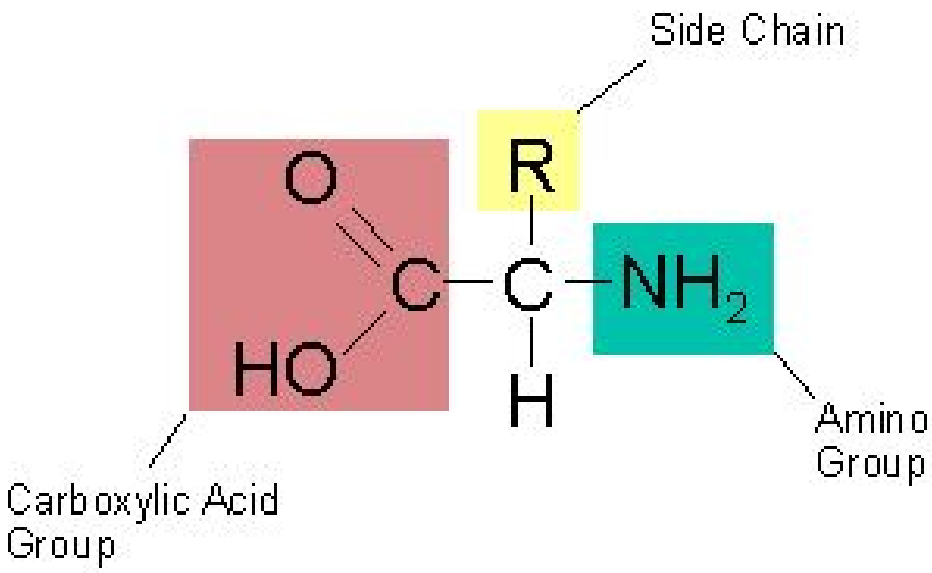
Protein structure and organisation

Monomer: Amino acid

Polymer (monomers joined together): Polypeptide chain

Polypeptide will fold to form a 3-D structure known as a protein

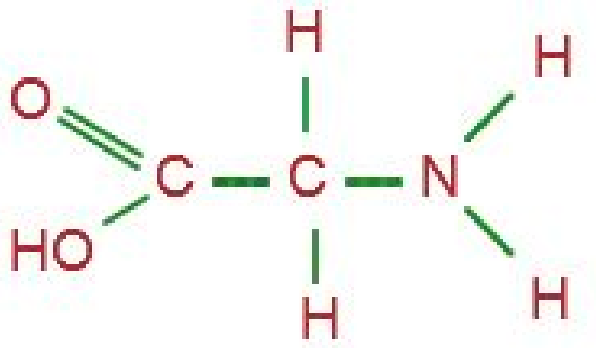
Amino acid



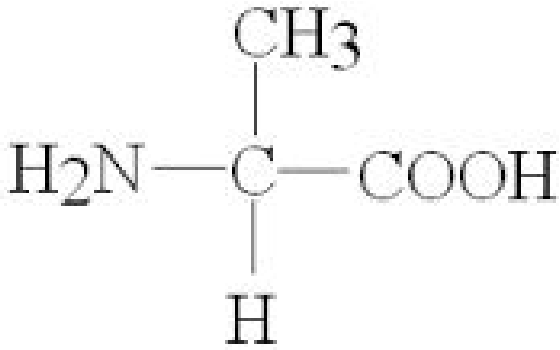
R = side chain
20 naturally occurring side chains = 20 different amino acids

(+ 2 rare amino acids)

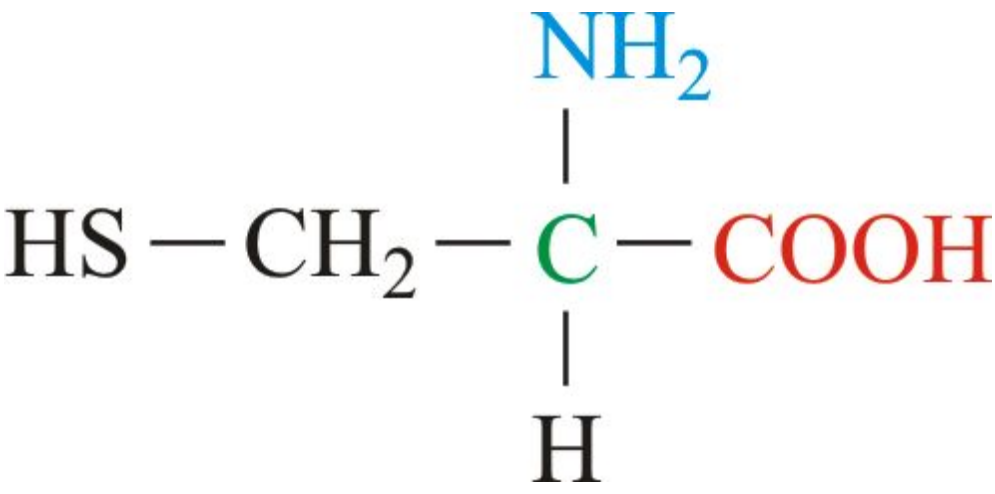
Glycine = simplest amino acid, R = H



Alanine = a common amino acid, R = CH_3



Cysteine = used for protein folding, contains a Sulfur group



R-groups can have charge, pH dependent

$NH_2 + H^+ \rightarrow NH_3^+$

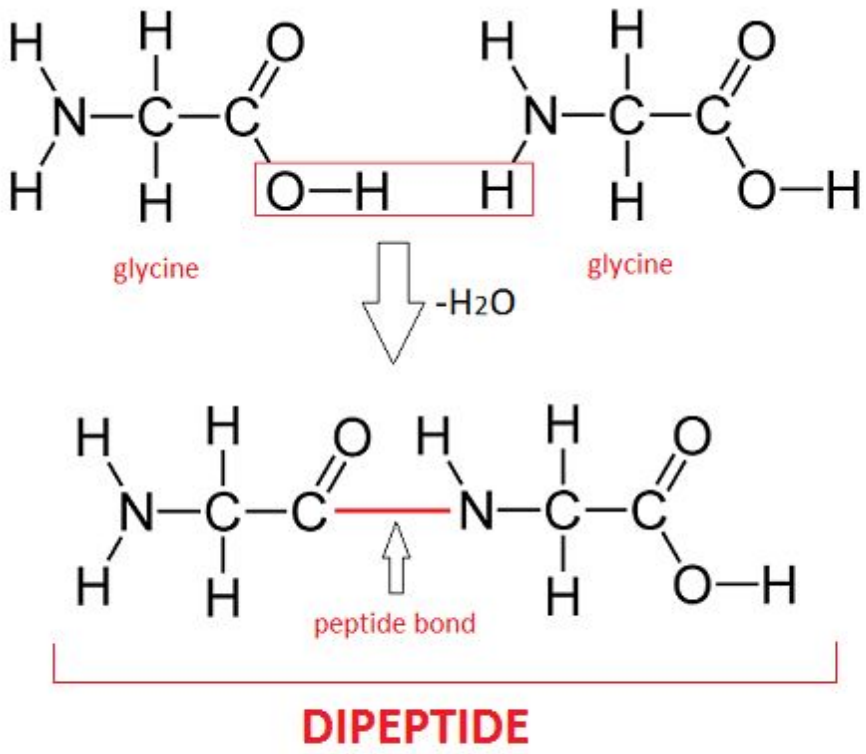
(acid) (positive ion)

$COOH + OH^- \rightarrow COO^- + H_2O$

(alkali) (negative ion)

Charge on the 'R' groups is important for protein folding

Dipeptide

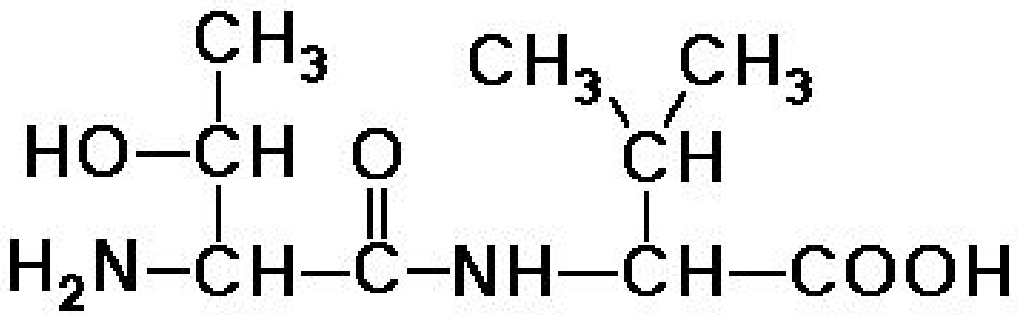


Removal of water to form a bond = condensation

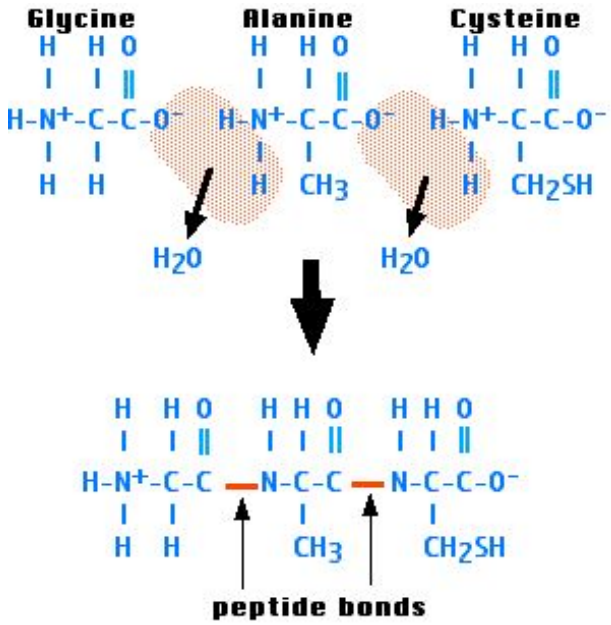
The reverse reaction is called hydrolysis.

Hydrolysis = addition of water to break a bond

Question: *Draw the two monomers from which this dipeptide is formed*



Polypeptide

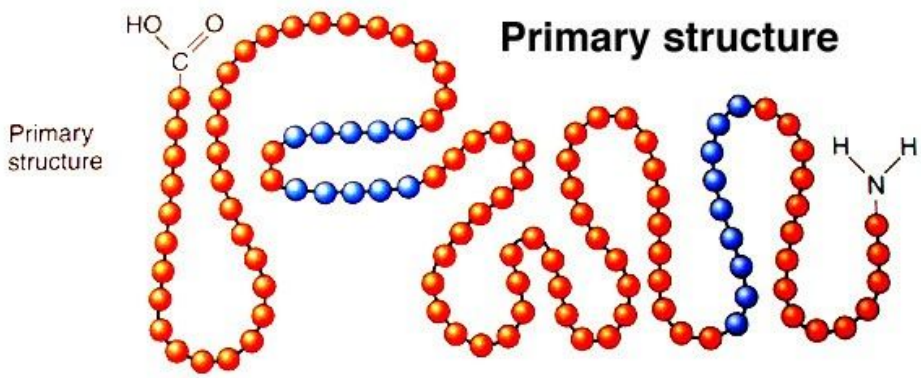


A string of amino acids joined together by peptide bonds

Polypeptide is the primary structure of a protein

Polypeptide is formed in the RER

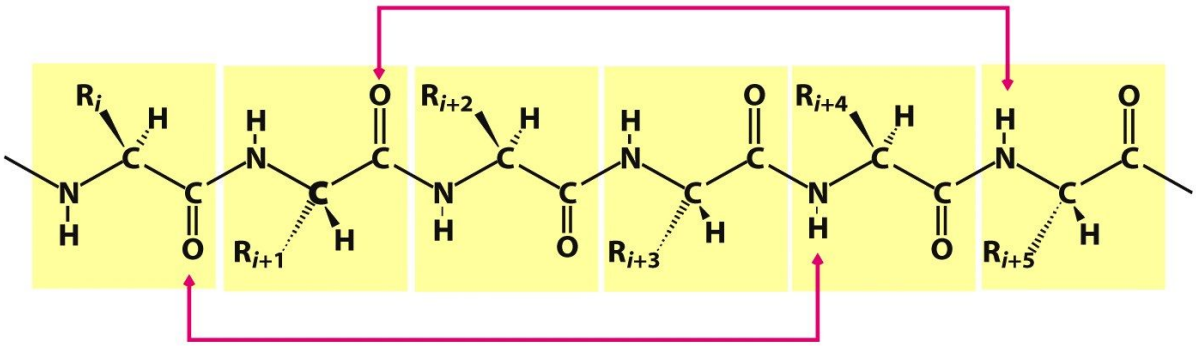
Polypeptide has no shape or function

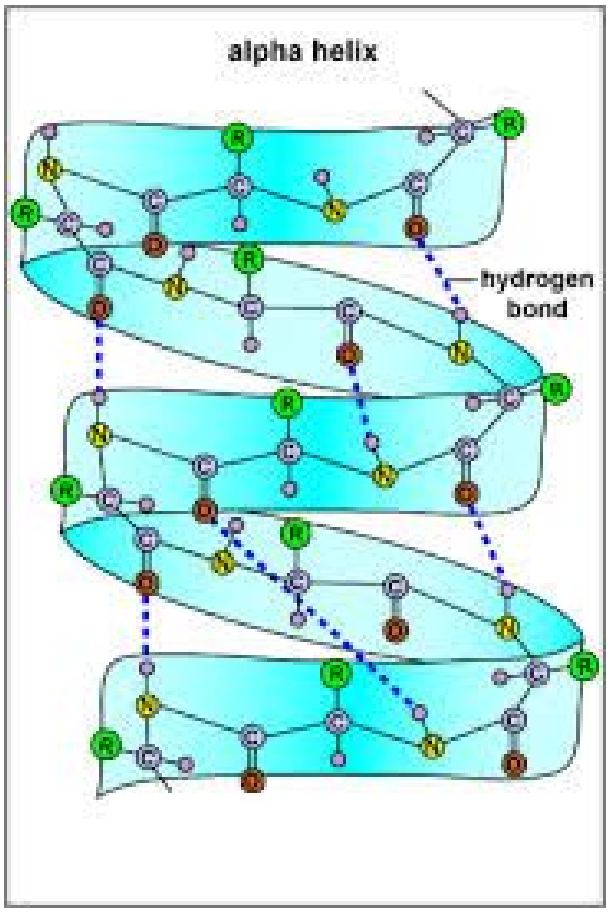


Secondary structure of a protein

Alpha Helix

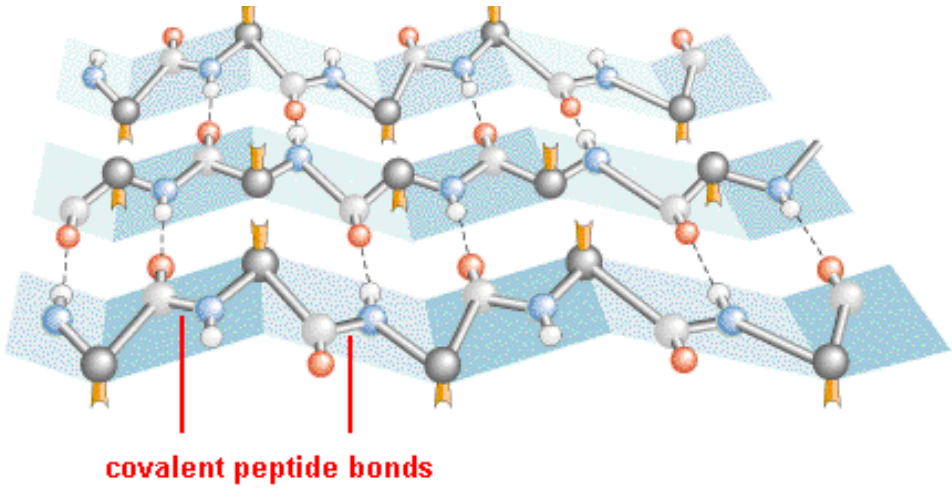
- Polypeptide folds into a spiral
- Hydrogen bonds form between C=O groups and N-H groups, between every 4th amino acid





Beta sheet

- Polypeptide forms a zig-zag structure, to form a beta fold
- Many folds together are called a sheet
- Hydrogen bonds form between alternate amino acids



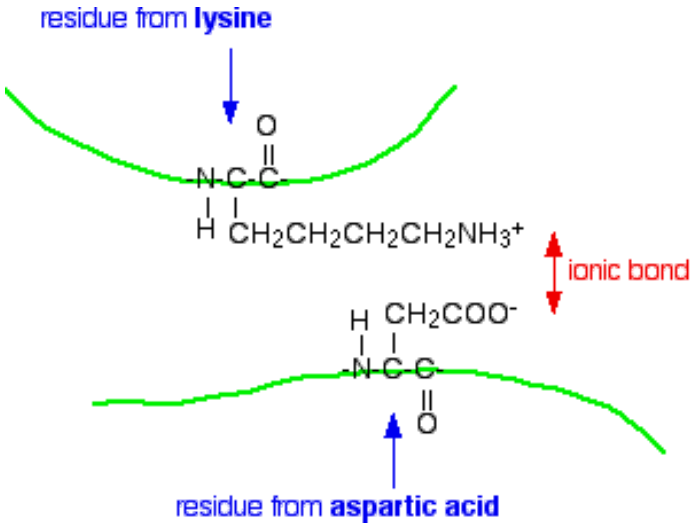
A polypeptide may fold entirely into an alpha-helix, or a beta sheet, or parts may fold into an alpha-helix and parts into a beta sheet.

A secondary structure has shape but no function

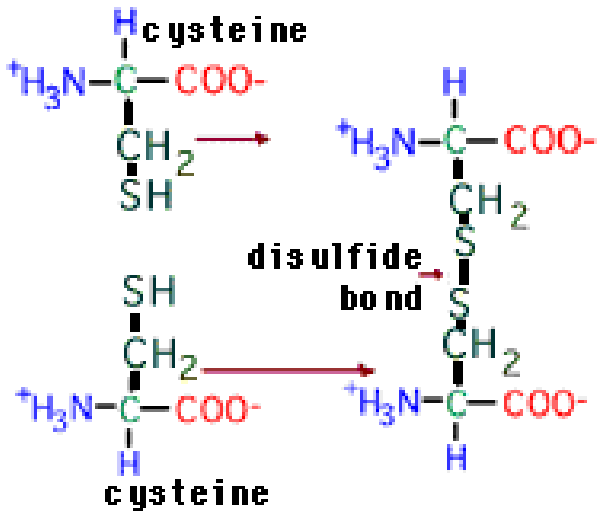
Tertiary structure

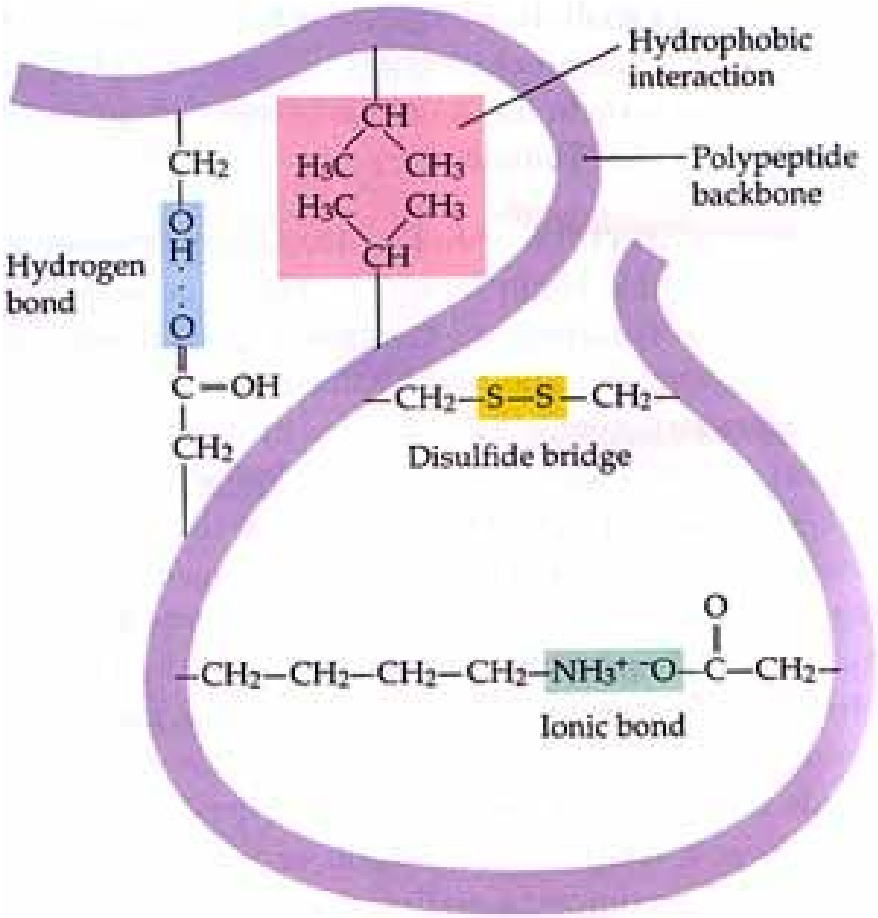
- The polypeptide is folded into a 3-D structure
- Now has shape + function
- Uses H-bonds, Ionic bonds, Disulphide bonds and hydrophobic interactions

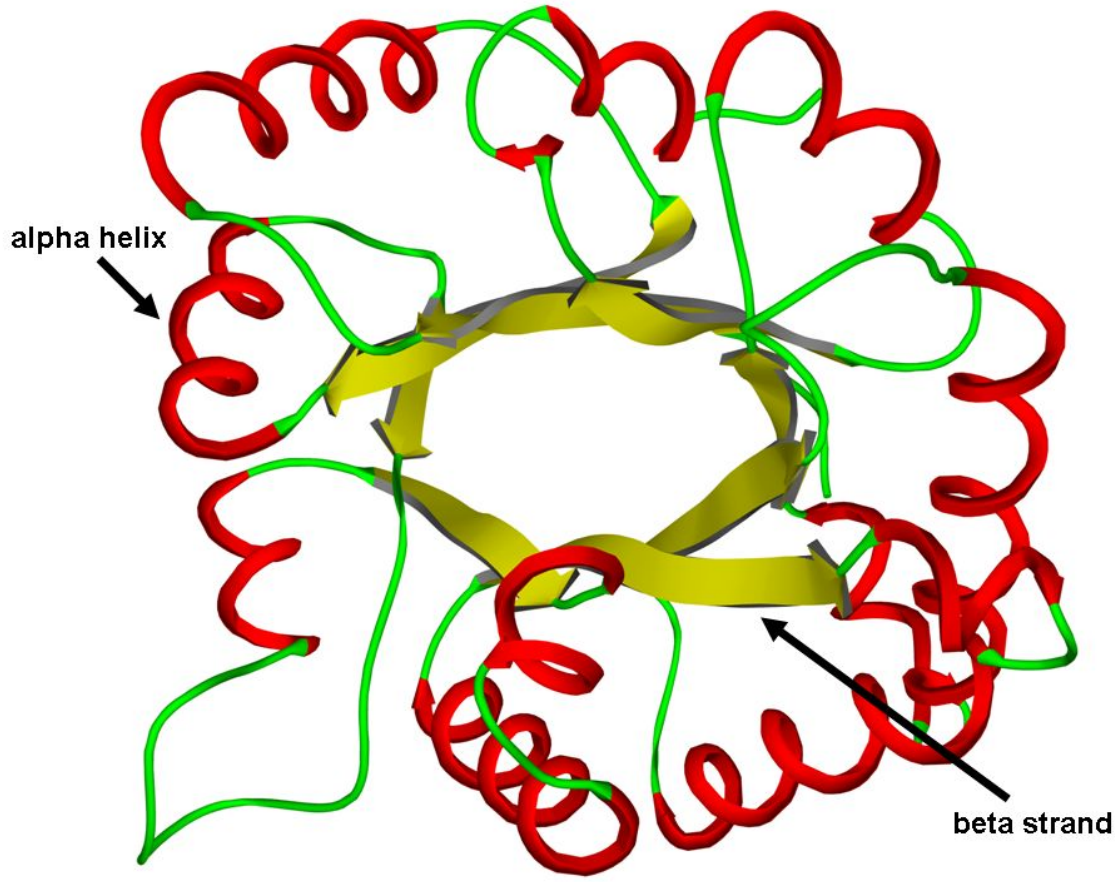
Ionic bond



Disulfide bond



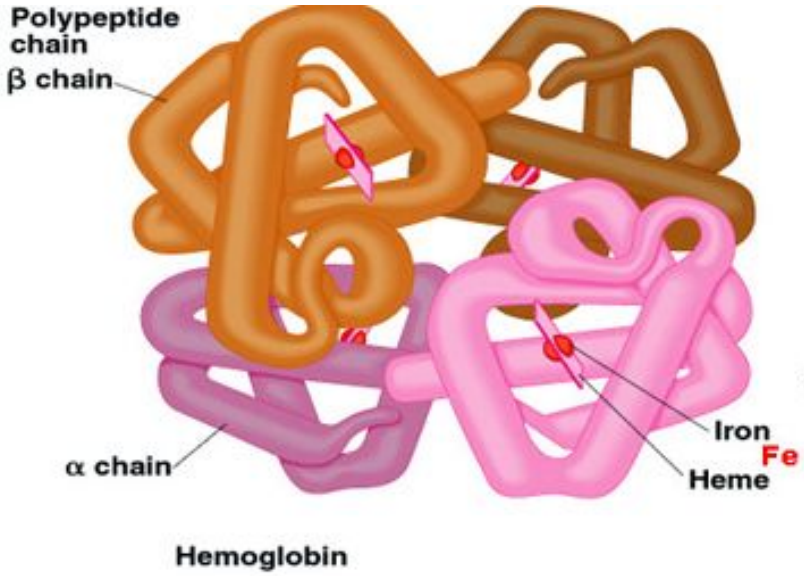

Hydrophobic interaction
Polypeptide backbone
Hydrogen bond
Disulfide bridge
Ionic bond


alpha helix
beta strand

Quaternary structure

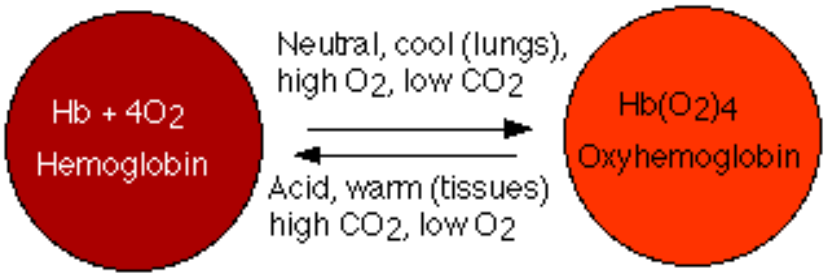
- Fourth level of organisation
- Formed by proteins already folded into their secondary or tertiary structure

Haemoglobin



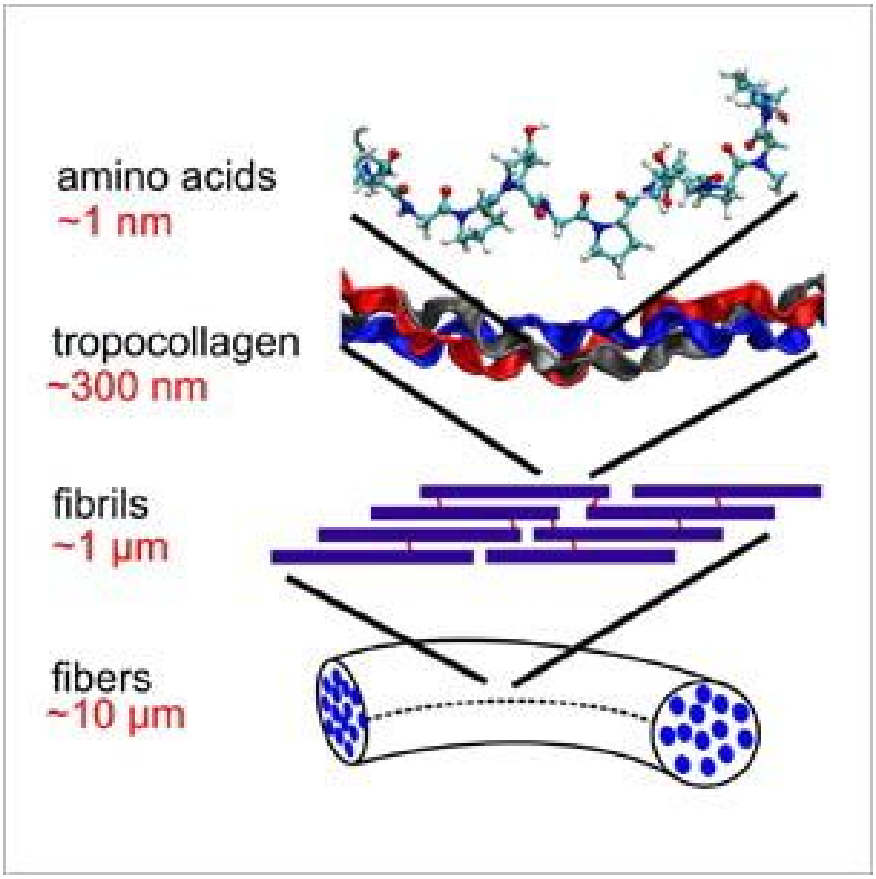
Hemoglobin

- 4 polypeptide chains (4 subunits) = globin
- Each folded into its tertiary structure
- Each subunit has an iron molecule in the centre, held flat by the HEME group (non-protein chemical group)
- Globular, compact shape



Collagen

- Fibrous protein
- Basic subunit - 3 strands woven together to form helix (tropocollagen) - 2º structure
- Helix joins together using H-bonds = fibrils - 3º str
- Fibrils joined together to form a collagen fibre - 4º (quaternary) str



Large number of H-bonds = strength = bones, cornea

H-bonds stretch, break and reform easily = elasticity = skin, tendons