

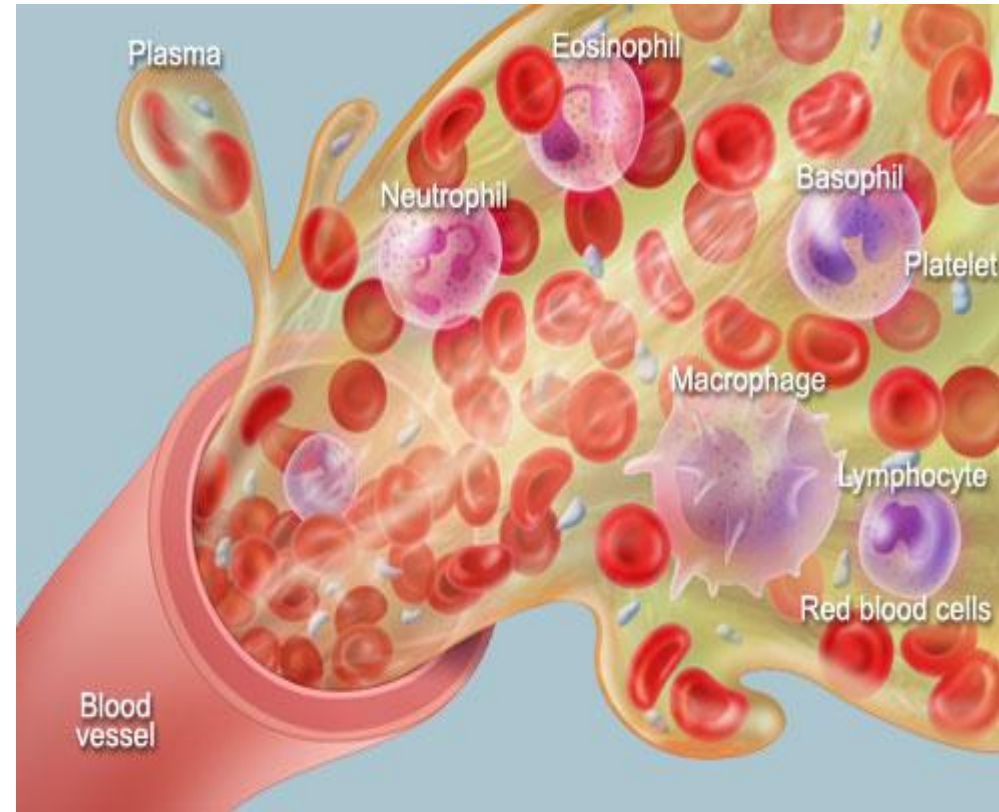
# BODY FLUID & BLOOD

# Body fluid

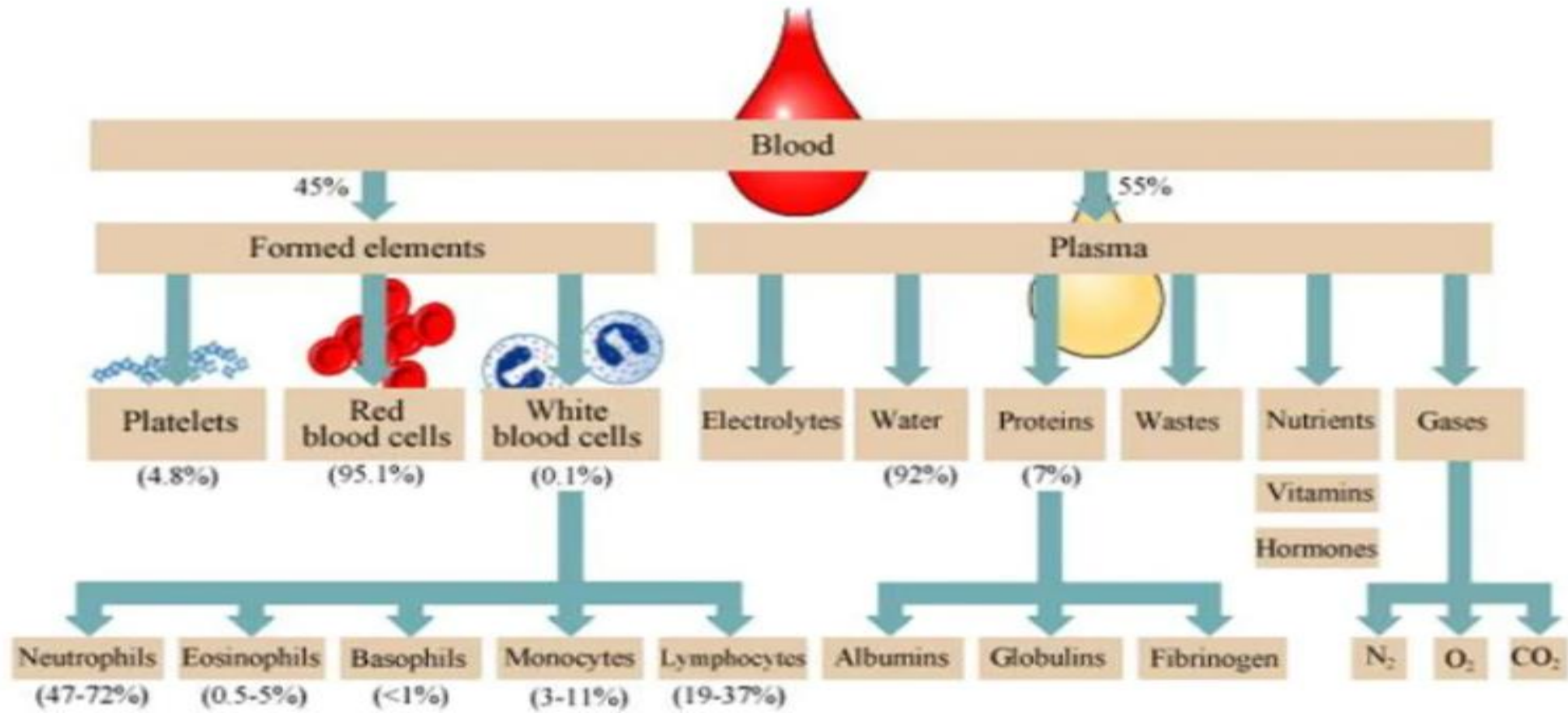
- The water and dissolved solutes throughout the body constitute the body fluid .

# Blood

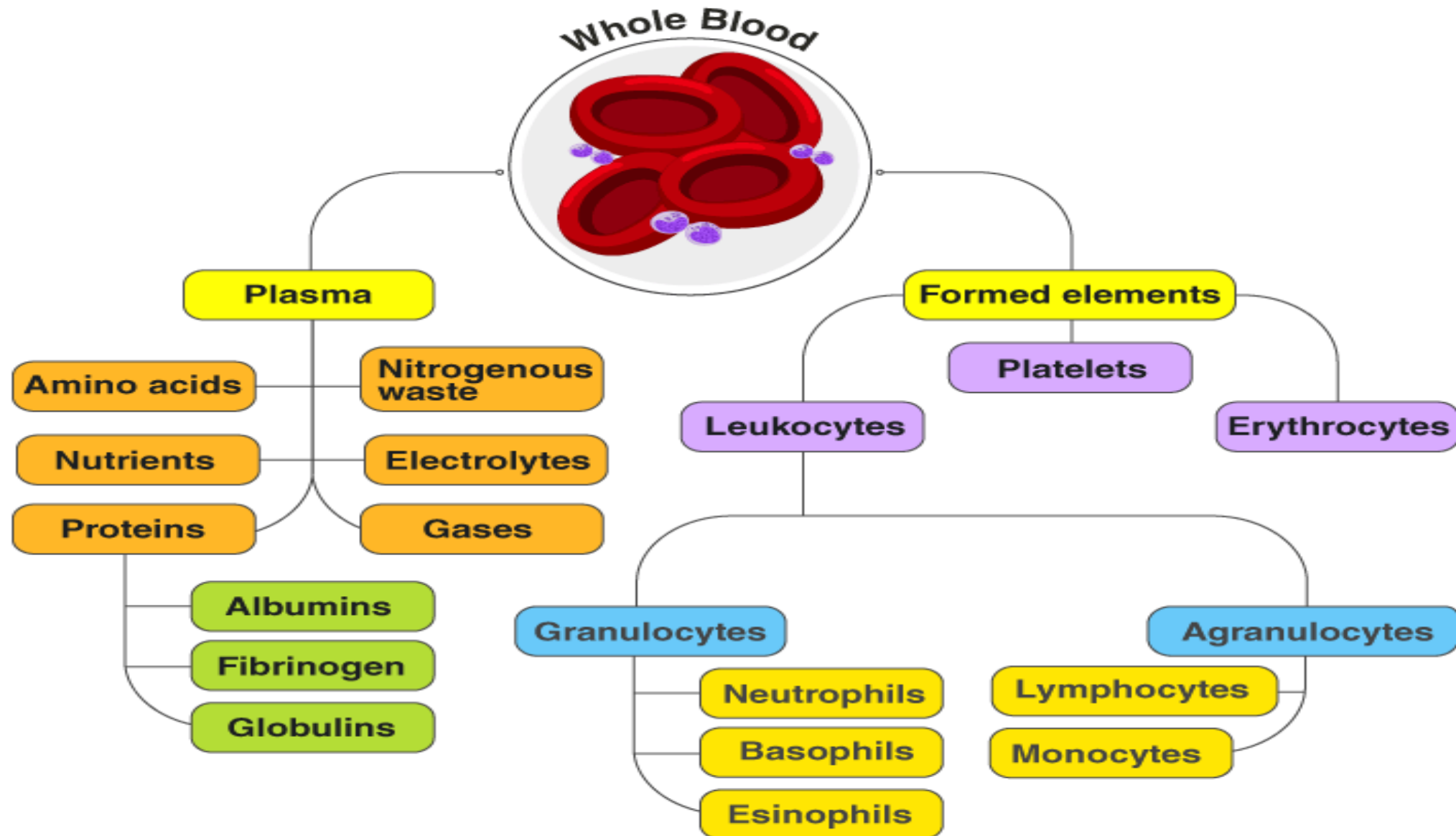
- Blood is a specialized mature liquid connective tissue.
- Total blood volume- 6ltr
- pH of blood- 7.4(slightly alkaline)
- Specific gravity- 1.055
- Location- circulatory system



# Blood Composition



# COMPOSITION OF BLOOD

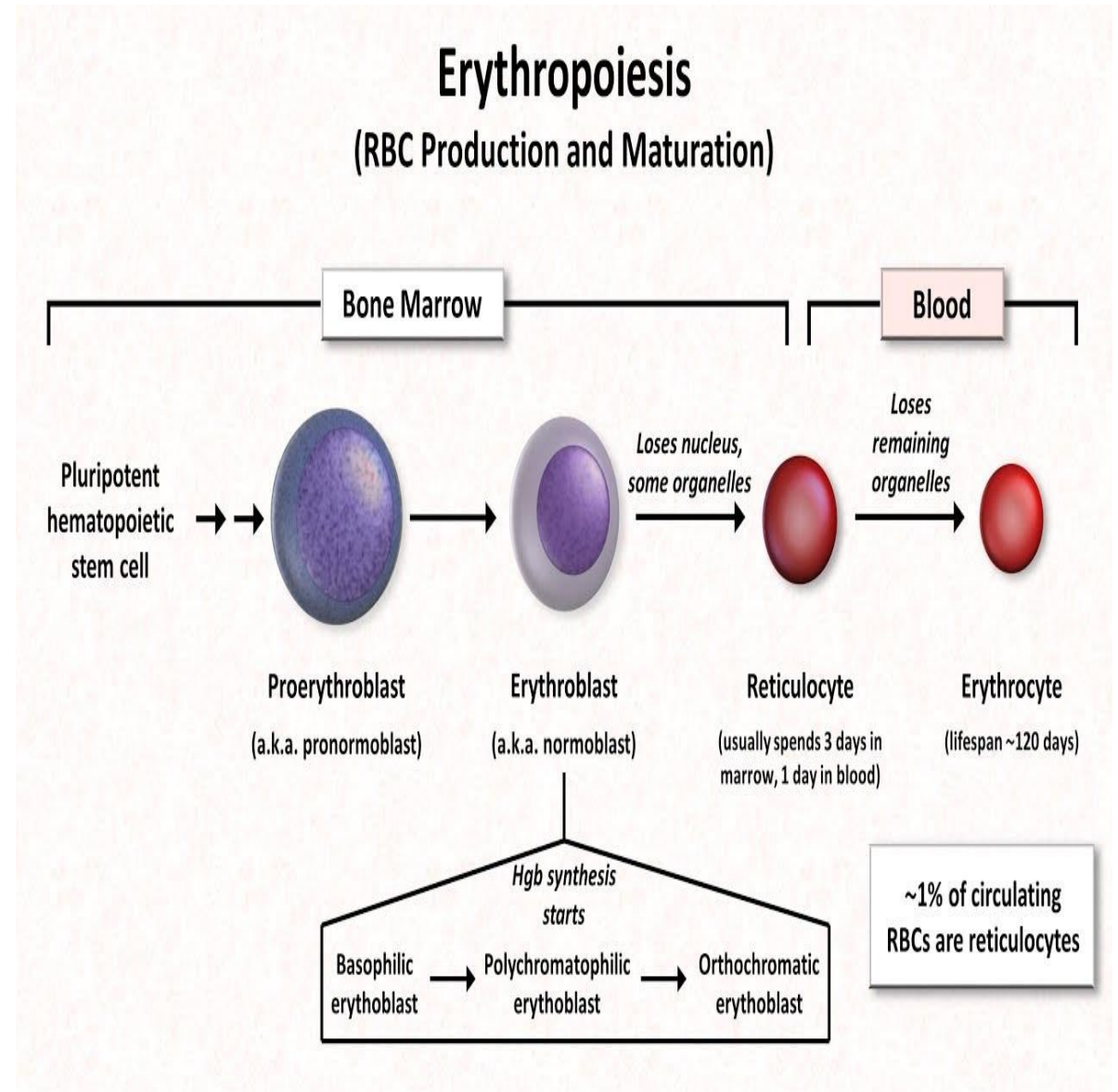


# Blood plasma

- Straw colored fluid
- Water content-91.5%
- Solute content -8.5%
- Solutes contain proteins, electrolytes, nutrients, enzymes, hormones, gases, waste products ( urea, uric acid, creatinine, ammonia, bilirubin)
- Proteins found in plasma- plasma protein
- Plasma proteins are synthesized by hepatocytes
- They are albumin, globulin, fibrinogen
  - Albumin- smallest proteins, maintains osmotic pressure of blood
  - Globulin- large proteins, produce immunoglobins to attack against bacteria & virus
  - Fibrinogen- large proteins, helps in coagulation of blood
- Serum= Blood plasma- fibrinogen

# Hemopoiesis

- The process by which the cellular elements of blood develops- hemopoiesis
- Primary site of RBC synthesis- bone marrow
- The process by which erythrocytes are formed- erythropoiesis
- Before birth- yolk sac, liver, spleen, thymus, lymph node
- Last trimester- RBM
- After birth & through out the life- RBM



# Regulation of haemopoiesis

- **Humoral regulation by hormones:**
- **Erythropoietin**
- **Leucopoietin**
- **Thrombopoietin**
- **These hormones are produced by kidney and liver.**



# RBC

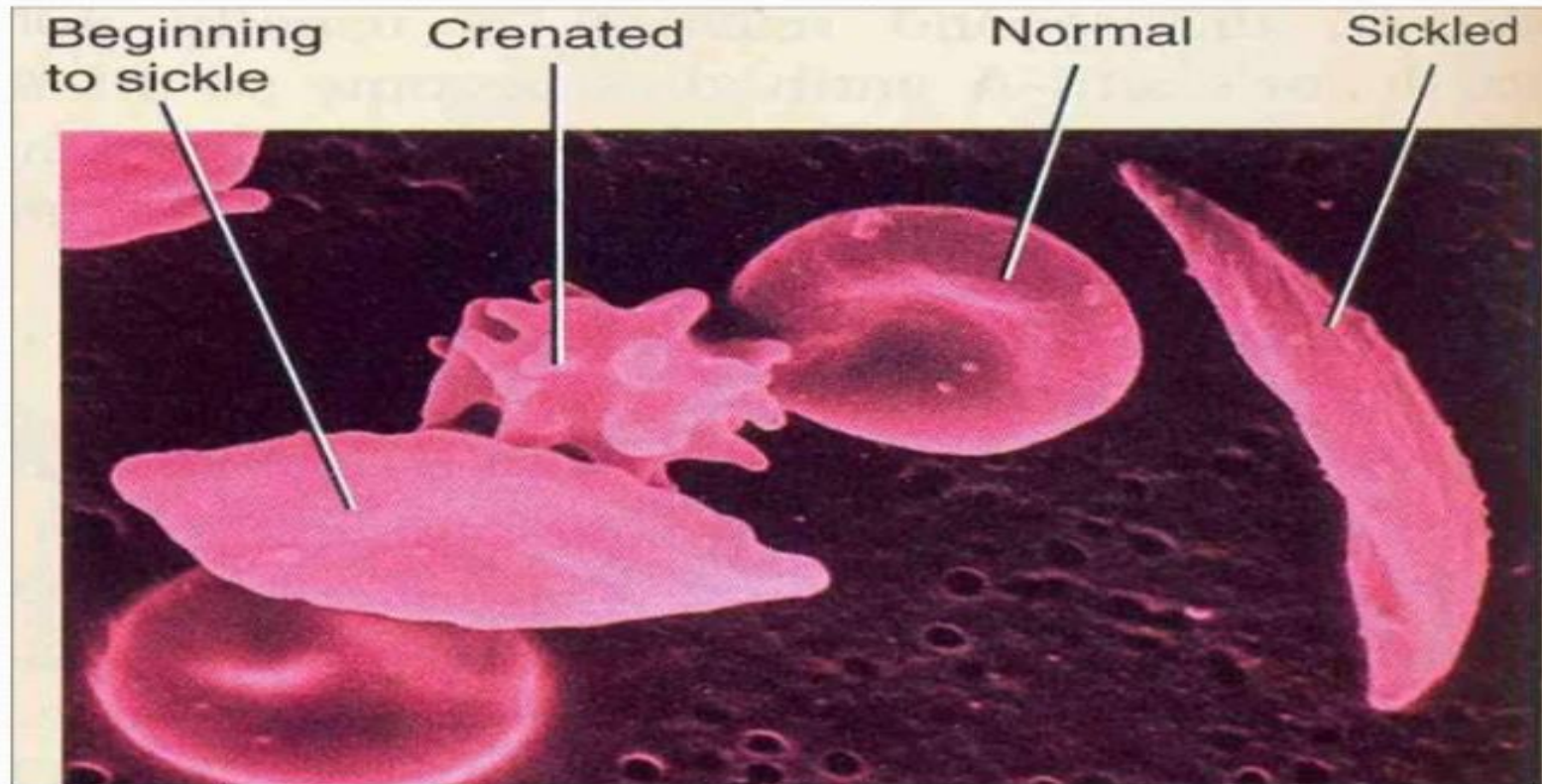
- **Red blood cells or erythrocytes**
- **Volume in healthy male-5.4million/ $\mu$ l**
- **In healthy female-4.8million/ $\mu$ l**
- **Biconcave discs of 7-8 $\mu$ m**
- **No nucleus found**
- **Red in color because of presence of hemoglobin**
- **Each rbc contains 280 million hemoglobin**
- **Hemoglobin=heme( $\text{Fe}^{2+}$ )+globin protein**
- **Hemoglobin binds with 4 oxygen**
- **Life span-120days**



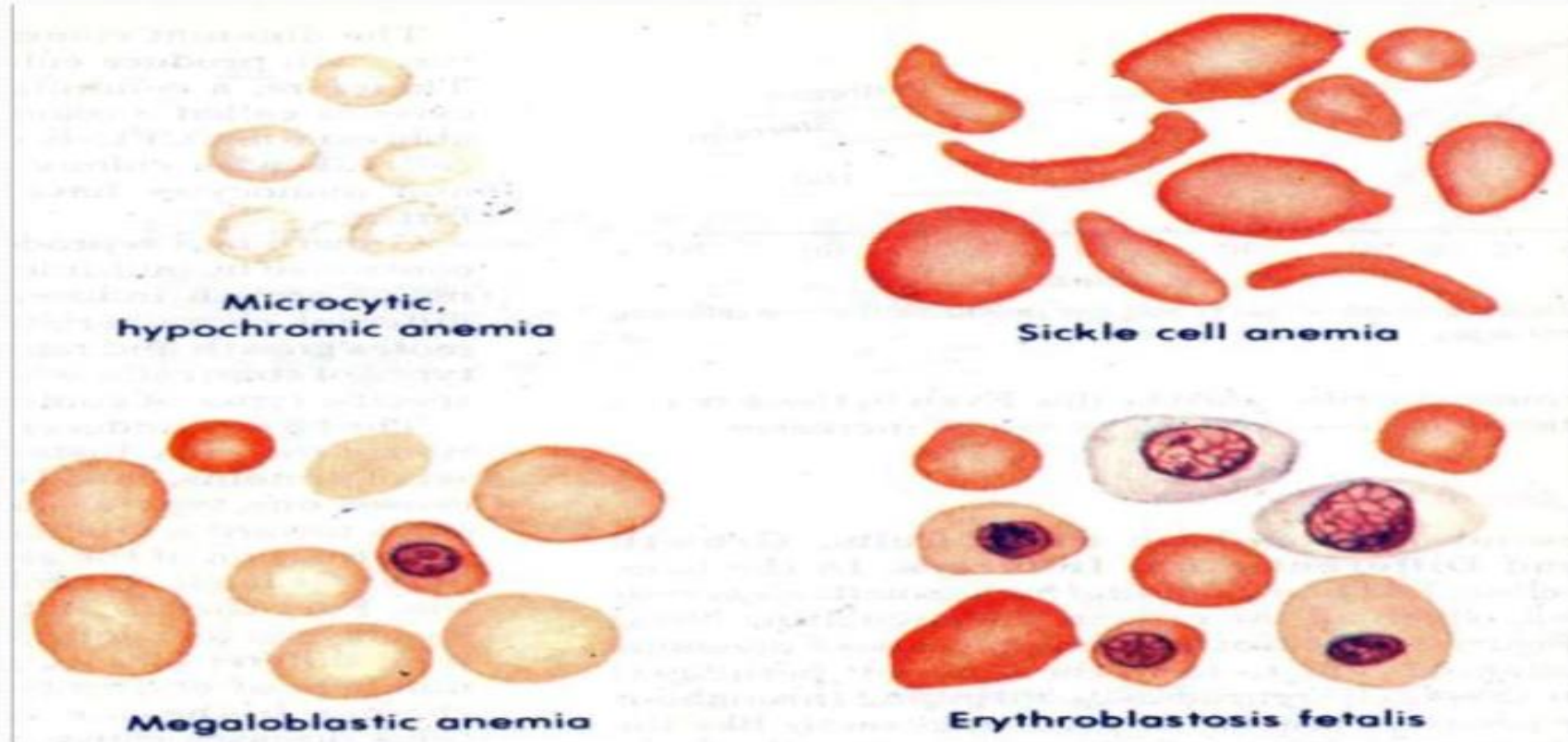
# Erythropoiesis

- Erythropoiesis is the process by which red blood cells (erythrocytes) are produced.
- It is stimulated by decreased O<sub>2</sub> in circulation, which is detected by the kidneys, which then secrete the hormone erythropoietin.
- The whole process lasts about 7 days. Through this process erythrocytes are continuously produced in the red bone marrow of large bones, at a rate of about 2 million per second in a healthy adult.

# Red Blood Cells-Pathological shapes

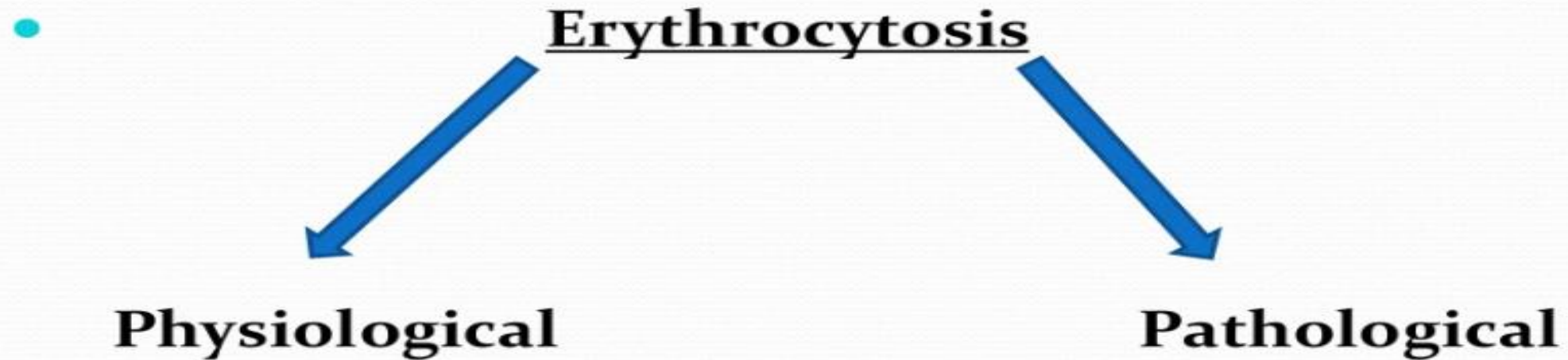


# Red Blood Cells-Pathological forms



# Erythrocytosis - (Polychythemia)

- If the erythrocyte count is more than normal, such state is called erythrocytosis.



# Erythrocytosis

- Physiological

- Absolute
  - In high altitude.
- Relative
  - Exercises.

- Pathological

- Primary
  - Bone marrow disorder.
- Secondary
  - due to any CV or respiratory disease.

# Erythropenia

- If the erythrocyte count is less than normal, such state is called erythropenia.
- A deficiency in number of RBCs or reduced haemoglobin levels in RBCs is known as anaemia.
- Erythropenia may be because of :
  - Problems in production
  - Excessive destruction (haemolysis)
  - Blood loss

# Erythropenia

- Physiological

- Absolute

- Deficiency of production

- Relative

- Pregnancy  
(RBC dissolves in fluid)

- Pathological

- Primary

- Bone marrow disorder.

- Secondary

- due to any kidney disease.



## 5. Erythrocyte Sedimentation Rate (ESR)

- The erythrocyte sedimentation rate (ESR), is the rate at which red blood cells sediment in a period of one hour.
- RBC and plasma will be separated.
- It is a common hematology test.
- Normal values :
  - Men - 2-10 mm/hr
  - Women - 2-15 mm/hr

## Erythrocyte Sedimentation Rate (ESR)

- **Factors influencing the ESR :**
  - **Plasma proteins mainly fibrinogen and globulin**
  - **negative charge of the erythrocytes (zeta potential)**

# Haemolysis of RBC

- **Haemolysis is the rupturing of erythrocytes and the release of their contents (cytoplasm) into surrounding fluid (blood plasma).**
- **Hemolysis may occur in vivo or in vitro (inside or outside the body).**

# Haemolysis of RBCs

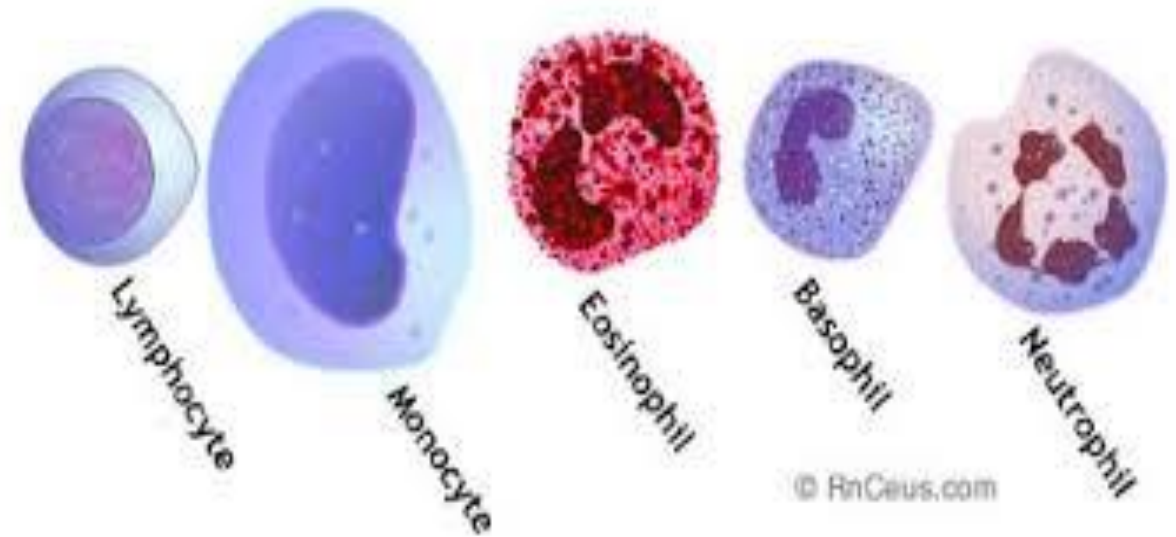
- **Causes :**
  - **Inherited defects in the blood cells**  
(*e.g.*, Hereditary spherocytosis , Thalassemia)
  - **Chemicals, venoms**
  - **The toxic products of microorganisms**
  - **Transfusion of the wrong blood type or**
  - **Rh incompatibility of fetal and maternal blood, a condition called erythroblastosis fetalis.**

# Types of haemolysis

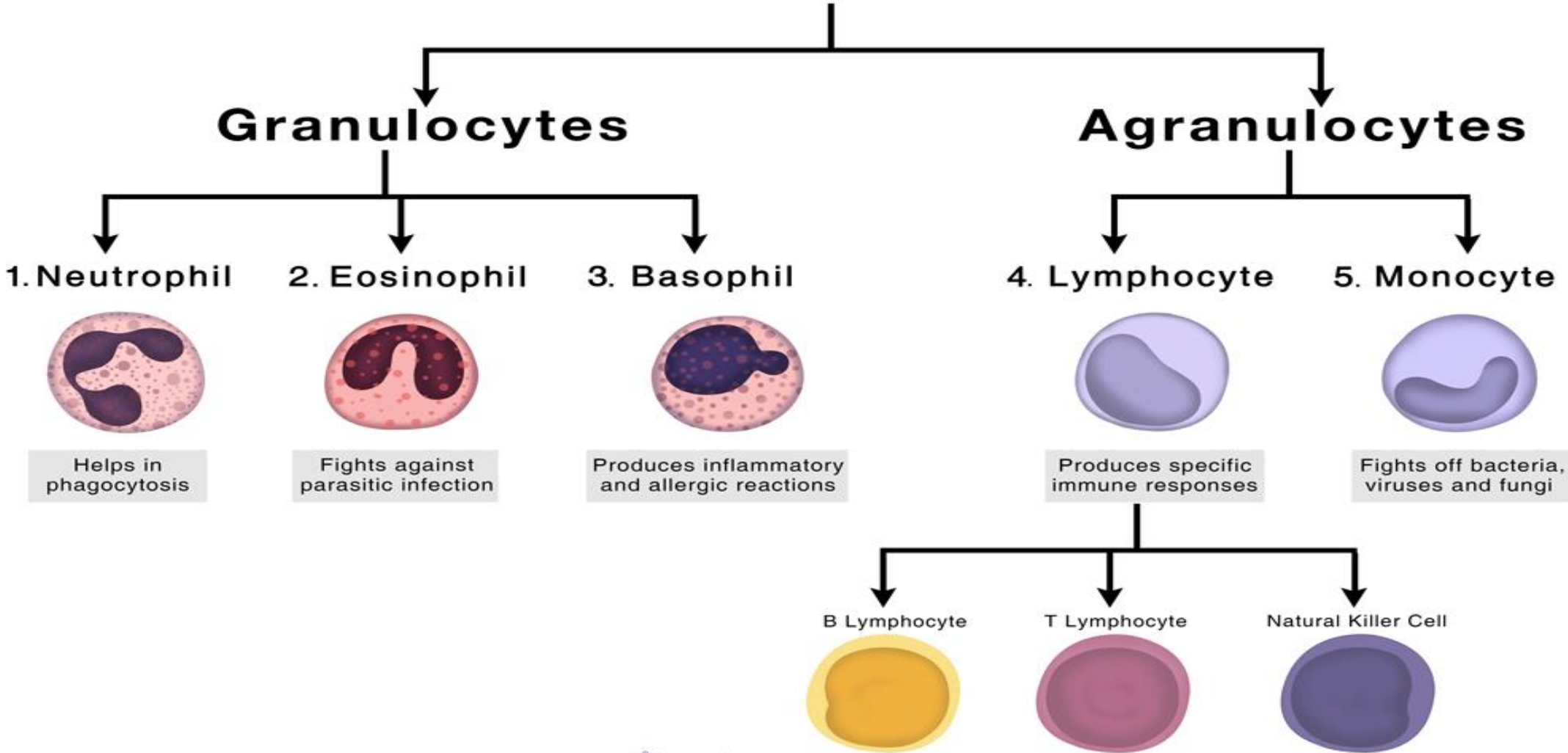
- **Types of haemolysis :**
- **Intrinsic** - Due to problems within the RBC
- **Physical** - Radiation injury
  - **Osmotic** - In hypotonic solution
  - **Mechanical** - Due to pressure
  - **Thermal** - Due to heat
- **Biological** - Blood transfusion, poison
  - **Chemical** - Due to drugs
  - **Extrinsic** - Antibodies against RBC(Immunological).

# WBC

- Known as leukocytes
- Contains nuclei but not hemoglobin
- Colorless cells containing nucleus
- Larger size than RBC
- Volume- 5000-10000 WBC/ $\mu$ l blood
- Life span- few hours to few days

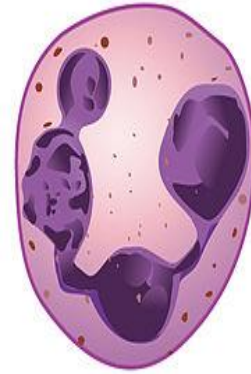


# TYPES OF WHITE BLOOD CELLS

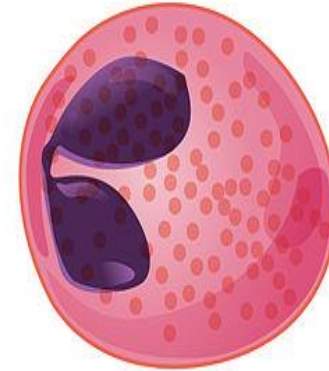


# Granulocytes

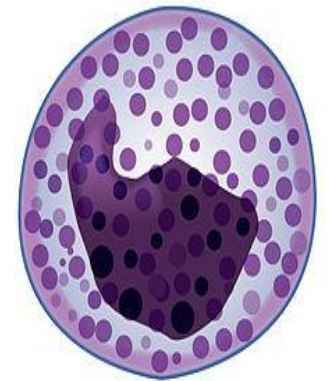
- WBCs have granules in the cytoplasm
- They contain 2 or more lobes
- Again divided into following 3 types
  - Neutrophils
  - Eosinophils
  - Basophils



Neutrophil



Eosinophil

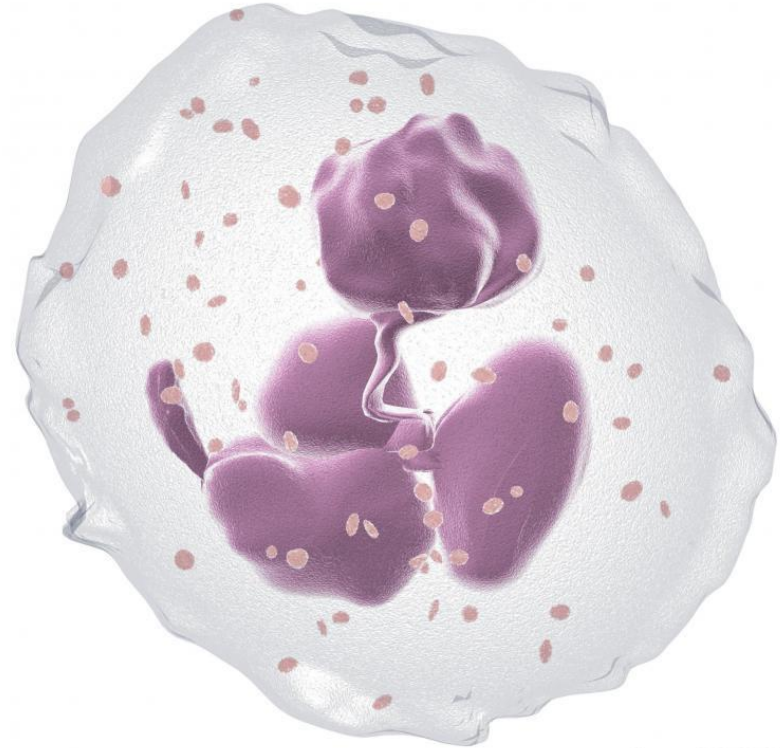


Basophil



# Neutrophils

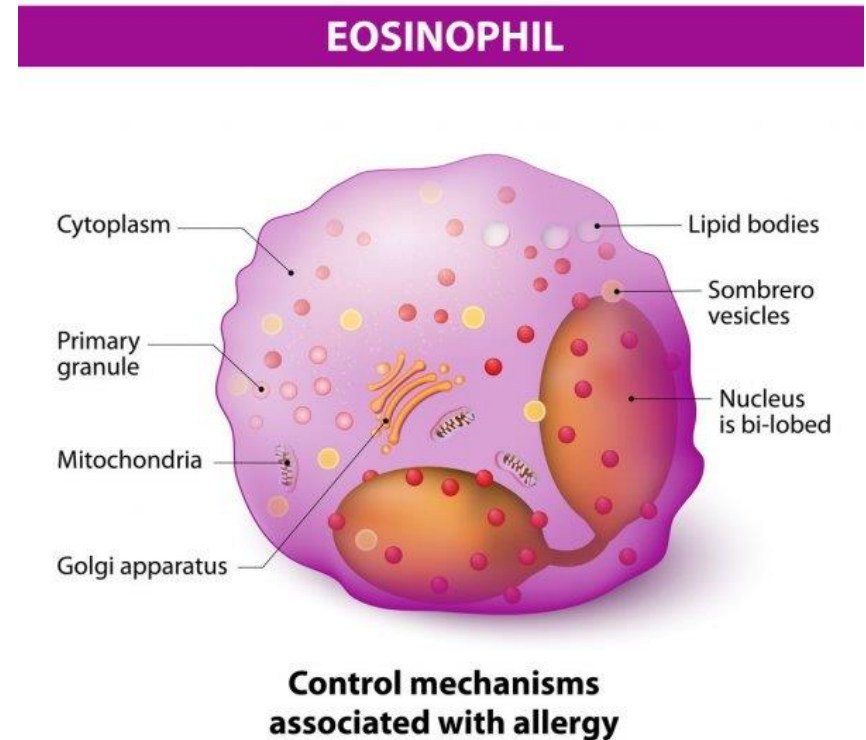
- Smaller than others
- Pale lilac color
- Do not attract either acidic or basic dyes
- Neutrophilic in nature
- 2-5 lobes, connected by thin strands of nuclear material
- Occupy 65-70% of total blood



wiseGEEK

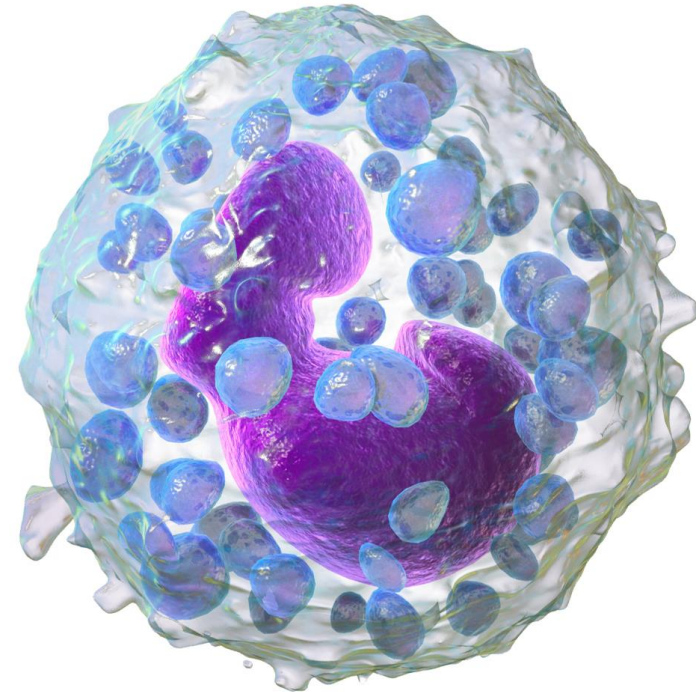
# Eosinophil

- Large, uniform sized granules which are eosinophilic
- Eosinophilic- eosin loving- attract to acidic dyes-red or orange
- 2 lobes connected by thin strands of nuclear material
- 2-4% of blood



# Basophils

- Round , variable sized granules
- Basophilic nature- basic loving- blue purple dyes
- 2 lobes, mostly kidney shaped
- 0.5% of total blood



# Agranulocytes

- Granules are not visible properly
- Poor staining quality
- Smaller in size

# Lymphocytes

- Nucleus stains dark, round & slightly indented
- Cytoplasm stains sky blue
- Major type of lymphocytes- T cell, B cell, NK cell
- Function- deactivate the toxins, act against microbes, virus, bacteria etc.
- According to cell diameter 2 types
  - Large(10-14 $\mu$ m)
  - Small (6-9 $\mu$ m)

# Monocytes

- Kidney shaped nucleus
- Cytoplasm stains blue grey color & foamy appearance
- Migrate from blood to tissue, enlarge, differentiate into macrophages. May be fixed or wondering.
- Clean up debris & microbes by phagocytosis after infection.

# Leucocytosis

- Increased amount of leucocytes in blood.
- It may be :

## Physiological

- Food intake
- Exercises
- Emotion
- Stress

## Pathological

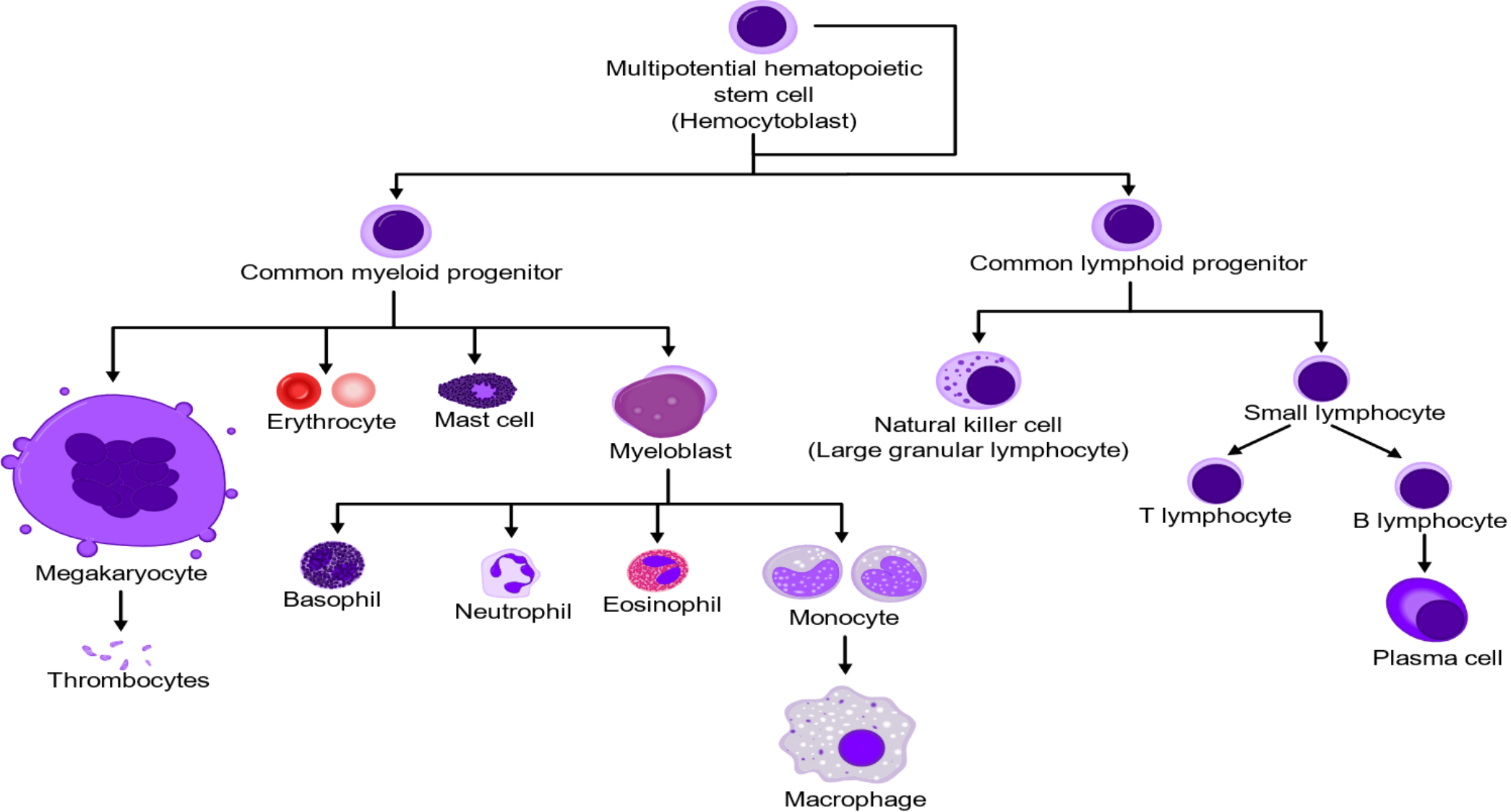
- Inflammation
- Cancer

# Leucopenia

- **Abnormally low concentration of leucocytes in blood.**
- Only pathological :
  - **Severe viral infections**
  - **Autoimmune disease**
  - **Chemotherapy**
  - **Radiation injury**



# Development of WBC

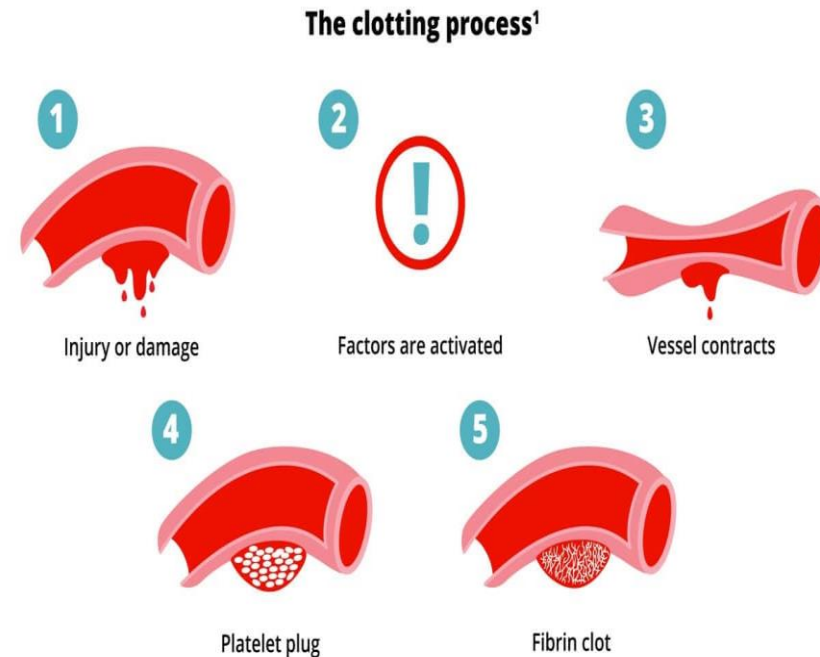


# Platelets

- 1,50,000-4,00,000/microl of blood
- Irregular disc shaped
- 2-4 micrometer diameter
- Many vescicles but no nucleus
- Life span 5-9 days
- Aged and dead platelets are removed by the fixed macrophages found in spleen & liver
- Contains a no of chemicals that promotes blood coagulation.

# Blood clotting

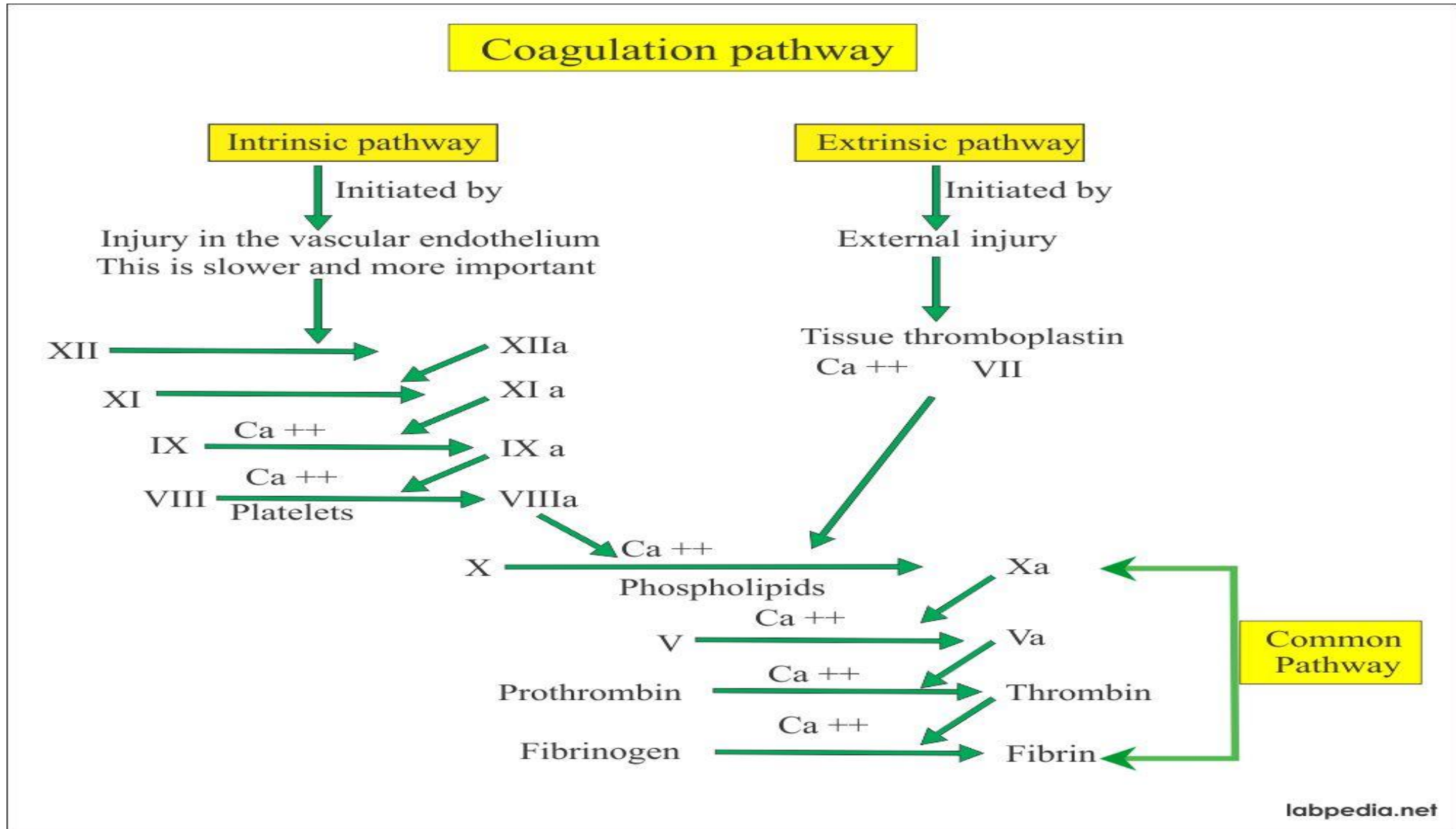
- A defense mechanism of body in which blood coagulates is known as blood coagulation or blood clotting.
- It is a series of chemical reaction.
- Several substances that involved in clotting is known as clotting factor
- There are 13 no. of clotting factors present I human body.
- Avg clotting time is 5-15min.



**TABLE 1****Coagulation Factor Synonyms**

<b>FACTOR</b>	<b>SYNONYM</b>
<b>I</b>	Fibrinogen
<b>II</b>	Prothrombin
<b>III</b>	Tissue factor, thromboplastin
<b>IV</b>	Calcium
<b>V</b>	Proaccelerin, labile factor
<b>VI</b>	—
<b>VII</b>	Proconvertin, stable factor
<b>VIII</b>	Antihemophilic factor
<b>IX</b>	Christmas factor
<b>X</b>	Stuart-Prower factor
<b>XI</b>	Plasma thromboplastin antecedent
<b>XII</b>	Hageman factor
<b>XIII</b>	Fibrin-stabilizing factor, transglutaminase

# Mechanism of blood clotting



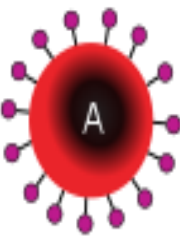
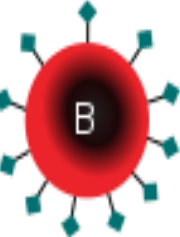
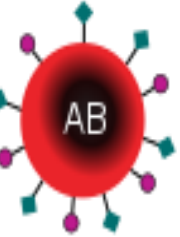







# Blood grouping

- The surfaces of erythrocytes contain a genetically determined classified antigens which is composed of glycoproteins & glycolipids.
- Antigens are called as agglutinogen.
- Basing upon the presence of antigens blood is differentiated into different groups.
- Major blood groups are: ABO & Rh
- Blood plasma contains antibodies called as agglutinins that react with the antigens.

# ABO Blood group

- Based on 2 glycolipid antigens i. e. A & B
- Anti-A antibody reacts with antigen A and anti-B antibody reacts with antigen B.
- Antibodies do not react with the antigens of own RBCs.

# ABO Blood group

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in red blood cell	A antigen 	B antigen 	A and B antigens 	None

Recipient	Blood donor			
	O	A	B	AB
O	✓	✗	✗	✗
A	✓	✓	✗	✗
B	✓	✗	✓	✗
AB	✓	✓	✓	✓



Rh Blood Group

**HOME WORK**