

KNOWLEDGE ORGANISER GUIDANCE

It is advised that you print the relevant subject knowledge organisers and have them available to you when needed at all times.

An alternative recommendation would be to download the knowledge organisers for your subjects onto your electronic devices so you can access them when needed.

With the knowledge organiser you should make revision cards to help revise and build in time during independent study to test yourself weekly on the content.

While you have independent study, you should use your Knowledge Planner to study the relevant subject's Knowledge Organiser and learn the information provided.

Haggerston School

SIXTH FORM KNOWLEDGE ORGANISER

Biology

2023/2024

Aspiration Creativity Character

Topic 1: Biological Molecules

Definitions and Concepts

Adenosine triphosphate (ATP)	A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups.
Amino acid	The monomers containing an amino group (NH ₂), a carboxyl group (COOH) and a variable R group that make up proteins.
Benedict's test	A biochemical test used to test for reducing sugars that produces a different colour based on the amount of reducing sugar present.
Biuret test	A biochemical test that produces a purple solution in the presence of protein.
Cellulose	A polysaccharide made of beta glucose monomers that is used as a structural polysaccharide which provides strength to plant cell walls.
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.
Deoxyribonucleic acid (DNA)	An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix.
Dipeptide	Molecules formed by the condensation of two amino acids.
Disaccharide	Molecules formed by the condensation of two monosaccharides.
DNA helicase	An enzyme that breaks the hydrogen bonds between the two DNA strands in the DNA molecule that is going to be replicated.
DNA polymerase	An enzyme that catalyses the condensation reactions between the new nucleotides in the synthesis of the new DNA strand.
Enzyme	A protein molecule that acts as a biological catalyst and increases the rate of biochemical reactions.
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.

Heat capacity	The amount of energy needed to raise the temperature of a substance by a specific amount.
Hydrolysis	Breaking a chemical bond between two molecules involving the use of a water molecule.
Induced-fit model	A model of enzyme action that describes how enzymes undergo subtle conformational changes to better fit the substrate.
Iodine test	A biochemical test used to test for the presence of starch.
Lactose	A disaccharide formed by condensation of a glucose molecule and a galactose molecule.
Latent heat	The amount of energy needed for a substance to change state.
Lipid emulsion test	A biochemical test that produces a cloudy emulsion when performed on lipids.
Maltose	A disaccharide formed by condensation of two glucose molecules.
Metabolite	A molecule formed or used in metabolic reactions.
Monomers	The smaller units from which larger molecules are made.
Monosaccharide	The individual sugar monomers from which larger carbohydrates are made.
Phospholipid	A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group.
Polymers	Molecules made from a large number of monomers joined together.
Polypeptide	Molecules formed by the condensation of many amino acids.
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.
Ribonucleic acid (RNA)	A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds.
Secondary structure	The local interactions of the amino acids in the polypeptide chain.
Semi conservative replication	The production of two daughter DNA molecules from one DNA molecule which both contain one original DNA strand and one newly synthesised strand.
Solvent	A substance which other solutes are dissolved in.
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.

Topic 2: Cells

Definitions and Concepts

Active immunity	A form of immunity provided by the immune response of the body upon detection of a pathogen.
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.
Agglutination	The clumping together of cells or particles caused by antibodies which assists phagocytosis.
Antibody	A protein found in the blood that is produced by plasma cells which binds to antigens as a part of the immune response.
Antigen	Marker molecules that can be detected by antibodies and trigger an immune response.
Binary fission	The method of cell division used by prokaryotes involving replication of the circular DNA and plasmids followed by cytoplasmic division.
Cell cycle	The series of stages preparing the cell for division consisting of interphase and mitosis.
Cell-surface membrane	A phospholipid bilayer studded with proteins that surrounds cells and separates them from their environment.
Cell vacuole	A membrane bound structure found in plant cells that contains cell sap.
Cell wall	A permeable layer that surrounds plant, algae and fungi cells made of polysaccharides which provides strength to the cell.
Chloroplast	An organelle found in plants and algae that is the site of photosynthesis.
Clonal expansion	The production of many genetically identical daughter cells through cell division of the activated B or T lymphocyte after clonal selection.
Clonal selection	The process of matching the antigens on an antigen presenting cells with the antigen receptors on B and T lymphocytes.
Co-transport	A method of membrane transport where two substances are both transported across a membrane at the same time either in the same direction or opposite directions.
Cytokinesis	Division of the cytoplasm to produce two new cells.
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.

Flagella	A whip-like structure found on bacterial cells that is used for cell movement.
Fluid-mosaic model	A model that describes membrane structure as a sea of mobile phospholipids studded with various proteins.
Golgi apparatus	An organelle found in eukaryotic cells that is involved in the modification and packaging of proteins.
Helper T cell	A type of T cell in the immune system that stimulates cytotoxic T cells, B cells and phagocytes.
Herd immunity	A type of disease immunity that occurs when a large proportion of a population are vaccinated against a disease which prevents the spread of the disease to unvaccinated individuals.
Human Immunodeficiency Virus (HIV)	A virus that attacks T cells in the immune system and can lead to AIDS (acquired immune deficiency syndrome).
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: $Image\ size = Actual\ size \times Magnification$
Mitochondrion	An organelle found in eukaryotic cells that is the site of aerobic respiration.
Mitosis	The part of the cell cycle in which a eukaryotic cell divides to produce two daughter cells, each with identical copies of DNA.
Monoclonal antibodies	Identical antibodies that have been produced by an immune cell that has been cloned from a parent cell.
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.
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 immunity	A form of immunity provided by the introduction of antibodies to a disease into the body.
Phagocytosis	The process where phagocytes engulf and destroy material.
Plasmids	A circular loop of DNA found in the cytoplasm of bacterial cells.
Primary immune response	The response produced by the immune system when it encounters a pathogen for the first time.
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.
Secondary immune response	The response produced by the immune system when it recognises a pathogen that it has encountered before.
Simple diffusion	The passive spreading out of substances from a high concentration to a lower concentration (down their concentration gradient) without the use of energy.
Smooth endoplasmic reticulum (SER)	A membrane-bound organelle involved in lipid synthesis.
Vaccine	The introduction of dead or inactive pathogens to stimulate an immune response and provide long term immunity.

Topic 3: Exchange

Definitions and Concepts

Alveoli	Small air sacs found in the lungs at the end of bronchioles which provide a large surface area for gas exchange.
Amylases	A class of enzymes that hydrolyze polysaccharides.
Antiporter	A membrane protein involved in the cotransport of molecules in opposite directions.
Aorta	The main artery that carries oxygenated blood away from the heart at high pressure.
Arteriole	A smaller type of blood vessel that connects arteries with capillaries.
Artery	A type of blood vessel that carries blood away from the heart.
Atrium	A type of chamber in the heart which receives blood directly from a vein and passes it on to a ventricle.
Bile salts	Molecules found in the small intestine that assist in the coagulation of lipids, increasing the lipid surface area for breakdown.
Bronchi	The two airways branching out from the trachea and lead to the smaller bronchioles.
Bronchioles	Small airways which branch out from the bronchi and end at the alveoli.
Capillary	A very small blood vessel with thin walls and a small diameter used for substance exchange in tissues.
Capillary bed	A network of many different capillaries that supply the tissues with blood.
Coronary artery	The main artery that supplies the heart tissue with blood.
Co-transport	A type of membrane transport mechanism involving two different molecules moving across a cell membrane.
Diaphragm	A large sheet of muscle below the lungs used to reduce and increase the lung capacity to create pressure changes necessary for ventilation.
Endopeptidase	A class of enzymes that hydrolyze peptide bonds within polypeptides.

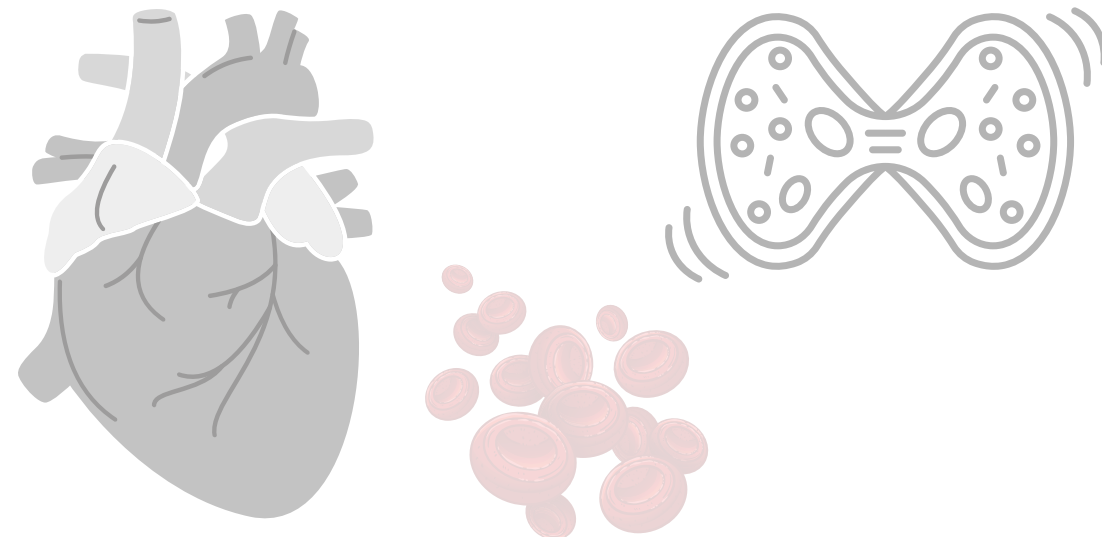
Exopeptidases	A class of enzymes that hydrolyze peptide bonds at the end of proteins (e.g. between the penultimate and last amino acid in the polypeptide).
External intercostal muscles	A set of muscles found between the ribs on the outside that are involved in forced and quiet inhalation.
Gill filaments	Small divisions of the gills in fish that extend off the gill arch.
Gill lamellae	Small protrusions on the gill filaments designed to increase the surface area available for gas exchange.
Haemoglobin	A protein found in red blood cells that has a quaternary structure and is specialised to carry oxygen to the tissues.
Internal intercostal muscles	A set of muscles found between the ribs on the inside that are involved in forced exhalation.
Left atrium	The chamber in the heart that receives oxygenated blood from the pulmonary vein and passes it on to the left ventricle.
Left ventricle	The chamber in the heart that receives oxygenated blood from the left atrium and pumps it out of the heart to the rest of the body.
Lipase	A class of enzymes that hydrolyze lipids.
Membrane-bound dipeptidases	A class of enzymes found within membranes that hydrolyze dipeptides into singular amino acids.
Membrane-bound disaccharidases	A class of enzymes found within membranes that hydrolyze disaccharides into monosaccharides.
Micelles	An organised group of lipid molecules that aggregate together to provide a hydrophobic capsule for the uptake of lipids.
Phloem	A type of tissue found in plants used to transport organic substances from where they are made to where they are needed.
Positive cooperativity	Conformational changes caused by the binding of oxygen to haemoglobin that increase the ability of haemoglobin to bind more oxygen.
Pulmonary artery	The main artery that carries deoxygenated blood from the heart to the lungs for reoxygenation.
Pulmonary vein	The main vein that carries oxygenated blood away from the lungs and back to the heart.

Topic 3: Exchange

Definitions and Concepts

Renal artery	The main artery that carries oxygenated blood to the kidneys from the heart.
Renal vein	The main vein that carries deoxygenated blood away from the kidneys back to the heart.
Right atrium	The chamber in the heart that receives deoxygenated blood directly from the vena cava and passes it on to the right ventricle.
Right ventricle	The chamber in the heart that receives deoxygenated blood from the right atrium and pumps it out of the heart to the lungs for reoxygenation.
Spiracles	Small openings on the surface of insects that allow for the exchange of gases with their environment.
Spongy mesophyll	A type of loosely packed mesophyll tissue with air pockets found in plant leaves which is specialised for gas exchange.
Stomata	Small holes found on leaves that can be opened or closed by guard cells to control the amount of water loss and gas exchange.
Symporter	A membrane protein involved in the cotransport of molecules in the same direction.
The Bohr effect	A decrease in the affinity of haemoglobin for oxygen in areas with a high carbon dioxide concentration.
Tissue fluid	Fluid filtered out from the blood that bathes tissues and provides the cells with substances like food and dissolved gases for exchange.
Trachea	The main airway that acts as a passage for air to pass to and from the bronchi.

Trachea (mammals)	A tube reinforced with cartilage that allows for the movement of air between the larynx and bronchi.
Tracheae (insects)	Tubes leading from the spiracles to the tracheoles that are part of the gaseous exchange system.
Tracheoles	Very small tubes that make up the respiratory system of insects and carry gases from the tracheae to the cells.
Vein	A type of blood vessel that carries blood into the heart from other parts of the body.
Vena cava	The main vein that carries deoxygenated blood into the right atrium of the heart.
Ventricle	A type of chamber in the heart which receives blood from the atrium above it and pumps it out of the heart.
Venule	A smaller type of blood vessel that connects capillaries with veins.
Xerophyte	A type of plant that is adapted to survive in places with very little water.
Xylem	The tissue that transports water in the stem and leaves of plants.



SIXTH FORM KNOWLEDGE ORGANISER

Topic 4: Biodiversity

Definitions and Concepts

Adaptation	A feature of an organism that increases its chance of survival in its environment. An adaptation may be anatomical, physiological or behavioural.
Allele	A version of a gene.
Anticodon	A sequence of three nucleotide bases at one end of a tRNA molecule that is specific to an mRNA codon.
Arithmetic mean	The average of a set of numbers calculated by dividing the sum of the values by the number of values.
Artificial classification	A type of classification that divides organisms into groups based on analogous characteristics such as leaf shape, number of legs and type of wing.
Binomial system	A universal system of naming organisms that consists of two parts: the generic name and the specific name, e.g. Homo sapiens.
Biodiversity	The variety of genes, species and habitats within a particular area.
Cellular proteome	The proteins expressed in a given type of cell.
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.
Chromosome mutation	A change to the number or structure of chromosomes that can occur spontaneously.
Classification	The organisation of organisms into groups. There are two types of classification: artificial and phylogenetic.
Codon	A sequence of three bases on mRNA that codes for a specific amino acid.
Conservation	The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources.

Courtship	The behaviour by which members of a species select reproductive partners. It enables organisms to recognise their own species, identify a mate with a capacity to breed, form a pair bond, synchronise mating and become able to breed themselves.
Crossing over	The process in meiosis 1 in which homologous chromosomes pair up, their chromatids wrap around one another and their alleles are exchanged at equivalent portions of chromatids. This creates genetic variation.
Degenerate	A feature of the genetic code; more than one triplet can code for a particular amino acid.
Deletion	A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may change all amino acids in a sequence, rendering the protein non-functional.
Directional selection	A type of selection that favours individuals that differ in one direction (fall to the left or the right) from the population mean. This changes the traits of the population.
Ecosystem diversity	A measure of the range of different habitats in a particular area.
Eukaryotic DNA	Linear molecules of DNA which, together with histones, form chromosomes. DNA in the mitochondria and chloroplasts of eukaryotic cells is circular and does not have associated proteins.
Exon	A sequence of DNA that codes for an amino acid sequence.
Fertilisation	The random fusion of haploid gametes during fertilisation to produce a diploid zygote. Genetic information is mixed, creating genetic variation.
Gene	A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA.
Gene mutation	A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations can occur spontaneously during DNA replication.
Generic name	Denotes the organism's genus. The first letter is written in uppercase, e.g. Homo.
Genetic code	The rules by which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is degenerate, universal and non-overlapping.

SIXTH FORM KNOWLEDGE ORGANISER

Topic 4: Biodiversity

Definitions and Concepts

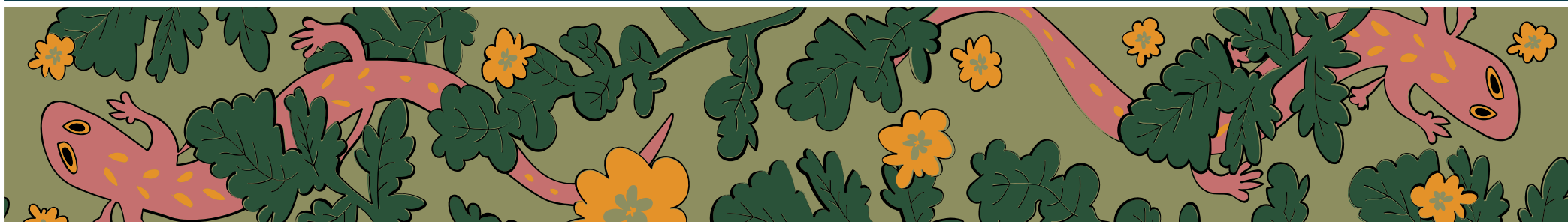
Genetic diversity	The number of different alleles in a population. Genetic diversity between organisms can be investigated by comparing observable characteristics, DNA and mRNA base sequences and amino acid sequences.
Genome	The entire set of genes in a cell.
Histones	Proteins that, together with DNA, form chromosomes in the nuclei of eukaryotic cells.
Homologous chromosomes	A chromosome pair, one paternal and one maternal, with the same gene loci.
Independent segregation	The random separation of homologous chromosomes in meiosis 1 that produces genetic variation.
Index of diversity (d)	Describes the relationship between the number of different species and the abundance of individuals in each of these species within a community. It is calculated using the formula: $d = \frac{N(N-1)}{\sum n(n-1)}$ where d is the index of diversity, N is the total number of organisms of all species and n is the total number of organisms of each species.
Intron	A non-coding sequence of DNA.
Locus	The position of a gene on a chromosome.
Mean (normal distribution curve)	A measure of the maximum height of a normal distribution curve.
Meiosis	A type of cell division that produces four genetically different daughter cells (gametes) with a haploid number of chromosomes. It involves two divisions.
Messenger RNA (mRNA)	A type of RNA that carries genetic information from the nucleus to the ribosomes for protein synthesis. It is a single helix consisting of thousands of mononucleotides.
Mitosis	A form of cell division that produces two genetically identical diploid daughter cells.

Mutagenic agent	An agent that increases the rate of gene mutations above normal level.
Natural selection	The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time.
Non-coding sequence	A sequence of DNA that does not code for an amino acid sequence e.g. repeating base sequences and introns. Non-coding sequences make up significant portions of eukaryotic nuclear DNA.
Nondisjunction	A change in the number of chromosomes due to the failure of homologous chromosomes to separate during meiosis. This may result in a gamete with one more or one less chromosome.
Non-overlapping	A feature of the genetic code; each base in a sequence is read once and is only part of one triplet.
Phylogenetic classification	A type of classification that divides organisms into groups based on evolutionary relationships and homologous characteristics. It uses a hierarchy in which smaller groups are contained within larger groups, with no group overlap.
Phylogeny	The evolutionary relationships between individuals or groups of organisms.
Prokaryotic DNA	Circular pieces of DNA that do not have associated proteins.
Random sampling	A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates.
Recombination	When broken-off pieces of chromatid combine with another chromatid on a different chromosome during crossing over.
Ribosomes	Sub-cellular structures where protein synthesis takes place. Ribosomes consist of a small subunit and a large subunit.
RNA polymerase	An enzyme that moves along the DNA template strand and joins adjacent nucleotides to form pre-mRNA.

Topic 4: Biodiversity

Definitions and Concepts

Species	A group of similar organisms that are able to breed with one another to produce living, fertile offspring.
Species diversity	A measure of the number of different species and the abundance of individuals in each of these species within a community.
Species richness	A measure of the number of different species in a community at a given time. It is a measure of species diversity.
Specific name	Denotes the organism's species. It is written in lowercase letters, e.g. sapiens.
Splicing	The process following transcription in eukaryotic cells in which introns are removed from pre-mRNA and exons are joined together to form mRNA.
Stabilising selection	A type of selection that favours individuals close to the mean, maintaining the traits of the population.
Standard deviation (normal distribution curve)	A measure of the width of a normal distribution curve and an indication of the range of values.
Substitution	A form of gene mutation in which one nucleotide base is exchanged for another. This may change an amino acid or produce the same amino acid (due to the degeneracy of the genetic code).
Taxon	Each group within a phylogenetic classification system.
Transcription	The formation of pre-mRNA in eukaryotes and mRNA in prokaryotes from a section of the template strand of DNA. It is the first stage of protein synthesis.
Transfer RNA (tRNA)	A form of RNA that carries specific amino acids to the ribosomes. It is single-stranded and takes a clover-leaf shape. One side is longer than the other enabling the attachment of an amino acid. At the opposite end is an anticodon specific to the amino acid.
Translation	The second phase of protein synthesis that takes place in the ribosomes. mRNA is used as a template for the attachment of tRNA molecules with complementary anticodons. The amino acids carried on adjacent tRNA molecules are joined to form a polypeptide chain.
Triplet	A sequence of three bases that codes for an amino acid.
Universal	A feature of the genetic code; the code is the same in almost all organisms. This is evidence for evolution.
Variation	The differences between individuals due to genes, the environment or a combination of both.



SIXTH FORM KNOWLEDGE ORGANISER

Topic 5: Energy Transfers

Definitions and Concepts

Acetyl coenzyme A	A two-carbon molecule formed in the link reaction when acetate reacts with coenzyme A. It is oxidised in the Krebs cycle.
Adenosine triphosphate (ATP)	Universal energy carrier found in all living cells.
Aerobic respiration	A form of cellular respiration that takes place in the presence of oxygen and produces carbon dioxide, water and ATP. It involves four main stages: glycolysis, link reaction, Krebs cycle, and oxidative phosphorylation. Overall: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
Ammonification	The production of ammonia when saprobiontic microorganisms feed on organic nitrogen-containing compounds. Ammonium ions are formed and added to the soil.
Anaerobic respiration	A form of cellular respiration that takes place in the absence of oxygen. In animals, lactate is produced. In plants and microorganisms, ethanol and carbon dioxide are produced. Less ATP is formed than in aerobic respiration.
Artificial fertilisers	Man-made compounds generally containing nitrogen, phosphorus and potassium that are used to increase the mineral content of soils.
ATP synthase	An enzyme found embedded in cellular membranes that phosphorylates ADP to form ATP as protons flow through it.
Biomass	The total mass of organic material, measured in a specific area over a set time period. This can be calculated in terms of dry mass or mass of carbon per given area.
Calorimetry	A technique used to estimate the chemical energy store in dry biomass.
Carnivores	Animals that prey on and eat other animals. They can be secondary or tertiary consumers.
Chemiosmotic theory	The synthesis of ATP through the movement of protons down their concentration gradient across a semipermeable membrane, catalysed by ATP synthase.

Chlorophyll	A photosynthetic pigment located in the thylakoids of chloroplasts that absorbs light energy and becomes ionised.
Coenzymes	Molecules that help enzymes carry out their function e.g. NAD, FAD, NADP.
Consumers	Organisms that feed on other organisms to obtain energy.
Denitrification	The conversion of nitrate ions to nitrogen gas by denitrifying bacteria.
Denitrifying bacteria	Anaerobic microorganisms found in waterlogged soils responsible for the reduction of nitrate ions to nitrogen gas.
Ecosystem	The community of organisms (biotic) and non-living (abiotic) components of an area and their interactions.
Efficiency of energy transfer	The efficiency of energy transfer between trophic levels is calculated using: $\text{percentage efficiency} = \frac{\text{energy available after transfer}}{\text{energy available before transfer}} \times 100$
Electron acceptor	Oxygen acts as the final electron acceptor in the electron transfer chain: $\frac{1}{2}O_2 + 2e^- + 2H^+ \rightarrow H_2O$
Electron transfer chain	A series of electron carrier proteins that transfer electrons in a chain of oxidation-reduction reactions.
Eutrophication	When a body of water becomes excessively rich with nutrients (often from fertilisers).
FAD	A carrier molecule that becomes reduced when it takes up protons and electrons during the Krebs cycle, forming reduced FAD.
Food chain	Describes the feeding relationships between organisms and the resultant stages of biomass transfer. It takes the form: producer \rightarrow primary consumer \rightarrow secondary consumer \rightarrow tertiary consumer
Food web	The interconnection of many different food chains in a habitat.
Glycerate 3-phosphate (GP)	A three-carbon molecule which is reduced by reduced NADP in the light-independent stage of photosynthesis to form two molecules of triose phosphate (TP). This requires ATP.
Glycolysis	The first stage of aerobic and anaerobic respiration that takes place in the cytosol of the cell and breaks down glucose into two molecules of pyruvate. Two molecules of ATP and two molecules of reduced NAD are also formed.

Topic 5: Energy Transfers

Definitions and Concepts

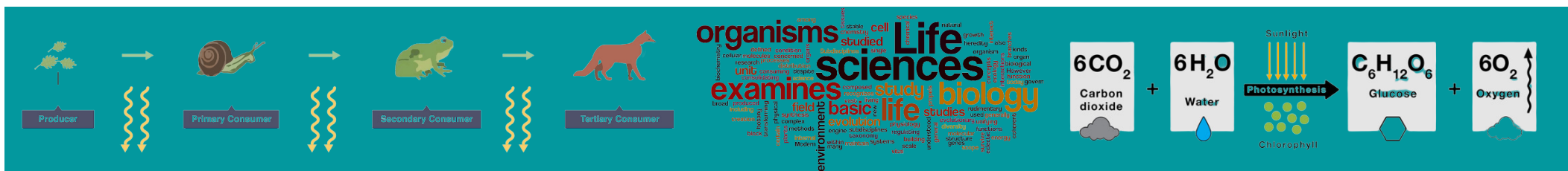
Gross primary production (GPP)	The total amount of chemical energy stored in plant biomass in a set area or volume.
Herbivores	Animals that eat plants, also known as primary consumers.
Krebs cycle	A series of oxidation-reduction reactions in the matrix of the mitochondria in which acetyl coenzyme A is oxidised generating reduced NAD, reduced FAD, ATP and carbon dioxide.
Leaching	The loss of nutrients from the soil due to rainwater.
Light-dependent reaction	The second stage of photosynthesis that uses light energy to produce ATP, reduced NADP and oxygen (by-product). It takes place in the thylakoids of the chloroplast.
Light-independent reaction	The third stage of photosynthesis, also known as the Calvin cycle, in which the products of the light-dependent stage and carbon dioxide are used to form a simple sugar. This stage does not require light energy and takes place in the stroma of the chloroplast.
Limiting factor	A variable that limits the rate of a particular reaction.
Link reaction	The second stage of aerobic respiration that takes place in the mitochondrial matrix and converts pyruvate into acetyl coenzyme A and carbon dioxide. Reduced NAD is also formed. Overall: $\text{Pyruvate} + \text{NAD} + \text{CoA} \rightarrow \text{acetyl CoA} + \text{reduced NAD} + \text{CO}_2$
Mycorrhizae	Mutualistic associations between some species of fungi and the roots of many plants that retain water and minerals around the roots.
NAD	A carrier molecule that becomes reduced when it takes up protons and electrons during aerobic respiration, forming reduced NAD.
NADP	A carrier molecule that becomes reduced when it takes up protons and electrons during the light-dependent stage of photosynthesis, forming reduced NADP.
Natural fertilisers	Dead and decaying organic matter used to increase the mineral content of soils.

Net primary productivity (NPP)	The chemical energy store that remains when energy losses due to respiration are subtracted from the total energy store. This is used in plant growth or reproduction and is also available to other trophic levels. $\text{net primary production (NPP)} = \text{gross primary production (GPP)} - \text{respiratory losses (R)}$
Net production of consumers (N)	Calculated by subtracting the chemical energy lost due to respiration (R) and as a result of excretion and egestion (F) from the chemical energy stored in ingested food (I). $N = I - (F + R)$
Nitrification	The conversion of ammonium ions to nitrate ions by nitrifying bacteria. This takes place in two stages: ammonium ions are oxidised to nitrite ions; nitrite ions are oxidised to nitrate ions.
Nitrifying bacteria	Aerobic microorganisms found in the soil responsible for the oxidation of ammonium ions to nitrate ions.
Nitrogen cycle	The cycle through which nitrogen moves between living organisms and the environment, involving ammonification, nitrification, nitrogen fixation and denitrification.
Nitrogen fixation	The conversion of atmospheric nitrogen gas into nitrogen-containing compounds by nitrogen-fixing bacteria in the soil or root nodules of legumes.
Nitrogen-fixing bacteria	Microorganisms responsible for the conversion of atmospheric nitrogen gas into nitrogen-containing compounds. They can be free-living or mutualistic.
Oxidation	The loss of electrons, gain of oxygen or loss of hydrogen in a substance.
Oxidative phosphorylation	The synthesis of ATP from reduced coenzymes and oxygen in the electron transfer chain of aerobic respiration.
Phosphorus cycle	The cycle through which phosphorus (in the form of phosphate ions) moves between living organisms and the environment. This involves absorption by plants, feeding, digestion and excretion by animals, sedimentation and erosion of rocks and the decay of guano, bones and shells.
Photoionisation	The process by which a molecule of chlorophyll is ionised. A chlorophyll molecule absorbs light energy causing a pair of electrons within it to become excited, raised to a higher energy level, and leave the molecule.

Topic 5: Energy Transfers

Definitions and Concepts

Photolysis	The splitting of a molecule of water in the presence of light that occurs during the light-dependent stage of photosynthesis. This produces protons, electrons and oxygen: $H_2O \rightarrow 2H^+ + 2e^- + \frac{1}{2}O_2$
Photosynthesis	A complex metabolic pathway that consists of three main stages: capturing of light energy, light-dependent reaction, light-independent reaction. Overall, in the presence of light: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
Primary productivity	The rate of primary production; the energy fixed by photosynthesis in a given area in a given period of time ($kJ\ ha^{-1}\ year^{-1}$).
Producers	Photosynthetic organisms at the start of the food chain that manufacture biomass (using light energy, carbon dioxide, water and mineral ions) for all living things.
Pyruvate	A three-carbon molecule produced in glycolysis. In aerobic respiration, pyruvate is oxidised to acetate in the link reaction. In anaerobic respiration it is converted to lactate (animals) or ethanol and carbon dioxide (plants and microorganisms).
Reduction	The gain of electrons, loss of oxygen or gain of hydrogen in a substance.
Ribulose biphosphate (RuBP)	A five-carbon compound which reacts with carbon dioxide in the light-independent stage of photosynthesis to form two molecules of glycerate 3-phosphate (GP).
Rubisco	An enzyme that catalyses the reaction of RuBP and carbon dioxide in the light-independent stage of photosynthesis.
Saprobionts	Microorganisms that break down dead plant and animal material into simpler organic matter to obtain nutrients. Also known as saprophytes.
Secondary productivity	The rate of secondary production; the rate at which animals convert the chemical energy in plants they eat into their own biomass in a given area in a given period of time ($kJ\ ha^{-1}\ year^{-1}$).
Substrate-level phosphorylation	The synthesis of ATP by the transfer of a phosphate group from a phosphorylated intermediate to ADP.
Triose phosphate (TP)	A three-carbon compound formed in the light-independent stage of photosynthesis that may be converted into useful organic substances or used to regenerate ribulose biphosphate (RuBP).
Trophic level	The position of an organism in a food chain.



Topic 6: Homeostasis

Definitions and Concepts

Acetylcholine	A type of neurotransmitter that is used for communication between neurons
Actin	A type of protein filament found in myofibrils. It forms thin filaments consisting of two long twisted chains.
Actinomyosin bridge	The cross-bridge formed when a myosin head attaches to the myosin binding site on an actin filament.
Action potential	The temporary change in electrical potential across the membrane of an axon in response to the transmission of a nerve impulse.
Adenylate cyclase	An enzyme that catalyses the conversion of ATP to cAMP.
Adrenaline	A hormone that is secreted by the adrenal glands under stressful conditions. It increases blood glucose concentration by activating enzymes involved in glycogenolysis.
Afferent arteriole	The blood vessel that stems from the renal artery and supplies blood to the nephron. It has a larger diameter than the efferent arteriole and divides into a complex system of capillaries, the glomerulus.
All-or-nothing	A principle that states that all stimuli above a certain threshold value will generate the same size of action potential, regardless of the strength of the stimulus.
Anisotropic (A) bands	The darker bands in a myofibril, which consist of overlapping actin and myosin filaments.
Antagonistic muscles	Pairs of muscles that work in opposite directions.
Antidiuretic hormone (ADH)	A hormone made by the hypothalamus and secreted by the posterior pituitary gland in response to a fall in blood water potential. It increases the permeability to water of the distal convoluted tubule and the collecting duct, allowing more water to be reabsorbed into the blood.

Ascending limb	The limb of the loop of Henle that rises into the cortex. It is wider in diameter than the descending limb and its walls are impermeable to water. Sodium ions are moved out of the ascending limb by active transport.
Atrioventricular node (AVN)	A group of cells located between the atria that slow down the wave of excitation and pass it between the ventricles, along the bundle of His.
Atrioventricular septum	A layer of non-conductive tissue between the right atrium and left ventricle of the mammalian heart.
Autonomic nervous system	A branch of the motor nervous system that carries nerve impulses to muscles and glands. It controls involuntary activities and has two divisions: the sympathetic nervous system and the parasympathetic nervous system.
Auxins	A class of plant hormones that control cell elongation.
Axon	A long fibre that conducts nerve impulses away from the cell body.
Bundle of His	A collection of Purkinje fibres which run from the AVN down to the apex of the ventricles.
Cell body	The region of the neuron that contains the organelles, notably the nucleus and the rough endoplasmic reticulum.
Central nervous system (CNS)	The brain and spinal cord.
Chemoreceptor	A type of receptor found in the walls of the carotid arteries that detects changes in blood pH and transmits nerve impulses to the medulla oblongata. For example, if blood pH decreases, chemoreceptors increase the frequency of nerve impulses to the medulla oblongata.
Cholinergic synapse	An excitatory or inhibitory synapse formed between neurons or neurones and other effector organs. It uses the neurotransmitter, acetylcholine.
Collecting duct	The final region of the nephron that collects urine from the distal convoluted tubules and empties it into the renal pelvis. Its permeability to water is altered by ADH.
Cone cells:	A type of light receptor cell that transduces light energy into a generator potential. Cone cells are concentrated in the fovea, detect light of high intensity, and lead to colour images. One cone cell forms a synapse with a single bipolar cell, giving high visual acuity.

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Topic 6: Homeostasis

Definitions and Concepts

Control mechanism	A self-regulating system consisting of five features: optimum point, receptor, coordinator, effector, and feedback mechanism.
Coordinator	Coordinates information from the receptors and sends instructions to the effectors.
Cyclic AMP (cAMP)	A 'second messenger' involved in the action of adrenaline that activates protein kinase.
Dendrites	Short, branched extensions of the cell body that receive nerve impulses from other neurons.
Dendrons	Extensions of the cell body which branch into smaller fibres, dendrites.
Depolarisation	A sudden, temporary change in the membrane potential of a neuron in response to the transmission of a nerve impulse. The inside of the axon is less negative than the outside.
Descending limb	The limb of the loop of Henle that dips down into the medulla. It is smaller in diameter than the ascending limb. The walls of the descending limb are permeable to water, so the filtrate loses water as it moves down.
Diabetes	A disorder of metabolism in which blood glucose concentration is not regulated properly. There are two forms: Type I and Type II diabetes.
Distal convoluted tubule	The twisted region of the nephron between the loop of Henle and the collecting duct. It controls blood pH by reabsorbing ions and alters the concentration of water and salts reabsorbed. Its permeability to water is altered by ADH.
Effector	An organ, tissue, or cell that produces a response to a stimulus.
Efferent arteriole	The blood vessel that carries blood away from the glomerulus and subdivides to form a network of capillaries. Its diameter is smaller than the afferent arteriole, creating a build up of hydrostatic pressure in the glomerulus.
Excitatory synapse	A synapse that produces new action potentials when neurotransmitters bind with receptor proteins on the postsynaptic neuron.

Fast-twitch muscle fibres	A type of muscle fibre that contracts more rapidly, with more power, over a shorter period. They are adapted for anaerobic respiration and intense activity.
Feedback mechanism	The mechanism by which the change to a system, brought about by the effector, is detected by the receptor.
Fovea	The point on the retina, opposite the pupil, that receives the highest intensity of light. It contains the greatest concentration of cone cells but no rod cells.
Generator potential	Depolarisation of the membrane of a sensory receptor cell that occurs in response to a stimulus.
Glomerular filtrate	The fluid produced by ultrafiltration of the blood into the renal capsule. It contains water, glucose, mineral ions and urea.
Glomerulus	A bundle of capillaries located in the renal capsule which are adapted for the filtration of blood. They later merge to form the efferent arteriole.
Glucagon	A hormone that is produced by α cells of the islets of Langerhans. It increases blood glucose concentration by activating enzymes involved in gluconeogenesis and the conversion of glycogen to glucose.
Gluconeogenesis	The formation of glucose from sources that are not carbohydrate, e.g. amino acids and glycerol.
Glycogenesis	The formation of glycogen from glucose in the liver.
Glycogenolysis	The breakdown of glycogen into glucose in the liver.
Gravitropism	A plant's growth response to gravity.
Homeostasis	The maintenance of a constant internal environment in the body, despite fluctuations in internal and external conditions.
Hormones	Cell signalling molecules produced by endocrine glands and released into the blood. They travel to target cells and bind to specific receptors, initiating a response. The effects of hormones are usually long-lasting.
Hyperpolarisation	A decrease in the membrane potential of an axon, so that it is even more negative than the resting potential.

Topic 6: Homeostasis

Definitions and Concepts

Hypothalamus	The region of the brain close to the pituitary gland that serves as the control centre for the autonomic nervous system. It is responsible for the regulation of body temperature and the water potential of body fluids.
H-zone	The lighter region in the centre of each A band.
Indoleacetic acid (IAA)	A plant growth factor that is a type of auxin and controls cell elongation. It stimulates elongation in shoots and inhibits elongation in roots.
Inhibitory synapse	A synapse that decreases the likelihood of an action potential in the postsynaptic neuron by causing potassium ions (K ⁺) to leave the postsynaptic neurone and chloride ions (Cl ⁻) to enter. This results in hyperpolarisation of the postsynaptic neurone.
Insulin	A hormone that is produced by β cells of the islets of Langerhans. It decreases blood glucose concentration by activating enzymes involved in the conversion of glucose to glycogen and increasing the number of glucose transport channels in the cell surface membranes of target cells.
Intermediate neurone	A neurone located in the spinal cord that links the sensory neurone to the motor neurone.
Iodopsin	The pigment found in cone cells.
Islets of Langerhans	Clusters of hormone-producing cells located in the pancreas. They consist of α -cells that secrete glucagon, and β -cells that secrete insulin.
Isotropic (I) bands	The lighter bands in a myofibril, which consist of non-overlapping actin and myosin filaments.
Kinesis	A response to a stimulus that is non-directional, changing the speed at which an organism moves and the rate at which its direction changes.
Loop of Henle	A loop consisting of a descending limb (dips into the medulla) and ascending limb (rises into the cortex) surrounded by blood capillaries. It creates a low water potential in the medulla, enabling the reabsorption of water.

Medulla oblongata	The part of the brain that controls heart rate. It is made up of two centres that are linked to the SAN. One centre is linked by the sympathetic nervous system and increases heart rate. The other is linked by the parasympathetic nervous system and decreases heart rate.
Motor neurone	A neurone that carries nerve impulses from the CNS to the effectors.
Myelin sheath	An electrically insulating layer consisting of the membranes of Schwann cells. It increases the speed of nerve impulses.
Myofibrils	Tiny contractile muscle fibres which group together. Numerous myofibril bundles constitute muscles. Myofibrils consist of two protein filaments: actin and myosin.
Myogenic	Describes cardiac muscle tissue that initiates its own contraction without outside stimulation from nervous impulses.
Myosin	A type of protein filament found in myofibrils. It forms thick filaments, consisting of long tails with bulbous heads, positioned to the side.
Myosin binding site	A site on actin that is normally blocked by tropomyosin. During muscle contraction, it becomes exposed, allowing a myosin head to attach.
Negative feedback	A feedback mechanism that inhibits the original stimulus and reverses the change in conditions, restoring the optimum point.
Negative tropism	The growth of a plant away from a stimulus.
Nephron	The functional unit of the mammalian kidney.
Nerve impulse	A wave of depolarisation that travels across an axon membrane. It is self-propagating.
Neuromuscular junction:	An excitatory synapse formed between a motor neurone and a muscle fibre that uses the neurotransmitter, acetylcholine.
Neurones	Nerve cells adapted to quickly transmit nerve impulses.

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Topic 6: Homeostasis

Definitions and Concepts

Neurotransmitters	Chemicals that are used for communication between neurones and their target cells. Neurotransmitters are stored in synaptic vesicles in the presynaptic neurone and released into the synaptic cleft.
Nodes of Ranvier	Gaps between adjacent Schwann cells in the myelin sheath at which action potentials can occur.
Optic nerve	A nerve that carries electrical impulses to the brain from the retina.
Optimum point	The point at which a system works most effectively.
Osmoreceptors	Sensory receptor cells located in the hypothalamus that detect a decrease in water potential.
Osmoregulation	The regulation of the water potential of the blood by the kidney.
Pacian corpuscle	A sensory receptor that detects changes in mechanical pressure.
Parasympathetic nervous system	A branch of the autonomic nervous system that is active under normal, resting conditions. It inhibits effectors, slowing down activity.
Peripheral nervous system (PNS)	Pairs of nerves that originate from the CNS and carry nerve impulses into and out of the CNS. It is divided into the sensory nervous system and motor nervous system.
Phosphocreatine	A compound stored in muscles that serves as a phosphate reserve, enabling ATP regeneration.
Phototropism	A plant's growth response to light.
Plant growth factors	Hormone-like substances (e.g. IAA) that control the growth of plants in response to external stimuli.
Polarisation	Describes the condition in which an axon has a membrane potential of -65mV (resting potential).
Positive feedback	A feedback mechanism that enhances the original stimulus and increases the change in conditions, deviating the system further from the optimum point.
Positive tropism	The growth of a plant towards a stimulus.
Posterior pituitary gland	The gland responsible for the secretion of ADH into the bloodstream.

Postsynaptic neurone	The neurone after the synapse which contains specific receptor proteins on its membrane, complementary to the neurotransmitter.
Pressure receptors	A type of receptor found in the walls of the carotid arteries and aorta which detects changes in blood pressure and transmits nerve impulses to the medulla oblongata. For example, if blood pressure increases, pressure receptors increase the frequency of nerve impulses to the medulla oblongata.
Presynaptic neurone	The neurone before the synapse which releases neurotransmitters from synaptic vesicles into the synaptic cleft.
Protein kinase	An enzyme that catalyses the conversion of glycogen to glucose.
Proximal convoluted tubule	The twisted portion of the nephron between the renal capsule and the loop of Henle. Its walls consist of epithelial cells that are adapted for the reabsorption of glucose and water into the blood.
Purkyne tissue	Specialised cardiac muscle fibres which conduct the wave of excitation from the AVN down to the apex of the ventricles.
Receptor	Specialised structure that detects a specific type of stimulus.
Reflex	A rapid, automatic response to a sensory stimulus by the body. It serves as a protective mechanism.
Reflex arc	The pathway of neurones involved in a reflex action: stimulus → receptor → sensory neurone → intermediate neurone → motor neurone → effector → response
Refractory period	The time period after an action potential during which further action potentials are prevented. This ensures that action potentials can only be propagated in one direction. It limits the frequency of action potentials and ensures nervous impulses are discrete.
Renal (Bowman's) capsule	The cup-like structure at the start of a nephron that surrounds the glomerulus. The inner layer of the capsule, through which filtration of the blood takes place, is composed of podocytes.
Repolarisation	The re-establishment of the resting potential (-65mV)
Response	A change in an organism as a result of a stimulus.

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Definitions and Concepts

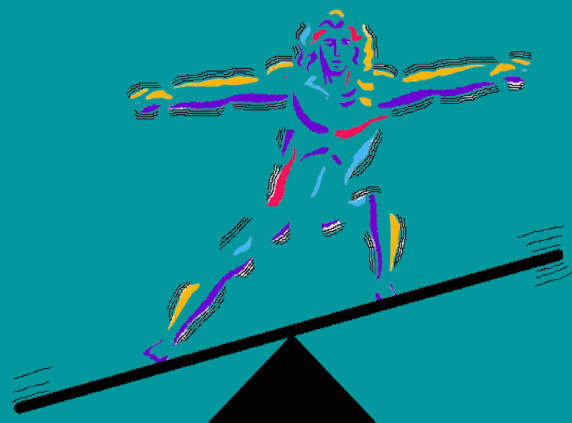
Resting potential	An electrical potential difference of -65 mV across the membrane of an axon. The inside of the axon is more negative than the outside. The membrane is described as polarised.
Retina	The inner layer of the mammalian eye. It consists of light receptor cells that act as transducers, converting light energy into electrical energy.
Rhodopsin	The pigment found in rod cells which is broken down to create a generator potential.
Rod cells	A type of light receptor cell that transduces light energy into a generator potential. They are located at the periphery of the retina, detect light of low intensity and lead to black and white images. Many rod cells form a synapse with a single bipolar cell, giving low visual acuity.
Saltatory conduction	The process by which a nerve impulse is propagated along a myelinated neurone. Depolarisation occurs at the nodes of Ranvier and action potentials jump from node to node, speeding up transmission.
Sarcomere	Each repeating unit of striations between adjacent Z-lines.
Sarcoplasm	The cytoplasm shared by muscle fibres. It consists of a high concentration of mitochondria and endoplasmic reticulum.
Schwann cells	Cells that wrap around the axon. They have a range of roles including electrical insulation, axon protection, nerve regeneration and phagocytosis.
Second messenger model	The mechanism by which a hormone (e.g. adrenaline or glucagon) has an effect inside a cell by triggering the production of a second messenger such as cAMP.
Sensory neurone	A neurone that carries nerve impulses from the receptors to the CNS.
Sinoatrial node (SAN)	A group of cells in the wall of the right atrium that generate electrical activity. The SAN is often referred to as the heart's pacemaker.
Skeletal muscle	A voluntary muscle responsible for movement. It makes up the majority of body muscle and is attached to the skeleton by tendons.
Sliding filament theory	The mechanism by which a muscle contracts. During contraction, myosin filaments pull actin filaments to the centre of the sarcomere. The actin filaments slide along the myosin filaments. The sarcomere is shortened and the muscle length is reduced.

Slow-twitch muscle fibres	A type of muscle fibre that contracts more slowly, with less power, over a greater period. They are adapted for aerobic respiration and enable endurance.
Sodium-potassium pump	A carrier protein found in the plasma membrane of an axon. It actively transports three sodium ions (Na+) out of the axon for every two potassium ions (K+) that it pumps into the axon.
Spatial summation	A type of summation involving the release of neurotransmitters from multiple presynaptic neurones. The concentration of neurotransmitters exceeds the threshold value and triggers an action potential in the postsynaptic neurone.
Stimulus	A change in an organism's internal or external environment that can be detected.
Stretch-mediated sodium channel	A type of sodium channel whose permeability to sodium changes upon distortion (e.g. pressure changes, stretching). They are found in the plasma membrane of the sensory neurone ending at the centre of the Pacinian corpuscle.
Summation	The build-up of neurotransmitters in the synaptic cleft, allowing low-frequency action potentials to trigger a new action potential in the postsynaptic neurone. There are two forms of summation: spatial and temporal.
Sympathetic nervous system	A branch of the autonomic nervous system that is active under stressful conditions. It stimulates effectors, speeding up activity.
Synaptic cleft	A small gap between neurones across which a nerve impulse is transmitted via neurotransmitters.
Synaptic vesicles	Secretory vesicles located in the presynaptic neurone that store neurotransmitters. Upon fusion with the presynaptic membrane, their contents are released into the synaptic cleft.
Target cells	Cells with specific receptor proteins on their cell surface membranes, complementary to the shape of a particular hormone.
Taxis	A response to a stimulus that is directional, i.e. the movement of an organism towards or away from a stimulus.

Topic 6: Homeostasis

Definitions and Concepts

Temporal summation	A type of summation involving the release of neurotransmitters from a single presynaptic neurone at a high frequency. The concentration of neurotransmitters exceeds the threshold value and triggers an action potential in the postsynaptic neurone.
Threshold value	A certain size of stimulus that is required to generate an action potential.
Transducer cells	Cells that convert one form of energy into an electrical signal.
Tropism	The growth response of a plant to a directional stimulus.
Tropomyosin	A protein found in muscles that forms a fibrous strand wrapped around an actin filament.
Type I diabetes	A form of diabetes (insulin-dependent) in which the body cannot produce insulin. It has an early, rapid onset and is treated using insulin injections.
Type II diabetes	A form of diabetes (insulin-independent) in which the body does not respond to insulin due to the loss of or unresponsiveness of glycoprotein receptors. In some cases, the body may not produce enough insulin. It has a late, slow onset and is controlled by managing diet and exercise.
Unidirectionality	Describes synaptic transmission; synapses can only transmit information in a single direction, from the presynaptic neurone to the postsynaptic neurone.
Visual acuity	The clarity of vision.
Z-line	The line in the centre of each I band.



Topic 7: Genetics

Definitions and Concepts

Abiotic factors	The non-living aspects of an ecosystem e.g. temperature, light intensity, moisture, soil pH and oxygen levels.
Adaptation	A feature of an organism that increases its chance of survival in its environment.
Allele	A version of a gene.
Allele frequency	The number of times an allele appears within a population's gene pool.
Allopatric speciation	A form of speciation that occurs when two populations become geographically isolated.
Autosomal linkage	When two or more genes are positioned on the same autosome. They are unlikely to be separated by crossing over during meiosis so are often inherited together.
Autosome	A chromosome that is not an X or Y chromosome.
Belt transect	A line along a sampled area, upon which quadrats are placed at certain intervals to determine the abundance and distribution of organisms in an ecosystem.
Biodiversity	The variety of genes, species and habitats within a particular area.
Biotic factors	The living components of an ecosystem e.g. food availability, pathogens and predators.
Carrying capacity	The average size of a population that can be supported by an ecosystem over extended periods of time. This varies depending on biotic and abiotic factors.
Chi-squared test	A statistical test used to determine whether a pattern of inheritance is statistically significant.
Climax community	The stable community of organisms that exists at the final stage of ecological succession.
Codominant	When both alleles for a gene in a heterozygous organism equally contribute to the phenotype.
Community	All of the populations of different species living together in a habitat.

Conservation	The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. This typically involves the management of succession.
Degrees of freedom (X² test)	The number of categories minus one.
Dihybrid inheritance	The inheritance of two different genes, that determine two phenotypes, on two different chromosomes.
Diploid	Describes a cell with a nucleus containing two sets of chromosomes.
Directional selection	A type of selection that favours one extreme phenotype and selects against all other phenotypes.
Disruptive selection	A type of selection that favours individuals with extreme phenotypes and selects against those with phenotypes close to the mean.
Dominant	Describes an allele that is always expressed. Represented by a capital letter.
Ecosystem	The community of organisms (biotic) and non-living (abiotic) components of an area and their interactions. It is a dynamic system.
Epistasis	Describes a relationship between genes where the allele of one gene affects the expression of a different gene.
Evolution	The gradual change in the allele frequencies within a population over time. Occurs due to natural selection.
Gene	A length of DNA on a chromosome that codes for the production of one or more polypeptide chains and functional RNA.
Gene pool	All of the different versions of genes (alleles) in the individuals that make up a population.
Genetic drift	Variations in allele frequencies in small populations due to chance.
Genetic variation	Differences in genotypes between members of a population which may occur due to mutations, meiosis, or random fertilisation.
Genotype	An organism's genetic composition. Describes all alleles.
Habitat	The region where an organism normally lives.

Topic 7: Genetics

Definitions and Concepts

Hardy-Weinberg principle	A model that predicts that the ratio of dominant and recessive alleles in a population will remain constant between generations if the following five conditions are met: no new mutations; no natural selection; no migration; large population; and random mating. It provides an equation for calculating the frequencies of alleles: $p^2 + 2pq + q^2 = 1.0$ where p is the frequency of the dominant allele, and q is the frequency of the recessive allele.
Heterozygous	When someone has two different alleles of a gene e.g. Ff.
Homozygous	When someone has two identical alleles of a gene e.g. ff.
Interspecific competition	A type of competition that takes place between members of different species.
Intraspecific competition	A type of competition that takes place between members of the same species.
Locus	The position of a gene on a chromosome.
Mark-release-recapture	A method of estimating the population size of motile organisms. It involves capturing a sample of the population, marking them and releasing them. At a later date, another sample is captured and the number of marked individuals recorded. The population size can be estimated using the following equation: $\text{estimated population size} = \frac{\text{number of individuals in first sample} \times \text{number of individuals in second sample}}{\text{number of marked individuals in second sample}}$
Monohybrid inheritance	The inheritance of one gene.
Multiple alleles	When a gene has more than two potential alleles.
Natural selection	The process by which the frequency of beneficial alleles gradually increases in a population's gene pool over time. This theory was developed by Charles Darwin.
Niche	Describes how an organism 'fits' into an ecosystem and its role in that environment.
Phenotype	An organism's observable characteristics. Due to interactions of the genotype and the environment.

Pioneer species	Species that can survive in hostile environments and colonise bare rock or sand e.g. lichens.
Population	All organisms of the same species living with one another in a habitat at the same time.
Predator	An organism that eats other organisms.
Prey	An organism that is eaten by predators.
Quadrat	A square grid of a known area used in sampling to determine the abundance of organisms in a habitat. There are two types: point quadrats and frame quadrats.
Random sampling	A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates.
Recessive	Describes an allele that is only expressed in the absence of a dominant allele. Represented by a small letter.
Selection pressures	Environmental factors that drive evolution by natural selection and limit population sizes e.g. competition, predation and disease.
Sex-linkage	The presence of a gene on an X or Y chromosome.
Speciation	The formation of new species due to the evolution of two reproductively separated populations. Two forms: allopatric and sympatric speciation.
Species	A group of similar organisms that are able to breed with one another to produce living, fertile offspring.
Stabilising selection	A type of selection that favours individuals with phenotypes close to the mean (average) and selects against extreme phenotypes.
Succession	Describes changes in the community of organisms occupying a certain area over time.
Sustainable	The ability to maintain something for future generations.
Sympatric speciation	A form of speciation that occurs when two populations within the same area become reproductively isolated.
Systematic sampling	A sampling technique used to determine the abundance and distribution of organisms along an area at periodic intervals e.g. along a belt transect. This is commonly used in ecosystems where some form of gradual change occurs.
Variation	The differences between individuals due to genes, the environment or a combination of both.

SIXTH FORM KNOWLEDGE ORGANISER

Topic 8: Control of gene expression

Definitions and Concepts

Acetylation	The addition of acetyl groups to histones. Acetylation activates the gene by making it more accessible to transcription factors.
Addition	A form of gene mutation in which one or more nucleotide bases are inserted into a DNA sequence. This may result in a frameshift to the right.
Benign	Describes a tumour that is non-cancerous. Such tumours grow slowly, are enclosed in a capsule and remain at the site of origin. They can usually be removed by surgery.
Cancer	A non-communicable disease resulting from tumour cells that metastasise.
Cellular proteome	The proteins expressed in a given type of cell.
Complementary DNA (cDNA)	A single strand of DNA complementary to the mRNA template strand.
Complete proteome	All of the proteins coded for by the genome.
Deletion	A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may result in a frameshift to the left.
Differentiation	A process in which cells become specialised for function.
DNA hybridisation	The process by which a single-stranded segment of DNA is combined with a complementary fragment of DNA or RNA.
DNA ligase	An enzyme that joins the sugar-phosphate backbone of two DNA segments.
DNA polymerase	An enzyme that synthesises a double-stranded molecule of DNA from a single template strand using complementary nucleotides.
DNA probe	A short, single-stranded segment of DNA that can be fluorescently or radioactively labelled. DNA probes are used to locate specific alleles of genes.

DNA sequencing	Determining the entire DNA nucleotide base sequence of an organism.
Duplication	A form of gene mutation in which one or more nucleotide bases are repeated. This may result in a frameshift to the right.
Epigenetics	The study of changes in gene expression that are not due to alterations in the nucleotide base sequence of DNA.
Frameshift mutation	A form of gene mutation in which the addition or deletion of nucleotide bases alters all subsequent triplet codes in a DNA sequence. This often leads to the production of a non-functional protein.
Gel electrophoresis	A technique that separates fragments of DNA by size using electric current.
Gene machine	A method of artificially manufacturing genes by feeding the desired sequence of bases into a computer.
Gene mutation	A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations occur spontaneously and may result in changes to genotype.
Gene therapy	A technique in which a functional gene, cloned from a healthy individual, is inserted into cells that lack the gene.
Genetically modified organism (GMO)	An organism that has had its genome altered.
Genetic counselling	A service that provides information and advice to people affected by or at risk of genetic diseases. This helps individuals and families to make informed decisions.
Genetic fingerprinting	A technique used to genetically identify an organism. It has applications in forensics, paternity testing, diagnostics and the breeding of plants and animals.
Genetic screening	Testing individuals for certain faulty alleles.
Genome	The complete genetic material of an organism.
Hypermethylation	Increased methylation of DNA. This results in the inactivation of tumour suppressor genes and the resulting formation of tumours.
Hypomethylation	Reduced methylation of DNA. This results in the activation of oncogenes genes and the resulting formation of tumours.

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Topic 8: Control of gene expression

Definitions and Concepts

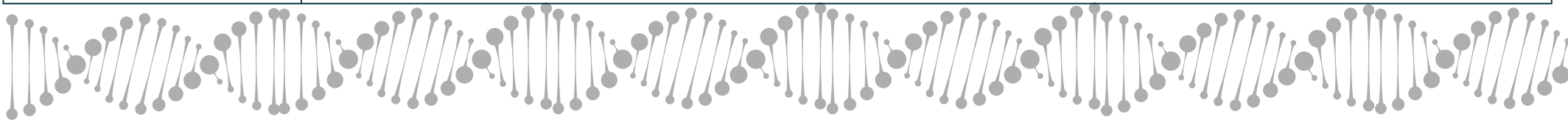
Induced pluripotent stem (iPS) cells	Unipotent cells that have been reprogrammed (using transcriptional factors) to become pluripotent stem cells. iPS cells are capable of self-renewal.
Inversion	A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence and reattach in the same position but in the reverse order.
In vitro	Describes a procedure that takes place outside of a living organism in a controlled environment e.g. DNA is amplified using PCR in a thermocycler.
In vivo	Describes a procedure that takes place inside of a living organism e.g. fragments of DNA can be transferred to a host cell (using a vector) where they are amplified.
Malignant	Describes a tumour that is cancerous. Such tumours grow rapidly, are not enclosed in a capsule and can spread to other regions of the body. Treatment involves radiotherapy, chemotherapy or surgery.
Marker genes	An additional gene inserted into a plasmid that is used to aid in the identification of host cells that have taken up the desired gene. Marker genes are easily recognisable e.g. fluoresce or provide antibiotic resistance.
Metastasis	The process by which cells break off from a primary tumour and spread to other areas of the body, forming secondary tumours.
Methylation	The transfer of methyl groups to cytosine bases of DNA. Methylation inhibits transcription by making the DNA less accessible to transcriptional factors or preventing transcriptional factors from binding. This deactivates the gene.
Multipotent cells	Stem cells found in mature mammals that can only differentiate into a limited number of cell types (specific to a tissue).
Mutagenic agent	An agent that increases the rate of gene mutations above normal level.
Mutation	A random change in DNA which may result in genetic variants.

Mutation rate	The frequency of mutations per biological unit (e.g. per cell division).
Non-coding DNA	DNA that does not code for a protein but instead controls gene expression.
Oestrogen	A steroid hormone involved in the initiation of transcription. It joins to a receptor site on a transcriptional factor, activating the DNA binding site and stimulating transcription.
Oncogenes	Mutations of proto-oncogenes that are activated continuously.
Personalised medicine	A form of medical care that enables doctors to provide healthcare customised to an individual's genotype.
Pluripotent cells	Stem cells found in embryos that have the ability to differentiate into almost all types of cell.
Polymerase Chain Reaction (PCR)	An in vitro technique used to rapidly amplify fragments of DNA.
Primers	Short nucleotide sequences, complementary to one end of each of the DNA fragments.
Promoter	Region of DNA where RNA polymerase binds during transcription.
Proto-oncogenes	Genes that stimulate cell division upon the attachment of growth factors to specific receptor proteins on the cell membrane.
Recognition sequences	Specific base sequences of DNA that restriction enzymes cut.
Recombinant DNA	A combination of DNA from two different organisms.
Recombinant DNA technology	The process by which segments of DNA are transferred from one organism to another.
Restriction endonucleases	Enzymes that cut DNA molecules at recognition sequences creating sticky ends.
Reverse transcriptase	An enzyme that synthesises DNA from RNA.
Risk factor	A variable associated with a greater chance of developing a disease or infection.

Topic 8: Control of gene expression

Definitions and Concepts

RNA interference (RNAi)	A method of controlling gene expression by breaking down target mRNA molecules, preventing translation.
Silent mutation	A type of substitution mutation that produces the same amino acid due to the degeneracy of the genetic code.
Stem cells	Cells that are unspecialised and retain the ability to differentiate into a range of cell types.
Sticky ends	The staggered cut formed by restriction endonucleases in double-stranded DNA.
Substitution	A form of gene mutation in which one nucleotide base is exchanged for another.
Terminator	Region of DNA where RNA polymerase is released, ending transcription.
Thermocycler	A machine controlled by a computer that varies temperatures at predetermined time intervals.
Totipotent cells	Stem cells found in early mammalian embryos which have the ability to differentiate into any type of body cell.
Transformation	The reinsertion of plasmids back into bacterial cells to form transgenic bacteria. This involves mixing the plasmids and bacterial cells in a medium containing calcium ions.
Tumour	An abnormal mass of cells formed by uncontrolled cell division.
Tumour suppressor genes	Genes that slow cell division, repair DNA and cause the breakdown of cells with damaged DNA by apoptosis.
Transcriptional factors	Specific molecules which pass from the cytoplasm of a cell into the nucleus, where they bind to complementary base sequences of DNA and initiate transcription.
Transgenic organism	An organism that contains recombinant DNA.
Translocation of bases	A form of gene mutation in which a group of nucleotide bases 'break off' from the DNA sequence on one chromosome and are added to the DNA sequence on a different chromosome.
Unipotent cells	Stem cells found in mature mammals that arise from multipotent cells and can only differentiate into a single cell type.
Variable number tandem repeats (VNTRs)	Repeated sequences of non-coding nucleotide bases. It is unlikely that two unrelated individuals will have the same VNTRs.
Vector	A carrier used to transfer a gene from one organism to another e.g. plasmid.
Whole-genome shotgun (WGS) sequencing	A method of sequencing an organism's entire genome. This involves cutting the DNA into small segments and aligning overlapping sections using computer algorithms.



SPaG

Grammar: Write in Sentences

A sentence is a group of words that make sense. Sentences start with a capital letter and end with a full stop, question mark or exclamation mark. All sentences contain clauses. You should try to use a range of sentences when writing. There are three main types of sentences.

Simple sentence: A sentence containing one main clause with a **subject** and a **verb**.

He reads.

Literacy is important.

Compound sentence: Two simple sentences joined with a conjunction. Both of these simple sentences would make sense on their own. Varying conjunctions makes your writing more interesting.

He read his book because it was written by his favourite author.

Literacy is important so students had an assembly about reading.

Complex sentence: A longer sentence containing a main clause and one or more subordinate clause(s), used to add more detail. The main clause makes sense on its own. However, a subordinate clause would not make sense on its own, it needs the main clause to make sense. The subordinate clause is separated by a comma (s) and/or conjunction. The clause can go at the beginning, middle or end of the sentence.

He read his book even though it was late.

Even though it was late, he read his book.

He read his book, even though it was late, because it was written by his favourite author.

How can you develop your sentences?

1. Start sentences in different ways. For example, you can start sentences with adjectives, adverbs or verbs.

Adjective: Funny books are my favourite!

Adverb: Regularly reading helps me develop a reading habit.

Verb: Looking at the front cover is a good way to choose a reading book.

2. Use a range of **punctuation**.

3. **Nominalisation**

Nominalisation is the noun form of verbs; verbs become concepts rather than actions. Nominalisation is often used in academic writing. For example:

It is important to read because it helps you in lots of ways.

Becomes: Reading is beneficial in many ways.

Germany invaded Poland in 1939. This was the immediate cause of the Second World War breaking out. Becomes:

Germany's invasion of Poland in 1939 was the immediate cause of the outbreak of the Second World War.

Connectives and Conjunctions

Cause And Effect	Because So Consequently Therefore Thus
Addition	And Also In addition Further (more)
Comparing	Whereas However Similarly Yet As with/ equally/Likewise
Sequencing	Firstly Initially Then Subsequently Finally After
Emphasis	Importantly Significantly In particular Indeed
Subordinate	Who, despite, until, if, while, as, although, even though, that, which

SPaG: Spelling and Punctuation**Punctuation**

Use a range of punctuation accurately when you are writing.

. Full stop Marks the end of a sentence.

, Comma Separates the items on a list or the clauses in a sentence.

' Apostrophe Shows possession (belonging) or omission (letters taken away).

" " Quotation marks Indicate a quotation or speech.

' ' Inverted commas Indicate a title.

? Question mark Used at the end of a sentence that asks a question.

! Exclamation mark Used at the end of a sentence to show surprise or shock.

: Colon Used to introduce a list or an explanation/ elaboration/ answer to what preceded. A capital letter is only needed after a colon if you are writing a proper noun (name of person or place) or two or more sentences.

; Semi-colon Joins two closely related clauses that could stand alone as sentences. Also used to separate items on a complicated list. A capital letter is not needed after a semi-colon unless you are writing a proper noun (name of person or place).

Brackets Used to add extra information which is not essential in the sentence.

Spelling

Use the following strategies to help you spell tricky words.

1. Break it into sounds (d-i-a-r-y)

2. Break it into syllables (re-mem-ber)

3. Break it into affixes (dis + satisfy)

4. Use a mnemonic (necessary - one collar, two sleeves)

5. Refer to word in the same family (muscle - muscular)

6. Say it as it sounds - spell speak (Wed-nes day)

7. Words within words (Parliament - I AM parliament)

8. Refer to etymology (bi + cycle = two + wheels)

9. Use analogy (bright, light, night, etc)

10. Use a key word to remember a spelling rule (horrible/drinkable for -ible & -able / advice/advise for -ice & -ise)

11. Apply spelling rules (writing, written)

12. Learn by sight (look-cover-say-write check)