ANSWER COPY

3.1 Biological Molecules

Learning Objectives

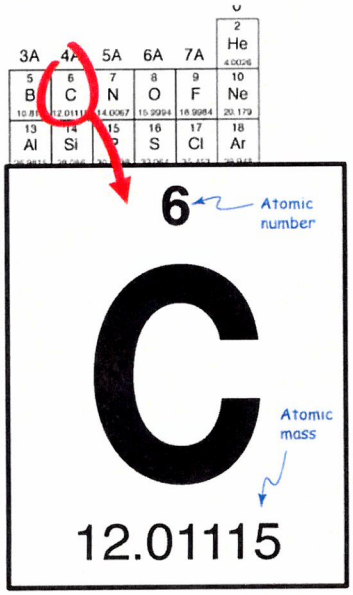
- Specification reference 3.1.1
- Understand that the variety of life, both past and present is extensive, but the biochemical basis of life is similar for all living things
- Know that monomers are the smaller units from which larger molecules are made.
- Know that monosaccharides, amino acids and nucleotides are examples of monomers.
- Know that polymers are molecules made from a large number of monomers joined together.
- Understand that a condensation reaction joins two monomers together with the formation of a chemical bond and the elimination of a water molecule.
- Understand that a hydrolysis reaction breaks a chemical bond between two molecules and involves a molecule of water.

What you should know from GCSE

- Many small molecules (monomers) join together to form very large molecules (polymers)
- Protein molecules are made up of long chains of amino acids

Life Shares a common Biochemistry

All life we know of on Earth is chiefly based on molecules containing the element carbon. Molecules containing large amounts of carbon are usually referred to as organic compounds; their chemistry is organic chemistry.



Carbon has a total of six electrons.

Two are buried in its inner electron shell, leaving four that can bond with other atoms.

Except in very special circumstances, carbon always forms four bonds.

Why are all living organisms composed of carbon based compounds?

Read the article 'Why Life chose carbon' by Lucy Banham and Barnard Brown, extracted from the Biological Sciences Review magazine 1988.

The article describes four special features of carbon that explain its importance to life:

1. Carbon atoms are able form stable covalent bonds to other carbon atoms. As well as straight chains, carbon can form branched chains and rings.

In the space below, draw an example of a straight chained carbon based molecule, a branched chain and a ring. Label them

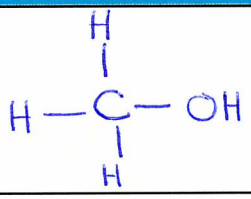
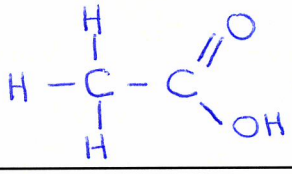
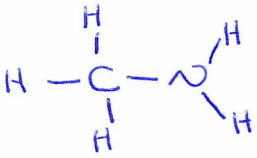
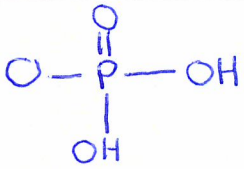
The 3 diagrams are at the top of the front page of the article.

2. The second special feature of carbon is that it can form covalent bonds with other atoms such as O, H, N, and S, so that a large number of **functional groups** can be introduced into organic molecules. Functional groups give **specific chemical properties** to the molecules that contain them.

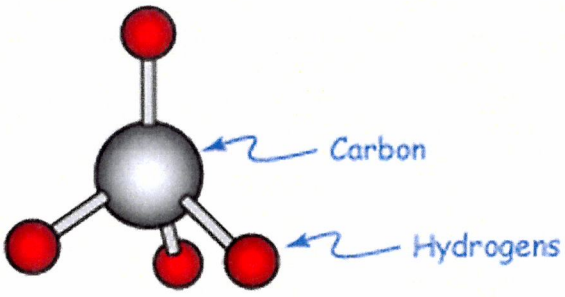
Watch the video Introduction to organic molecules: functional groups by Craig Savage:

https://www.youtube.com/watch?v=IXROzlRf284 (6.57)

Use the information in the video to complete the table on the next page.

Functional group	Formula	Structure	Property
Hydroxyl	$-OH$		gives polarity
Carboxyl	$-COOH$		proton donor
Amino	$-NH_2$		proton acceptor
Phosphate	—Ⓟ		gives polarity

3. The third special feature of carbon is that carbon compounds have a distinctive three dimensional structure.



Because the electrons in bonds repel each other as much as possible, the bonds of carbon tend to arrange themselves in a tetrahedron. The central carbon, in this case, is surrounded by four hydrogen (H) atoms. Except when it binds to another atom with a double or triple bond, carbon "centres" in molecules always have this tetrahedral shape.

4. Describe the fourth special feature of carbon below. Explain the importance of this final feature.

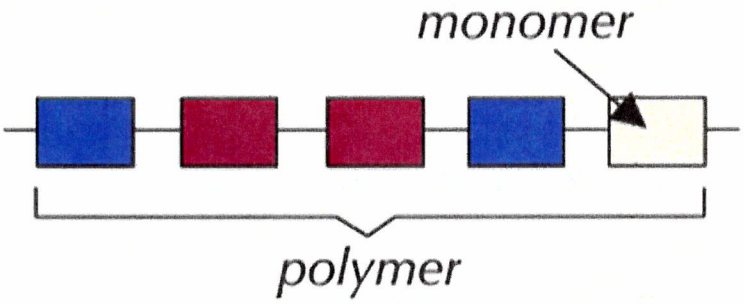
- See line 113 (back page, from multiple bonds) – line 123.

- The ability of two carbon atoms to form more than one bond with each other. By sharing two or three electron pairs, double and triple bonds can form.

- Multiple bonds are shorter and stronger than single bonds and provide an additional way of introducing variety.

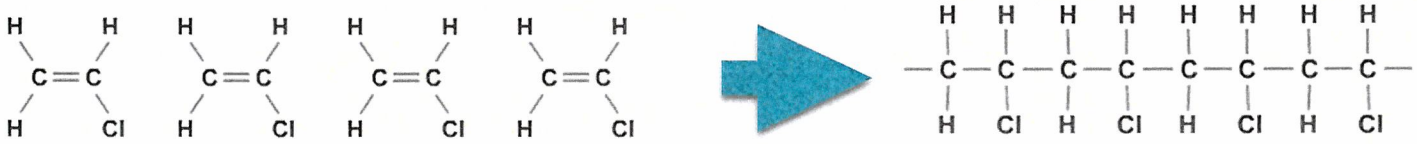
Monomers and Polymers

At GCSE, as part of your learning on crude oil in Chemistry, you learnt that alkenes can be used to make polymers. Polymers are very large molecules made when many small molecules join together, end to end. The smaller molecules are called monomers.



The example below from BBC Bitesize shows how the monomer chloroethene can be used to make **poly** chloroethene (PVC).

http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/substancesfromcrudeoil/polymersandethanolrev1.shtml (see animation)



chloroethene

a section of poly (chloroethene) PVC

There are many important polymers In Biology too. The polymers that you will learn about this year are carbohydrates, proteins and nucleic acids

Complete the table of monomers and polymers below (extracted from mrothery.co.uk biochemistry)

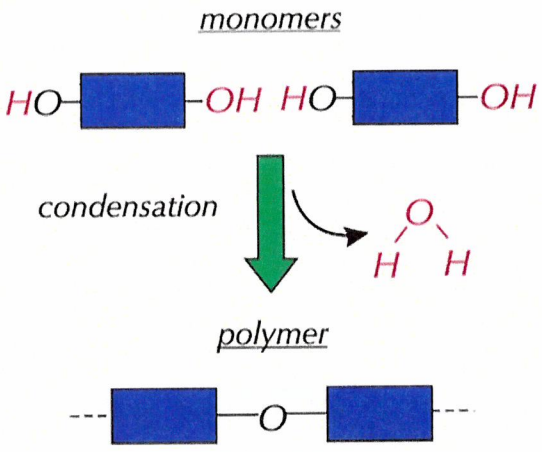
Group Name	Monomer	Polymer	% Dry Mass of Living Organisms
Carbohydrates	monosaccharide	polysaccharide	15
Proteins	amino acid	polypeptide	50
Nucleic Acids	nucleotide	polynucleotides	15

You will also learn about lipids, another very important component of living organisms. Lipids are not composed of repeating monomers.

GROUP NAME	COMPONENTS	LARGEST UNIT	% DRY MASS
lipids	fatty acids + glycerol	Triglycerides	10

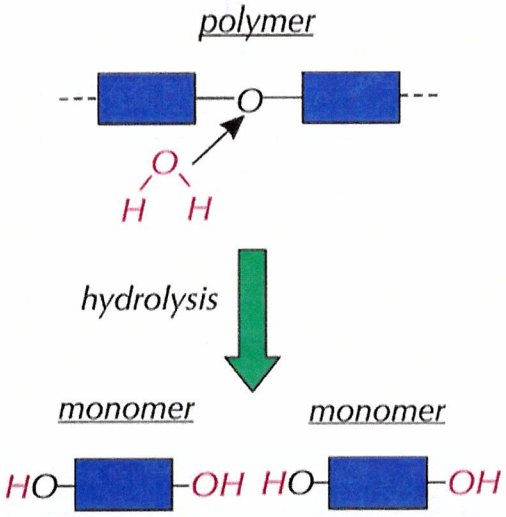
Making Polymers

Most Biological Polymers are formed from their monomers by condensation reactions. The reaction forms a chemical bond between monomers releasing a molecule of H_2O.

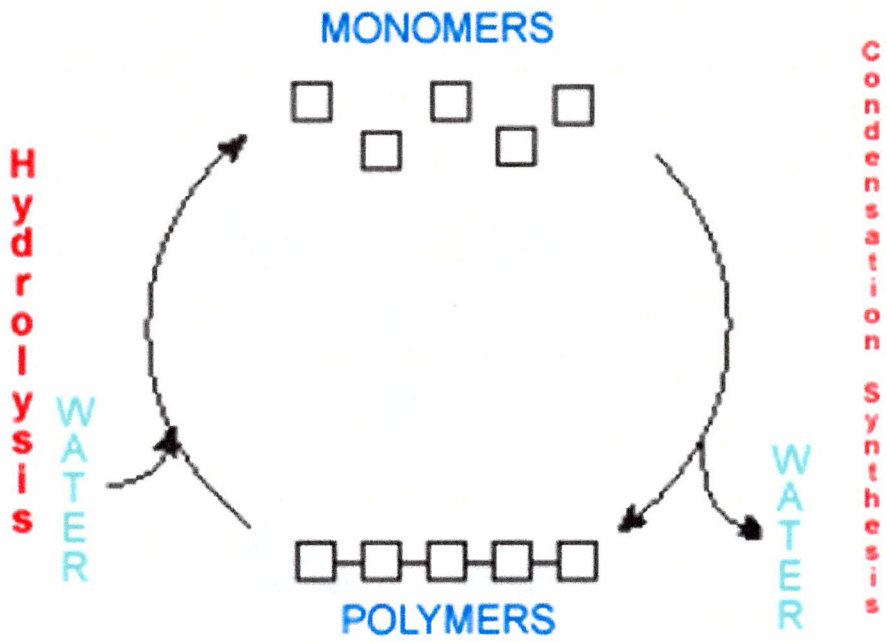


Breaking down polymers

Biological polymers can be broken down into monomers by hydrolysis reactions. The reaction breaks the chemical bond between monomers using a water molecule.



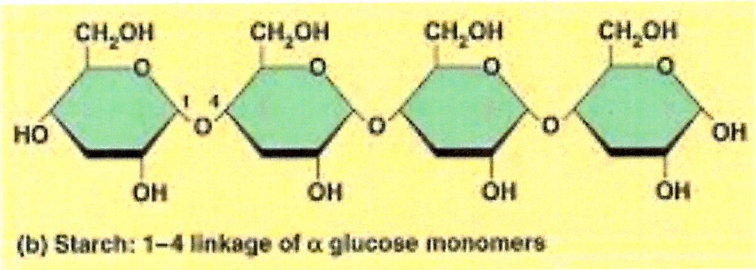
Summary Diagram



Can you identify the monomers in the diagrams of polymers below?

Place a circle around one monomer in each diagram

1.



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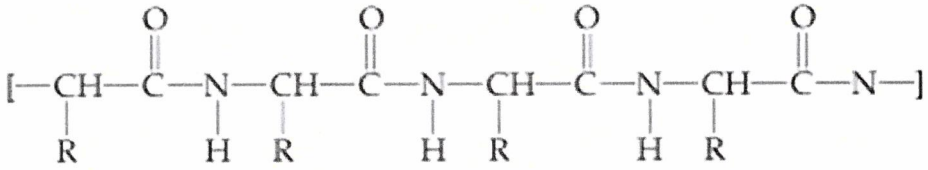

3.