07: All about Proteins

Key Terms

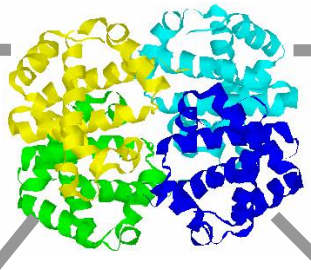
- **Antibody:** A specific protein that interacts with a foreign substance (antigen) in a specific way.
- **Beta-sheet (ß-sheet):** A sheet like structure formed by the interaction between two or more extended polypeptide chains.
- **Cytoskeleton:** The filamentous skeleton, formed in the eukaryotic cytoplasm that is largely responsible for controlling cell shape.
- **Dalton:** A unit of mass equivalent to the mass of a hydrogen atom (1.66 x 10-24 g)
- **Disulfide Bridge:** A covalent linkage formed between two cysteine-SH groups either in the same polypeptide chain or in different polypeptide chains.
- **Enzyme:** A molecule, most often a protein that contains a catalytic site for a biochemical reaction.
- **Globular protein:** A folded protein that adopts an approximately globular shape. May also be called soluble proteins.
- **Glycoprotein**: A protein linked to an oligosaccharide or a polysaccharide. Glycosaminoglycans. Long, unbranched polysaccharide chains composed of repeating disaccharide subunits in which one of the two sugars is either N-acetylglucosamine or N-acetylgalactosamine.
- **Nuclear Magnetic Resonance:** NMR is a phenomenon which occurs when the nuclei of certain atoms are immersed in a static magnetic field and exposed to a second oscillating magnetic field. Some nuclei experience this phenomenon, and others do not, dependent upon whether they possess a property called spin.
- **Polypeptide:** A linear polymer of amino acids held together by peptide bonds.
- **Inducible proteins:** Those which are synthesized in different amounts depending on cellular signals.
- **Isoelectric point or pH**: The pH at which a protein has no net charge.
- **Membrane Protein:** A protein associated with a membrane, rather than found free in the cell. A membrane protein may be integral (embedded or buried) in the membrane, or peripheral (attached more loosely to the membrane.
- **Myosin:** The main protein of the thick filaments in a muscle myofibril. It is composed of two coiled subunits (Mr about 220,000) that can aggregate to form a thick filament, which is globular at each end.
- **Structural Protein:** A protein that serves a structural function.
- **Transport Protein:** A protein whose primary function is to transport a substance from one part of the cell to another, from one cell to another, or from one tissue to another.
- **Unwinding Proteins:** Proteins that help to unwind double-stranded DNA during DNA replication.
- **X-ray crystallography:** is an experimental technique that exploits the fact that X-rays are diffracted by crystals.
- **Zymogen:** An inactive precursor of an enzyme. For example, trypsin exists in the inactive form trypsinogen before it is converted to its active form, trypsin.

Amino Acids – Building Blocks

- **pKa:** is defined as negative logarithm of Ka (the dissociation constant for a acid). Since there are two groups viz. amino and carboxyl. In an amino acid both of them will dissociate at a particular pH. Therefore we get two pKa values (pK1 and pK2).
- **pI:** is the isoelectric point where the net charge on the amino acid is zero and is the average of pK1 and pK2.

The box below explains about the proteins with hemoglobin as example

3D structure of Hemoglobin



- The picture shows the 4 monomeric subunits of Hemoglobin; they are colored differently for clarity.
- The individual subunits are polypeptide chains.
- This picture represents the quaternary structure of the protein.
- There are two alpha and two beta subunits.
- The 3D structure is important for its function.

The main function of Hemoglobin is to transport oxygen to the tissues in the body and to remove the carbon dioxide from them.
The binding of hemoglobin to oxygen is very much related to its native structure.
If there be any change in its structure (e.g. A mutation as in SCA, it results in defective binding of oxygen resulting in severe anemia.

- The 3D structure of the protein is dependent on the amino acids in the sequence.
- The nature of the side chain of the amino acid and its dissociation under a particular pH is also important for the 3D structure.
- If there be any change in its structure (e.g. a mutation as in SCA it results in defective binding of oxygen resulting in severe anemia.
- Four molecules of oxygen bind to hemoglobin.
- The binding of first oxygen enhances the binding of successive molecules – a property called positive cooperativity.

- The angles between various atoms in a peptide bond are important.
- Because those angles and their freedom of rotation only determines the type of secondary structure.
- A typical example is collagen; a triple helical protein is with a predominantly alpha helical structure.
- Its function is fully dependent on its triple helical structure.
- Ramachandran's plot explains about the type of secondary structure formed with given set of psi and phi angles.

How to Use This Cheat Sheet: These are the keys related to this topic. Try to read through it carefully twice then recite it out on a blank sheet of paper. Review it again before the exams.

