



Key Aims

1. Polymers and Monomers.
2. Condensation and Hydrolysis Reactions.
3. Examples of Monomers and Polymers.

1.1 Monomers and Polymers

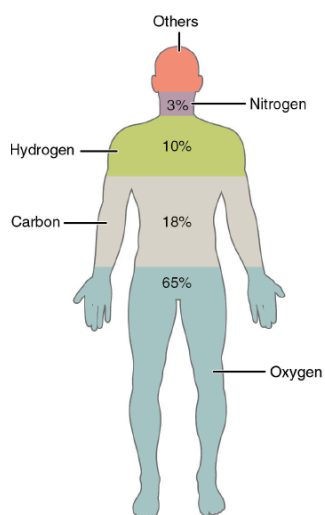
Biological Molecules

- **Biological molecules are the building blocks of biology.** **Biological molecules** is a term that is typically used to characterise most molecules and ions in living organisms that contribute to various biological processes (e.g. metabolism, cell division, etc).
- **Most biological molecules are organic compounds.** Meaning that they are mostly made up of the atom carbon.
- **Biological molecules consist of many elements.** In addition to carbon, these molecules also consist of oxygen, *nitrogen*, and hydrogen, which along with carbon makeup 96% of the human body's mass!



AQA Specification

The variety of life, both past and present, is extensive, but the biochemical basis of life is similar for all living things.



Element	Symbol	Percentage in Body
Oxygen	O	65.0
Carbon	C	18.5
Hydrogen	H	9.5
Nitrogen	N	3.2
Calcium	Ca	1.5
Phosphorus	P	1.0
Potassium	K	0.4
Sulfur	S	0.3
Sodium	Na	0.2
Chlorine	Cl	0.2
Magnesium	Mg	0.1
Trace elements include boron (B), chromium (Cr), cobalt (Co), copper (Cu), fluorine (F), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se), silicon (Si), tin (Sn), vanadium (V), and zinc (Zn).		less than 1.0

Table 1. Chemical Composition of the Human Body: Elements that make up the human body are listed from most abundant to least abundant relative to their mass percentage in the human body.

- **AQA Biology studies four major classes of biological molecules.** Although there are thousands of various biological molecules, the four



major classes we will concern ourselves with in this chapter are **carbohydrates**, **lipids**, **proteins**, and **nucleic acids**. Together, these four are the most crucial molecules for sustaining life.



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Monomers are the smaller units from which larger molecules are made. Polymers are molecules made from a large number of monomers joined together.

Polymers

Polymers Are Chains of Monomers

- **Polymers consist of a chain of monomers.** Polymers are simply very large, long, and complex molecules which consist of smaller and simpler monomers strung together in a chain (Fig. 1).



Fig 1. The Relationship Between a Monomer and a Polymer.

- **Polymers can be homogenous or heterogenous.** **Homogenous** means that all of their monomers are the same, and **heterogenous** means that their monomeric subunits are different. In later sections of this chapter, we will come across various homogenous and heterogenous polymers.



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Monosaccharides, amino acids and nucleotides are examples of monomers.



Fig 2. Homogenous Polymer.



Fig 3. Heterogenous Polymer.

- **You need to learn 3 key monomers.** Monosaccharides, amino acids, and nucleotides are key monomers, important in making up some important polymers (see table).
- Most biological molecules are polymers. Carbohydrates, lipids, proteins, and nucleic acids are all examples of polymers.





Knowledge Recall

1. What are the four major classes of biological molecules?
2. What monomers and polymers are carbohydrates made from?
3. Are lipids homogenous or heterogenous polymers?

Biological Molecule	Monomer	Polymer
Carbohydrates	Monosaccharide	Polysaccharide
Proteins	Amino Acids	Polypeptide
Lipids	Fatty Acid, Glycerol	Lipid
Nucleic Acids	Nucleotide	Nucleic Acid

Table 2. Monomers and Polymers in Biological Molecules.



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A hydrolysis reaction breaks a chemical bond between two molecules and involves the use of a water molecule.

Polymers Are Put Together by a Condensation Reaction

- A condensation reaction involves release of water. A **condensation reaction** is the process by which monomers join together to produce polymers. In the process, there is removal of water (H₂O), which enables formation of a covalent bond to link two monomers together.
- A condensation reaction is a synthesis reaction. **Synthesis reactions** are specific chemical processes by which organic compounds (including biochemical compounds) are made.

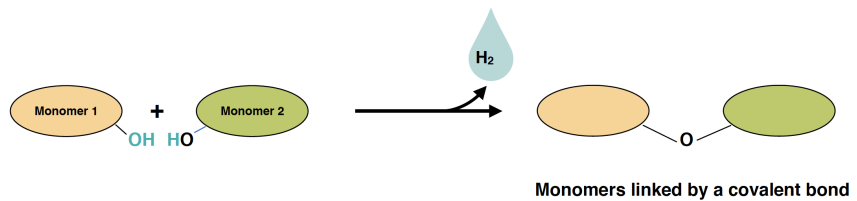


Fig 4. Mechanism of a Condensation Reaction.



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A condensation reaction joins two molecules together with the formation of a chemical bond and involves the elimination of a molecule of water.

Polymers can be broken down by hydrolysis

- Polymers put together by a condensation reaction can be broken down by **hydrolysis**.



- **Hydrolysis involves addition of a water molecule.** The addition of a water molecule breaks the covalent bond between two monomers (hydro = water, lysis = break down).
- **Condensation and hydrolysis are opposite reactions.**

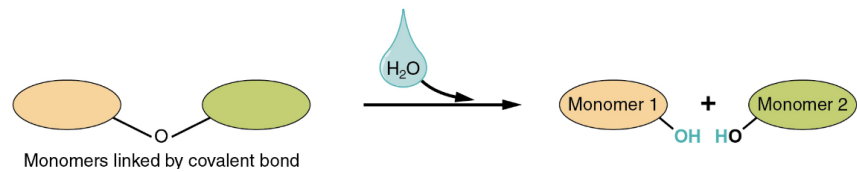


Fig 5. Mechanism of a hydrolysis reaction.