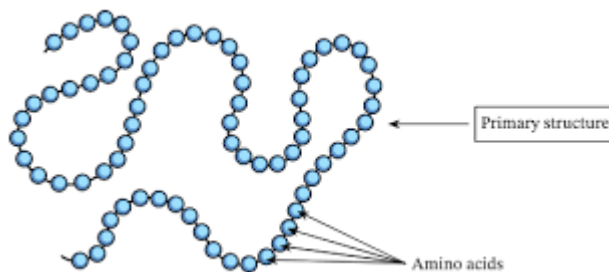


# Structure of proteins

## Primary Structure of Protein

- The Primary structure of proteins is the exact ordering of amino acids forming their chains.
- The exact sequence of the proteins is very important as it determines the final fold and therefore the function of the protein.
- The number of polypeptide chains together form proteins. These chains have amino acids arranged in a particular sequence which is characteristic of the specific protein. Any change in the sequence changes the entire protein.

The following picture represents the primary protein structure (an amino acid chain). As you might expect, the amino acid sequence within the polypeptide chain is crucial for the protein's proper functioning. This sequence is encrypted in the DNA genetic code. If mutation is present in the DNA and the amino acid sequence is changed, the protein function may be affected.



## Secondary Structure of Protein

**Secondary structure of protein refers to** local folded structures that form within a polypeptide due to interactions between atoms of the backbone.

- The proteins do not exist in just simple chains of polypeptides.
- These polypeptide chains usually fold due to the interaction between the amine and carboxyl group of the peptide link.
- The structure refers to the shape in which a long polypeptide chain can exist.
- They are found to exist in two different types of structures  $\alpha$  – helix and  $\beta$  – pleated sheet structures.
- This structure arises due to the regular folding of the backbone of the polypeptide chain due to hydrogen bonding between -CO group and -NH groups of the peptide bond.
- However, segments of the protein chain may acquire their own local fold, which is much simpler and usually takes the shape of a spiral an extended shape or a loop. These local folds are termed secondary elements and form the proteins secondary structure.

## SECONDARY STRUCTURE



$\alpha$ - helices     $\beta$ - sheets

### Secondary Structure of Protein

#### (a) $\alpha$ – Helix:

$\alpha$  – Helix is one of the most common ways in which a polypeptide chain forms all possible hydrogen bonds by twisting into a right-handed screw with the -NH group of each amino acid residue hydrogen-bonded to the -CO of the adjacent turn of the helix. The polypeptide chains twisted into a right-handed screw. The backbone adopts a cylindrical spiral structure in which there are 3.6 amino acids per turn. H-bonds occur between residues located in the  $n$  and  $n + 4$  positions relative to one another.

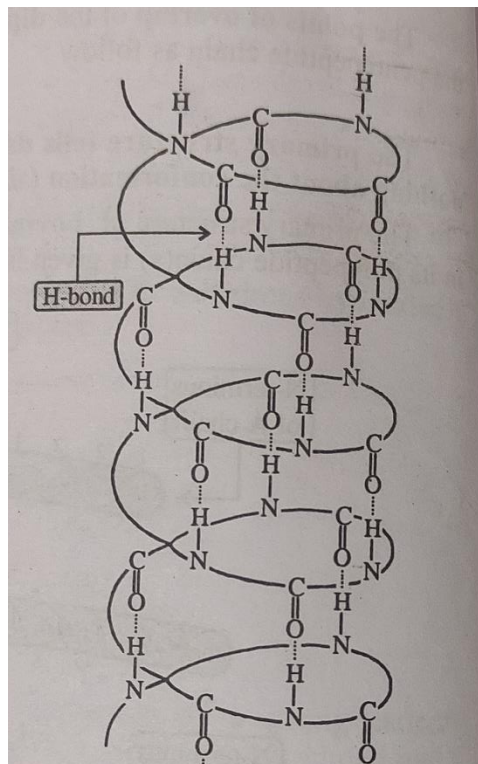


Figure: alpha-helical structure of polypeptide

#### (b) $\beta$ – pleated sheet:

In this arrangement, the polypeptide chains are stretched out beside one another and then bonded by intermolecular H-bonds. In this structure, all peptide chains are stretched out to nearly maximum extension and then laid side by side which is held together by intermolecular hydrogen

bonds. The structure resembles the pleated folds of drapery and therefore is known as  $\beta$  – pleated sheet. Strands can orient antiparallel or parallel to one another in  $\beta$  sheets. R-groups of every other amino acid point up or down relative to the sheet. Most  $\beta$  strands in proteins are 5 to 8 amino acids long.  $\beta$  Turns consist of 3-4 amino acids that form tight bends.

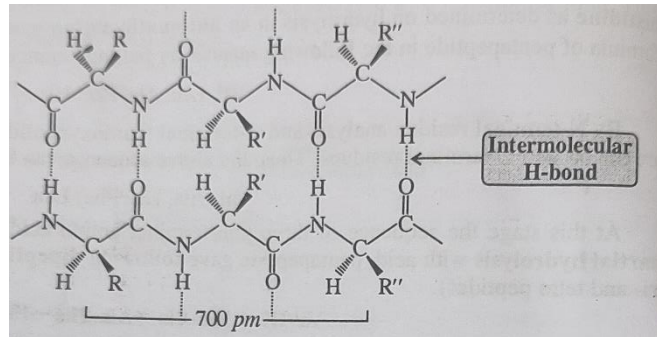


Figure: Beta-sheet structure of polypeptide

## Tertiary Structure of Protein

- This structure arises from further folding of the secondary structure of the protein.
- H-bonds, electrostatic forces, disulphide linkages, and Vander Waals forces stabilize this structure.
- The tertiary structure of proteins represents overall folding of the polypeptide chains, further folding of the secondary structure.
- It gives rise to two major molecular shapes called fibrous and globular.
- The main forces which stabilize the secondary and tertiary structures of proteins are hydrogen bonds, disulphide linkages, van der Waals and electrostatic forces of attraction.

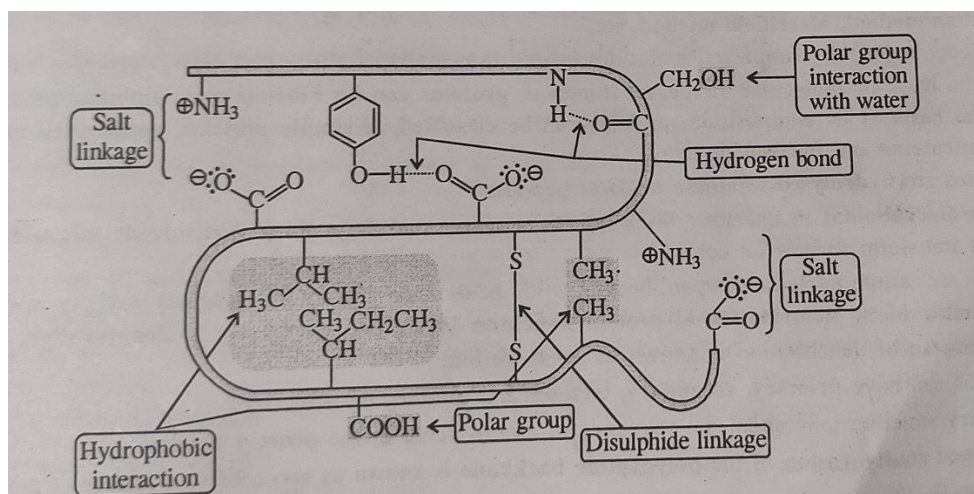


Figure: Bonds that stabilize the tertiary structure of protein

## Quaternary Structure of Protein

The spatial arrangement of various tertiary structures gives rise to the quaternary structure. Some of the proteins are composed of two or more polypeptide chains referred to as sub-units. The spatial arrangement of these subunits with respect to each other is known as quaternary structure.

**QUATERNARY  
STRUCTURE**

