type; multipotent — several related types; pluripotent — almost any body cell; totipotent — all cell types including extra-embryonic tissues.			
	Label the cell membrane using the fluid mosaic model, including phospholipids, protein channels, cholesterol and glycoproteins.	Phospholipid bilayer forms the barrier; proteins transport/communicate; cholesterol stabilises; glycoproteins aid recognition/signalling.			

	Explain how the cell membrane regulates movement through simple diffusion, facilitated diffusion, osmosis, protein-mediated active transport, endocytosis and exocytosis.	Diffusion moves down a gradient; osmosis is water movement; facilitated diffusion uses proteins without ATP; active transport uses energy against a gradient; endocytosis brings material in; exocytosis sends material out.			
	Compare active and passive transport.	Passive transport moves down a gradient and requires no cellular energy; active transport uses energy to move substances against a gradient.			
	Explain how cell size is limited by surface area-to-volume ratio and rate of diffusion.	As a cell gets larger, volume increases faster than surface area, making exchange relatively less efficient.			
	Use or interpret light microscope images of cells and tissues.	Identify visible structures and tissues and use scale/magnification information to interpret the image.			
Topic 2: Exchange of nutrients and wastes	Recognise the structure and function of carbohydrates, proteins and lipids.	Carbohydrates — energy/storage/structure; proteins — enzymes, structure, transport and more; lipids — energy storage, membranes and signalling.			
	Know the difference between a monomer and a polymer.	A monomer is a small building block; a polymer is a larger molecule made from repeating monomers.			
	Recognise that condensation/dehydration synthesis removes water and forms bonds.	Water is removed as smaller molecules join to form a larger molecule.			
	Know that carbohydrates form glycosidic bonds, proteins form peptide bonds and lipids form ester bonds.	Carbohydrates → glycosidic; proteins → peptide; lipids → ester.			
	Recognise that hydrolysis adds water and breaks these bonds.	Water is added to split the bond between subunits.			
	Recognise that starch, glycogen and cellulose are polysaccharides.	All three are polymers of glucose, but their structures and functions differ.			
	Know the products formed when carbohydrates, proteins and lipids are chemically digested.	Carbohydrates → monosaccharides; proteins → amino acids; lipids → fatty acids and glycerol.			
	Know the roles of amylase, protease and lipase in chemical digestion.	Amylase digests starch/carbohydrates; protease digests proteins; lipase digests lipids.			
	Explain how villi and capillaries allow efficient nutrient exchange.	Villi provide a large surface area; thin walls shorten diffusion distance; capillaries maintain concentration gradients and transport absorbed nutrients.			
	Explain how a closed circulatory system facilitates efficient transport of materials to and from cells.	Blood remains in vessels, allowing controlled, efficient delivery and removal of substances from tissues.			
	Identify the main structures of a nephron: glomerulus, Bowman's capsule, proximal tubule, Loop of Henle, distal tubule and collecting duct.	Know the sequence: glomerulus → Bowman's capsule → proximal tubule → Loop of Henle → distal tubule → collecting duct.			
	State the function of each nephron structure in urine production.	Glomerulus filters; Bowman's capsule collects filtrate; proximal tubule reabsorbs useful substances; Loop of Henle establishes the concentration gradient; distal tubule adjusts filtrate; collecting duct regulates final water reabsorption and carries urine onward.			
	Explain glomerular filtration, selective reabsorption and secretion across nephron membranes.	Filtration forces small molecules into the nephron; useful substances are selectively reabsorbed; substances can be secreted from blood into the tubule.			
	Explain how these processes contribute to the removal of metabolic wastes.	Urea and other wastes remain in the filtrate or are secreted into it, then leave the body in urine.			
	Recall the structure and function of enzymes, including the active site.	Enzymes are globular proteins; the active site binds the substrate and lowers activation energy.			

	Compare the lock-and-key and induced-fit models of enzyme function.	Lock-and-key: active site is complementary to substrate; induced fit: binding causes the active site to change shape around the substrate.			
	Explain how enzyme activity is affected by temperature, pH, inhibitors and substrate concentration.	Rate rises to an optimum then falls; unsuitable pH/temperature can alter structure; inhibitors reduce activity; increasing substrate raises rate until enzymes are saturated.			
	Explain the effects of competitive and non-competitive inhibitors.	Competitive inhibitors compete for the active site; non-competitive inhibitors bind elsewhere and alter enzyme shape.			
	Understand that different enzymes have different optimum conditions.	Each enzyme has conditions where its activity is greatest, reflecting its structure and normal environment.			
	Explain temperature effects in terms of kinetic energy, successful collisions and denaturation.	Higher temperature increases kinetic energy and collisions up to an optimum; excessive heat disrupts bonds and denatures the enzyme.			
	Interpret, describe and explain enzyme activity graphs.	Identify the independent/dependent variables, describe the trend, identify the optimum and explain changes using enzyme theory.			
	Interpret experimental data investigating factors affecting enzyme activity.	Use patterns in data to identify effects, compare treatments and support a conclusion with evidence.			
Topic 3: Cellular energy, gas exchange and plant physiology	Distinguish between catabolism and anabolism.	Catabolism breaks molecules down and releases energy; anabolism builds molecules and requires energy.			
	Explain how ATP allows energy from catabolic reactions to be used in anabolic reactions.	Catabolic reactions generate ATP; ATP hydrolysis provides usable energy for anabolic reactions.			
	Know why ATP is considered a universal energy currency.	ATP is a small, readily hydrolysed molecule that transfers energy between cellular reactions.			
	Recall the overall aerobic respiration equation: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 36-38 \text{ ATP}$.	Glucose and oxygen are reactants; carbon dioxide, water and ATP are products.			
	Know the location and net inputs and outputs of glycolysis, the Krebs cycle and the electron transport chain.	Glycolysis — cytoplasm; Krebs cycle — mitochondrial matrix; ETC — inner mitochondrial membrane. Know the main reactants and products at each stage.			
	Recall the major stages of glycolysis, the Krebs cycle and the electron transport chain.	Glycolysis splits glucose; Krebs cycle releases CO_2 and loads electron carriers; ETC uses electrons to generate most ATP.			
	Know where each stage of aerobic respiration occurs.	Glycolysis — cytoplasm; link/Krebs reactions — matrix; ETC — inner mitochondrial membrane.			
	Know the net products of each stage.	Glycolysis — pyruvate, ATP and reduced NAD; Krebs — CO_2 , ATP and reduced electron carriers; ETC — ATP and water.			
	Compare aerobic and anaerobic respiration.	Aerobic respiration uses oxygen and produces much more ATP; anaerobic respiration occurs without oxygen and produces much less ATP.			
	Know that anaerobic respiration produces much less ATP than aerobic respiration.	Anaerobic respiration yields only 2 ATP per glucose compared with about 36–38 ATP aerobically.			
	Explain how alveoli and capillaries allow efficient gas exchange.	Alveoli provide large surface area and thin walls; dense capillary networks maintain concentration gradients.			
	Relate gas exchange efficiency to surface area, diffusion distance, concentration gradients and blood supply.	Large area, short distance, steep gradients and good blood flow increase diffusion rate.			

Predict the direction of movement of substances between alveoli and capillaries.	Oxygen diffuses alveoli → blood; carbon dioxide diffuses blood → alveoli. Look at the partial pressures of the gases. The gases will move from a higher partial pressure to a lower one.			
Predict the direction of movement of substances between capillaries and muscle tissue.	Oxygen and nutrients move blood → muscle; carbon dioxide and other wastes move muscle → blood.			
Recall the overall photosynthesis equation: $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$.	Carbon dioxide and water use light energy to form glucose and oxygen.			
Know the location and net inputs and outputs of the light-dependent and light-independent reactions.	Light-dependent reactions — thylakoid membranes; produce ATP, reduced electron carriers and O_2 . Calvin cycle — stroma; uses CO_2 , ATP and reduced electron carriers to make carbohydrate.			
Recall the major stages and final net products of the light-dependent reactions and Calvin cycle.	Light reactions capture light energy and split water; the Calvin cycle fixes CO_2 and uses ATP/reducing power to produce carbohydrate.			
Compare the structure and function of xylem and phloem tissues.	Xylem transports water/minerals, mainly upward, through lignified vessels; phloem transports organic substances through living sieve tubes.			
Explain how stomata and guard cells facilitate gas exchange in plants.	Stomata are pores; guard cells control opening and closing, allowing CO_2 in and O_2 /water vapour out.			
Define transpiration.	Transpiration is the loss of water vapour from a plant, mainly through stomata.			
Explain factors affecting transpiration, including light intensity, temperature, wind and humidity.	Higher light, temperature and wind generally increase transpiration; higher humidity generally decreases it.			
Interpret data from experiments investigating factors affecting transpiration.	Identify trends, compare treatments and use evidence to explain changes in transpiration rate.			

UNIT 2 — MAINTAINING THE INTERNAL ENVIRONMENT

TOPIC	WHAT DO I NEED TO KNOW?	MEMORY TRIGGER / BRIEF ANSWER	Revised once?	Revised again for luck?	Have you got this?
Topic 1: Homeostasis	Define homeostasis.	Maintenance of a relatively stable internal environment despite external or internal change.			
	Explain how the nervous and endocrine systems use negative feedback to coordinate responses to stimuli and maintain homeostasis.	A stimulus is detected, a control centre coordinates a response and effectors act to oppose the original change.			
	Use the stimulus-response model.	Stimulus → receptor → communication pathway/control centre → effector → response → negative feedback.			
	Identify chemoreceptors, thermoreceptors, mechanoreceptors, photoreceptors and nociceptors and the stimuli they detect.	Chemicals; temperature; mechanical pressure/stretch; light; potentially damaging stimuli/pain.			
	Identify the structure and function of dendrites, soma/cell body, axon, myelin sheath, nodes of Ranvier, axon terminal and synapse.	Dendrites receive; soma maintains cell; axon conducts; myelin insulates; nodes allow rapid impulse transmission; axon terminal releases neurotransmitters; synapse is the junction.			
	Distinguish between sensory neurons, interneurons and motor neurons.	Sensory: receptor → CNS; interneuron: within CNS; motor: CNS → effector.			
	Explain how an action potential is transmitted along a neuron.	Depolarisation reaches threshold, followed by repolarisation; the change in membrane potential propagates along the axon.			
	Explain synaptic transmission, including neurotransmitters, receptors, synaptic cleft, vesicles, presynaptic and postsynaptic neurons and signal transduction.	Impulse reaches the presynaptic terminal → vesicles release neurotransmitter → neurotransmitter crosses cleft → binds postsynaptic receptors → changes the next cell's activity.			
	Interpret an action potential graph, including the voltages associated with firing.	Know resting potential, threshold, depolarisation, repolarisation and return to resting potential; identify threshold as the voltage required to trigger an action potential.			
	Explain how hormones relay messages to cells displaying specific receptors via the circulatory or lymphatic system.	Hormones travel in body fluids and affect only target cells with complementary receptors.			
	Explain how receptor binding alters cellular activity.	Hormone binding activates a receptor and triggers intracellular signalling that changes cell activity.			
	Understand that cell sensitivity to a hormone is related to the number of receptors displayed for that hormone.	More receptors generally means greater sensitivity to that hormone.			
	Analyse feedback-control diagrams to identify the stimulus, receptors, control centre, effectors and communication pathways.	Trace the pathway from the initial change to detection, coordination and response, then identify how the response restores the variable.			
	Explain thermoregulatory mechanisms of endotherms, including brown adipose tissue and insulation.	Insulation reduces heat loss; brown adipose tissue generates heat through thermogenesis.			
	Explain behavioural thermoregulatory responses including kleptothermy, hibernation, aestivation and torpor.	Kleptothermy gains heat from another organism; hibernation reduces metabolism in cold periods; aestivation reduces activity in heat/dryness; torpor is a temporary reduction in metabolic activity.			
	Explain physiological mechanisms including evaporative heat loss, thermogenesis and vasomotor control.	Evaporation removes heat; thermogenesis produces heat; vasodilation increases heat loss and vasoconstriction reduces it.			

	Explain human thermoregulation using sweating, shivering, vasodilation and vasoconstriction.	Too hot → sweating and vasodilation; too cold → shivering and vasoconstriction.			
	Explain osmoregulation in humans, including the role of ADH and the kidney, using feedback-control diagrams.	Low blood water → more ADH → collecting ducts become more permeable → more water reabsorbed → concentrated urine.			
	Explain how stomata, vacuoles, cuticle and abscisic acid maintain water balance in plants.	Cuticle reduces water loss; stomata regulate gas exchange/water loss; vacuoles store water; ABA promotes stomatal closure during water stress.			
	Interpret data comparing the number and distribution of stomata in plants adapted to different environments.	Xeric plants generally have adaptations that reduce water loss; compare stomatal number/location with environmental conditions.			
Topic 2: Infectious disease and epidemiology	Distinguish between infectious and non-infectious disease.	Infectious diseases are caused by transmissible pathogens; non-infectious diseases are not caused by pathogens.			
	Identify key features of prions, viruses, bacteria, fungi, protists and parasites.	Know the basic biological nature and distinguishing features of each pathogen group.			
	Explain how adherence factors, invasion factors, capsules and toxins affect pathogenesis.	They help pathogens attach to, enter or evade host tissues and cause damage.			
	Explain how host cells recognise self from non-self.	Cells display molecular markers; the immune system recognises normal self markers and identifies foreign antigens.			
	Identify the three lines of defence in vertebrates.	1: skin/mucous membranes; 2: innate inflammatory/complement responses; 3: adaptive immune response.			
	Know that the first line of defence includes skin and mucous membranes and is non-specific.	Physical barriers prevent pathogens entering the body.			
	Know that the second line of defence includes the inflammatory response and complement system and is non-specific.	Rapid innate responses detect and attack pathogens without targeting one specific pathogen.			
	Know that the third line of defence is the specific adaptive immune response.	B and T lymphocytes recognise specific antigens and produce targeted responses.			
	Describe the inflammatory response, including prostaglandins, vasodilation, neutrophils, macrophages and natural killer cells.	Chemical signals promote vasodilation and recruit immune cells; neutrophils/macrophages attack pathogens and NK cells destroy infected or abnormal cells.			
	Explain the humoral immune response, including B lymphocytes and antibodies.	B cells produce antibodies that bind specific antigens and help neutralise or remove pathogens.			
	Explain the cell-mediated immune response, including T lymphocytes.	T cells recognise infected/abnormal cells and coordinate or carry out cellular immune responses.			
	Explain the role of memory cells.	Memory B/T cells persist after infection and allow a faster, stronger response to the same antigen.			
	Compare active and passive immunity, including naturally and artificially acquired immunity.	Active immunity results from the individual's own immune response; passive immunity receives antibodies. Each can be natural or artificial.			
	Interpret long-term immune response data.	Look for primary versus secondary responses, antibody levels, timing and evidence of immune memory.			

	Describe innate immune responses in plants, including physical barriers, leaf structures, plant defensins and toxins.	Plants use barriers and chemical defences to prevent entry and inhibit or kill pathogens.			
	Interpret data from an experiment investigating the effect of an antimicrobial agent on microorganism growth.	Greater inhibition of microbial growth indicates greater antimicrobial effectiveness under the tested conditions.			
	Understand and interpret zones of inhibition.	The clear area around an antimicrobial source indicates inhibited microbial growth; larger zones generally indicate greater effectiveness.			
	Describe disease transmission by direct contact, body fluids, contaminated food, contaminated water and disease-specific vectors.	Identify how the pathogen moves from an infected source to a susceptible host.			
	Explain how pathogen persistence, transmission mechanism, population immunity/immunisation and population mobility affect disease spread.	Longer persistence, efficient transmission, low immunity and high mobility generally increase spread.			
	Explain how personal hygiene, contact tracing and quarantine control disease spread.	Hygiene reduces exposure; tracing identifies contacts; quarantine separates potentially infected people from others.			
	Analyse data to predict outbreaks.	Use changes in case numbers and patterns over time to identify and predict increasing transmission.			
	Analyse data to determine the source of an outbreak.	Trace common exposures, locations or contacts back to the most likely source.			
	Analyse data to infer the mode of disease transmission.	Use spatial, temporal and exposure patterns to determine how the pathogen is spreading.			
	Analyse data to determine the effectiveness of strategies used to control disease spread.	Compare disease trends before and after interventions and use evidence to judge their effectiveness.			