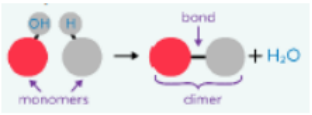
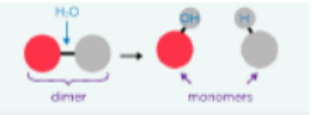
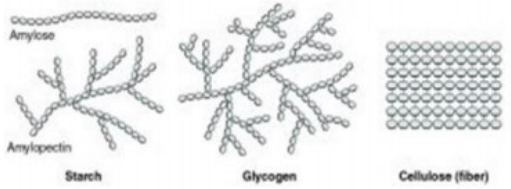
Biology: Biological Molecules

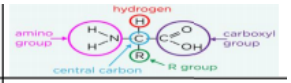
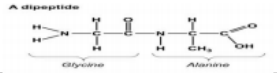
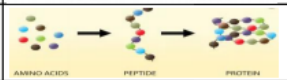
1. Monomers and Polymers

Monomers and polymers (see key vocabulary table)

1	Condensation reaction (see key vocab)	
2	Hydrolysis reaction (see key vocab)	



3. Proteins

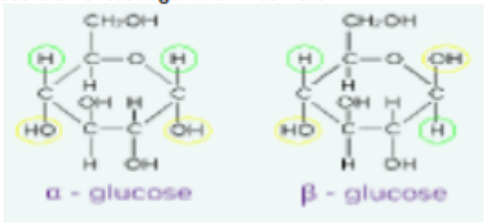
Amino acids (see key vocab)	
Dipeptide (see key vocab)	
Polypeptide (see key vocab)	

Level	Definition	Bond type
Primary	The specific sequence of amino acids in a polypeptide chain	Peptide bonds
Secondary	The curling or folding of the polypeptide chain into α-helices and β-pleated sheets due to the formation of hydrogen bonds	Hydrogen bonds
Tertiary	The overall specific 3-D shape of a protein, which is determined by interactions between R groups and the properties of R groups	Hydrogen bonds Ionic bonds Disulphide bridges
Quaternary	The specific 3-D shape of a protein that is determined by the multiple polypeptide chains and/or prosthetic groups bonded together	Hydrogen bonds Ionic bonds Disulphide bridges

2. Carbohydrates

1 Monosaccharides
Eg: glucose, fructose, galactose (see key vocab)

Glucose is a hexose sugar with 2 isomers



2 Disaccharides (see key vocab) Eg: maltose, sucrose, lactose

Name	Monosaccharide constituent
a) Maltose	2 × α-glucose
b) Sucrose	α-glucose and fructose
c) Lactose	β-glucose and galactose

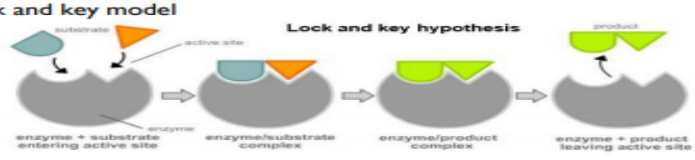
3 Polysaccharides (see key vocab) Eg: Amylose, glycogen, cellulose

Name	Function
a) Amylose	Amylopectin (starch) is the main polysaccharide energy store in plants. It is composed of alpha glucose.
b) Glycogen	Polysaccharide energy store in animals, composed of alpha glucose
c) Cellulose	Structural component of plant cell walls, composed of long unbranched chains of beta glucose

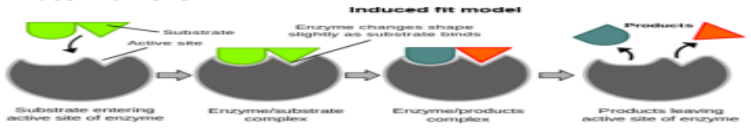
4.Enzymes

There are two models proposed for how enzymes (see key vocab) function. The specificity of enzymes is due to the tertiary structure of its active site, allowing complementary binding to substances

1 Lock and key model



2 Induced fit model



Key Vocabulary

1	Monomer	Individual molecules that make up a polymer
2	Polymer	Long chains composed of many individual monomers bonded together in repeating pattern
3	Condensation reaction	Occurs when two molecules combine to form a more complex molecule with the removal of water
4	Hydrolysis reaction	Occurs when larger molecules are broken down into smaller molecules with the addition of water
5	Monosaccharide	Simplest carbohydrates, consisting of only one sugar molecule eg: glucose, fructose, galactose
6	Disaccharide	Sugars composed of **two** monosaccharides joined together by a glycosidic bond, in a condensation reaction eg: maltose, sucrose, lactose. Can be separated by a hydrolysis reaction.
7	Polysaccharide	Sugars composed of **many** monosaccharides joined together by glycosidic bonds, in a condensation reaction eg: amylose, glycogen, cellulose. Can be separated by a hydrolysis reaction.
8	Amino acid	Monomer units that make up proteins. 20 amino acids exist with different R groups
9	Dipeptide	Two amino acids joined together by a peptide bond in a condensation reaction. Can be separated by a hydrolysis reaction.
10	Polypeptide	A polymer made of many amino acids joined together by peptide bonds in a condensation reaction. Can be separated by a hydrolysis reaction.
11	Protein	Contains one or more polypeptide chains. There are four structural levels

4.Enzymes (2)

Enzymes catalyse both intracellular and extracellular reactions that determine structures and functions from cellular to whole organism level. There are several factors that affect enzyme activity;
Temperature, pH and Substrate Concentration

Biology: Biological Molecules

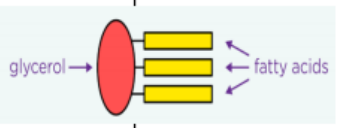
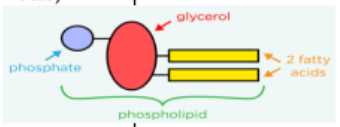
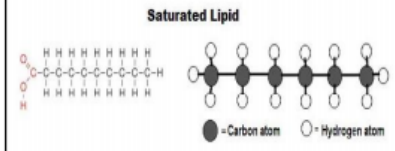
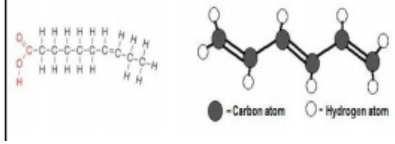
Key Vocabulary

Lipids	Macromolecules made of fatty acid monomers. 2 types: triglycerides, phospholipids
Saturated	Molecule contains no carbon double bonds (C=C), only has carbon single bonds (C-C) has as many hydrogen atoms as possible
Unsaturated	Molecule contains at least one C=C bond and has fewer hydrogen atoms than is maximally possible
Triglyceride	Molecule formed by the joining of one glycerol to three fatty acids by a ester bonds, through condensation reactions. 3 molecules of water are produced as 3 reactions occur. Can be separated by a hydrolysis reaction.
Phospholipid	Molecule formed by the joining of one glycerol to two fatty acids and one phosphate molecule by ester bonds, through condensation reactions
Enzymes	Biological catalysts that speed up the rate of reaction. They remain unchanged and can be used again. They lower the activation energy of the reaction.
Activation energy	Minimum amount of energy required for the reaction to occur
Lock and key model	A model that proposes that each substrate (key) only fits a specific enzyme (lock)
Induced fit model	A model that proposes when the substrate binds with the enzyme, the enzyme changes shape and molds itself to the substrate

4. Enzymes (3)

Enzyme inhibitor- a molecule that binds to an enzyme to decrease its activity. There are two types; competitive and non-competitive inhibitors (see key vocab)

5. Lipids

	Structure	Function
Triglyceride (see key vocab)		Roles in respiration, energy storage- due to insolubility and high carbon to hydrogen ratio
Phospholipid (see key vocab)		Hydrophobic tails (water hating) and hydrophilic heads (water loving) allow the phospholipids to form phospholipid bilayers (membranes)
Saturated (see key vocab)		
Unsaturated (see key vocab)		

6. Biochemical (food) tests

Molecule	Reagent	Positive result
Reducing sugars	Benedict's reagent → Heat	Red/orange precipitate
Starch	Iodine in potassium iodide solution	Blue/black
Non-reducing sugars	Hydrochloric acid → Heat Sodium hydrogencarbonate Benedict's reagent → Heat	Red/orange precipitate
Proteins	Sodium hydroxide Copper (II) sulphate	Purple
Lipids	Ethanol Water → Shake	Cloudy white

7. ATP

	ATP to ADP+Pi	ADP+Pi to ATP
Reaction	Hydrolysis	Condensation
Enzyme involved	ATP hydrolase	ATP synthase
Energy profile	Releases energy	Requires energy

8. Inorganic Ions

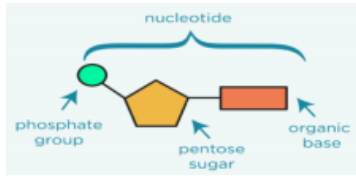
Hydrogen (H)	Determine the pH of body fluids. Higher concentration = lower pH
Iron (Fe)	Part of the prosthetic group in haemoglobin and binds to oxygen
Sodium	Used in co-transport of glucose and amino acids across cell membranes
Phosphate	Essential component of DNA, RNA, ATP

Key Vocabulary

Competitive inhibitor	An inhibitor that resembles the normal substrate binds to the enzyme, usually at the active site, and prevents the substrate from binding.
Non-competitive inhibitor	An inhibitor that does not compete for the active site with the substrate however binds at another place (allosteric site) and changes the shape of the active site so prevents the original substrate binding
ATP	Adenosine triphosphate- An organic compound that provides energy.
ADP + Pi	Adenosine diphosphate + phosphate
Inorganic ions	Atoms or molecules with an electric charge, containing no carbon. Occur in solution in the cytoplasm and body fluids of organisms in high/low concentrations
Cations	Positively charged ions
Anions	Negatively charged ions

9. DNA and RNA

Nucleotide structure



	DNA	RNA
Number of Strands	Two antiparallel strands	One strand
Length	Very long	Relatively short
Pentose Sugar	Deoxyribose	Ribose
Nitrogenous Bases	Adenine, Cytosine, Guanine & Thymine	Adenine, Cytosine, Guanine & Uracil
Function	Store genetic information	Transfer genetic information & forms ribosomes with proteins

Biology: Biological Molecules

Key Vocabulary

DNA (Deoxyribonucleic acid)	A nucleic acid, composed of nucleotides, that carries genetic instructions. It is double stranded and forms a double helix structure, composed of two polynucleotide chains that interact to form a coil.
RNA (Ribonucleic acid)	A nucleic acid molecule essential in various biological roles in coding, decoding, regulation and expression of genes.
Nucleotide	A structural component of DNA and RNA. Consists of a phosphate group, pentose sugar and organic base
Semi conservative replication	Method by which DNA replicates to form two identical molecules of DNA (consist of one original DNA strand and one newly synthesised DNA strand)
Polarity (water)	A molecule containing polar bonds due to the difference in electronegativity. Consists of one negatively charged and one positively charged end,. Eg: Water
Water	Consist of two hydrogen (positively charged) covalently bonded to one oxygen (negatively charged). This causes attraction (hydrogen bonds) between one water molecule and another.

12. Water

Property	Why is it useful?
Liquid medium	Provides aquatic habitats, medium for chemical reactions & used for transport
Metabolite	Use in hydrolysis & condensation reactions
High specific heat capacity	Keeps aquatic & cellular environments stable
High latent heat of evaporation	Evaporation has a cooling effect on organisms
Cohesion	Water is 'sticky'- helps to move/pull up the xylem
Surface tension	Allows pond skaters to move on surface
Solvent + transport medium	Dissolves ionic & polar molecules so they can be transported
Reaction medium	Cytoplasm in cells is aqueous solution
Incompressible	Prevents plants from wilting & acts as a hydrostatic skeleton for invertebrates

10. RNA

There are 3 types of RNA;

Messenger RNA (mRNA)-a transcript copy of a gene which encodes a specific polypeptide

Transfer RNA (tRNA)-carries the polypeptide subunits (amino acids) to the organelle responsible for synthesis (ribosome)

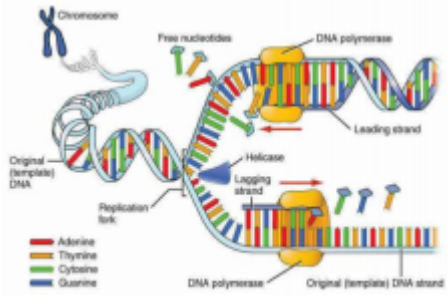
Ribosomal RNA (rRNA)-a primary component of the ribosome and is responsible for its catalytic activity

11. DNA Replication

Polynucleotides	Polymers made up of many nucleotide monomers joined by phosphodiester bonds in a series of condensation reactions
DNA double helix	Held together by hydrogen bonds between complementary base pairs. Adenine + thymine- 2 bonds Cysteine + guanine- 3 H bonds

Semi conservative replication

1- DNA helicase breaks H bonds between the two strands
2-Free nucleotides complementary base pair to the exposed strands
3-DNA polymerase catalyses condensation reactions to join adjacent nucleotides, forming phosphodiester bonds



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