

PROTEINS

- The Molecules which yields amino acids upon hydrolysis are called proteins.
- Proteins are natural polymer of amino acids.
- The number of amino acids in a protein molecule may range from two to several thousands.
- Protein molecules contain Nitrogen, Carbon, Hydrogen and Oxygen.

PROTEINS

- Proteins are the basis for the major structural components of animal and human tissue.
- They act as biological catalysts (Enzymes), form structural parts of organisms, participate in different cell reactions, act as molecules of immunity and also provide fuel.

Classification of Proteins

- Classification of proteins on their composition
- Classification by structure
- Classification by biological function
- Classification by shape and solubility
- Classification on nutritional basis

CLASSIFICATION OF PROTEINS

(a) Simple Proteins

- Those which give one amino acid only upon hydrolysis.

(b) Conjugated Proteins

- Those which give an amino acid and a non-protein group upon hydrolysis.

(c) Derived Proteins

- Those which are derived from simple and conjugated proteins.

(a) SIMPLE PROTEINS - Albumins



Blood
(Serumbumin)



Milk
(Lactalbumin)



Egg White
(Ovolbumin)



Lentils
(Legumelin)



Kidney Beans
(Phaseolin)



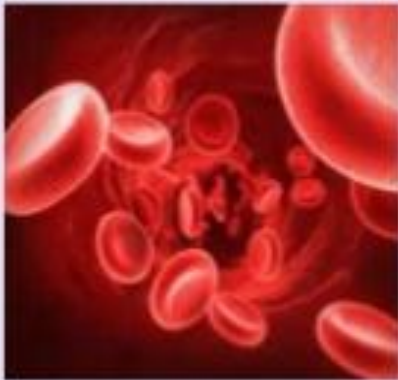
Wheat
(Leucosin)

Prepared by: Sidra Javed

(a) Simple Proteins - Albumins

- Globular protein is insoluble in water and dilute salt solution.
- Precipitated by saturation with $(\text{NH}_4)_2\text{SO}_4$ solution.
- Coagulated by heat.
- Found in plant and animal tissue.

(a) Simple Proteins - Globulins



Blood (Serum Globulins)



Muscles (Myosin)



Potato (Tuberin)



Brazil Nuts (Excelsin)



Hemp (Edestin)



Lentils (Legumin)

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(a) Simple Proteins - Globulins

- Globular Protein is sparingly soluble in water and neutral solutions.
- Precipitated by dilute Ammonium Sulphate.
- Coagulated by Heat.
- Distributed in both plant and animal tissues.

(a) Simple Proteins - Glutelins



Wheat (Glutenin)



Rice (Oryzenin)

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(a) Simple Proteins - Glutelins

- Insoluble in water and dilute salt solutions.
- Soluble in dilute acids.
- Found in grains & cereals.

(a) Simple Proteins - Histones

- Thymus Gland, Pancrease and Nucleoproteins (Nucleohistones).
- Soluble in water, salt solutions & dilute acids.
- Insoluble in Ammonium Hydroxide.
- Yeilds large amount of Lysine & arginine.
- Combined with nucleic acids within cells.

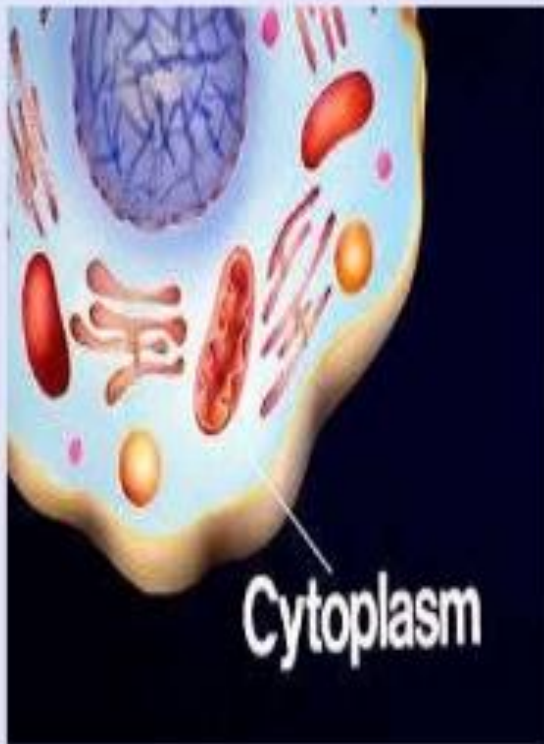
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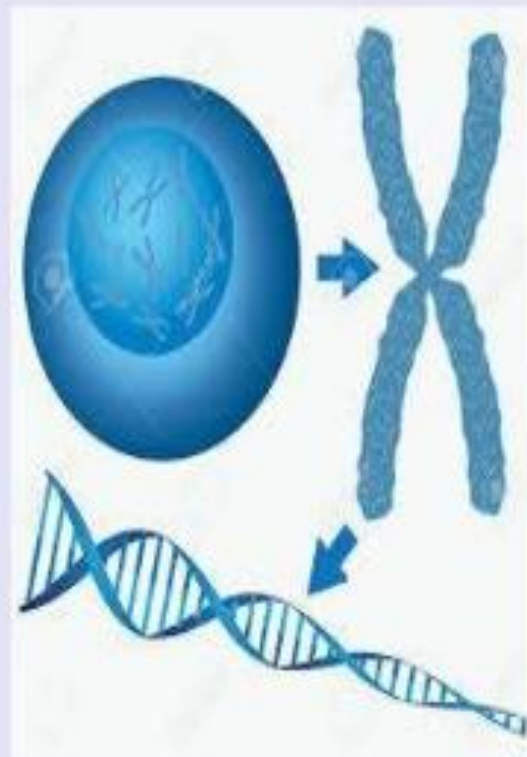
(a) Simple Proteins - Scleroproteins

- Connective tissues and hard tissues.
- Fibrous protein is insoluble in all solvents.
- Resistant to digestion.

(a) Conjugated Proteins - Nucleoproteins



Cytoplasm of Cells
(Ribonucleoprotein)



Nucleus of Chromosomes &
Ribosomes
(Deoxyribonucleoprotein)



Viruses &
Bacteriophage

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(a) Conjugated Proteins - Nucleoproteins

- It contains nucleic acids, nitrogen and phosphorus.
- It is present in chromosomes and in all living forms as a combination of protein with either DNA or RNA.

(b) Conjugated Proteins - Mucoprotein

- Saliva (Mucin) and Egg white (Ovomucoid).
- Proteins combined with amino sugars, sugar acids and sulfates.

(b) Conjugated Proteins - Glycoproteins

- Bones (Osseomucoid), Tendons (Tendomucoid) and Cartilage (Chondromucoid).
- Containing more than 4% Hexosamine, mucoproteins; if less than 4%, then Glycoproteins.

(b) Conjugated Proteins – Phosphoproteins

- Milk (Casein) and Egg yolk (Ovovitellin).
- Phosphoric acid joined in ester linkage to protein.



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(c) Derived Proteins - Proteans

- Edestan (from Elastin) and Myosin (Myosin).
- It results from short action of acids or enzymes
- Insoluble in water.

(c) Derived Proteins - Proteases

- Intermediate product of protein digestion
- Soluble in water.
- Not coagulated by heat.
- Precipitated by saturated ammonium sulphate
- Result from a partial digestion of protein by pepsin or trypsin.

(c) Derived Proteins -Peptones

- Intermediate product of protein digestion
- Same properties as proteases except that they cannot be salted out.
- Smaller molecular weight than proteases.

(c) Derived Proteins - Peptides

- Intermediate product of protein digestion
- Two or more amino acids joined by a peptide linkage.
- Hydrolyzed to individual amino acids.

CLASSIFICATION BY STRUCTURE



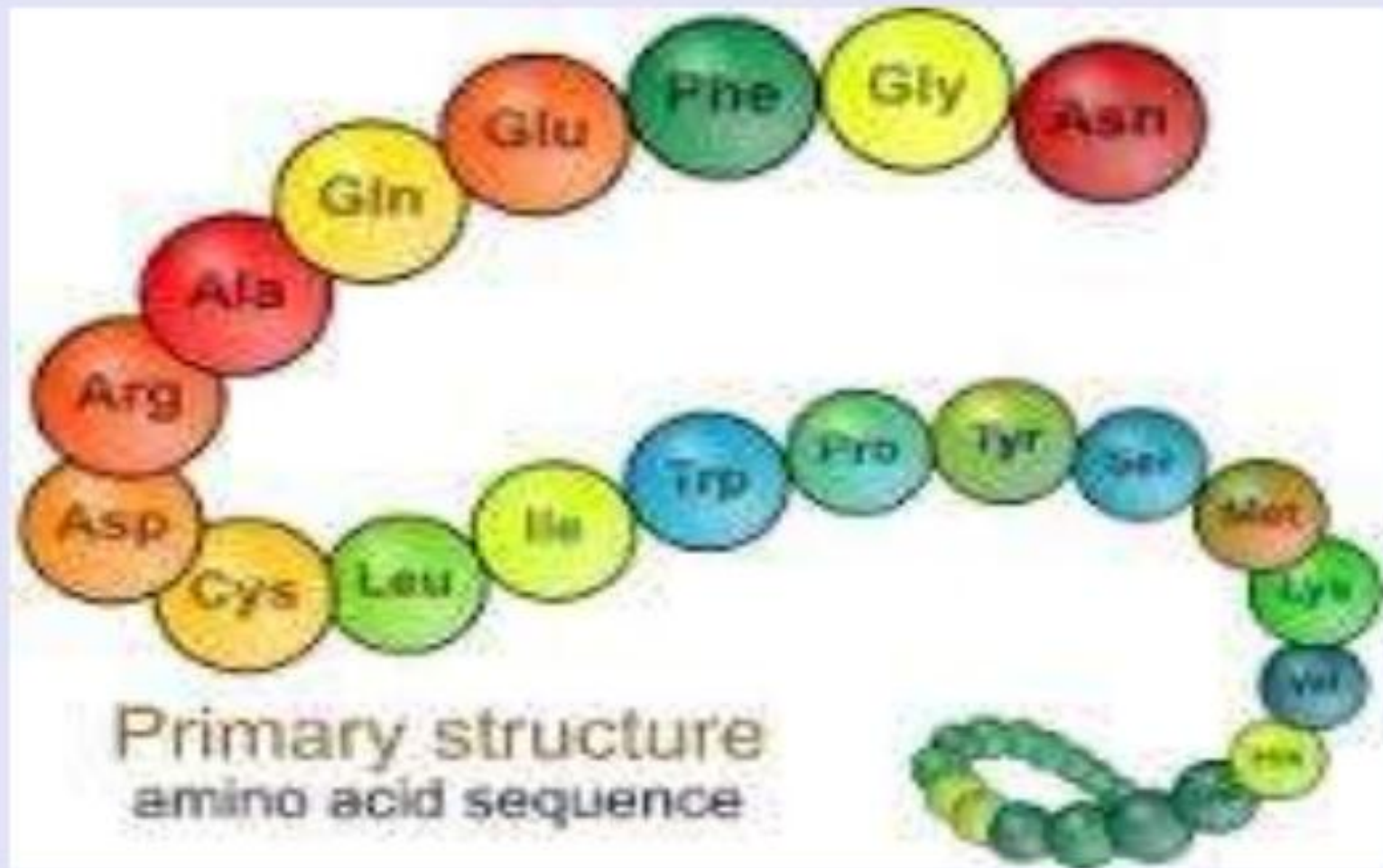
STRUCTURE OF PROTEINS

- Depends upon the spatial arrangement of polypeptide chains.
- Three arrangements are possible.
- Four structures:
 - i. Primary structure
 - ii. Secondary structure
 - iii. Tertiary Structure
 - iv. Quaternary Structure

The Primary Structure Of Proteins

- The sequence of amino acids in a polypeptide chain is called a primary structure.
- Amino Acids are linked with one another through peptide bonds.

The Primary Structure Of Proteins

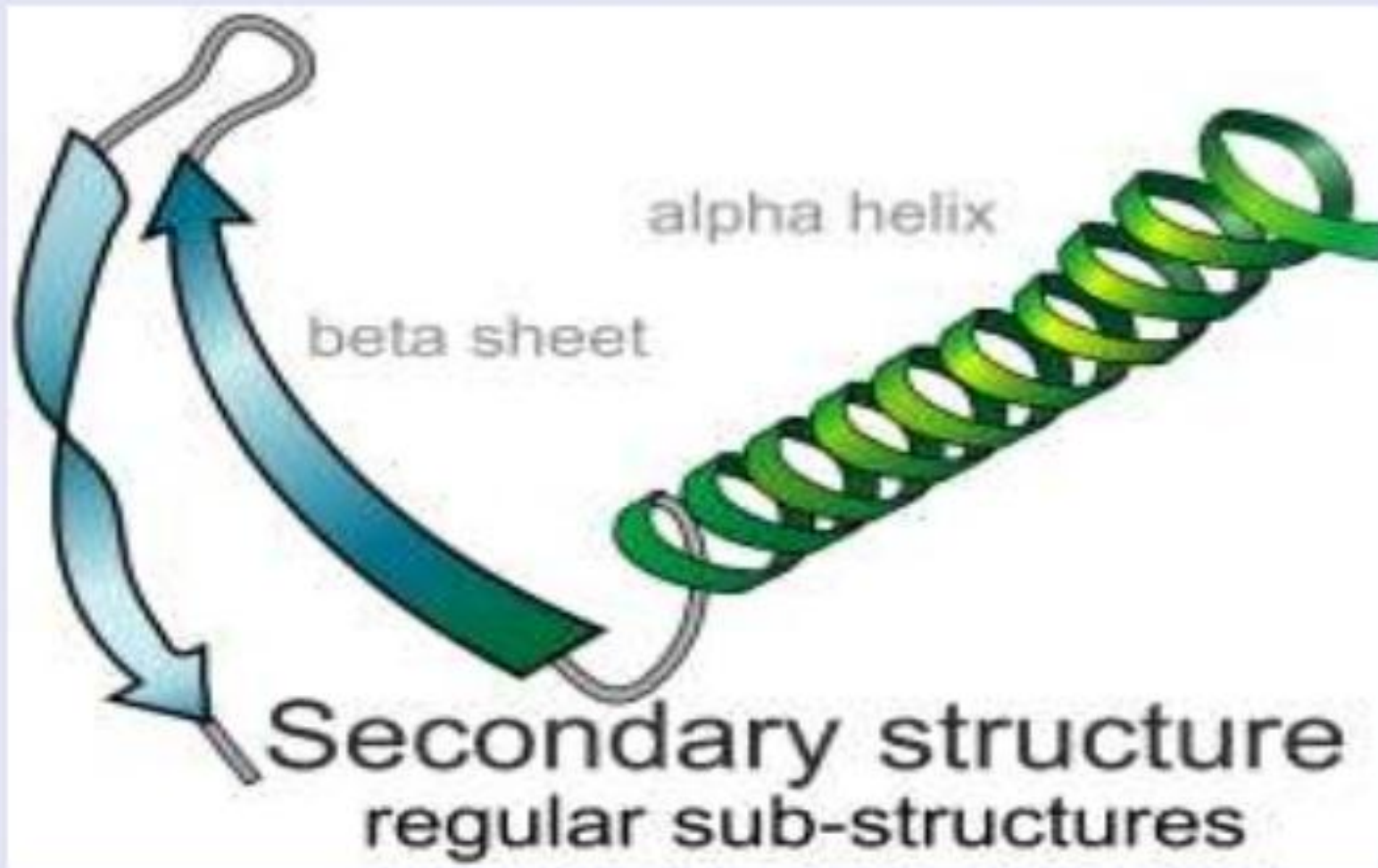


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The Secondary Structure Of Proteins

- Peptide chains may acquire spiral shape or may be present in a zig zig manner.
- This coiling of peptide chains is called the secondary structure of proteins.
- It is due to Hydrogen bonding.

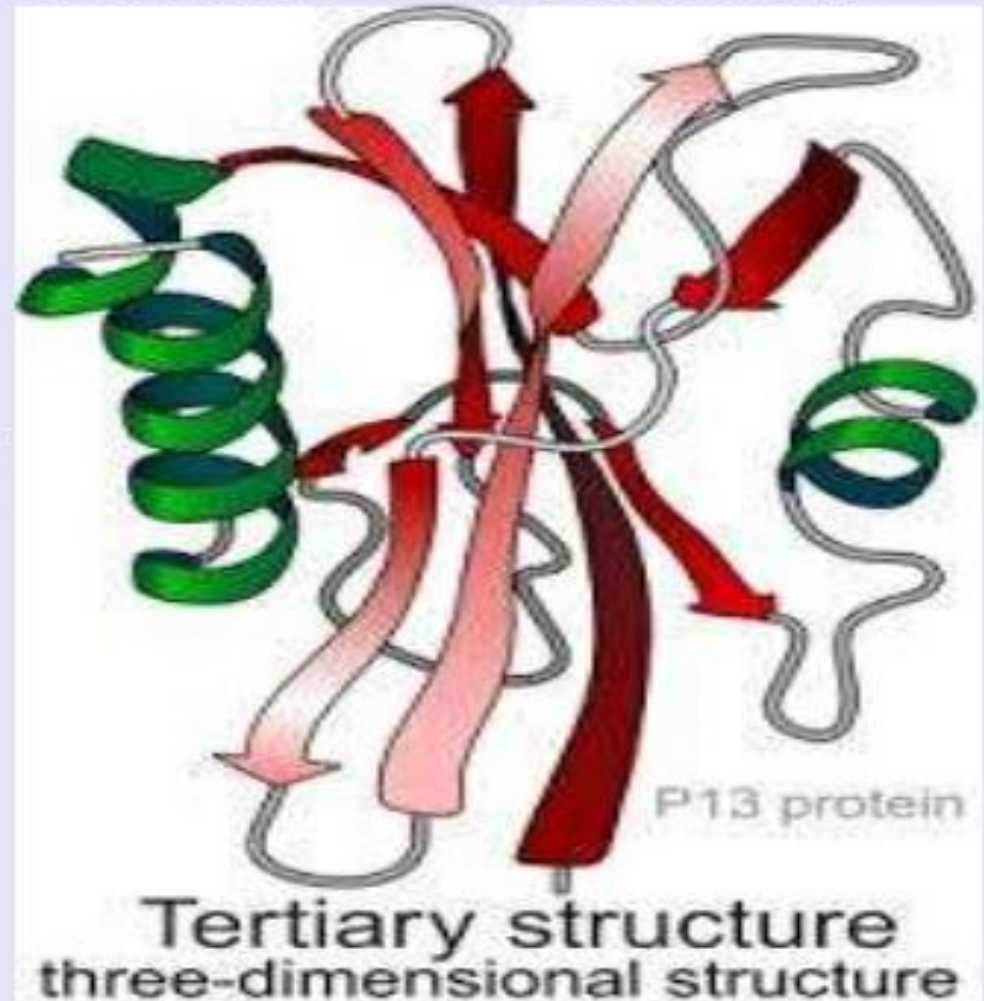
The Secondary Structure Of Proteins



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The Tertiary Structure Of Proteins

- Twisting or folding of polypeptide chains represents tertiary structure of proteins.



The Quaternary Structure Of Proteins

- Quaternary means four.
- It is the arrangement of multiple folded protein or coiling protein molecules in a multi-subunit complex.
- A variety of bonding interactions including Hydrogen bonding, salt bridges and disulfide bonds holds the various chains into a particular geometry.

The Quaternary Structure Of Proteins



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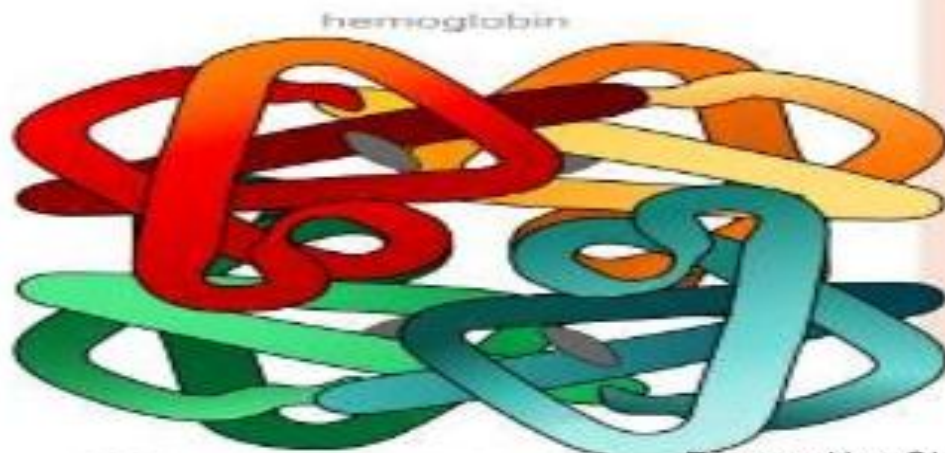
Primary structure
amino acid sequence



alpha helix

beta sheet

Secondary structure
regular sub-structures



Tertiary structure
three-dimensional structure

Quaternary structure
complex of protein molecules

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CLASSIFICATION BY BIOLOGICAL FUNCTION



ENZYMES

Substrate

Products of
the Reaction

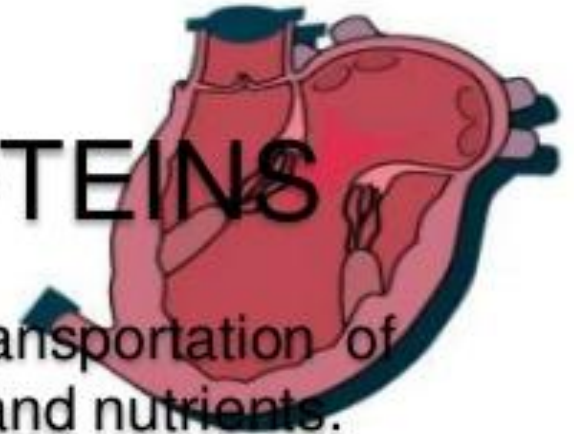
○ Those proteins which are highly specialized in their function with catalytic activity.

○ These proteins regulate almost all biological reactions going on inside all living cells.

○ There are about 2000 different enzymes has been recognized; each capable of catalyzing a different kind of biochemical reaction.

Enzyme

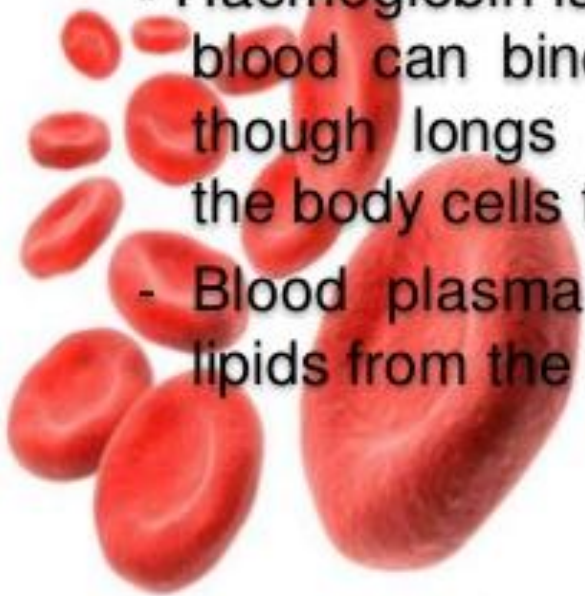
TRANSPORT PROTEINS



- are those proteins which help in transportation of life sustaining chemicals vital gases and nutrients.
- Carry essential substances throughout the body.
- Example:

- Haemoglobin is a globular protein present in RBC of blood can binds with oxygen when blood passes through lungs and distributes oxygen through out the body cells to affect cellular respiration.

- Blood plasma contains lipoprotein which carries lipids from the liver to other organs.



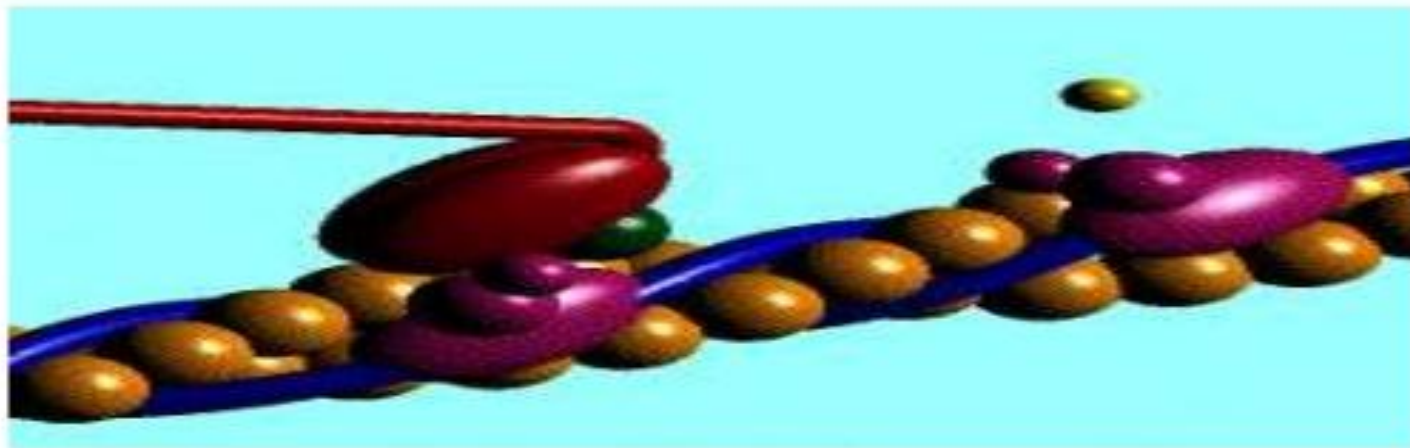
STORAGE PROTEINS

- are those stored inside the cells or tissue as reserved food and can be mobilized at the time of nutrient requirement to provide energy.
- Store nutrients.
- Example:
 - *Casein stores protein in milk.*
 - *Ferritin stores iron in the spleen and liver.*



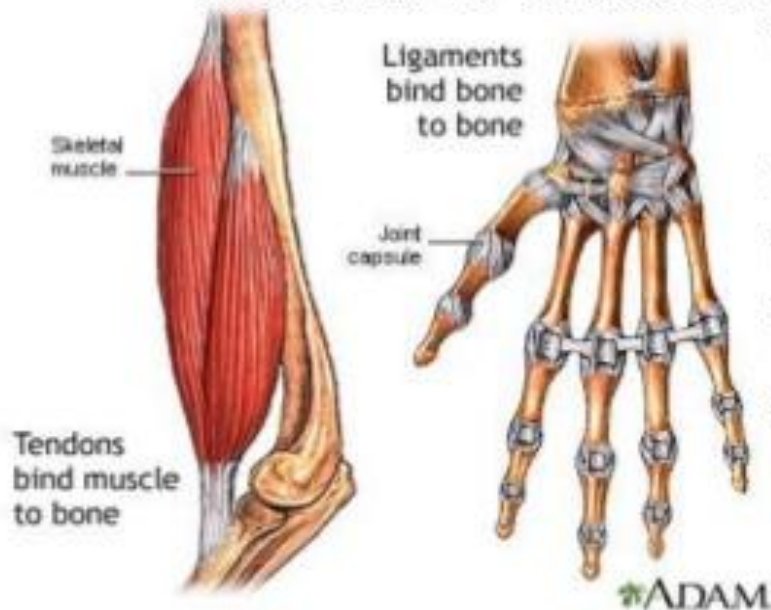
CONTRACTILE/MOTILE PROTEINS

- Move muscles.
- the ability to contract to change the shape or to move about.
- These proteins includes. Actin and myosin; which are present in form of filamentous protein in muscle cells for functioning in the contractile systems.



STRUCTURAL PROTEINS

- This type of protein form major component of tendons, cartilages and bones.
- These are fibrous proteins named collagen. Ligaments are contains special structural protein capable of stretching in two dimensions called as



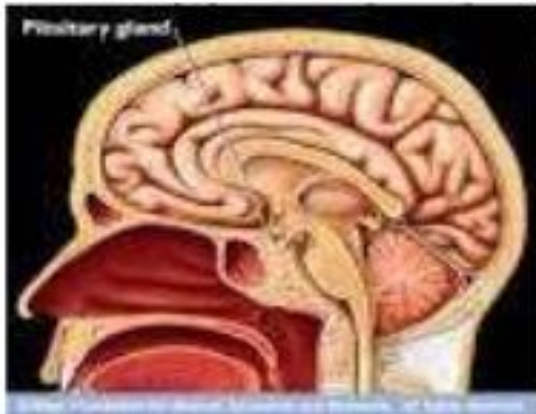
athers of birds consists of toughened keratin.

silk fibers, threads of spider and protein named fibroin.



REGULATORY PROTEIN

- Some proteins help to regulate cellular or physiological activity. Among them are many hormones, such as insulin; which is a regulatory protein formed in pancreatic tissue help to regulate the blood sugar level.
- Growth hormones of pituitary and parathyroid hormones regulate Ca^{++} and phosphate transport in body. Other proteins called repressors regulate of enzymes.



OTHER FUNCTIONAL PROTEINS

- There are number of proteins whose functions are not yet specified and are rather exotic. These includes –
- **Monelin:** - A protein of an African plant has an intensely sweet taste and used as non toxic food sweetener for human use.
- **Antifreeze:** A protein present in blood plasma of Antarctic fisher which protect their blood freezing in ice cold water.
- **Resillin:** A type of protein present in wing hinges of some insects with elastic properties.



CLASSIFICATION BY SHAPE & SOLUBILITY



FIBROUS PROTEINS

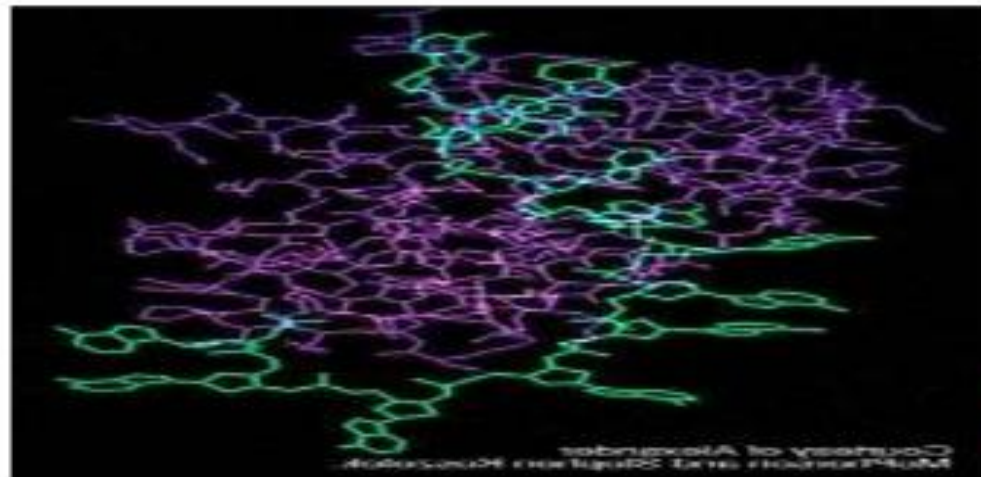
- these proteins have a rod like structure. They are not soluble in water.

(a) These are made up of polypeptide chain that are parallel to the axis & are held together by strong hydrogen and disulphide bonds.

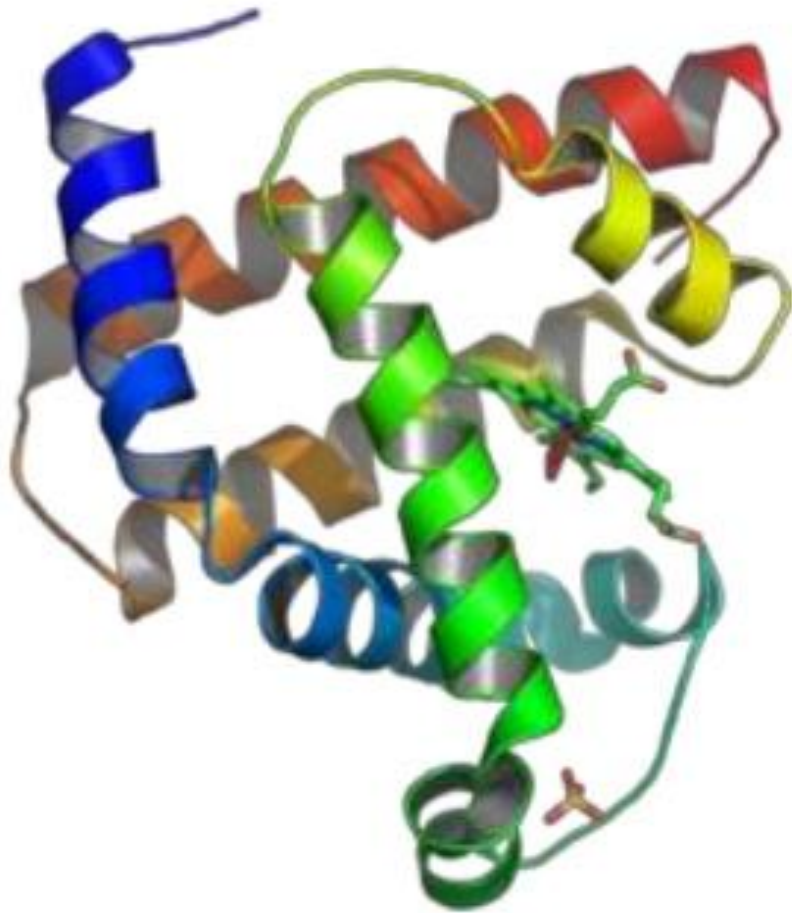
(b) They can be stretched & contracted like thread.

- Examples:

- Collagen
- Keratin
- Fibrinogen
- Muscle protein



GLOBULAR PROTEINS



- these proteins more or less spherical in nature. Due to their distribution of amino acids (hydrophobic inside, hydrophilic outside) they are very soluble in aqueous solution.
- Examples
Myoglobin, albumin, globulin, casein, haemoglobin, all of the enzymes, and protein hormones.



NUTRITIONAL BASIS



COMPLETE PROTEINS

- A complete protein contains an adequate amount of all of the essential amino acids that should be incorporated into a diet.
- Some protein contains all the amino acids needed to build new proteins, which generally come from animal and fish products. A complete protein must not lack even one essential amino acid in order to be considered complete.
- Sources: The following foods are examples of complete proteins, which need not be combined



INCOMPLETE PROTEINS

- An incomplete protein is any protein that lacks one or more essential amino acids in correct proportions. These can also be referred to as partial proteins.
- Even if the protein contains all the essential amino acids, they must be in equal proportions in order to be considered complete. If not, the protein is considered incomplete.
- Sources of Incomplete Proteins: Grains, Nuts, Beans, Seeds, Peas, Corn

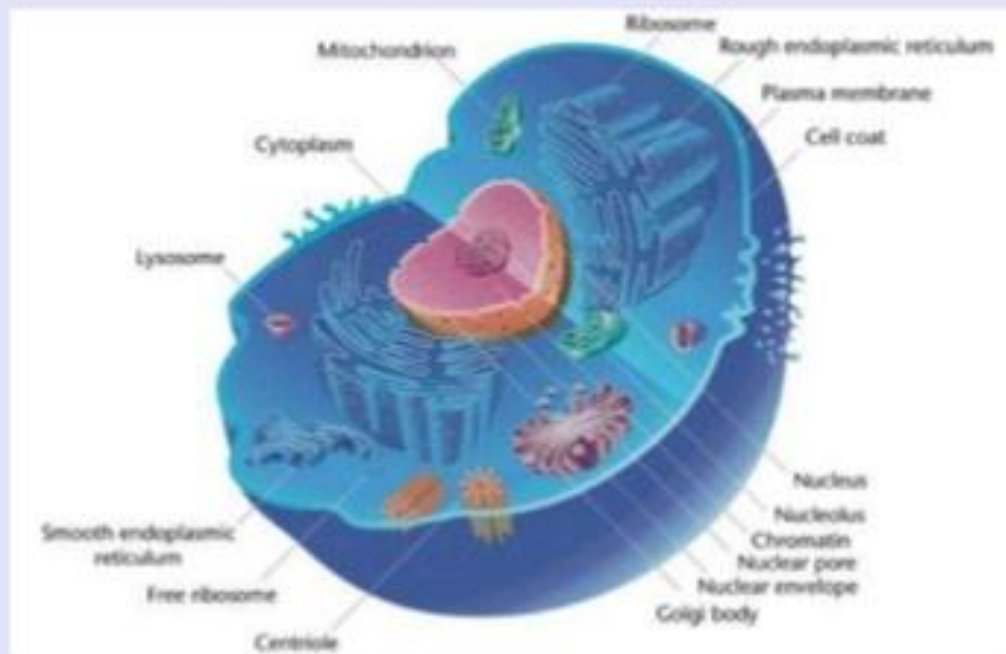


Properties Of Proteins

- Found in all living organisms.
- Involved in processes such as digestion of food, cell structure, catalysis, movement, energy manipulation etc.
- Complex molecules.
- Polymers of amino acids.
- Long chains of amino acids are called Polypeptides.

Importance of Proteins

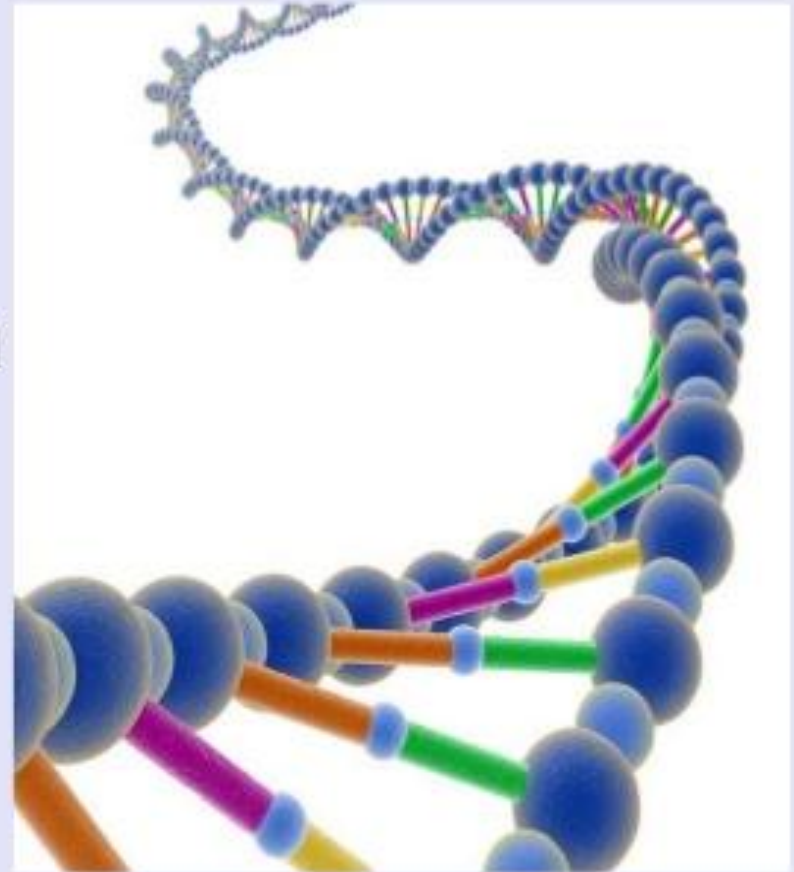
- Proteins play an important role in formation of protoplasm.



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Importance of Proteins

- Nucleoproteins are complex proteins and act as the carrier of heredity materials from one generation to another.



Importance of Proteins

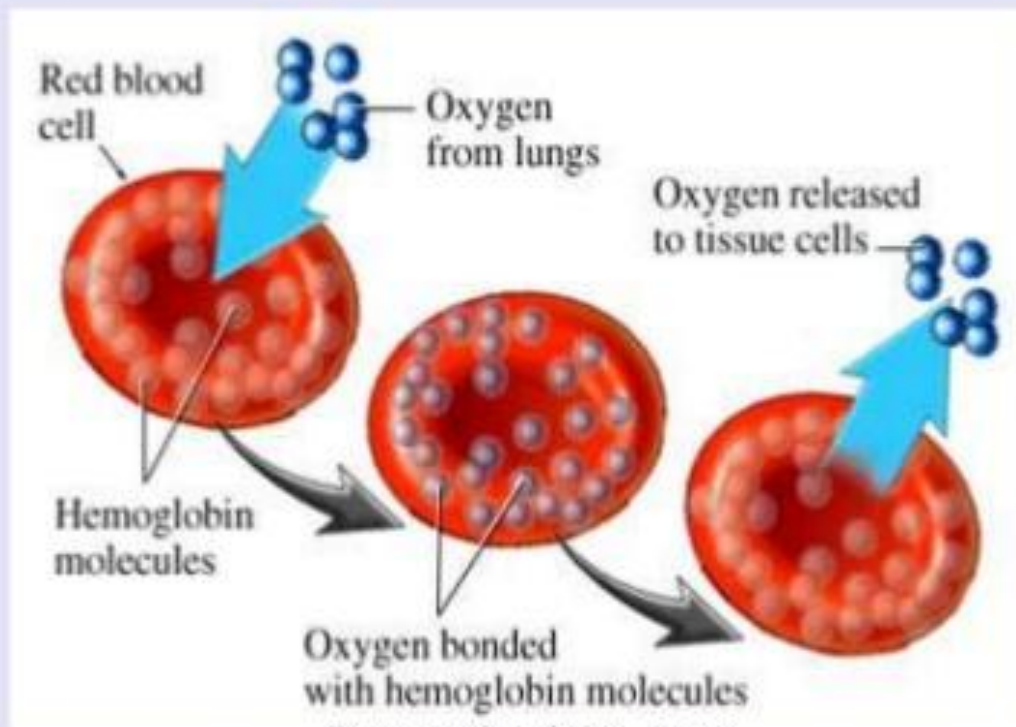
- Enzymes are the biological catalyst and they are also proteins



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Importance of Proteins

- Hemoglobin is a protein. It act as oxygen carrier.



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Importance of Proteins

- Tanning of hides is actually precipitation of proteins by tannic acid.



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Importance of Proteins

- Gelatin is obtained by heating bones, skins and tendons in water. It is used in bakery goods.



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Importance of Proteins

- Casein is another protein used in manufacture of buttons and buckles.
- Proteins obtained from soya bean are used for manufacture of plastics.

