



Physiology of Cardiovascular System: Blood and Plasma

By
Assist. Prof. Dr Dler Gallaly

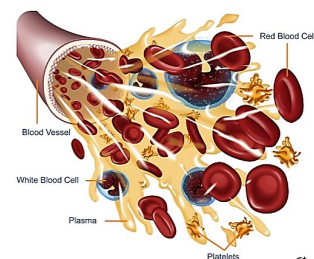
PhD in Medical Physiology
Dept. of Physiotherapy
Faculty of Applied Sciences
Tishk International University
Kurdistan Region, Erbil, Iraq.
2024 / 2025
Mob.#: (+964) 750 461 87 58
Email: dler.qader@tiu.edu.iq



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Contents:

- Introduction and Definition.
- Characteristics of Blood.
- Major Functions of Blood.
- Components of Blood.
- Blood Plasma.
- Components of Blood Plasma.



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Objectives:

By the end of this lecture, you will be able to:

- Define the Blood and Plasma.
- List the main characteristics of Blood.
- List the major functions of Blood.
- Describe the components of Blood.
- Define the Blood Plasma.
- Describe the components of Blood Plasma.

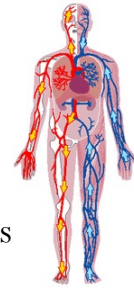


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Introduction and Definition:

■ Blood is the:

- Fluid of life.
- Circulating fluid of the body.
- Fluid that circulates in the heart and blood vessels
- Specialized connective tissue.
- Fluid contains cells suspended in a fluid matrix.
- Fluid transportation tissue.



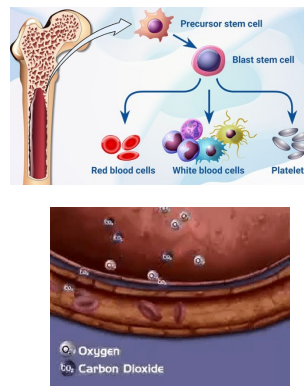
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Introduction and Definition:

- Anatomically, blood is considered the **only fluid connective tissue in the human body**. **How and Why?**

due to its:

- Origin (in the bones)
- Function.



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Introduction and Definition:

- **Hematology:** deals with the:
 - blood and blood-forming tissues.
- **Hematopathy:** abnormal condition (disease) of the:
 - blood or blood cells or
 - hemopoietic tissues.



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Characteristics of Blood:

1. Blood is denser and more viscous than water.

- ~3-5 times thicker than water.
- Blood viscosity is increased by:
 - ✓ Blood cells and plasma proteins.
- Blood viscosity contributes to normal BP:



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Characteristics of Blood:

2. Blood temperature is 38°C:

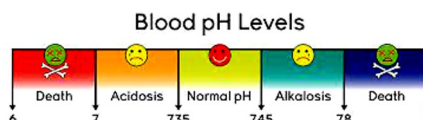
- ~ 1°C > oral temperature.

How and Why?



3. Blood pH is from 7.35 - 7.45:

- Venous blood pH < Arterial blood pH. **Why?**



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Characteristics of Blood:

4. Blood color is red (?) (varies with O₂ content). **How?**

Arterial blood is bright red. **High O₂ content**

Venous blood is dark red. **why?** **Low O₂ content**

5. Blood is amounting 8% of the total body mass:

- It constitutes ~20% of extracellular fluid.

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Characteristics of Blood:

6. Volume of blood is 4 - 6 Liters:

■ In adult  = 5-6 L

■ In adult  = 4-5 L

7. Blood tastes like:

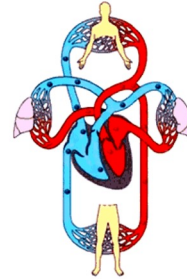
- Iron (hemoglobin).
- Copper (Ceruloplasmin).

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Major Functions of Blood:

1. Transporting dissolved gases, nutrients, hormones, and metabolic wastes.

- carries O₂ from the lungs to the tissues.
- carries CO₂ from the tissues to the lungs.
- distributes nutrients throughout the body.
- carries hormones toward their target cells.
- absorbs and carries the wastes produced by active cells to the kidneys for excretion.



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Major Functions of Blood:

2. Regulating the pH and ion composition of interstitial fluids:

- Diffusion between interstitial fluids and blood eliminates local deficiencies or excesses of ions such as Ca⁺² or K⁺².
- Blood also absorbs and neutralizes the acids generated by active tissues.

Example: production of lactic acid by skeletal muscle.

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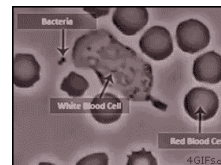
Major Functions of Blood:

3. Restricting fluid losses at injury sites:

- Blood clotting factors initiate the process of blood coagulation.
- The process acts to prevent further blood loss.

4. Defending against toxins and pathogens:

- Blood transports WBCs to fight infections or remove debris.
- It also delivers antibodies (attack invading pathogens).



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Major Functions of Blood:

5. Stabilizing body temperature:

- Blood absorbs the heat generated by active skeletal muscles and redistributes it to other tissues.
- ✓ If body temperature is **high**, blood is directed toward the skin surface, where heat is lost to the environment.
- ✓ If body temperature is **too low**, warm blood is directed to the brain and other temperature-sensitive organs.

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Components of Blood:

Blood has 2 components:

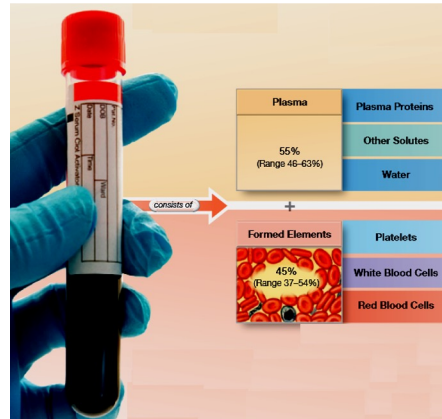
1. **Blood plasma (55%):**

- The yellowish liquid portion of the blood.

2. **Formed elements (45%):**

- **Are cells and cell fragments:**

- ✓ Red blood cells (RBCs)
- ✓ White blood cells (WBCs)
- ✓ Platelets

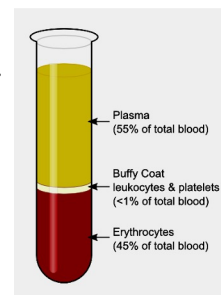


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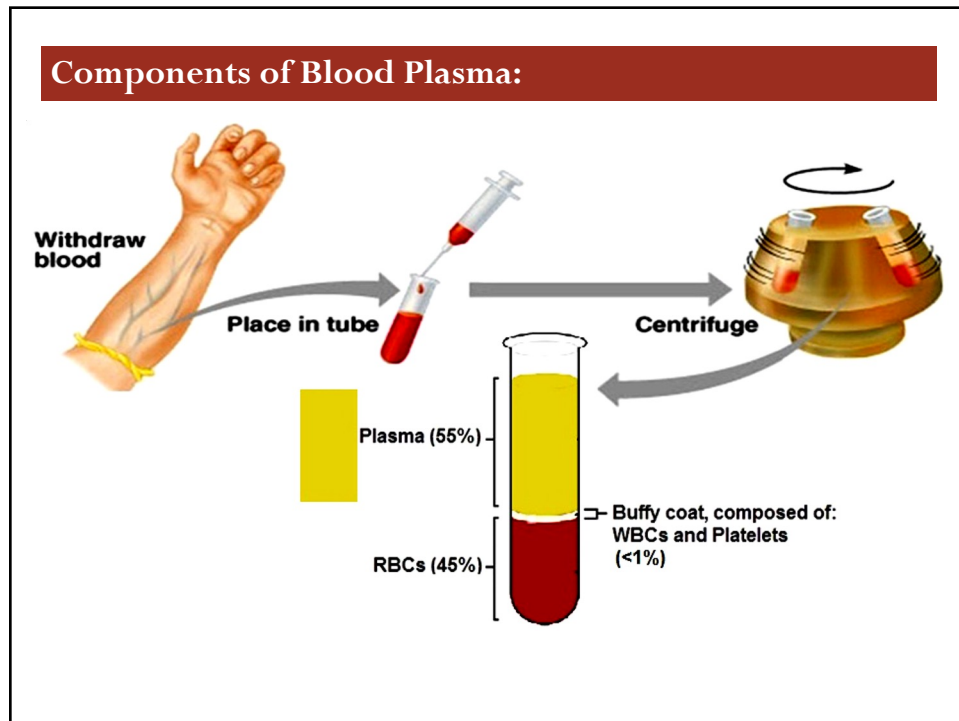
Components of Blood: The Blood Plasma:

■ **The Blood Plasma is:**

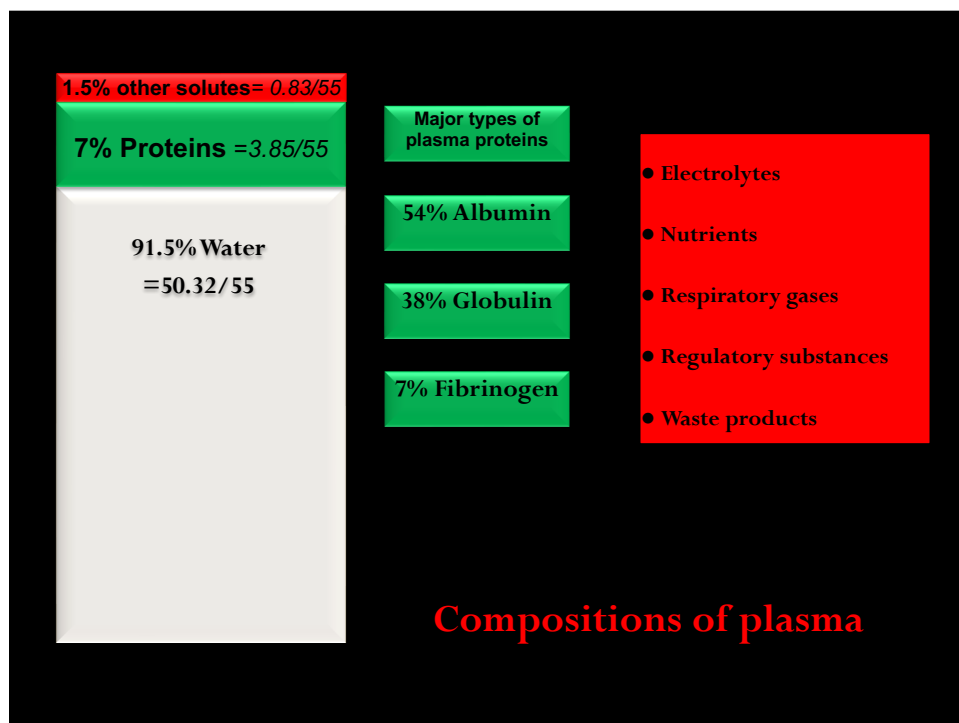
- the liquid portion of blood (pale yellow).
- blood minus the formed elements.
- a watery extracellular matrix (contains dissolved subst.)
- a Solution (ions and other small solutes).
- a Colloid (presence of larger plasma proteins).
- ~1.5 times as viscous as water.



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Compositions Blood Plasma:

Water (91.5%):

- Solvent and suspending medium.
- High heat capacity.
- High heat of vaporization.
- Helps maintain homeostasis of body temp.
 - ✓ Absorbs, transports, and releases heat.

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Compositions Blood Plasma:

Plasma Solutes (1.5%):

- **Electrolytes:**
 - ✓ Are Inorganic salts:
 - **Cations** Na^+ , K^+ , Ca^{+2} , Mg^{+2} , Cu^{2+}
 - **Anions** Cl^- , HPO_4^{-2} , SO_4^{-2} , HCO_3^-
 - ✓ Help maintain osmotic pressure and play essential roles in the function of cells.
- **Nutrients:**
 - ✓ Glucose, Amino Acids, Triglycerides..... etc.

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Compositions Blood Plasma:

Plasma Solutes (1.5%):

■ Respiratory gases:

✓ **O₂:** Mostly is associated with Hemoglobin.

✓ **CO₂:** Mostly is dissolved (HCO³⁻)

■ Regulatory substances:

✓ **Enzymes** (catalyze chemical reactions)

✓ **Hormones** (regulate metabolism, growth, & development)

✓ **Vitamins** (cofactors for enzymatic reactions)

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Compositions Blood Plasma:

Plasma Solutes (1.5%):

■ Waste Products:

Most are breakdown products of protein metabolism.

✓ **Uric acid** (from nucleic acids)

✓ **Blood urea nitrogen** (from protein)

✓ **Creatinine** (from creatine)

✓ **Bilirubin** (from heme)

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Compositions Blood Plasma:

Plasma Proteins (7%): Three Major Types:

Albumins (54% of plasma proteins):

- ✓ The smallest (weight).
- ✓ The highest (concentration)

Fibrinogens (7% of plasma proteins):

- ✓ Forming blood clots (coagulation protein).

Globulins (38% of plasma proteins):

- ✓ α and β -globulins:
- ✓ γ -globulins: (antibodies or immunoglobulins).

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Questions/Comments



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