

Blood composition and function and viscosity

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2025-2026

Blood is a vital fluid tissue that circulates inside blood vessels. It represents 8% of body weight (5.6 L).

➤ **Functions of blood:**

- Transport function (O₂, CO₂, nutrients, waste products, hormones).
- Defensive function (WBs & antibodies).
- Hemostasis (stoppage of bleeding).
- Homeostasis: keeping internal environment (extracellular fluid) of the body constant for optimum function of the cell (PH, osmotic pressure, volume, gases, minerals, temperature, nutrients).

- **Composition of blood:**

Blood is composed of **two main parts: cellular part & fluid part (plasma):**

I. Cellular part (blood cells) = 45% of total blood volume (TBV);

1. **Red blood corpuscles (RBCs) or erythrocyte:**

5 million per cubic mm. Their decrease is called **anemia** and their increase is called **polycythemia**.

2. **White blood cells (WBCs) or leucocyte:** 4000-11000 per cubic mm. Their decrease is called **leucopenia** and their increase is called **leukocytosis**.

3. **Platelets or thrombocyte:** 250000 to 500000 per cubic mm. Their decrease is called **thrombocytopenia** and their increase is called **thrombocytosis**.

- **Plasma** is a yellow clear fluid **consisting of:**
 - 91 % Water.
 - 7 % Proteins: Albumin, Globulin, Fibrinogen, & Prothrombin.
 - 2% other substances:
 - Ions (Na^+ , Ca^{++} , Cl^- and other).
 - Nutrients Waste products
 - Gases & Regulatory substances (as hormones & vitamins).

Composition of Blood

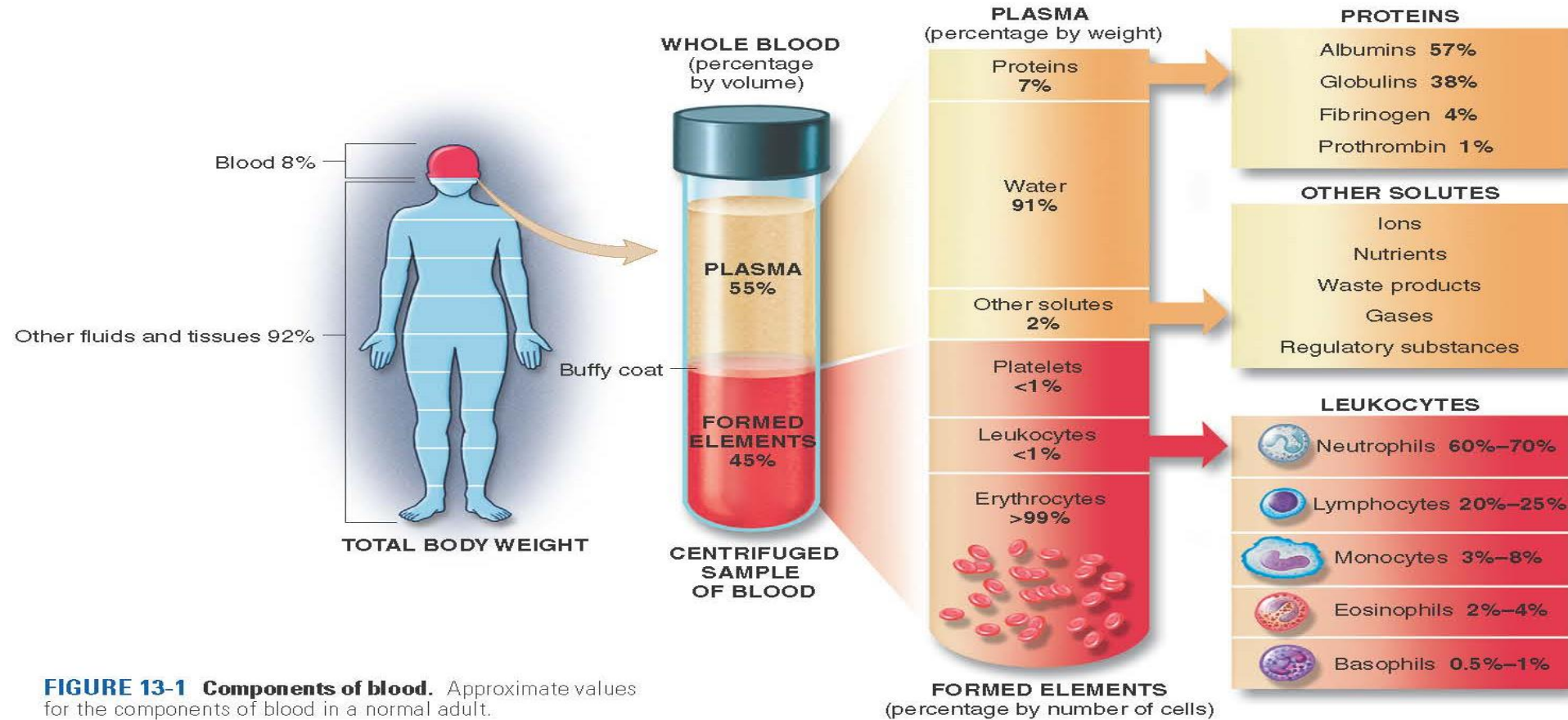
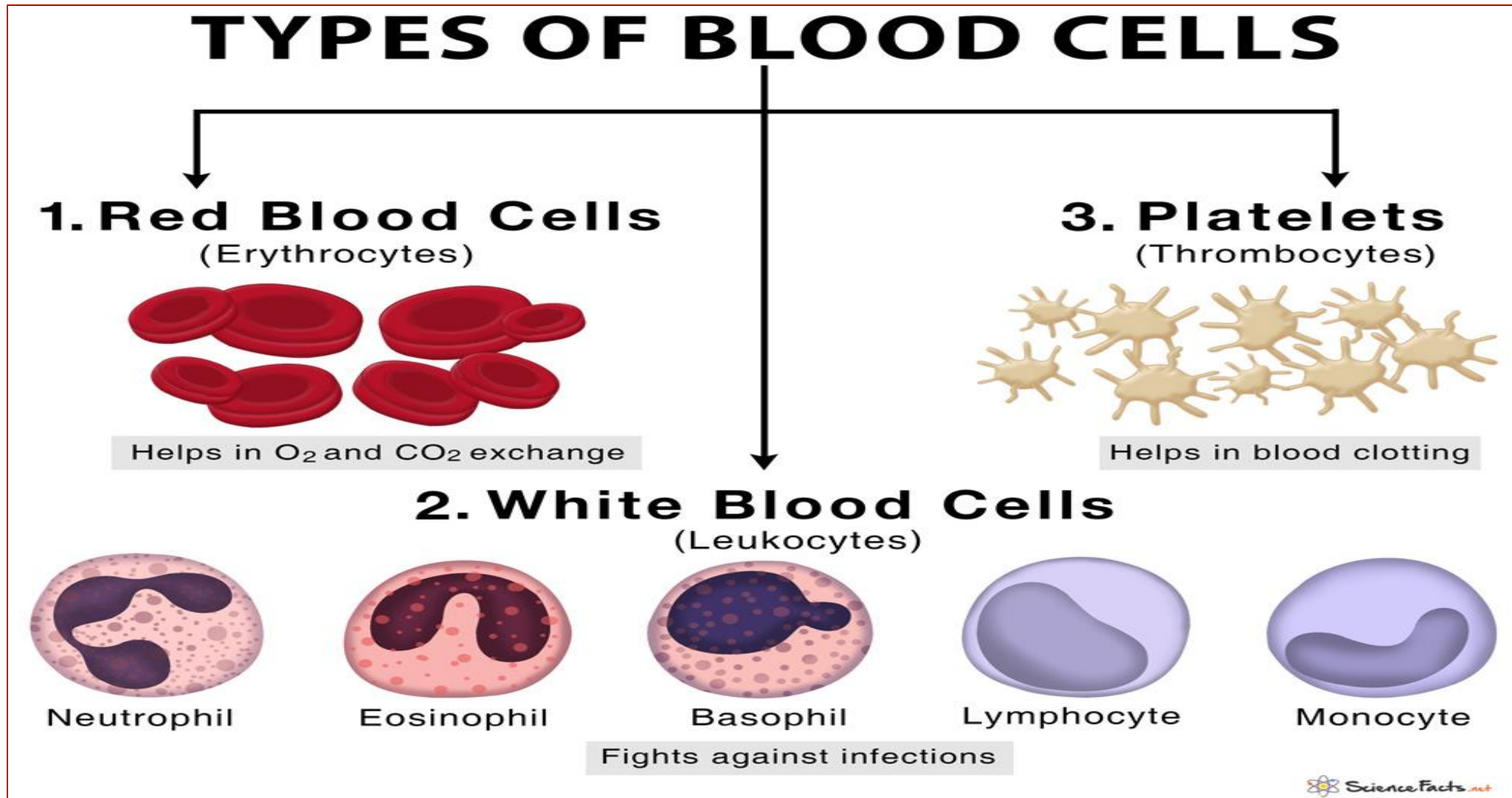


FIGURE 13-1 Components of blood. Approximate values for the components of blood in a normal adult.

1-Blood Tissue (45% of the blood)



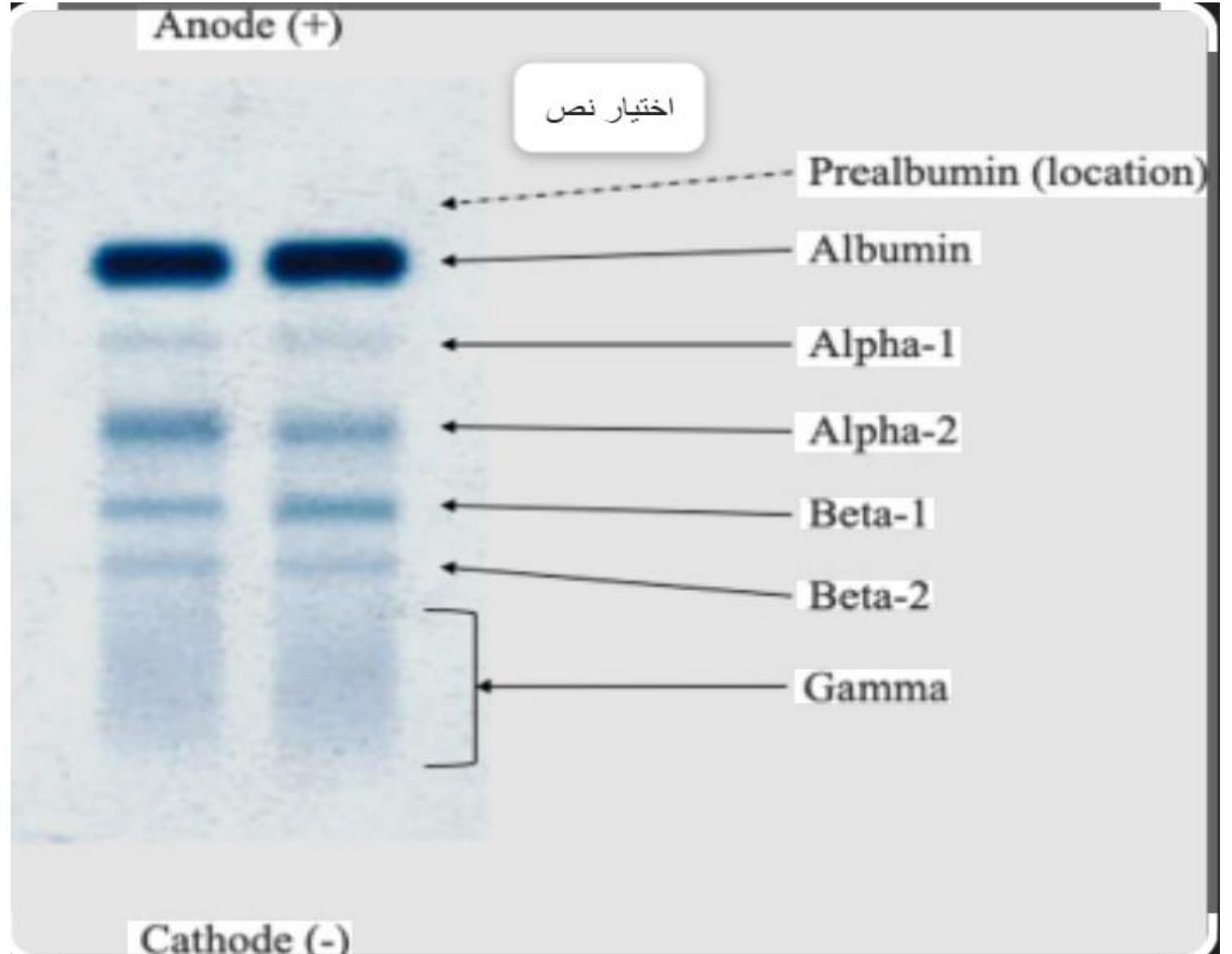
Plasma Proteins

Type	Concentration	Function	Site of formation
Albumin	4 gm/100 ml plasma (Highest Concentration)	<ul style="list-style-type: none"> - Colloidal osmotic pressure due to its highest concentration. - Transport of some substances. 	Liver.
Globulins (α , β , γ)	2.5 gm/100 ml plasma	<ul style="list-style-type: none"> - Defensive function (γ globulins). - Transport of some substances. 	(α, β, γ) : in the liver. (γ) : in the liver as well the plasma cells (Reticuloendothelial system (R.E.S))
Fibrinogen	0.4 gm/100 ml plasma (Highest MW)	<ul style="list-style-type: none"> - Blood clotting. - Plasma viscosity due to its highest MW. 	Liver.
Prothrombin	10 mg/100 ml plasma	- Blood clotting.	Liver.

- **Separation of plasma proteins through**

1- Electrophoresis

2- Centrifuge



• **The Albumin/Globulin (A/G) Ratio:**

This is the ratio between albumin and globulin concentration in blood = 1.2 – 1.7

$$\frac{\text{Albumin}}{\text{Globulin}} = 1.2 - 1.7$$

➤ **Significances of A/G ratio:**

Decreases in:

Liver disease due to decreased formation of albumin. $\frac{\downarrow\downarrow\downarrow \text{Albumin}}{\downarrow \text{Globulin}}$

Kidney disease due to loss of albumin in urine. $\frac{\downarrow\downarrow\downarrow \text{Albumin}}{\downarrow \text{Globulin}}$

Infection due to increase globulin concentration. $\frac{\text{Albumin}}{\uparrow\uparrow\uparrow \text{Globulin}}$

• Increases in:

Acquired immunodeficiency syndrome (AIDS)

Aglobulinemia

➤ **Functions of plasma proteins:**

Plasma is essential to life. Death occurs when plasma proteins decrease to 1-2 gm %.

Plasma proteins have the following functions:

1. **Blood clotting:** **prothrombin & fibrinogen.**
2. **Regulate blood volume:** mainly by **albumin** due to its highest concentration.

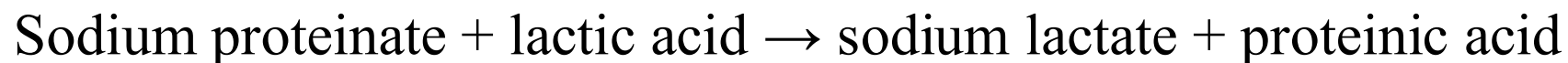
Mainly by albumin due to its highest concentration. The colloidal osmotic pressure of plasma proteins (25 mmHg) regulates the exchange of fluid between the plasma & tissue fluid to keep blood volume constant. The crystalloids (Na⁺, K⁺, Cl⁻) has no role in creation of plasma osmotic pressure because they move continuously move between intravascular and interstitial fluid compartment while proteins have large molecular weight (mainly albumin) cannot pass the capillaries.

3. Blood viscosity:

Blood is 3 times more viscous than water and plasma is 1.5 more viscous than water. **Fibrinogen** is responsible for blood viscosity due its highest molecular weight. Viscosity is important for the maintenance of arterial blood pressure especially diastolic blood pressure.

3. Buffering function of blood:

- Plasma proteins can act as weak acids or weak bases (i.e. **amphoteric molecules**) depending on the blood pH. They have both carboxyl (COO-) and imino (NH₂) groups so they can form sodium proteinate and proteinic acid and which in turn constitute buffer system and so are responsible for **15%** of buffering power of the blood.
- If an acid is added to blood as lactic acid during muscular exercise, **the following reaction takes place:**



(Very weak acid that does not change pH).

5. **Defensive function of blood:** **gamma globulin.**
6. **Capillary permeability;** plasma proteins are essential for normal permeability of capillaries by closing the capillaries pores.
7. **Plasma proteins carry and transport important elements** as iron, copper, and hormones; forming complexes to conserve it and prevent its loss in urine.
8. It can be used by tissues to supply proteins during starvation **(Reserve protein).**

- **Hypoproteinemia**

- Hypoproteinemia **means** decreased P.P conc. in blood. Plasma protein levels are maintained during starvation until body protein stores are markedly depleted.

- Hypoproteinemia is **caused by** liver diseases, kidney diseases (Nephrosis), prolonged starvation, malnutrition, malabsorption syndrome and rare congenital absence of one of plasma protein.

- Because of the **decrease in the plasma osmotic pressure, edema** tends to develop.



THANK YOU

