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.

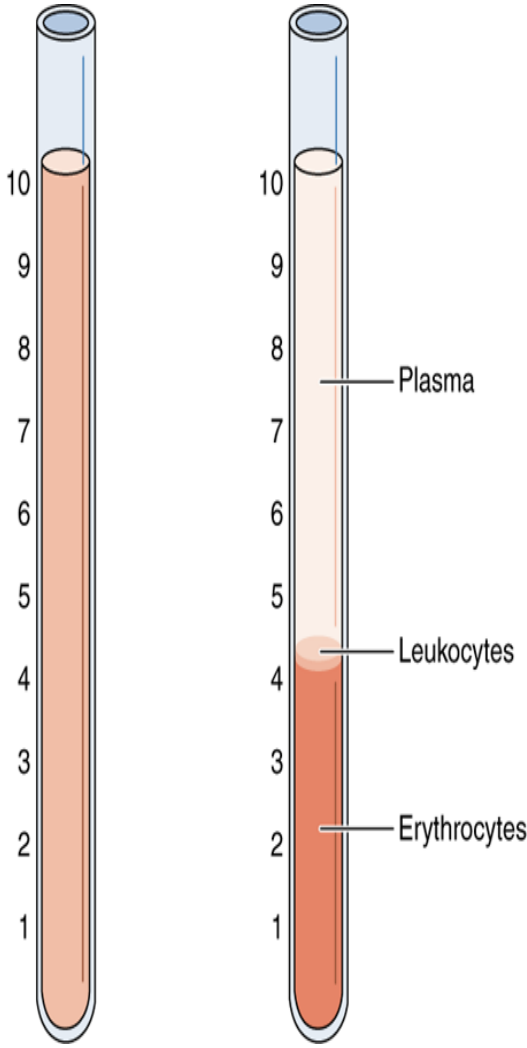
Blood cells

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**

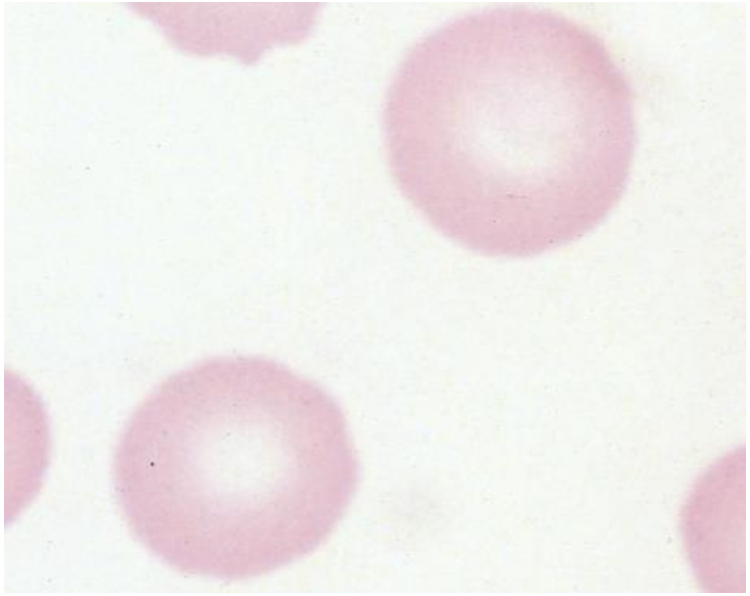
  - males 5 million / cubic millimeter of blood

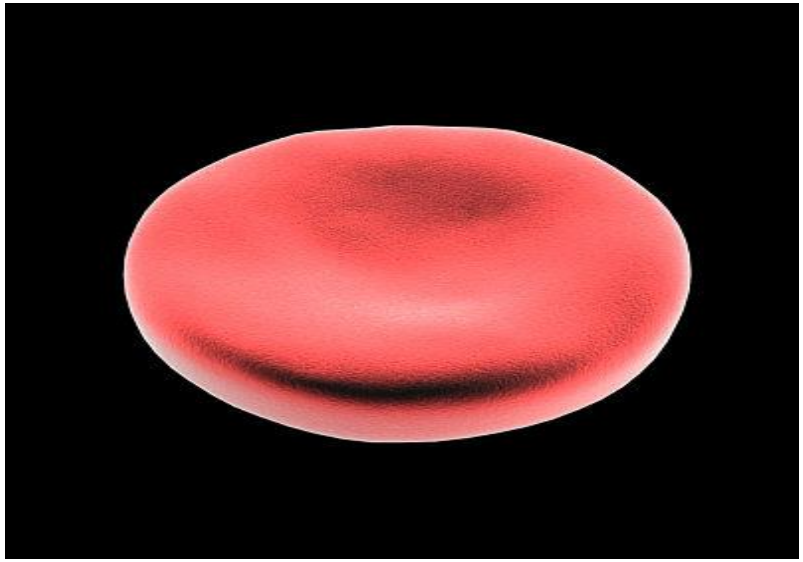
  - females 4.5 millions / cubic millimeter of blood

- **Abnormal number**

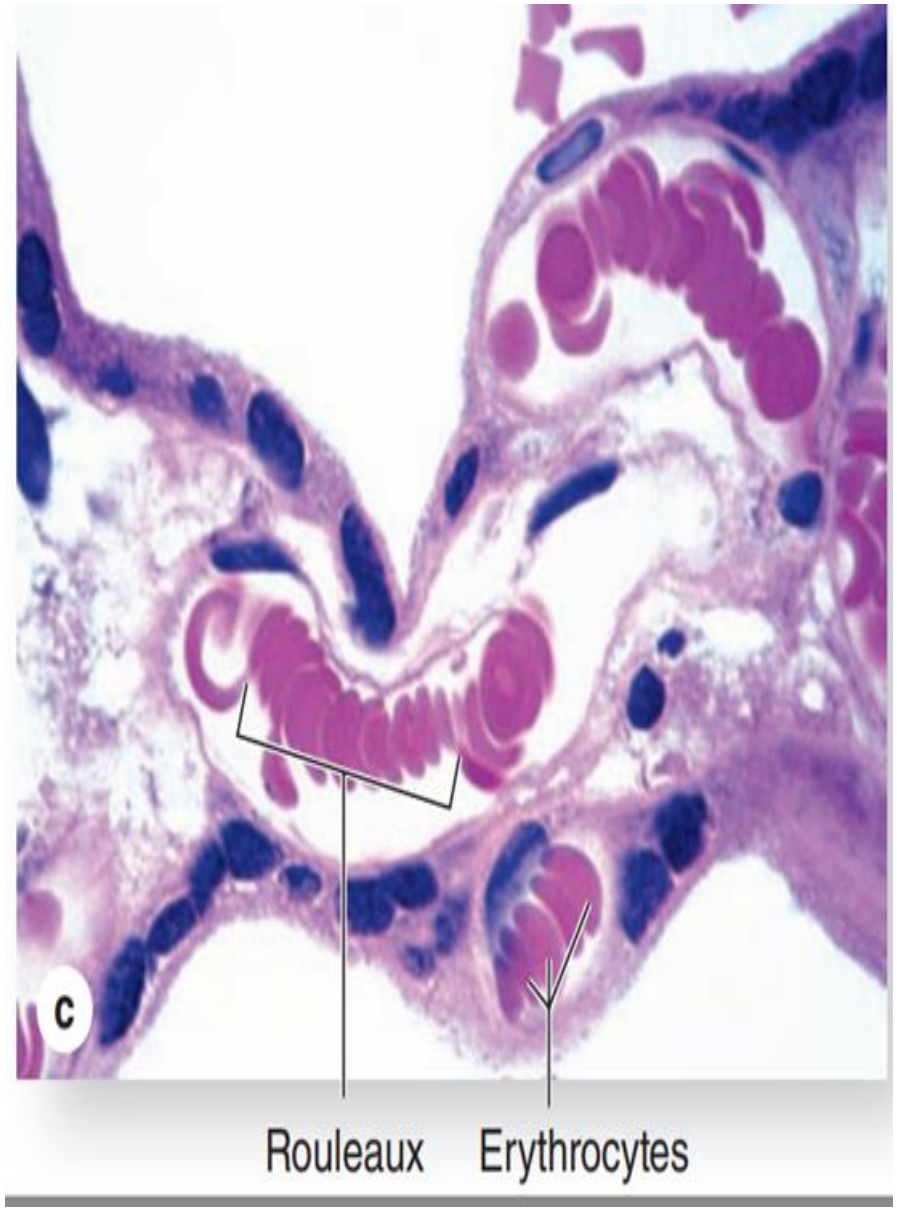
  Decrease in the number of RBCs is known as ***anemia***.

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

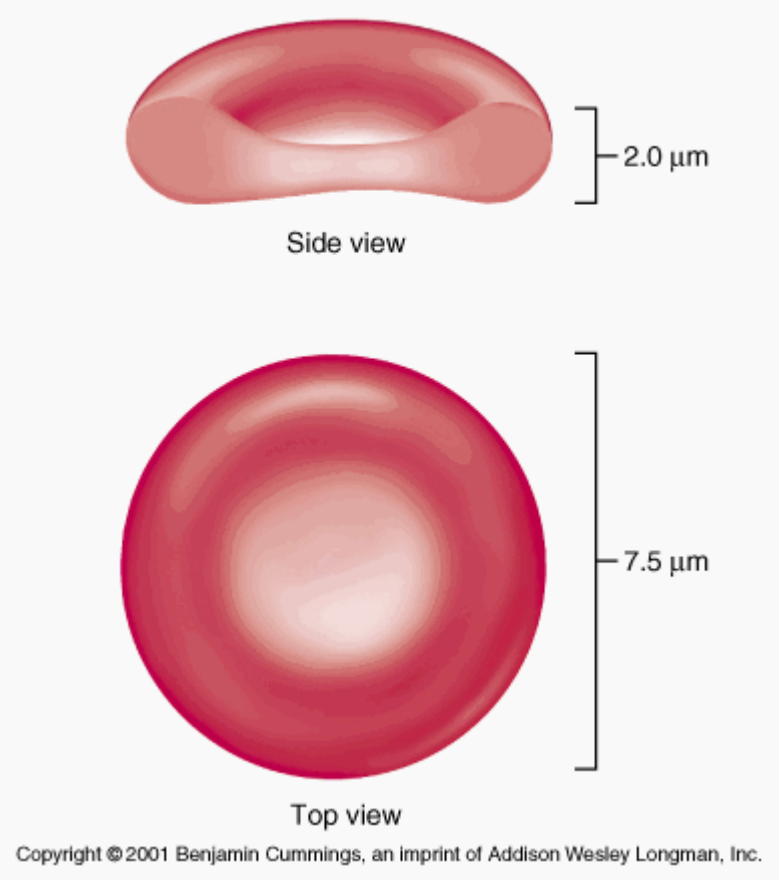




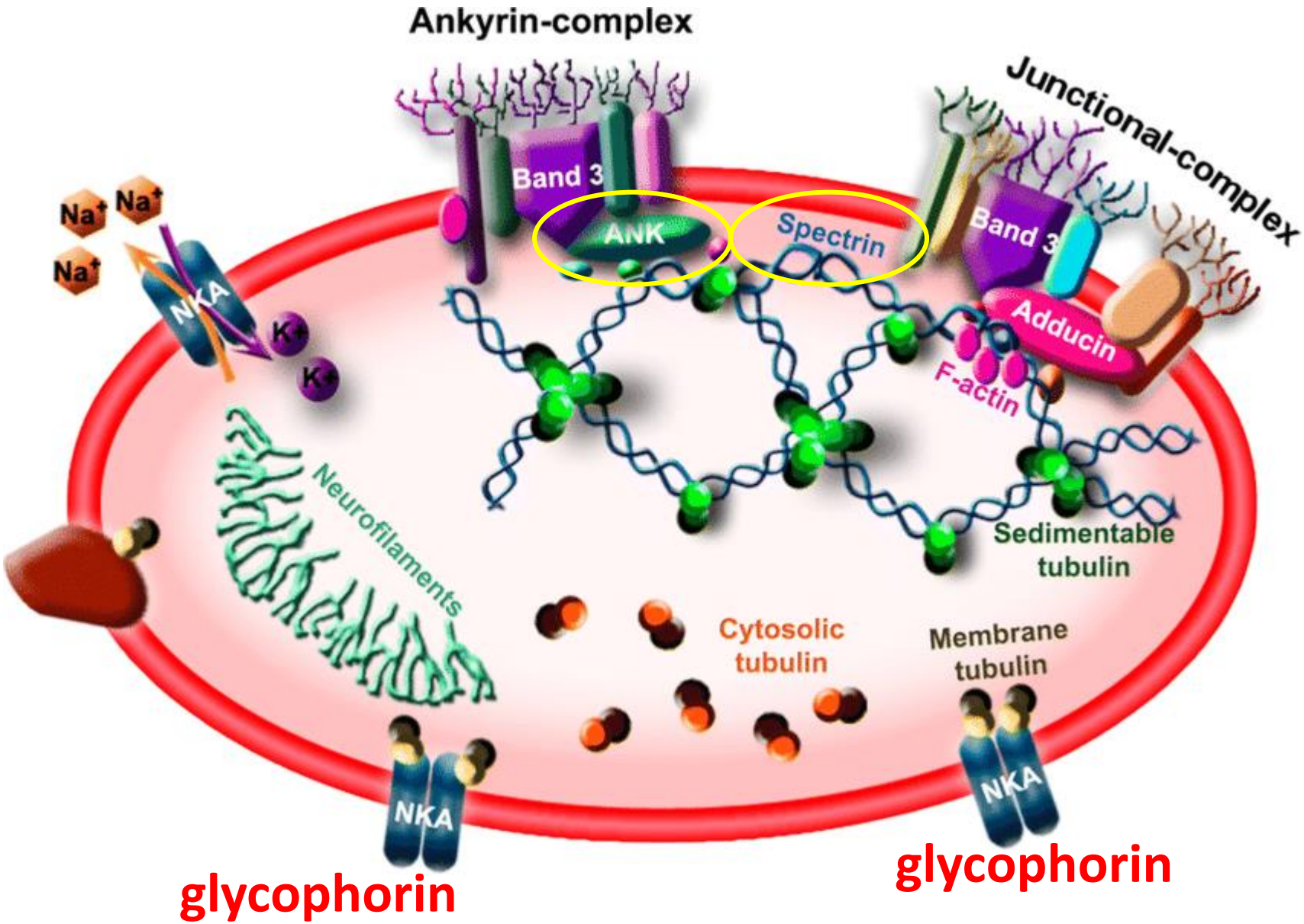
- **Shape :** biconcave discs.
- Erythrocytes are normally quite flexible, which permits them to bend and adapt to the irregular turns and small diameters of capillaries.
- In larger blood vessels RBCs often adhere to one another loosely in stacks called rouleaux


c
Rouleaux
Erythrocytes

- **Size of RBCs:**
  7.2 microns in diameter and 1.9 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:** Unstained erythrocytes have greenish yellow colour due to their content of hemoglobin.
- Hemoglobin = the iron ("heme"), oxygen transport protein, ("globin").
- Normally, the erythrocytes in a dry smear of peripheral blood stain deep pink or salmon colour with Wright's stain.
- 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.


Ankyrin-complex
Junctional-complex
Band 3
ANK
Spectrin
Band 3
Adducin
F-actin
Na+
Na+
Na+
NKA
K+
K+
Neurofilaments
Sedimentable tubulin
Cytosolic tubulin
Membrane tubulin
NKA
NKA
glycophorin
glycophorin

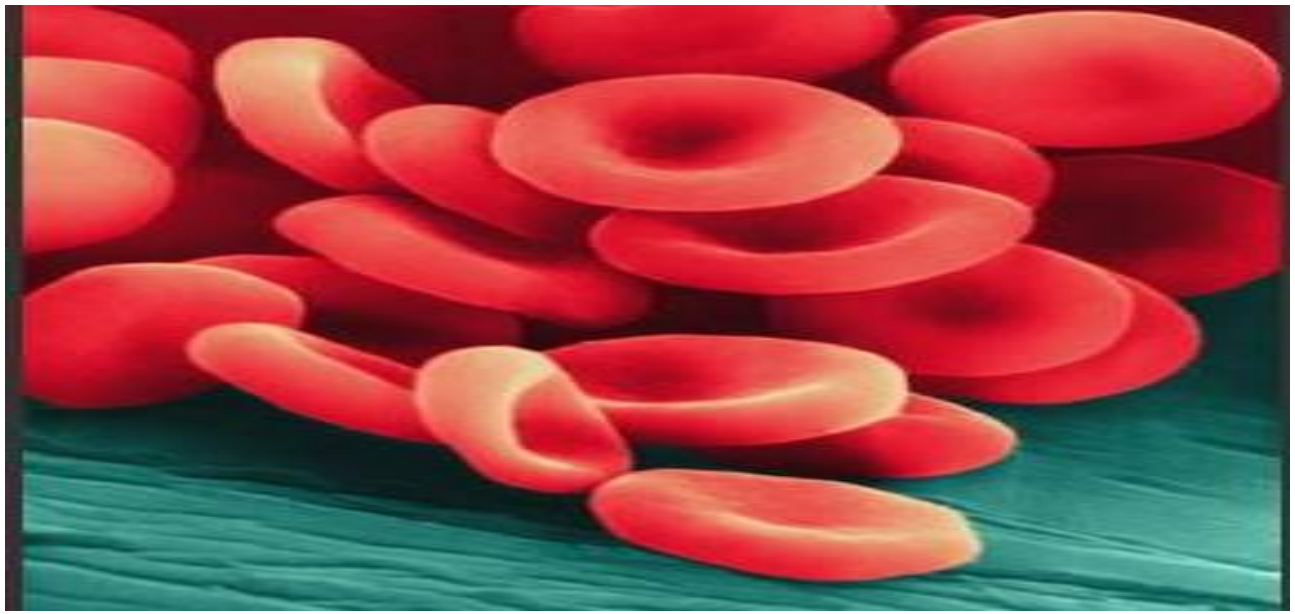
- The plasmalemma of the erythrocyte consists of about 40% lipid, 10% carbohydrate, and 50% protein. Most of them are **integral membrane proteins**, including glycophorin (antigenic sites that form the basis for the ABO blood system).

- **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.

- 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.

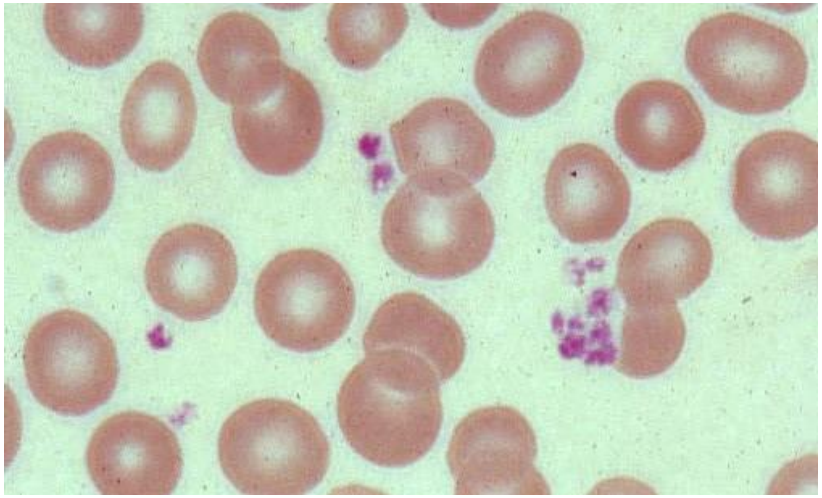
- **Life-span of RBCs:** 100-120 days. Old RBCs are removed from the circulation mainly by macrophages of the spleen and bone marrow.
- **Functions:** Transport of oxygen from lung to tissues and carbon dioxide from tissues to lung.



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.

Platelets (Thrombocytes)



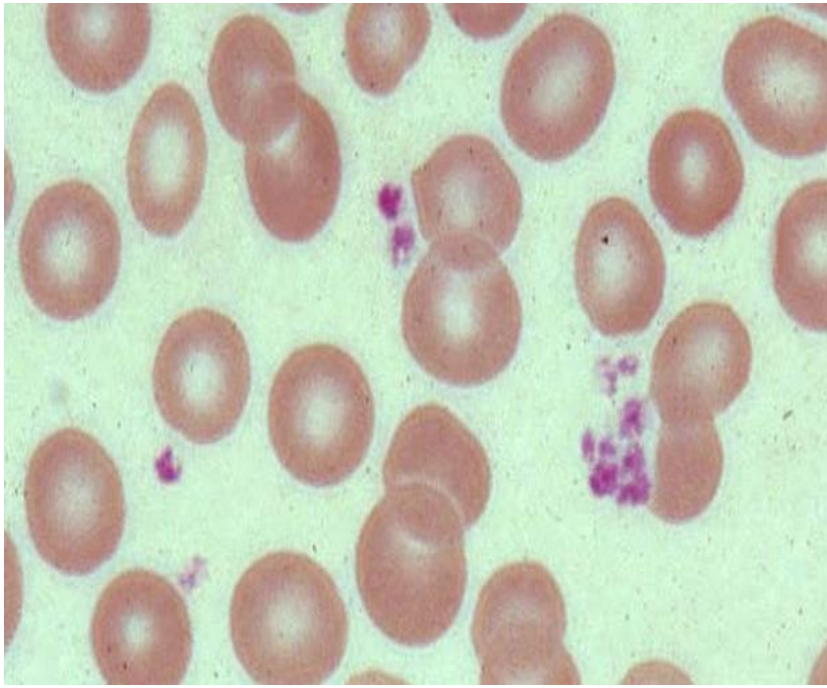
- **Origin:** **Megakaryocytes (B.M)**
- **Shape:** cytoplasmic fragments
- **Size:** 2-5 micron
- **Count:**150,000 – 400.000 / cubic millimeter of blood.
- **Life span:** is about 10 days.
- **Function:**

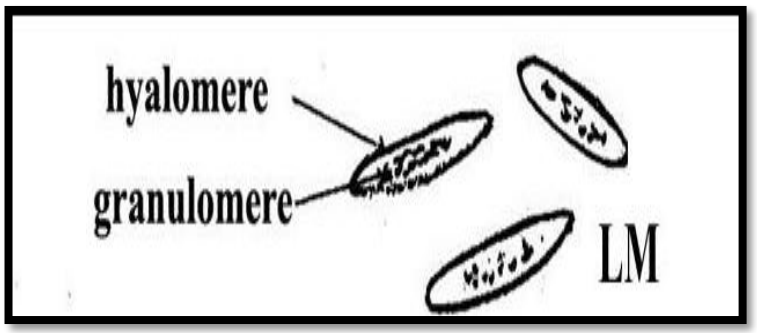
- Promote blood clotting, so preventing loss of blood.

- 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
ER
G
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 Ca2+ ions.

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

Thank You