

BLOOD

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Blood

Blood is a specialized connective tissue in which cells are suspended in fluid extracellular material called plasma . It is about 5 L of blood in an average adult

Functions of the blood:

- 1- Acid-base balance maintenance.
- 2- Control body temperature
- 3- Defense against infection
- 4- Transport oxygen, carbon dioxide and hormones.
- 5-Removal of waste products of cell metabolism.



Components of Blood

Blood cells
45%

- 1- Red blood cells (corpuscles) or erythrocytes.**
- 2- White blood cells or leukocytes.**
- 3- Platelets.**

Blood plasma
55%

- It is a yellow fluid in which the blood cells are suspended.
- 1- Water 90 % .**
 - 2- Plasma proteins 7% (albumin, globulin, -fibrinogen and prothrombin) .**
 - 3- Small amounts of**
 - Ca
 - sodium chloride,
 - bicarbonate
 - phosphate.

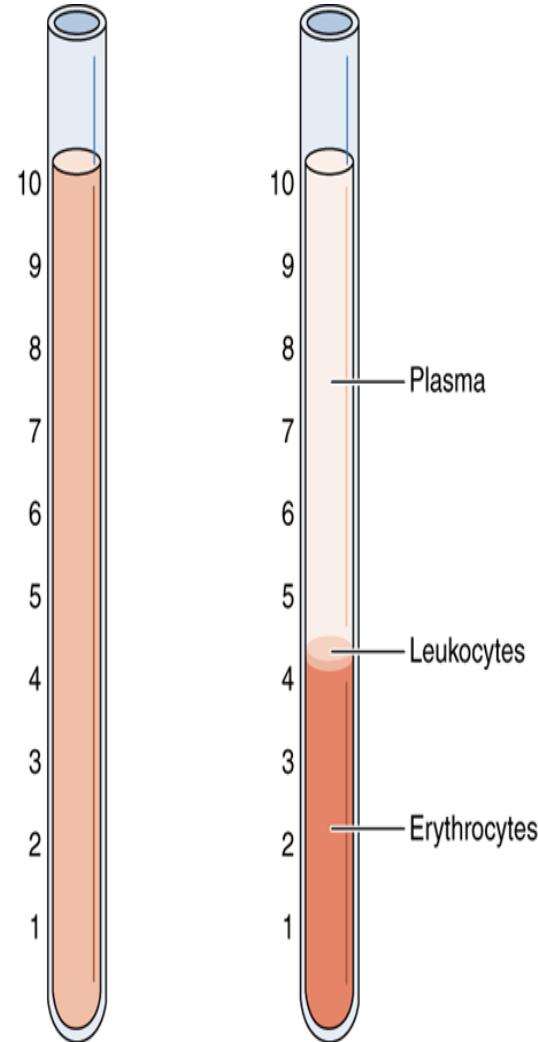
Blood cells

1-True: have nucleus.

- White blood cells or leukocytes (1%).

2-Not True:

- Red blood corpuscles or erythrocytes (44%).
- Platelets or thrombocytes (less than 1%).



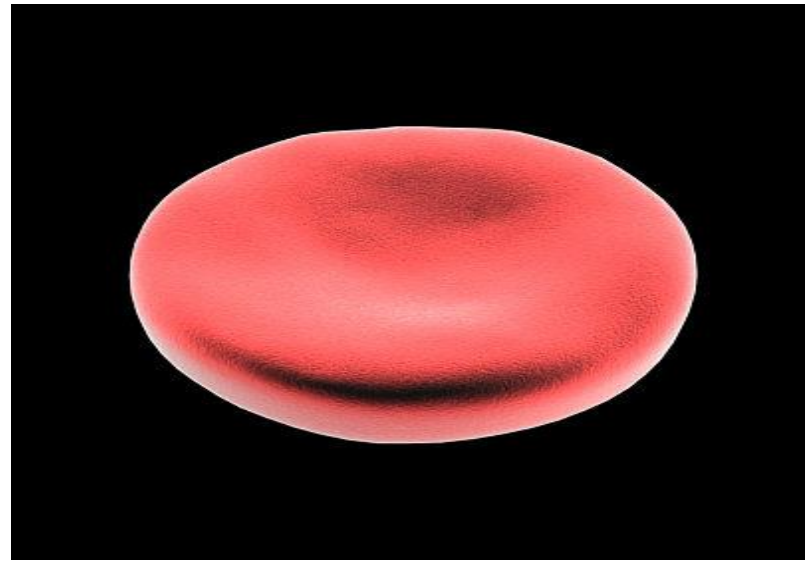
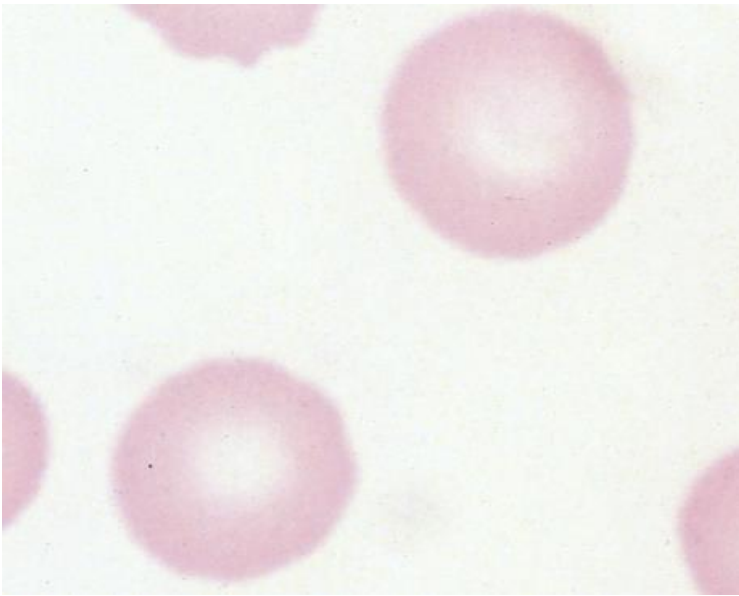
Erythrocytes (RBCs)

- **Erythrocytes** (red blood cells or RBCs) are terminally differentiated structures lacking nuclei and completely filled with the O₂ carrying protein **hemoglobin**. RBCs are the only blood cells whose function does not require them to leave the vasculature.
- **Number of RBCs**
 - males 5 million / cubic millimeter of blood
 - females 4.5 millions / cubic millimeter of blood
- **Abnormal number**

Decrease in the number of RBCs is known as **anemia**.

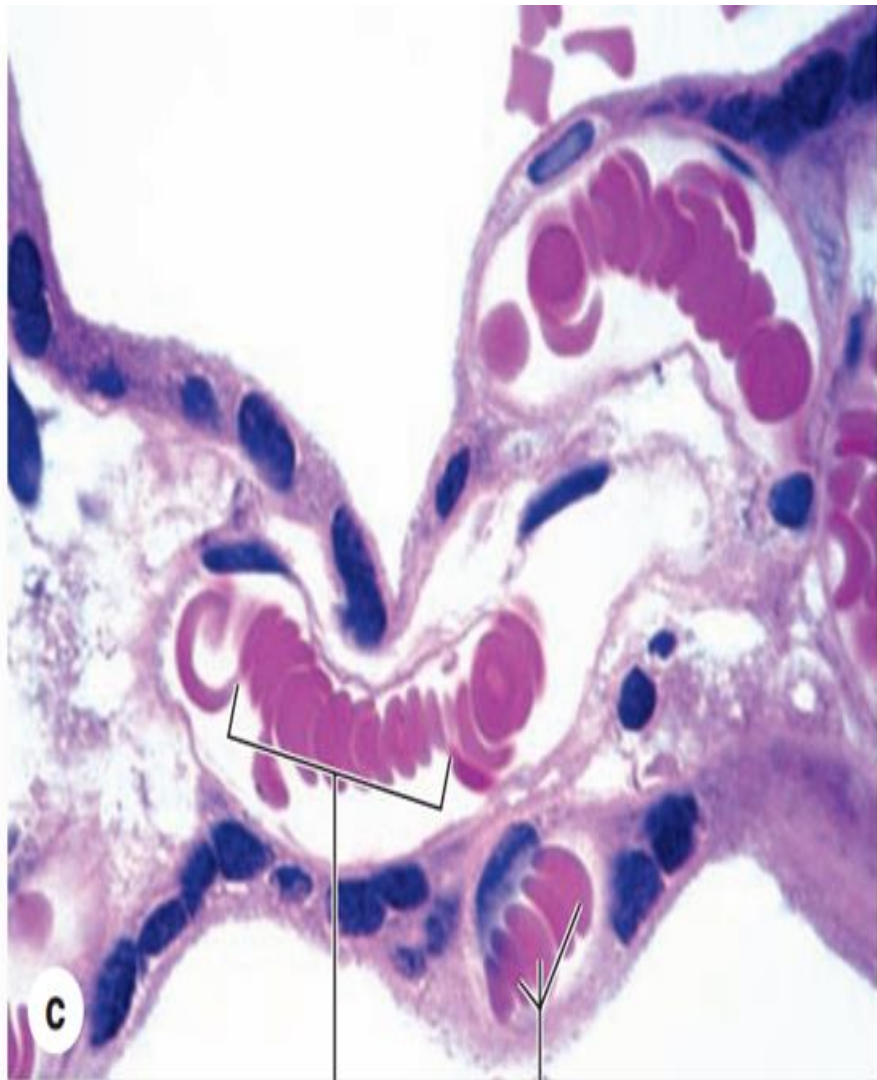
Increase in their number is known as **polycythemia**.





- **Shape** : biconcave discs.
- Erythrocytes are normally quite flexible, which permits them to bend and adapt to the irregular turns and small diameters of capillaries.
- In larger blood vessels RBCs often adhere to one another loosely in stacks called rouleaux





Rouleaux Erythrocytes

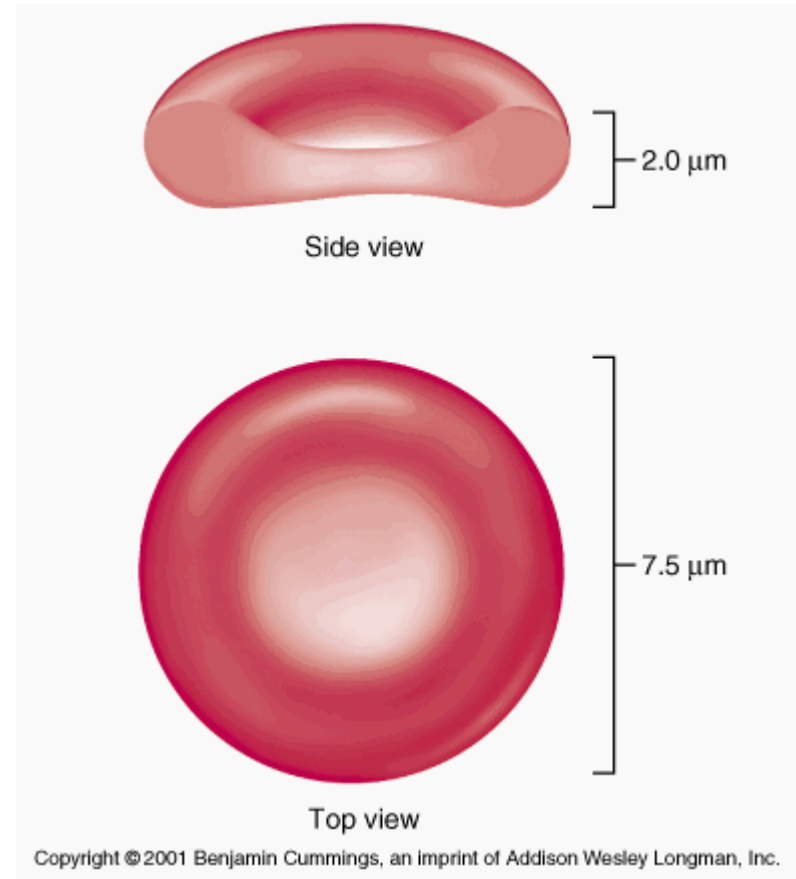


- **Size of RBCs:**

7.5 microns in diameter and 2 microns in thickness

- **Abnormal shape and size of RBCs: .**

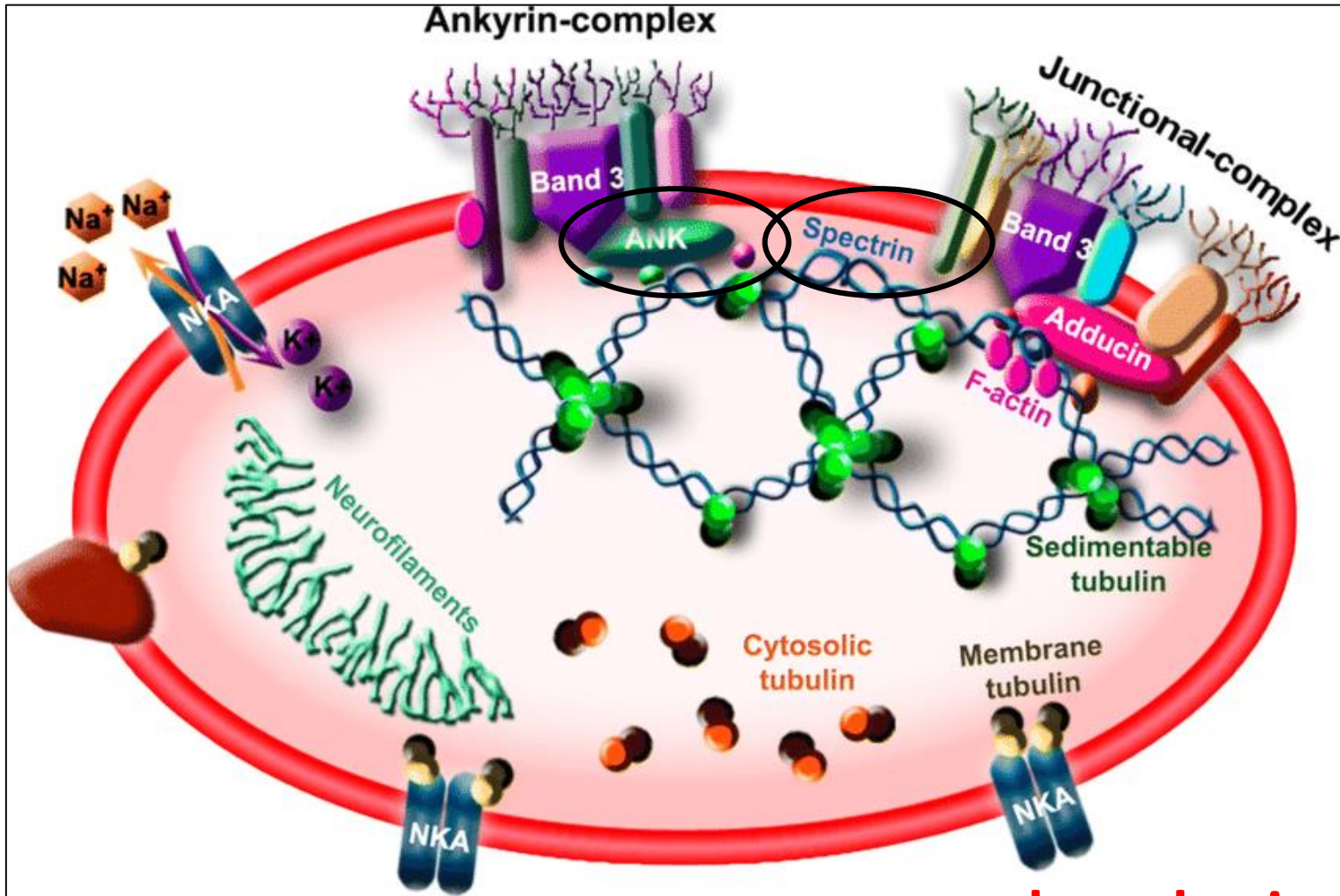
- ▶ **Macrocytic anemia**, diameter of RBCs increases.
- ▶ **Microcytic anemia**, their diameter decreases.
- ▶ **Anisocytosis**, abnormal sizes of RBCs may appear in the circulation.



- **Colour:** bright red
- Hemoglobin = the iron ("heme"), oxygen transport protein, ("globin").
- In hyperchromic anemia, the RBCs are darkly stained and contain more Hb % than normal.
- In hypochromic anemia, RBCs are faintly (lightly) stained and contain less Hb % than normal.

Hyperchromic	Normochromic	Hypochromic
		
MCH: >31 pg/cell	MCH: 27-31 pg/cell	MCH: <27 pg/cell

STRUCTURE:

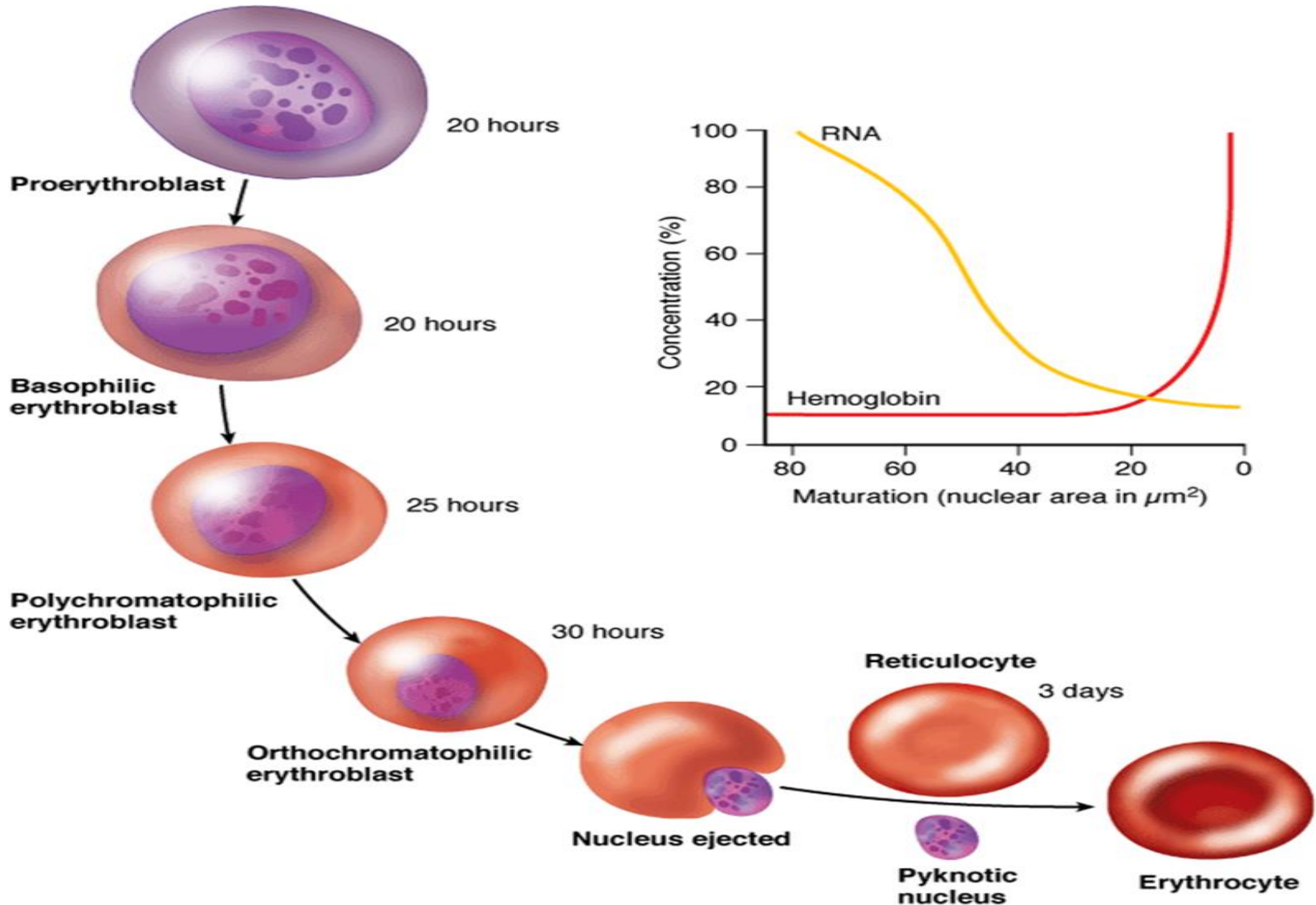


glycophorin

glycophorin

- The plasmalemma of the erythrocyte consists of about 40% lipid, 10% carbohydrate, and 50% protein. Most of them are integral membrane proteins, including **glycophorin** (antigenic sites that form the basis for the ABO blood system).
- Several peripheral proteins are associated with the inner surface of the membrane, including **spectrin** and **ankyrin**, which stabilizes the membrane, maintains the cell shape, and provides the cell elasticity required for passage through capillaries.

Differentiation and maturation processes in B.M

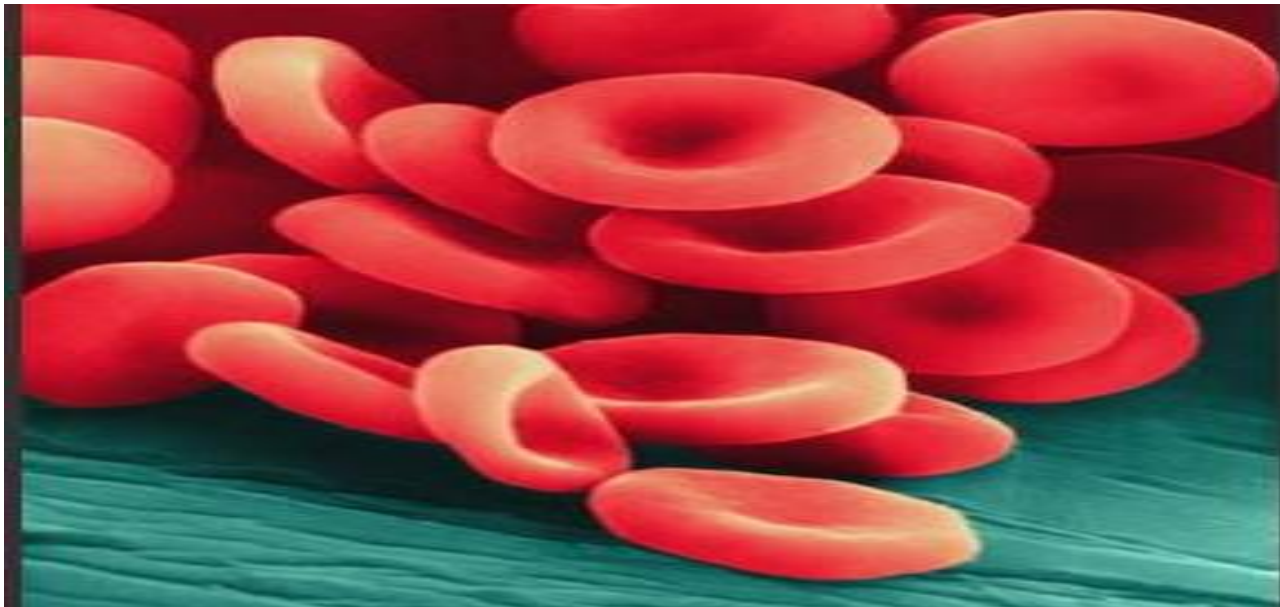


- During **differentiation and maturation** processes (bone marrow), erythrocytes synthesize large amount of Hb, before they are released into the systemic circulation, the nucleus is extruded from the cytoplasm and the mature RBCs assumes a biconcave shape. This shape provides more surface area for carrying respiratory gases.
- Mature RBCs are highly specialized to transport O₂ & Co₂. Iron molecules in Hb bind with O₂ and most of the O₂ in the blood is carried to tissues in the form of **oxyhemoglobin**. Co₂ from the cells and tissues is carried to the blood with Hb (**carbaminohemoglobin**). These reactions are reversible.

Reticulocytes:

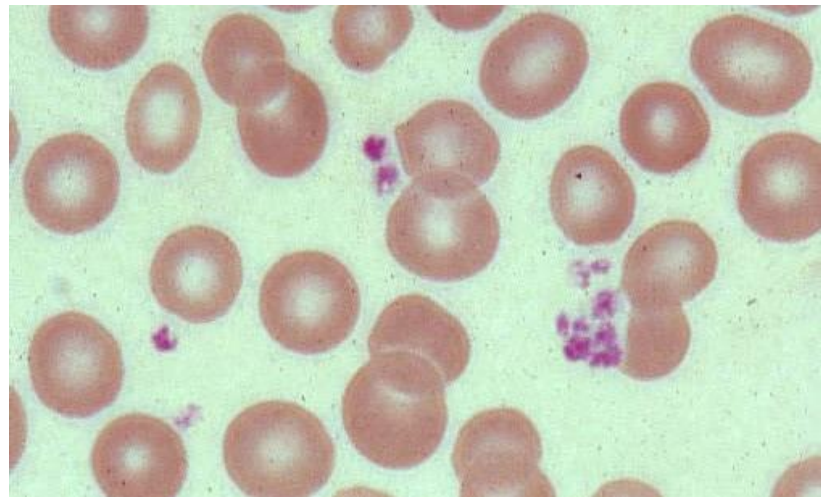
- The younger erythrocytes (**immature**) are called reticulocytes. Their cytoplasm is basophilic having no nuclei, some free ribosomes in the form of a net like structure and few mitochondria are present. Their diameter is 8 μm .
- They normally constitute about **1%** of the total blood number of circulating RBCs.
- They are stained by **supravital stains** (brilliant cresyl blue).
- Increase the number of reticulocytes indicates a demand for increased O₂-carrying capacity as in hemorrhage and in high altitude.

- **Life-span of RBCs:** 100-120 days. Old RBCs are removed from the circulation mainly by macrophages of the spleen and bone marrow.
- **Functions:** Transport of oxygen from lung to tissues and carbon dioxide from tissues to lung.



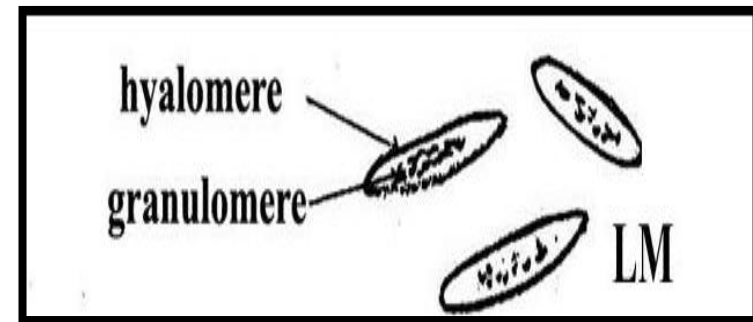
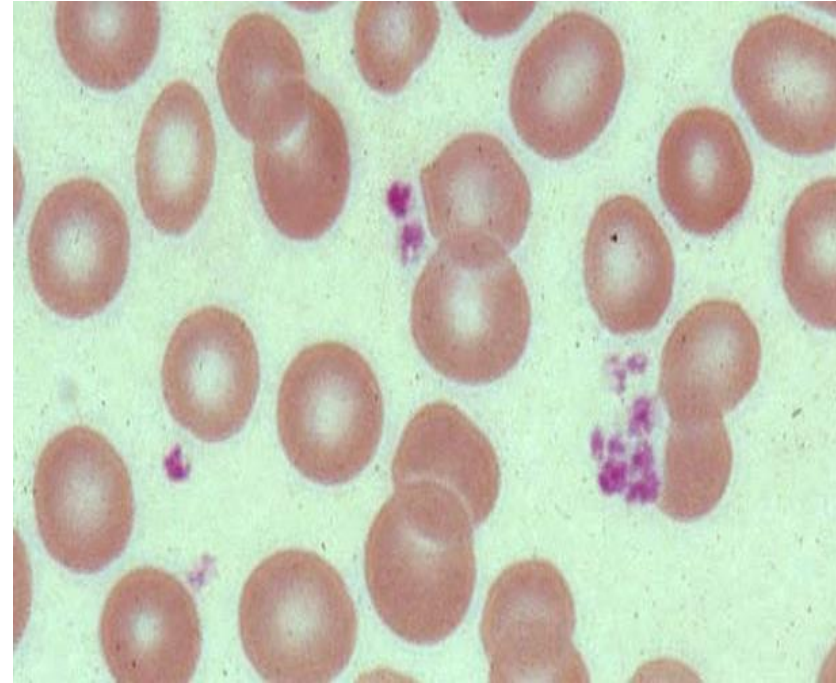
Platelets (Thrombocytes)

- **Origin:** Megakaryocytes (B.M)
- **Shape:** cytoplasmic fragments
- **Size:** 2-5 micron
- **Count:** 150,000 – 400.000 / cubic millimeter of blood.
- **Life span:** is about 10 days.
- **Function:**
 - Promote blood clotting, so preventing loss of blood.
 - wound healing.



Platelets

- **L/M:** in stained blood smears, they often appear in clumps. Each platelet has a peripheral light blue-stained transparent zone (hyalomere), and a central zone containing purple granules (granulomere).





ER

δG

αG

G

ER

OCS

Microtubules & microfilaments

- **E/M:** platelets are surrounded by cell membrane, covered by a thick glycocalyx (cell coat).
- The **hyalomere** contains electron dense tubular system, bundles of microtubules (to maintain the oval shape), and microfilaments (help in platelet movement and aggregation).
- Also in the hyalomere are two systems of membrane channels ,**open canalicular system of vesicles** which is invaginations of the plasma membrane and much less prominent set of **irregular tubular vesicles** which derived from the ER and stores Ca^{2+} ions.



- The **granulomere** contains one or two mitochondria, numerous small clear vesicles, glycogen and varying numbers of membrane bounded dense granules named:
 - **alpha** most numerous (platelet-derived growth factor (PDGF), platelet factor 4),
 - **delta** (ADP, ATP, and serotonin)
 - **lambda** granules: lysosomes



Thank You

