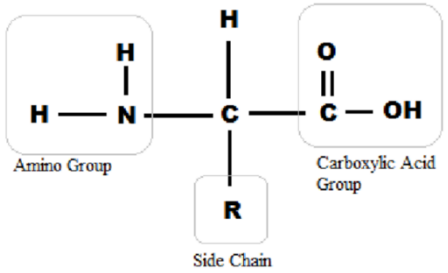
science

biology

A-Level Proteins

Proteins are large molecules (polymers) made up of chains of amino acids (monomers).

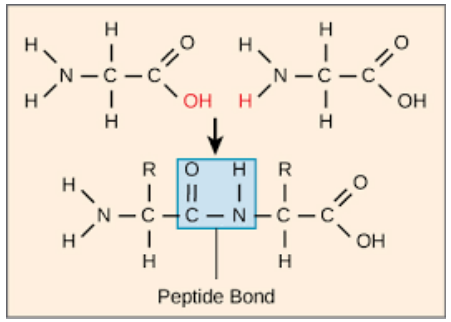
There are 20 amino acids all with the same basic structure. The R group is the variable part. It can be as simple as a hydrogen atom (glycine) or have complex ring structures (tryptophan).

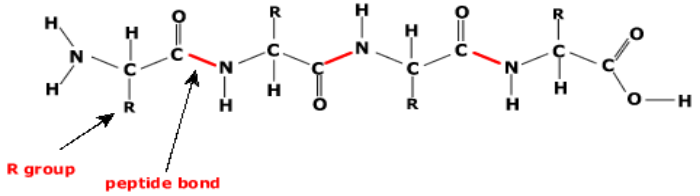


Two amino acids can join together to form a **dipeptide**. This process involves the removal of a water molecule (red atoms) in a **condensation reaction** and the formation of a **peptide** bond.

Polypeptides are formed by the condensation of many amino acids.

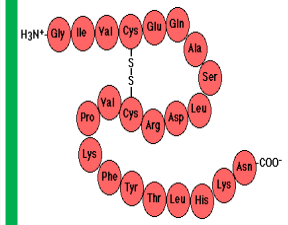
A functional protein may contain one or more polypeptide chains e.g. haemoglobin

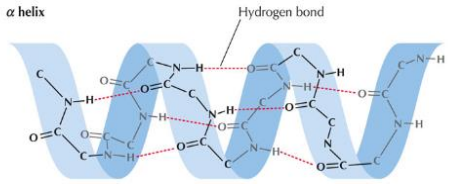


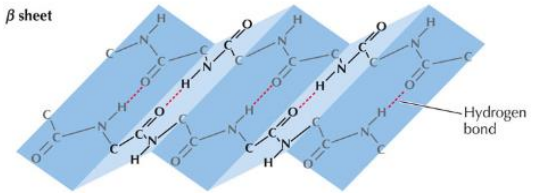


Proteins are large molecules with different levels of structure.

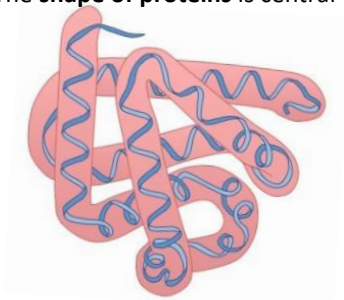
Primary structure – this is simply the order of amino acids in the polypeptide chains.
Secondary structure – the polypeptide chain can fold into specific shapes:
α-helix: hydrogen bonds form between the oxygen of a –CO group of one amino acid and the hydrogen of the $–NH_2$ of another holding a section of the polypeptide chain in a helical shape.
β-pleated sheet: parts of the polypeptide chain which are connected laterally by hydrogen bonds.



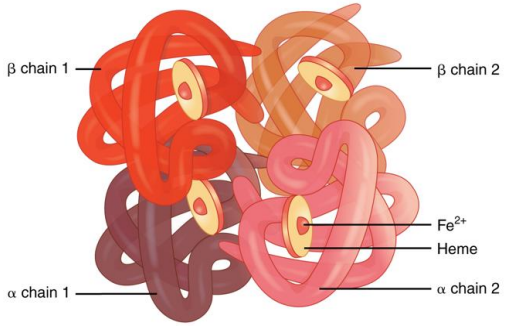




Tertiary structure – the α-helices and β-pleated sheets fold round themselves to form a 3D molecule. The 3D shape of the protein is maintained by a combination of **hydrogen bonds**, **ionic bonds** and **disulfide bridges**. The **shape of proteins** is central to their function.



Quaternary structure – functional proteins are often made up of more than one polypeptide chain. If this is the case they are said to have a quaternary structure. An example of this is haemoglobin which consists of four polypeptide chains, each associated with a non-protein haem group containing iron.



Testing for proteins

The **biuret** test is used to test for proteins:

- Start with an aqueous solution of the sample.
- Add an equal amount of 1% sodium hydroxide.
- Add a few drop of 0.5% copper (II) sulphate and gently mix.
- A purple colour will develop if protein is present.

No heating is required for the biuret test.

The biuret test works by detecting the presence of peptide bonds. The Cu^{2+} ions bind as shown causing a violet colour to develop. The intensity of the violet colour is proportional to the concentration of protein and can be determined using colorimetry.

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