

A close-up, microscopic view of numerous red blood cells, which are biconcave discs, filling the frame. The cells are a vibrant red color and are slightly out of focus, creating a sense of depth. The lighting highlights the texture and shape of the cells.

# BLOOD

## Composition and Functions

HAP Unit 5th

# INTRODUCTION

- The normal pH range of blood is 7.35 to 7.45, which is slightly alkaline. The venous blood normally has a lower pH than the arterial blood because of presence of more Carbon dioxide.

## Temperature

- The temperature of the blood is 38°C(100.4°F), about 1°C higher than oral or rectal body temperature.

## Viscosity

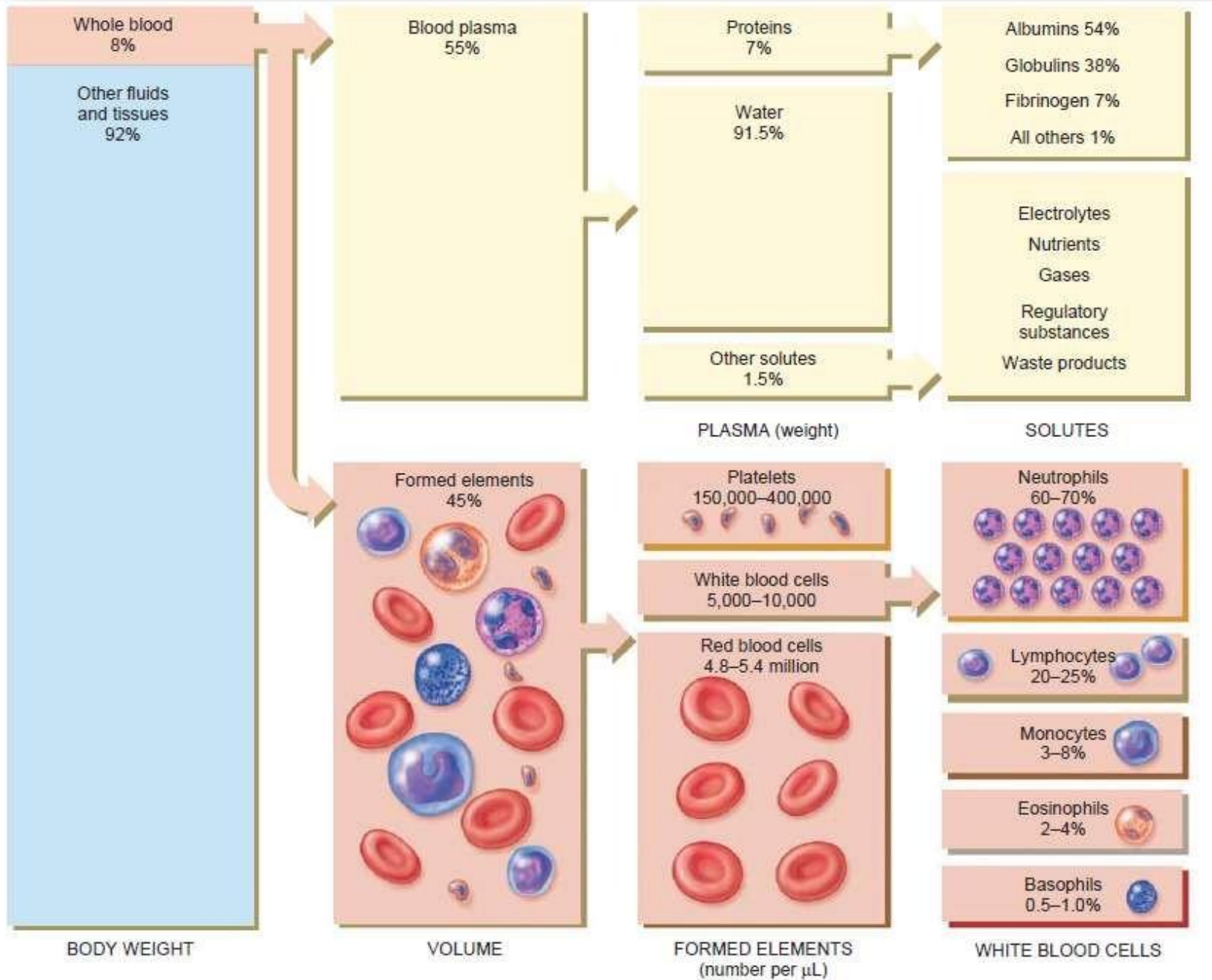
- 'Viscosity' means thickness or resistance to flow. Blood is about 3-5 times denser & more viscous(thicker) than water & feels slightly sticky. Viscosity is increased by the presences of blood cells & plasma proteins. This thickness contributes to normal blood pressure.

- The colour of blood varies with its oxygen content. Arterial blood is bright red due to it's high level of oxygen. Venous blood has given up much of it's oxygen in tissues & thus has a darker, dull red colour.

## Amount

- Blood constitutes about 20% of extracellular fluid, amounting to 8% of total body mass. The blood volume is 5L to 6L(1.5gal) in average sized adult male & 4L to 5L(1.2gal) in an average sized adult female.

# COMPOSITION OF BLOOD





# PLASMA

**When formed elements are removed from blood, a straw coloured liquid called blood plasma is left. The table below describes the chemical composition of blood plasma-**




<b>WATER(91.5%)</b>	Liquid portion of blood. Acts as solvent and suspending medium for components of blood; absorbs, transports and releases heat.
<b>PLASMA PROTEIN(7.0%)</b>	Exert colloid osmotic pressure , which helps maintain water balance between blood and tissues and regulates blood volume.
<b>ALBUMIN</b>	Smallest and most numerous blood plasma proteins; produces by liver. Transports proteins for several steroid hormones and for fatty acids.
<b>GLOBULINS</b>	Produces by liver and plasma cells, which develop from B lymphocytes. Antibodies help attack viruses and bacteria. Alpha and beta globulins transport iron, lipids and fat soluble vitamin.
<b>FIBRINOGEN</b>	Produces by liver. Plays essential role in blood clotting.

<p><b>OTHER SOLUTES(1.5%) ELECTROLYTES</b></p>	<p>Inorganic salts. Positively charged ions(cations) include <math>\text{Na}^+</math>, <math>\text{K}^+</math>, <math>\text{Ca}^+</math>, <math>\text{Mg}^{2+}</math>; Negatively charged ions(anions) include <math>\text{Cl}^-</math>, <math>\text{HPO}_4^{2-}</math>, <math>\text{SO}_4^{2-}</math>, <math>\text{HCO}_3^-</math>. Help maintain osmotic pressure and plays essential roles in function of cells.</p>
<p><b>NUTRIENTS</b></p>	<p>Products of digestion pass into blood for distribution to all body cells. Includes amino acids(from proteins), glucose(from carbohydrates), fatty acids and glycerol(from triglycerides), vitamins and minerals.</p>
<p><b>GASES</b></p>	<p>Oxygen, Carbon dioxide and Nitrogen. More <math>\text{O}_2</math> is associated with hemoglobin inside red blood cells; more <math>\text{CO}_2</math> is dissolved in plasma. <math>\text{N}_2</math> is present but has no known functions in the body.</p>
<p><b>REGULATORY SUBSTANCES</b></p>	<p>Enzymes, produced by body cells, catalyze chemical reactions. Hormones, produced by endocrine glands, regulate metabolism, growth and development. Vitamins are cofactors for enzymatic reactions.</p>
<p><b>WASTE PRODUCTS</b></p>	<p>Most are breakdown products of protein metabolism and are carried by blood to organs of excretion. Include urea, uric acid, creatine, creatinine, bilirubin and ammonia.</p>

## FORMED ELEMENTS

NAME AND APPEARANCE	NUMBER	CHARACTERISTICS*	FUNCTIONS
<p><b>Red Blood Cells(RBCs) or Erythrocytes</b></p> <div style="text-align: center; margin-top: 10px;">  </div>	<p>4.8 million/<math>\mu\text{L}</math> in females 4.5 million/<math>\mu\text{L}</math> in males</p>	<p>7-8 <math>\mu\text{m}</math> diameter, biconcave discs, without nuclei; live for about 120 days.</p>	<p>Hemoglobin within RBCs transports most of the oxygen and part of carbon dioxide in the blood.</p>
<p><b>White Blood Cells(WBCs) or Leukocytes</b></p>	<p>5000-10,000/<math>\mu\text{L}</math></p>	<p>Most live for a few hours to a few days. Some called T and B memory cells can live for many years.</p>	<p>Combat pathogen and other foreign substances that enter the body.</p>
<p><b>Granular Leukocytes</b></p> <p>Neutrophils</p> <div style="text-align: center; margin-top: 10px;">  </div>	<p>60%-70% of all WBCs</p>	<p>10-12<math>\mu\text{m}</math> diameter; nucleus has 2-5 lobes connected by thin strands of chromatin; cytoplasm has very fine, pale, lilac granules.</p>	<p>Phagocytosis. Destruction of bacteria with lysozymes, defensins and strong oxidants, such as superoxide anion, hydrogen peroxide, and hypochlorite anion.</p>

\*Colors are those seen using Wright's stain

<p>Eosinophils</p> 	<p>2-4% of all WBCs</p>	<p>10-12µm diameter; nucleus usually has 2 lobes connected by a thick strand of chromatin; large, red-orange granules fill the cytoplasm.</p>	<p>Eliminates parasites, such as worms which are too big to be phagocytosed; phagocytes antigen-antibody complexes &amp; combat the effects of histamine in allergic reactions</p>
<p>Basophils</p> 	<p>0.5-1% of all WBCs</p>	<p>8-10µm diameter; nucleus has 2 lobes; large cytoplasmic granules appear deep blue-purple.</p>	<p>Liberate heparin, histamine and serotonin in allergic reactions that intensify the overall inflammatory response.</p>
<p><b>Agranular Leukocytes</b></p> <p>Lymphocytes (T cells, B cells &amp; natural killer cells)</p> 	<p>20-25% of all WBCs</p>	<p>Small lymphocytes are 6-9µm in diameter; large lymphocytes are 10-14µm in diameter; nucleus is round or slightly indented; cytoplasm forms a rim around the nucleus that looks sky blue; the larger the cell, the more cytoplasm is visible.</p>	<p>Medium immune response, including antigen-antibody reactions. B cells develop into plasma cells, which secrete antibodies, T cells attack invading viruses, cancer cells, and transplanted tissue cells. Natural killer cells attack a wide variety of infectious microbes and certain spontaneously arising tumor cells.</p>

Monocytes



3-8% of all WBCs

12-20 $\mu$ m diameter; nucleus is kidney shaped or horseshoe shaped. Cytoplasm is blue-grey and has foamy appearance.

Acts on the hypothalamus, causing the rise in body temperature with microbial infections; stimulates the production of some globulins by the liver; enhances the production of activated T-lymphocytes; Phagocytosis

**Platelets(Thrombocytes)**



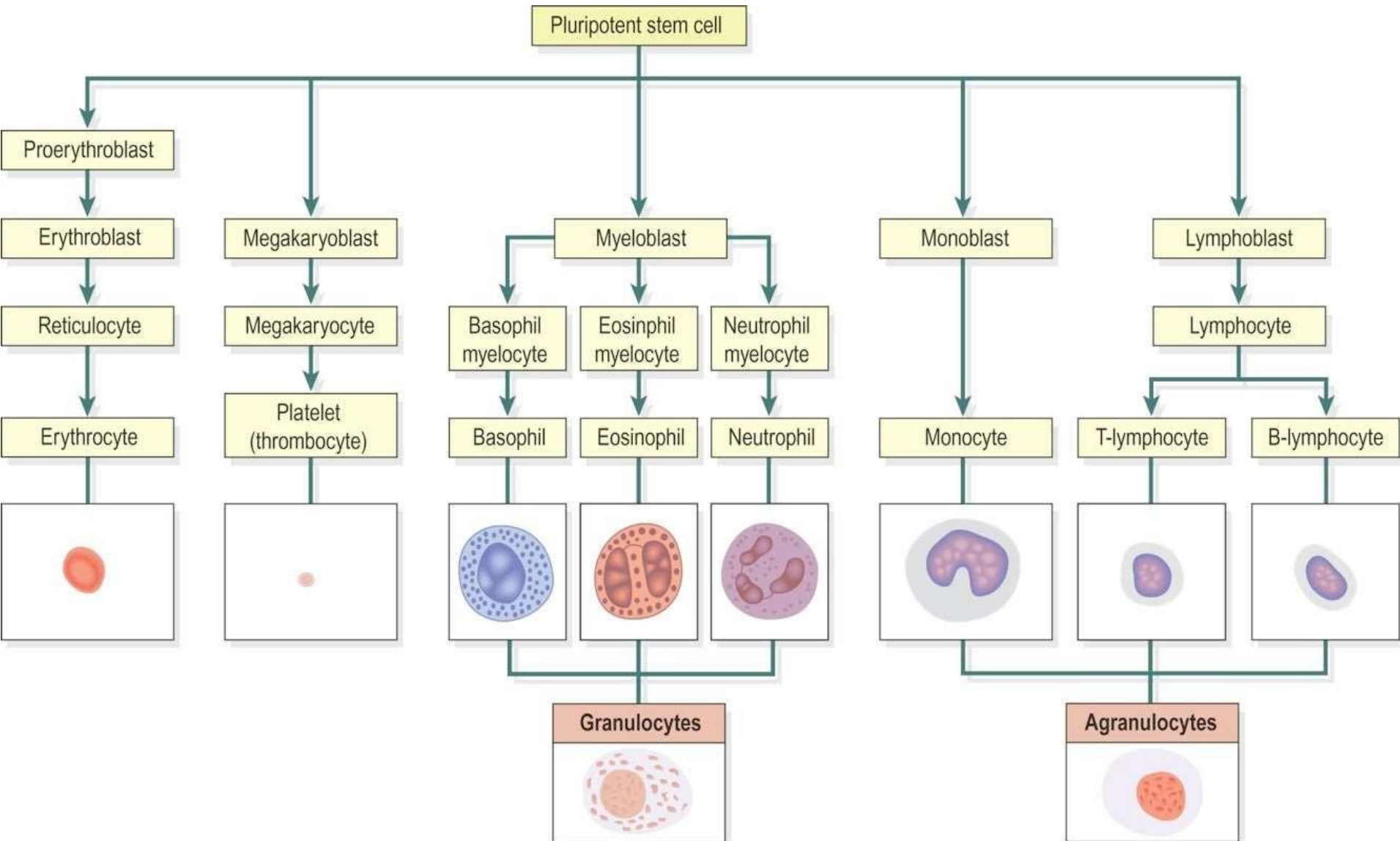
150,000-400,000/ $\mu$ L

2-3 $\mu$ m diameter cell fragments that live for 5-9days; contains many vesicles but no nucleus.

Form platelet plug in homeostasis; release chemicals that promote vascular spasm and blood clotting.



# Haemopoiesis: Stages in the development of blood cells



# FUNCTIONS OF BLOOD

## TRANSPORTATION

- Respiration
- Nutrient carrier from GIT
- Transportation of hormones from endocrine glands
- Transports metabolic wastes

## REGULATION

- Regulates pH
- Adjusts and maintains body temperature
- Maintains water content of cells

## PROTECTION

- WBC protects against disease by phagocytosis
- Reservoir for substances like water, electrolyte etc.
- Performs haemostasis

THANK  
YOU!

