BIO-MEDICAL IMPORTANCE OF PROTEINS
Like other Biological Macromolecules such as polysaccharides and nucleic acids, Proteins are essential parts of all living organisms and participate in every process within cells.
The RDA of protein intake for **adults** is **0.8 g** per kilogram of body mass.

For **children**, a higher intake is recommended **2 to 4 g/kg** of body mass.

Protein intake should be **increased** by **10g a day** for **pregnant** women and **20 g daily** for **nursing mother**.

The protein requirements **decreases with age**.

**Stress, disease, injury, and prolonged heat exposure** increases the protein requirement.
Proteins are essential building blocks of the cells

- Form a major part of body, next to water.
- Essential component of Protoplasm.
- Essential component of the biological membranes (cell membrane, Nuclear membrane and membranes of the organelles).
- Make the basic structure of muscles, skin, hair, nail, bones and all the tissues of the body.
- Essential for the repair of damaged tissues.
BIO-MEDICAL IMPORTANCE

- Cell membrane
- • Connective tissue (collagen & elastin)
- • Inert protein (hair & nails)
- • Enzymes
- • Hormones (insulin)
- • Fluid balance
- • Blood proteins (albumin & haemoglobin)
- • Skeletal & smooth muscle
- • Antibodies (Immunoglobulins)
- • Energy source
- • Acid-base regulator
- • Transporters
BIO-MEDICAL IMPORTANCE

- Regulation
- Movement
- Signaling
- Catalysis
- Proteins
- Immune
- Transport
Enzymes determine the functions:
- Enzymes are powerful catalysts for biological reactions.
- Specific type of proteins are enzyme.

Hormones regulate metabolism:
- Many proteins such as Insulin and Growth hormone are well known regulators of metabolic reactions.
Proteins are the molecular instruments through which genetic information is expressed.
Genetic Proteins (DNA-binding proteins):

Within Chromosomes, DNA (Genes) are held in complexes with structural Proteins (Histones).
DNA wound around Histone allows about two meters of DNA to fit into a small nucleus of some μ in diameter
Contractile Proteins:
- Actin & Myosin are the specialized proteins responsible for muscle contraction.

Storage Proteins:
- These are the storage forms of protein for nutritional purposes e.g. ovalbumin in egg white, gliadin in wheat and zein in maize.

Coagulation Proteins:
- Help in the coagulation of blood e.g. fibrinogen and Prothrombin.
Defensive mechanism against injurious agents

- Antibodies (Immunoglobulins):
  - Antibodies, (γ-Globulin) playing a vital role in defense mechanism of the body.
Transport of molecules

- Many proteins transport & bind particular small molecules and transport them to other locations in the body such as:
  - Hemoglobin :: carries O2
  - Albumin carries :: iron and bilirubin
Plasma proteins exert colloid osmotic pressure which is necessary to maintain:

- Water balance of the body.
- Proper circulation of blood.

**Energy:**

- 1 Gm of dietary protein provides about 4.2 kilocalories.
Structural Role of Proteins

- **Essential building blocks of the cells.**
  - Form a major part of body, next to water.
  - Essential component of Protoplasm.
  - Essential component of the biological membranes (Cell membrane, Nuclear membrane and membranes of the organelles).

- **Essential for the repair of damaged tissues.**
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.
People are deprived of protein, energy or both result in PEM. Forms of PEM are Kwashiorkor and Marasmus.

In undeveloped countries PEM is most frequently in hospitalized patients with chronic illness, or in individuals who suffer from major trauma, severe infection, or the effects of major surgery.
Kwashiorkor (Inadequate Intake Of Proteins)

- Kwashiorkor is a kind of malnutrition.
- Primarily due to insufficient intake of proteins.
- Extreme muscle wasting (emaciation), weakness.
- Edema.
- Skin lesions, Depigmented hair.
- Enlarged fatty liver, Plump belly.
Marasmus

- **Marasmus** is a kind of malnutrition that occurs due to deficiency of proteins, carbohydrates and fats in the diet.

- **Symptoms:** Arrested growth, extreme muscle wasting (emaciation), weakness, and anemia. Victims of Marasmus do not show the edema.
EXCESS PROTEIN

- Dietary protein consumed in excess of requirements is not stored, but is deaminated, or its storage as glycogen or fat, depends upon the specific amino acid and the energy balance. The nitrogen waste generated is excreted in the urine as either urea or ammonia.
- High protein intakes can increase urinary calcium excretion.
- long-term high protein intakes to risk of renal disease or of diabetic nephropathy.
DISEASES RELATED TO PROTEIN EXCESS

- **Heart Disease**: Food rich in animal protein are rich in saturated fats. The amino acid homocysteine may be a risk factor for heart disease. But arginine may be protective.

- **Cancer**: Colon, Breast, Kidney, Pancreas & Prostate.

- **Adult bone loss**: (osteoporosis) - Calcium excretion rises as protein intake increases.

- **Kidney diseases**: Protein rich diet increases the work of kidney.
DISEASES RELATED TO PROTEIN EXCESS

- **Diabetes mellitus**: due to abnormal synthesis of Insulin (A Protein).
- **AIDS**: due to deficiency of immunoglobulins (Specific Defence proteins).
- Hundreds of **other diseases** due to deficiency of enzymes (Specific types of proteins).
Alzheimer's Disease (β amyloid)
Parkinson's Disease (α synuclein)
Diabetes mellitus
AIDS
Sickle cell Disease
Thalassemia
Proteins as diagnostic tools

- **Alpha-fetoproteins.**
  - For the diagnosis of fetal anomalies especially Tumors.

- **Bence Jones protein.**
  - Found in the urine of patients suffering from a disease of spinal cord known as Multiple Myeloma.

- **Albumin in urine.**
  - Found in patients with renal disorders especially in Nephrotic Syndrome.