



**SNS COLLEGE OF ALLIED HEALTH SCIENCES**

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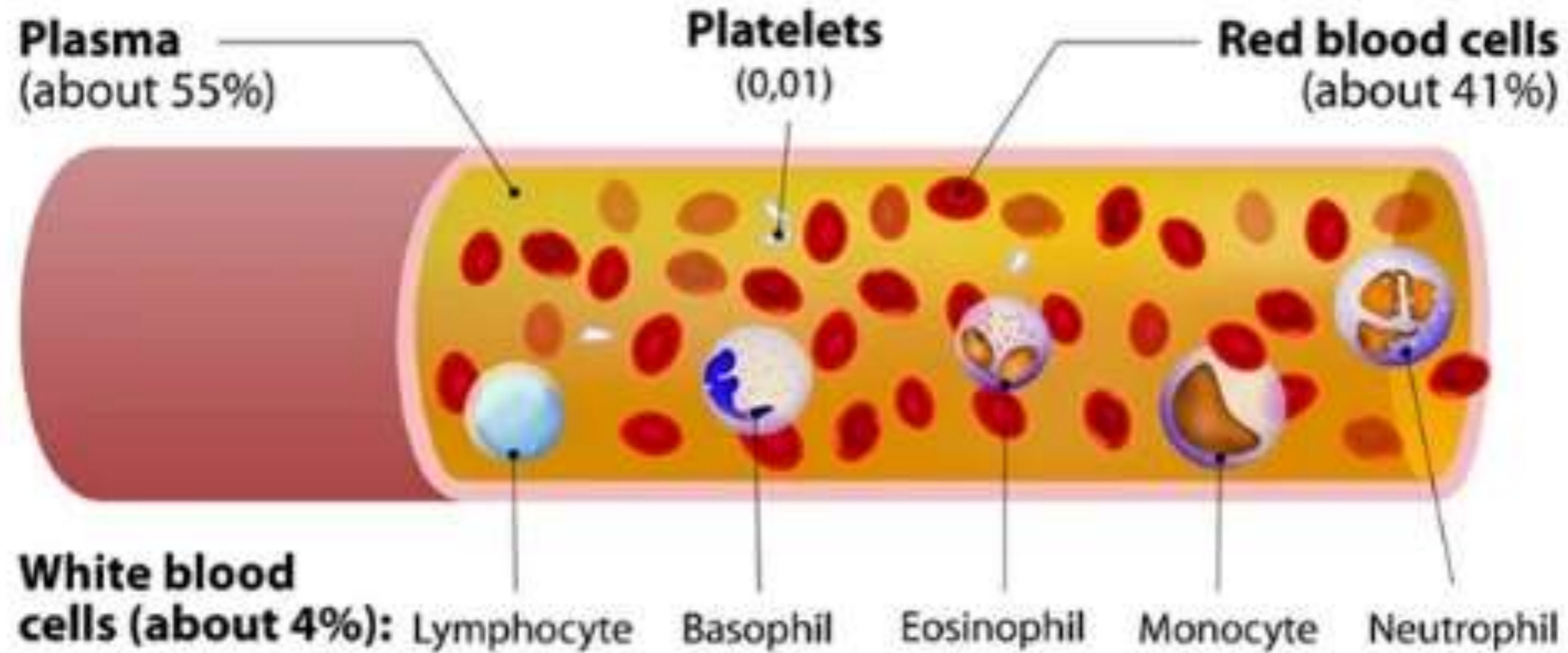


**DEPARTMENT OF CARDIAC TECHNOLOGY**

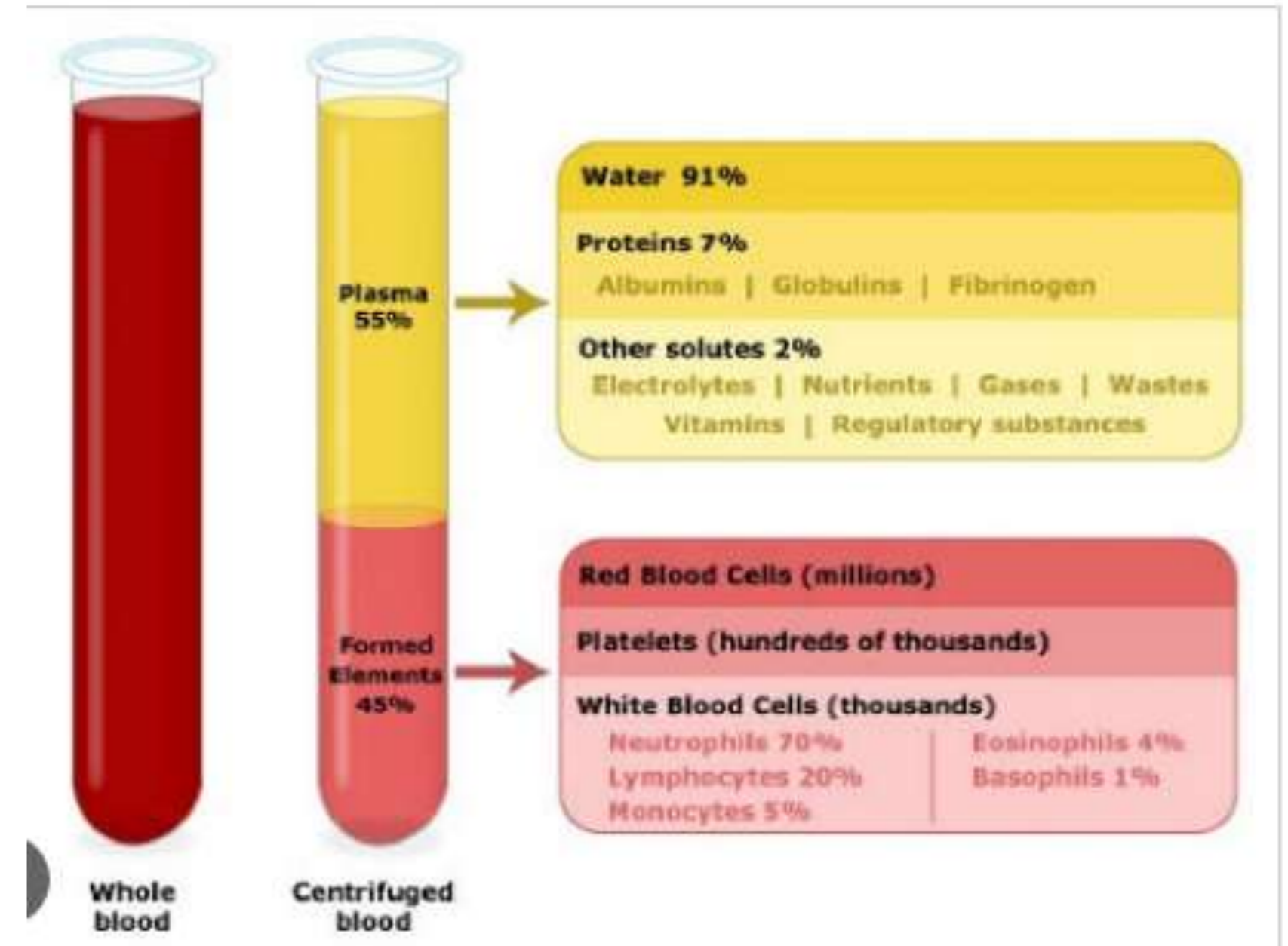
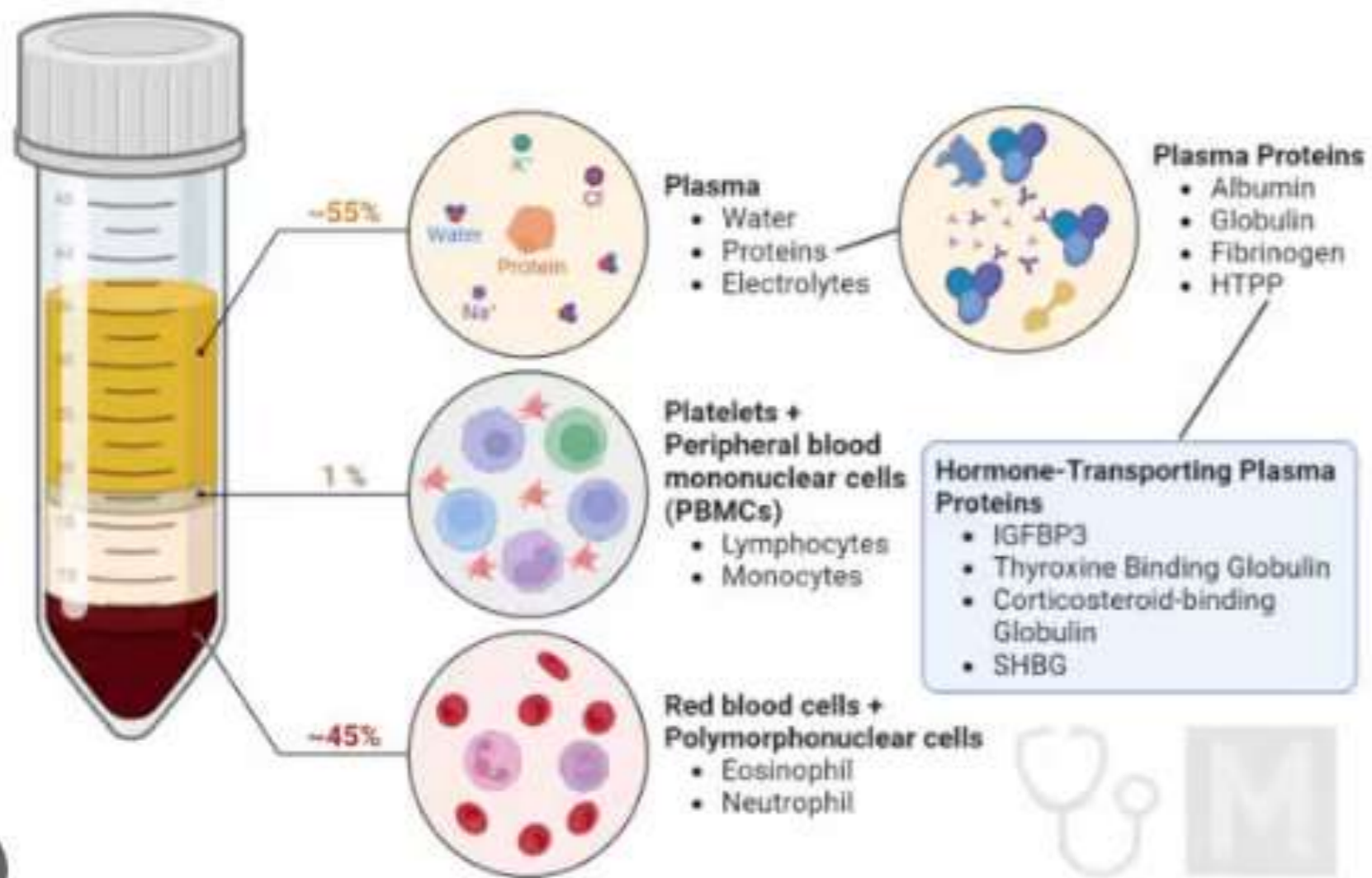
**COURSE NAME : BIOCHEMISTRY**

**TOPIC : PLASMA PROTEINS**

# The elements of blood



## PLASMA PROTEINS





# INTRODUCTION



- Blood - plasma and solid components.
- Plasma - comprising about 55%.
- Appears as a straw-colored fluid – composed of water, but also carries enzymes and salts.
- Designed to carry nutrients, hormones, and proteins to the different parts of the body.
- It also carries away the waste products of cell metabolism from various tissues to the organs responsible for detoxifying and/or excreting them.
- In addition, plasma is the vehicle for the transport of the blood cells through the blood vessels.

Plasma contains about 90% water, with 10% being made up of ions, proteins, dissolved gases, nutrient molecules, and wastes.

- The proteins in plasma include the antibody proteins, coagulation factors, and the proteins albumin and fibrinogen which maintain serum osmotic pressure.



- The pH and osmotic pressure of blood are maintained by the plasma ions, proteins, and other molecules.
- **Plasma Proteins**
- Complex molecules called plasma proteins are present in blood plasma.
- **Mostly produced by the liver**, they are then released into the blood plasma.
- The proteins present in human blood plasma are a mixture of simple proteins, glycoproteins, lipoproteins, and other conjugated proteins called "**Plasma Protein**".
- Plasma proteins are the most abundant substances in the plasma and are present in three major types, namely, albumin, globulins, and fibrinogen.



# ALBUMIN



- Helps to maintain the colloid osmotic pressure of the blood.
- The colloid osmotic pressure of the blood is important in maintaining a balance between the water inside the blood and that in the tissue fluid, around the cells.
- When the plasma proteins are deficient, the water in the plasma seeps out into the space around the blood vessels and may result in interstitial edema, a feature of liver disorders, kidney disease and malnutrition.
- Helps to transport many substances such as drugs, hormones, and fatty acids.



- It is a simple protein made up of just one amino acid chain.
- Essential for preserving the blood's osmotic pressure, which is required to maintain the body's electrolyte and water balance.
- Additionally, it aids in the transportation of numerous molecules such as [fatty acids](#), hormones, and enzymes.



# GLOBULINS



- Globulins are of three types, alpha, beta, and gamma, from smallest to largest.
- The alpha globulins include the high-density lipoproteins (HDL) which are important in carrying fats to the cells for building various substances as well as for energy metabolism.
- Low-density lipoproteins (LDL) are beta globulins which transport fat to the cells for steroid and cell membrane synthesis.
- Antibodies or gamma globulins are also called immunoglobulins.
- They are produced by the B lymphocytes, a subset of the immune cells.
- Antibodies are responsible for the body's humoral immune function, recognizing pathogens via specific receptors and neutralizing them by various mechanisms.





# FIBRINOGEN



- Fibrinogen is a complex protein that is involved in the blood clotting process
- Important soluble plasma clotting factor precursor, which is converted to a threadlike protein called fibrin on contact with a sticky surface.
- It is synthesized by the liver and is converted to fibrin during the clotting process.
- Fibrin helps to form a clot, which is necessary to stop bleeding after an injury.
- The fibrin threads formed in this way trap platelets to form the primary platelet clot on which a stable blood clot is formed by the process of coagulation.



## OTHER TYPES



- In addition to these three main types of plasma proteins, there are also a number of other proteins that are found in smaller quantities in the blood plasma.
- **Lipoproteins**
- Transport lipids throughout the body & enzymes, which catalyze biochemical reactions.
- **Complement Proteins**
- The complement system is another important set of plasma proteins which are involved in immune and inflammatory reactions in response to many different infectious particles.



# PLASMA PROTEINS - FUNCTIONS



- Plasma proteins keep the blood pH slightly alkaline by binding excess hydrogen ions in the blood.
- Can also supply amino acids if required by being broken down by macrophages.
- Plasma proteins are also often carriers for small molecules, each binding after absorption from the gut with its own specific protein carrier for transport to the tissue or organ.
- The maintenance of the body's general health depends on plasma proteins.
- They assist in controlling the body's water balance, moving crucial chemicals around the body, and guarding the body against infections.
- **Transportation** – Hormones and other molecules are transported by globulins and albumin, which also aid in the movement of enzymes and other molecules.



- **Blood Clot Formation** – The primary protein that aids in the formation of blood clots is fibrinogen. In order to stop excessive bleeding after an injury, they are also essential for the blood clotting process.
- **Immunity** – Some globulins, including immunoglobulins, participate in the immunological response and aid in defending the body against infections.
- **Protein Nutrition**
- It acts as a source of protein for the tissues whenever the need arises.
- **Osmotic pressure and water balance**
- The most abundant plasma protein in the blood is albumin, which plays a crucial role in maintaining fluid balance in the body. Albumin helps to regulate the amount of fluid in the blood vessels, preventing excessive fluid build-up in the tissues.



- **Buffering action**
- Plasma proteins help maintain the body's pH by acting as ampholytes.
- At normal blood pH, they act as acids and accept protons.
- **Transport of Lipids**
- One of the essential functions of plasma proteins is to transport lipids and lipid-soluble substances throughout the body.
- Fatty acids and bilirubin are transported mainly by Albumin, whereas cholesterol and phospholipids are carried by the lipoproteins present in  $\beta$ -globulins also transport fat-soluble vitamins (A, D, K, and E)



# OTHER PLASMA COMPONENTS



- ***Proteins***
- Cytokines are cellular signaling molecules produced by cells in order to communicate with each other and to regulate important cellular processes.
- ***Electrolytes***
- Sodium is the most abundant ion carried in plasma and contributes plasma osmolarity.
- ***Amino acids***
- Tissues or plasma proteins may be broken down and the amino acids recycled for use in the synthesis of other biological structures.
- ***Nitrogenous compounds***
- Such as urea are produced by the breakdown of various substances in the body. These are carried in the plasma to the kidneys to be excreted.



- ***Nutrients***
- Nutrients absorbed from the gut or from other organs of origin are carried in the plasma, such as glucose, fats, amino acids, minerals, and vitamins.
- ***Dissolved gases***
- Plasma also contains dissolved oxygen and carbon dioxide, in small amounts, as well as a significant amount of nitrogen.



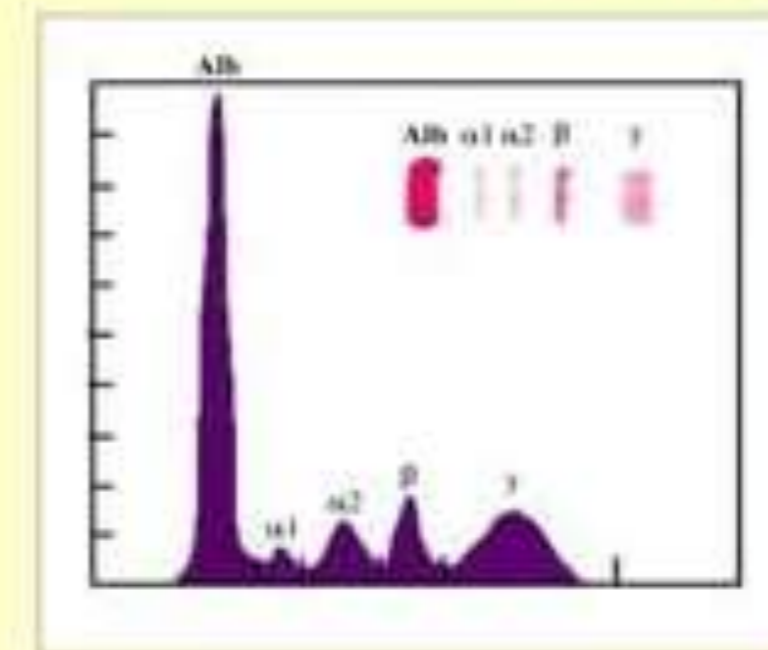
# Normal Results



- Normal value ranges are:
- Total protein: 6.4 to 8.3 grams per deciliter (g/dL) or 64 to 83 grams per liter (g/L)
- Albumin: 3.5 to 5.0 g/dL or 35 to 50 g/L
- Alpha-1 globulin: 0.1 to 0.3 g/dL or 1 to 3 g/L
- Alpha-2 globulin: 0.6 to 1.0 g/dL or 6 to 10 g/L
- Beta globulin: 0.7 to 1.2 g/dL or 7 to 12 g/L
- Gamma globulin: 0.7 to 1.6 g/dL or 7 to 16 g/L

## Serum proteins electrophoresis in diagnostics of diseases

### Normal pattern



#### Reference ranges:

Total protein	6.0 - 8.0 g/dL
Albumin	3.5 - 5.0 g/dL
α1-globulins	0.1 - 0.4 g/dL
α2-globulins	0.4 - 1.3 g/dL
β-globulins	0.6 - 1.3 g/dL
γ-globulins	0.6 - 1.5 g/dL





# Abnormal Results



- **Decreased total protein may indicate:**
- Abnormal loss of protein from the digestive tract or the inability of the digestive tract to absorb proteins ([protein-losing enteropathy](#))
- [Malnutrition](#)
- Kidney disorder called [nephrotic syndrome](#)
- Scarring of the liver and poor liver function ([cirrhosis](#))
  
- **Increased alpha-1 globulin proteins may be due to:**
- Acute inflammatory disease
- Cancer
- Chronic inflammatory disease (for example, [rheumatoid arthritis](#), [SLE](#))



- **Decreased alpha-1 globulin proteins may be a sign of:**
- [Alpha-1 antitrypsin deficiency](#)
- Increased alpha-2 globulin proteins may indicate a:
- Acute inflammation
- Chronic inflammation
- **Decreased alpha-2 globulin proteins may indicate:**
- Breakdown of red blood cells ([hemolysis](#))
- **Increased beta globulin proteins may indicate:**
- A disorder in which the body has problems breaking down fats (for example, hyperlipoproteinemia, [familial hypercholesterolemia](#))
- Estrogen therapy



- **Decreased beta globulin proteins may indicate:**
- Abnormally low level of LDL [cholesterol](#)
- Malnutrition
  
- **Increased gamma globulin proteins may indicate:**
- Blood cancers, including multiple myeloma, [Waldenström macroglobulinemia](#), lymphomas, and chronic lymphocytic leukemias
- Chronic inflammatory disease (for example, [rheumatoid arthritis](#))
- Acute infection
- Chronic [liver disease](#)



# Assessment



1. What is blood plasma?
2. What is Albumin?
3. What is Globulin?
4. What is Fibrinogen?
5. Functions of Plasma Proteins?
6. Normal values of Plasma Proteins?



**THANK YOU**