

Protein Structure

1. Peptide bonds are the covalent bonds that join together individual amino acids within a protein. They are formed in a reaction in the ribosome in which the carboxyl group of one amino acid is joined to the amino end of another amino acid. Proteins always have a free alpha amino end and a free alpha carboxyl end.
2. Interesting molecules made from or containing amino acids include histamine (involved in allergies), nutrasweet (artificial sweetener made of aspartic acid and phenylalanine), and glutathione (cellular antioxidant).
3. Calculating the charge on a polypeptide is simple. One simply tallies the charge of the alpha carboxyl group, the alpha amino group, and all of the R groups. Note that the internal carboxyl/amino groups are destroyed in making the peptide bond.
4. Peptide bonds act like double bonds due to electronic resonance.
5. Primary structure of a polypeptide corresponds to the sequence of amino acids comprising it. Every property of a protein ultimately traces to the primary structure of a protein. As the primary structure changes, so too does the nature of what the protein can do changes.
6. Secondary structure arises from interactions between amino acids close to each other (within 10) in primary sequence. Alpha helices are common secondary structures in polypeptides. Alpha helices are stabilized by hydrogen bonds between the oxygen of a carbonyl group and a hydrogen on the amide four amino acids away. Forces that destabilize hydrogen bonds also destabilize alpha helices. Heat is one such force that destabilizes alpha helices. Soap is another.
7. Beta strands are other protein secondary structures. When aligned in multiple units, beta strands are referred to as beta sheets. The forces holding the strand together are hydrogen bonds.
8. Both alpha helices and beta sheets were discovered by the most famous scientist ever to graduate from OSU, Dr. Linus Pauling.
9. Fibrous proteins, such as the keratin of your hair, contain almost exclusively primary and secondary structure, but no tertiary or quaternary structure. Examples include keratin (hair, nails) and collagen. Proteins that 'fold' into glob-like structures are known as globular proteins. Globular proteins are far more common than fibrous proteins.
10. Globular proteins have a folded structure arising from turns between regions of secondary structure. Tertiary structure arises from interactions between amino acids that are NOT close in primary structure.
11. Turns are critically important for determining the overall three-dimensional structure of a protein. Turns occur over about a distance of 4 amino acids and involve amino acids with bulky or inflexible side chains. A common component of turns is the amino acid proline.
12. The following forces stabilize protein structure
 - Primary = peptide bonds (covalent)
 - Secondary = hydrogen bonds
 - Tertiary = hydrogen bonds, ionic interactions, hydrophobic interactions, covalent (disulfide) bonds,

ionic interactions

13. Proteins can have many regions of alpha helix and beta sheets within them. The overall 3D structure of a protein is a function of how all of them are arranged together.
14. Globular proteins have many folds and turns than arrange the helices and sheets into unusual patterns. The process whereby the protein assumes its final shape is called 'folding.'
15. Globular proteins that are soluble in water usually have their polar amino acids on the outside in contact with water and their non-polar amino acids on the inside associating with each other (thus avoiding water).
16. Disruption of forces that stabilize protein structure cause folded proteins to unfold. Unfolded proteins are not functional. We describe them as denatured. Denaturing agents include heat, detergent, acid or base.