Edexcel (B) Biology A-level

Topic 1 - Biological Molecules

Definitions and Concepts

1.1 - Carbohydrates

Alpha glucose - An isomer of glucose which has the hydroxy group (OH) on carbon-1 above the plane of the ring.

Beta glucose - An isomer of glucose which has the hydroxy group (OH) on carbon-1 below the plane of the ring.

Cellulose - A structural polysaccharide found in plants that composes the cell wall and is made of beta glucose monomers joined by β(1-4) glycosidic bonds.

Condensation reaction - A type of reaction between two molecules which forms a bond and releases water.

Disaccharides - Molecules formed by the condensation of two monosaccharides.

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

Glycosidic linkage - A type of covalent bond formed between two sugars during a condensation reaction in the form C-O-C.

Hexose sugar - A type of monosaccharide which contains 6 carbon atoms such as glucose.

Hydrolysis - A type of reaction which breaks a chemical bond using a molecule of water.

Lactose - A simple disaccharide composed of glucose and galactose joined by a glycosidic bond.

Maltose - A simple disaccharide composed of two glucose molecules joined by a glycosidic bond.

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

Polysaccharide - Polymers formed by the condensation of many monosaccharides.

Ribose - A 5-carbon (pentose) sugar which is found in the structure of molecules like RNA.

Starch - A polysaccharide made of amylose and amylopectin that is used as the main storage of energy in plants.

Sucrose - A simple disaccharide composed of glucose and fructose joined by a glycosidic bond.

1.2 - Lipids

Amphipathic - A molecule which has both hydrophobic parts and hydrophilic parts.

Ester bond - A type of bond formed in a condensation reaction which joins each of the fatty acid tails to the glycerol molecule in a triglyceride.

Fatty acids - Long carbon chain molecules which have a carboxylic acid head group (COOH) and may contain double C=C bonds.

Glycerol - A 3-carbon molecule which contains 3 hydroxy (OH) groups and is a component of triglycerides.

Phospholipid - A type of amphipathic lipid found in cell membranes which is based on a triglyceride where one of the fatty acid tails is replaced with a negative phosphate group.

Saturated lipid - A lipid molecule containing only single bonds between the carbon atoms.

Triglyceride - A lipid macromolecule composed of one molecule of glycerol joined by ester bonds to 3 fatty acid tails.

Unsaturated lipid - A lipid which contains at least one C=C double bond.

1.3 - Proteins

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

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

Disulfide bond - A type of covalent bond formed between two sulphur containing R-groups which holds together the tertiary and quaternary structures of proteins.

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

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

Haemoglobin - A conjugated globular protein that is specialised to transport oxygen around the body and has a quaternary structure which is composed of two alpha chains and two beta chains that contain non-protein haem groups.

Hydrogen bond - A type of intermolecular bond between a δ+ hydrogen and a δ- atom such as oxygen or nitrogen which is used to hold together the secondary, tertiary and quaternary structures of proteins.

Ionic bond - A type of bond between two charged R-groups which helps to stabilise the tertiary and quaternary structures of proteins.

Peptide bond - A type of bond which joins the amino group in one amino acid to the carboxyl group in another amino acid in a condensation reaction.

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

Protein - A polymer made up of amino acid monomers joined by peptide bonds in condensation reactions.

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

Secondary structure - The local interactions of the amino acids in the polypeptide chain held together by hydrogen bonds in the form of alpha helices or beta pleated sheets.

Tertiary structure - The way that the whole protein folds to make a three dimensional structure involving hydrogen bonds, ionic bonds and disulphide bridges.

1.4 - DNA and protein synthesis

Anti-sense strand - The strand of DNA which is used as a complementary template and is used for complementary mRNA synthesis.

Coding DNA - The sections of DNA which code for proteins.

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

Deletion mutation - A type of mutation where nucleotide(s) are not incorporated into the chain and are lost which results in a frameshift mutation.

Deoxyribonucleic acid DNA - A helical double-stranded polymer made of deoxyribonucleotide monomers joined by phosphodiester bonds which contains genes that code for proteins.

DNA helicase - The enzyme which unzips the DNA helix by breaking the hydrogen bonds between the chains during processes like DNA replication and transcription.

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

Gene - A sequence of bases on a DNA molecule coding for a sequence of amino acids in a polypeptide chain.

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 harmful or beneficial changes to the genotype.

Insertion mutation - A type of mutation where extra nucleotide(s) are incorporated into the growing DNA chain which results in a frameshift mutation.

Ligase - The enzyme which joins Okazaki fragments on the lagging strand together by forming phosphodiester bonds between them.

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

Non-coding DNA - The sections of DNA which do not code for proteins.

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

Nucleotides - The individual monomers that make up polynucleotides which are composed of a phosphate group, pentose sugar and a nitrogenous base.

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

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

Ribosome - An organelle found either free in the cytoplasm or as a part of the rough endoplasmic reticulum which catalyses protein synthesis.

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

Semi-conservative replication - A type of DNA replication where each new molecule of DNA produced contains one original strand and one newly synthesised strand.

Sense strand - The strand of DNA which is complementary to the anti-sense strand and is identical to the transcribed mRNA (with the exception of the sense strand containing thymine in the place of uracil).

Sickle cell anaemia - A type of genetic disease which produces faulty 'sickle shaped' haemoglobin due to a point mutation that causes a change in a single amino acid in the polypeptide sequence.

Substitution mutation - A type of mutation where the incorrect nucleotide is incorporated into the growing DNA chain.

Transcription - The process of synthesising a new mRNA strand from a molecule of DNA which occurs in the nucleus.

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

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

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

1.5 - Enzymes

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

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

Enzyme - Globular proteins which act as biological catalysts to lower the activation energy of biochemical reactions.

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

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

Extracellular reaction - A reaction that occurs outside of cells.

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

Intracellular reaction - A reaction that occurs within cells.

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

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

pH - A measure of the acidity or alkalinity of a solution based inversely on the concentration of H^+ ions.

Rate of reaction - The change in concentration of reactants or products over time.

Substrate - Molecule(s) which bind to the active site of an enzyme and are acted upon by the enzyme.

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

1.6 - Inorganic ions

Calcium ions (Ca^{2+}) - An inorganic ion used by plants to form calcium pectate for the middle lamellae.✢

Magnesium ions (Mg^{2+}) - An inorganic ion used by plants to produce chlorophyll.✢

Nitrogen ions (NO_3^-) - An inorganic ion used by plants to make DNA and amino acids.✢

Phosphate ion (PO_4^{3-}) - An inorganic ion used to make ADP and ATP.✢

1.7 - Water

Dipole - A molecule which has partially positive and partially negative parts.

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

Polar solvent - A solvent which is composed of molecules which contain dipoles and so have slightly positive and slightly negative parts.

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

Surface tension - A strong attraction of molecules at the surface of a fluid which provides a strong surface which has the potential to support life.

✢ Definition taken from: Edexcel Biology B Specification (9BI0) 2015 (Pearson)