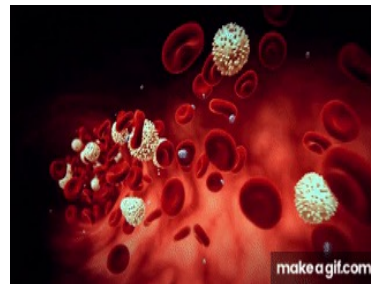




## Physiology of Cardiovascular System (CVS): Blood and Plasma

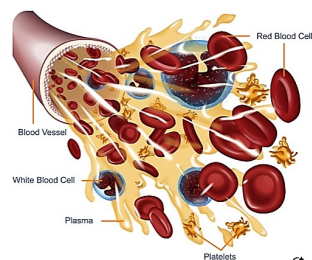
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### Contents:

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

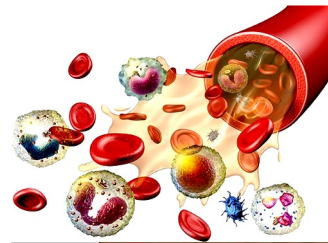


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## Objectives:

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



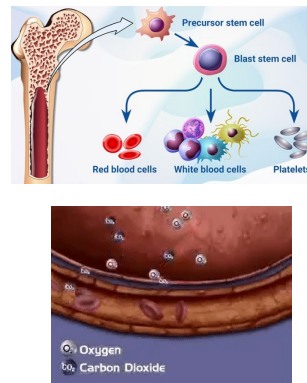
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## Introduction and Definition:

- 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 & 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:

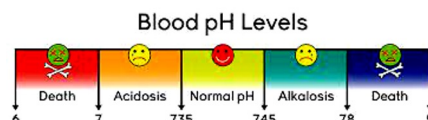
- ~ 1°C > oral temperature.

**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 O<sub>2</sub> content). **How?**

**Arterial blood is bright red.** **High O<sub>2</sub> content**

**Venous blood is dark red.** **Low O<sub>2</sub> 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:**

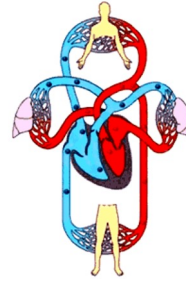
- Iron (hemoglobin).
- Copper (Ceruloplasmin).

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## Major Functions of Blood:

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

- carries O<sub>2</sub> from the lungs to the tissues.
- carries CO<sub>2</sub> 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<sup>+2</sup> or K<sup>+2</sup>.
- Blood also absorbs and neutralizes the acids generated by active tissues.

**Example:** production of lactic acid by skeletal muscle.

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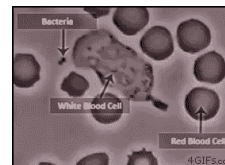
## Major Functions of Blood:

### 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:

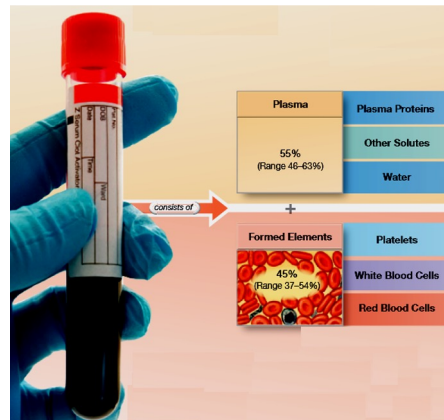
### 1. Blood plasma (55%):

- 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

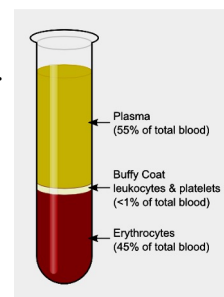


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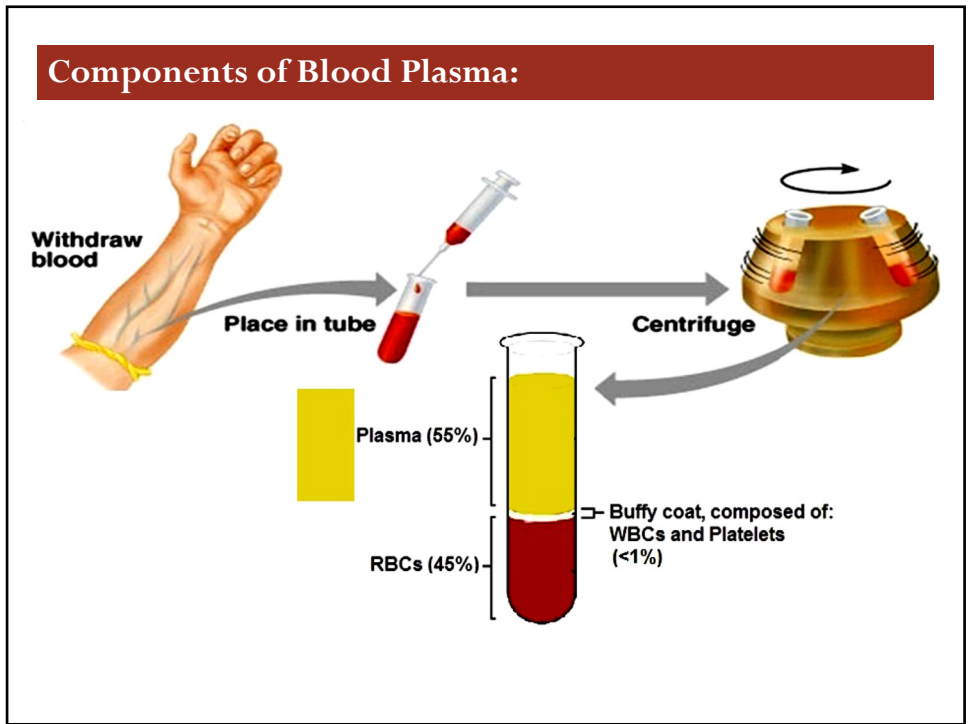
## Components of Blood: The Blood Plasma:

### ▪ 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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1.5% other solutes = 0.83/55

7% Proteins = 3.85/55

91.5% Water  
= 50.32/55

Major types of plasma proteins

54% Albumin

38% Globulin

7% Fibrinogen

- Electrolytes
- Nutrients
- Respiratory gases
- Regulatory substances
- Waste products

Compositions of plasma

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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  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{Cu}^{2+}$
    - Anions  $\text{Cl}^-$ ,  $\text{HPO}_4^{-2}$ ,  $\text{SO}_4^{-2}$ ,  $\text{HCO}_3^-$
  - ✓ 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:

- ✓ **O<sub>2</sub>**: Mostly is associated with Hemoglobin.
- ✓ **CO<sub>2</sub>**: Mostly is dissolved (HCO<sup>3-</sup>)

#### ■ 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):

- ✓  $\alpha$  and  $\beta$ -globulins:
- ✓  $\gamma$ -globulins: (antibodies or immunoglobulins).

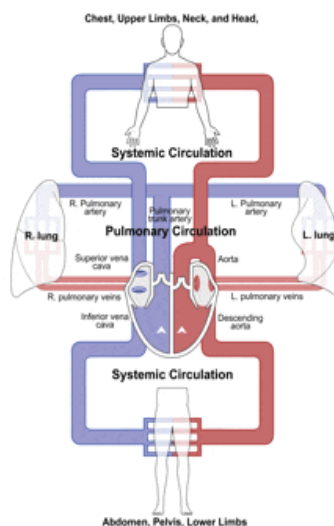
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## In Summary: Functions of CVS:

**Oxygen and Nutrient Delivery:** It transports oxygenated blood from the lungs and nutrients from the digestive system to every cell in the body.

**Waste Removal:** It carries carbon dioxide to the lungs for exhalation and other metabolic wastes to the kidneys and liver for disposal.

**Hormone Transport:** It carries hormones (chemical messengers) from endocrine glands to target organs, ensuring proper regulation of bodily functions.



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### In Summary: Functions of CVS:

#### Temperature Regulation:

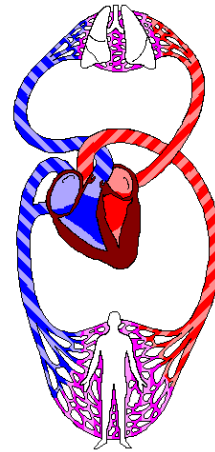
Blood vessels **dilate or constrict** to manage heat loss, keeping body temperature stable.

#### Protection and Repair:

White blood cells are transported to **fight infection**, and platelets act to clot blood and **seal injuries**.

#### Regulation of pH and Fluids:

It helps manage the body's **pH levels** and maintains **fluid balance**.



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## Questions and Comments:



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