

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

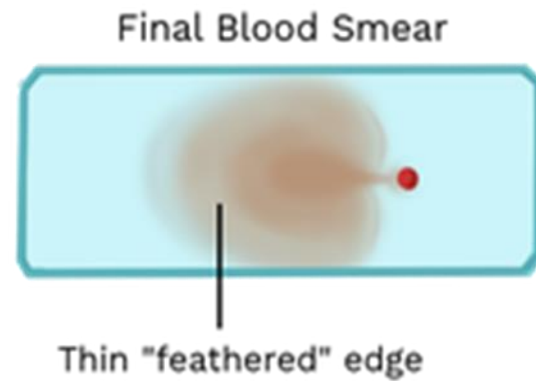
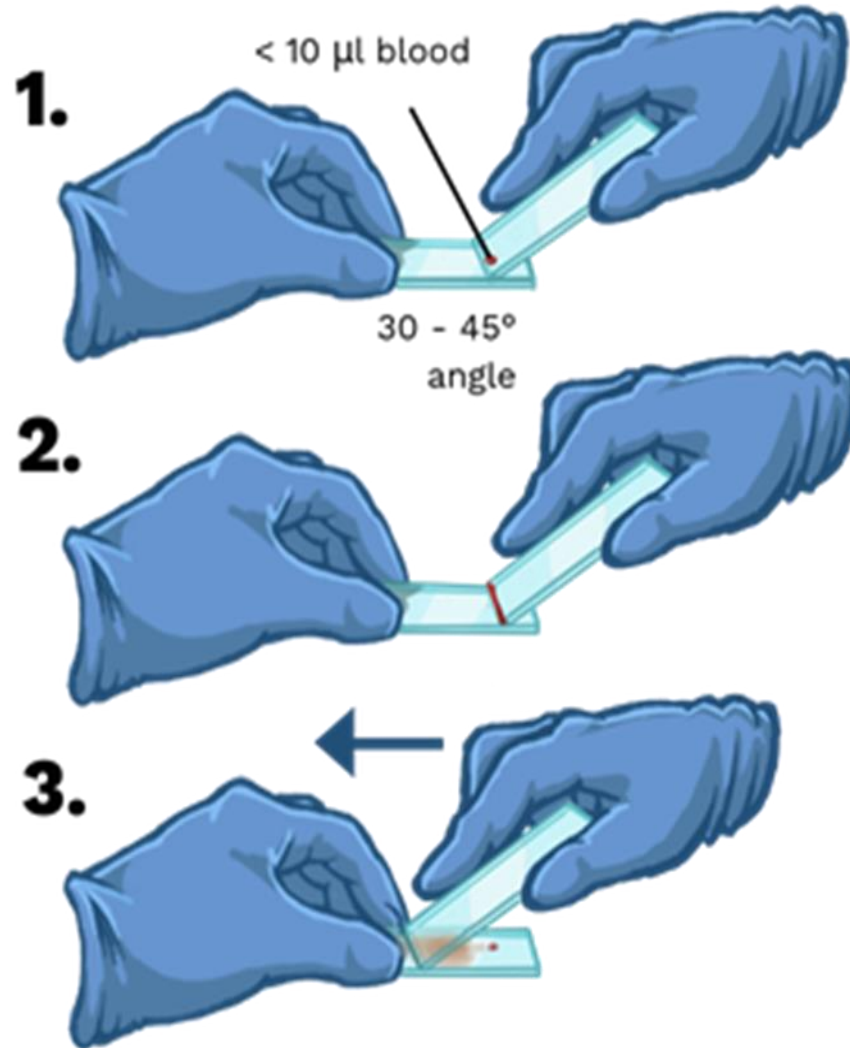
Blood cells
45%

- 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 film or peripheral blood smear



Blood film or peripheral blood smear

-It is a thin layer of blood smeared on a glass microscopic slide to be stained to allow the various blood cells to be examined microscopically.

-Preparation of blood film:

1-A drop of blood is placed on a clean microscopic slide.

2-Another slide (spreader slide) is used to disperse the blood over the slide's length.

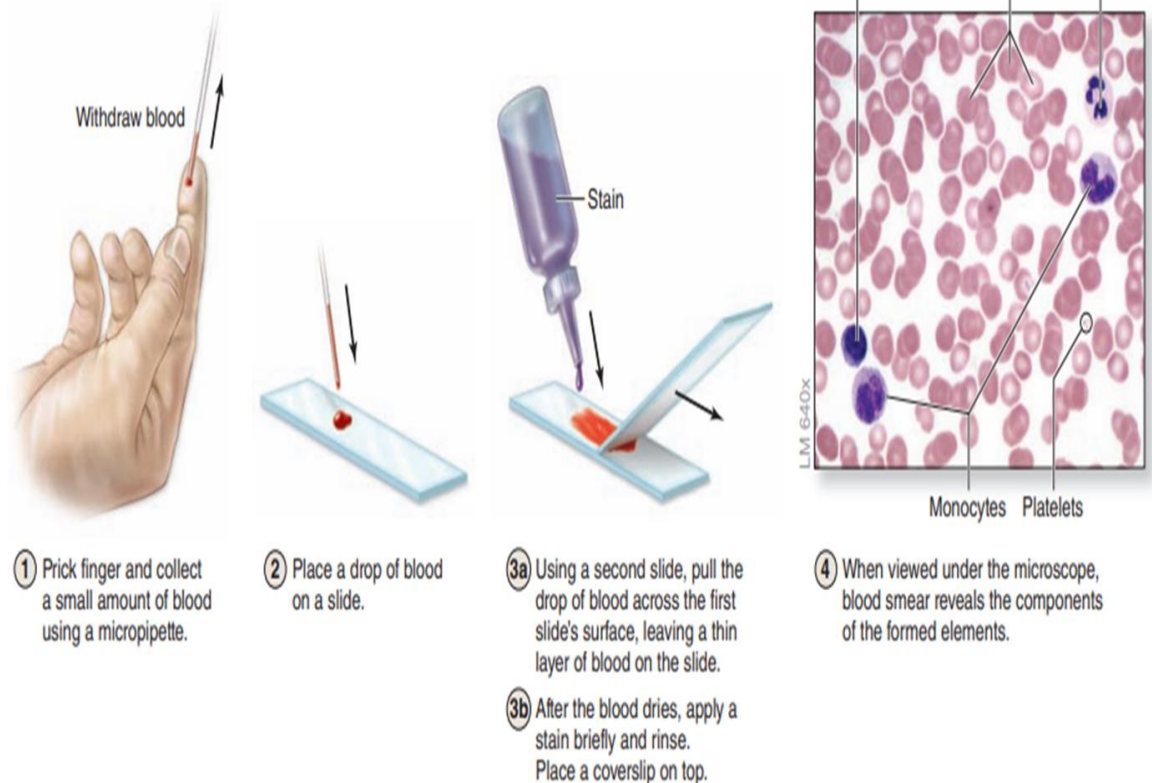
3-The blood film is left to dry for 5 minutes.

4-The dried blood film is then stained to be examined by light microscope.

❖ Romanowsky stains commonly used in Hematology laboratory for staining the blood cells. There are 4 different types of Romanowsky stains:

- ▶ Giemsa Stain
- ▶ Leishman Stain
- ▶ Field's Stain
- ▶ Wright's Stain
- Each is composed of (basic) and (acidic) stains.

FIGURE 12-3 Preparing a blood smear.



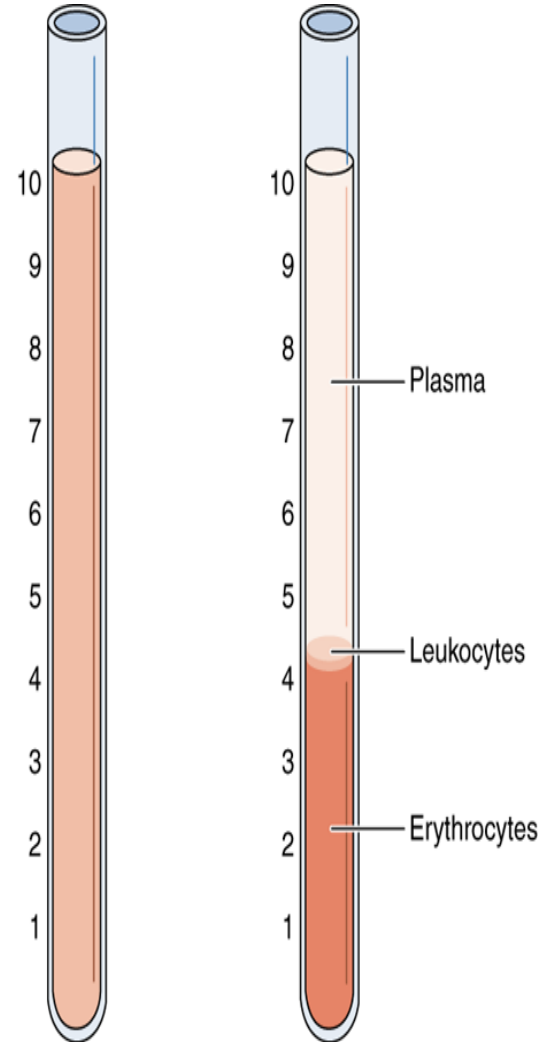
Blood cells

1-True: have nucleus.

- White blood cells or leukocytes (1%).

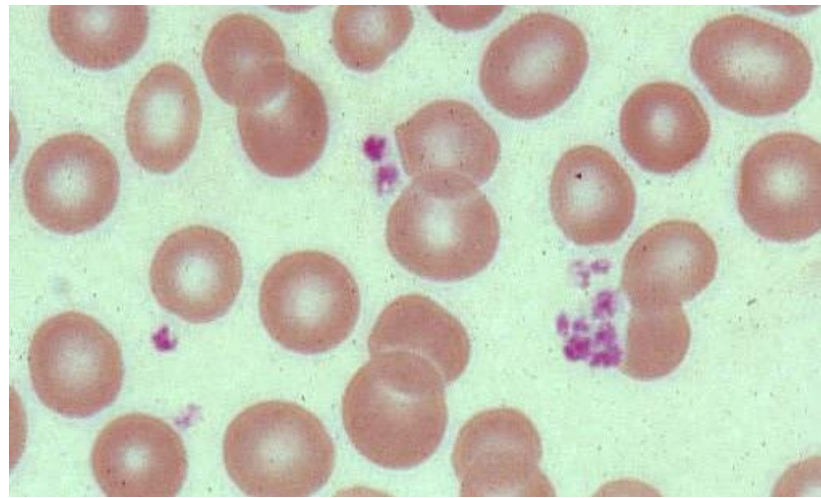
2-Not True:

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

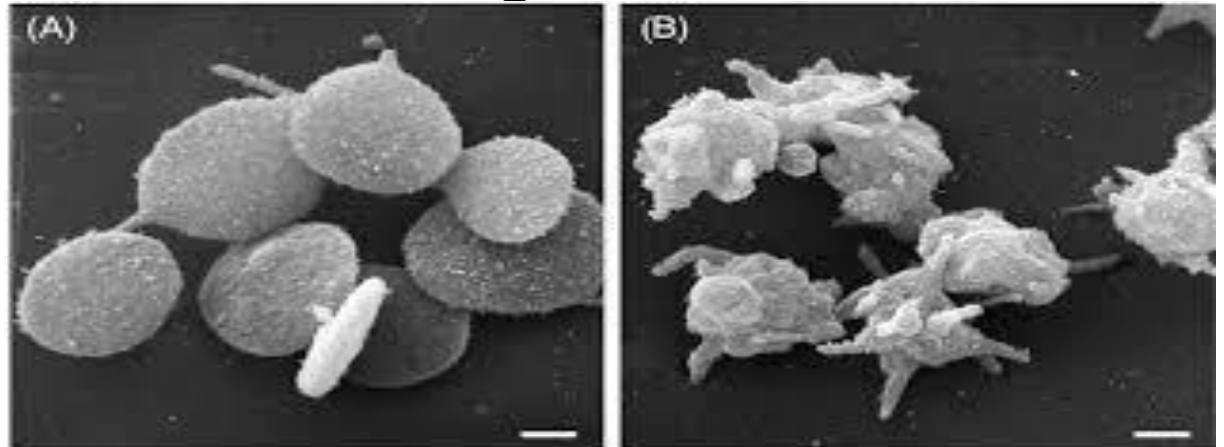


Platelets (Thrombocytes)

- **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.

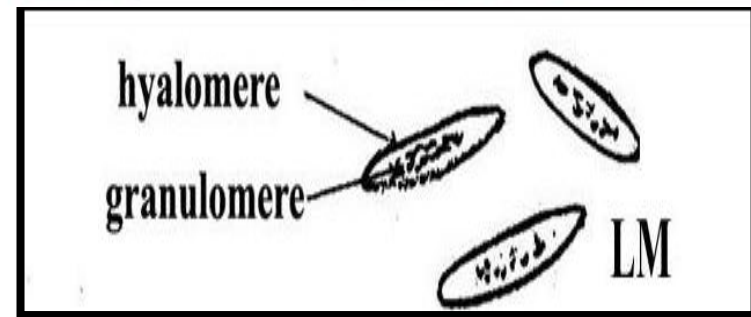
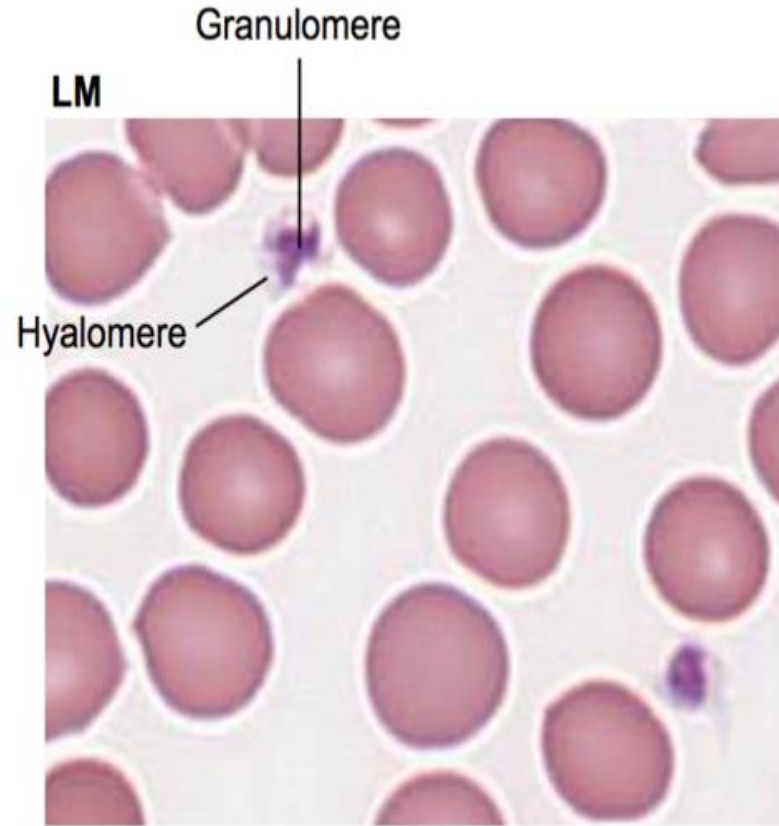


- platelets are considerably smaller than the other blood elements, erythrocytes and leukocytes. Mammalian platelets are anucleated cells arising from cytoplasmic fragmentation of megakaryocytes in the bone marrow, and have a typical diameter of $\sim 2\text{--}3\ \mu\text{m}$.
- Platelets circulate in a discoid form. However, following activation, they undergo dramatic changes in shape and ultrastructure; the membranes become ruffled with cytoplasmic projections and the granules are centralized and discharged



Platelets

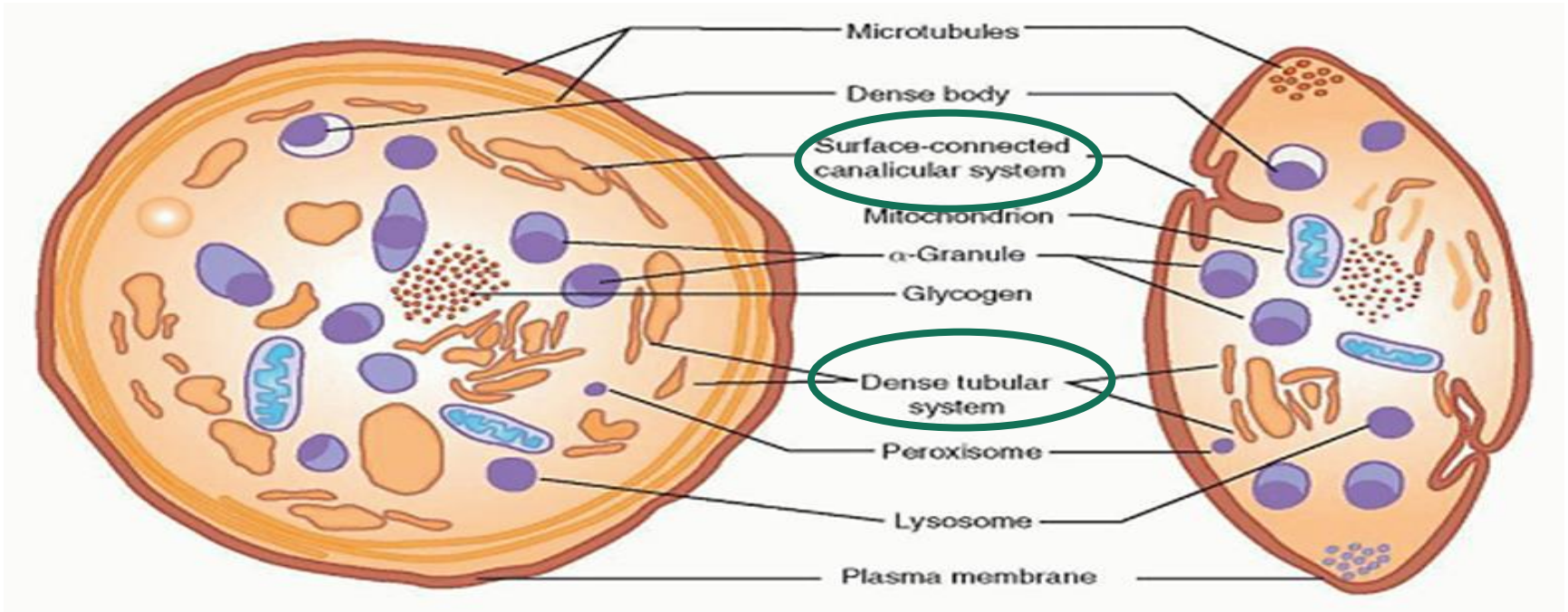
- **L/M:** in stained blood smears, they often appear in clumps. Each platelet has a peripheral light blue-stained transparent zone (hyalomere), and a central zone containing purple granules (granulomere).

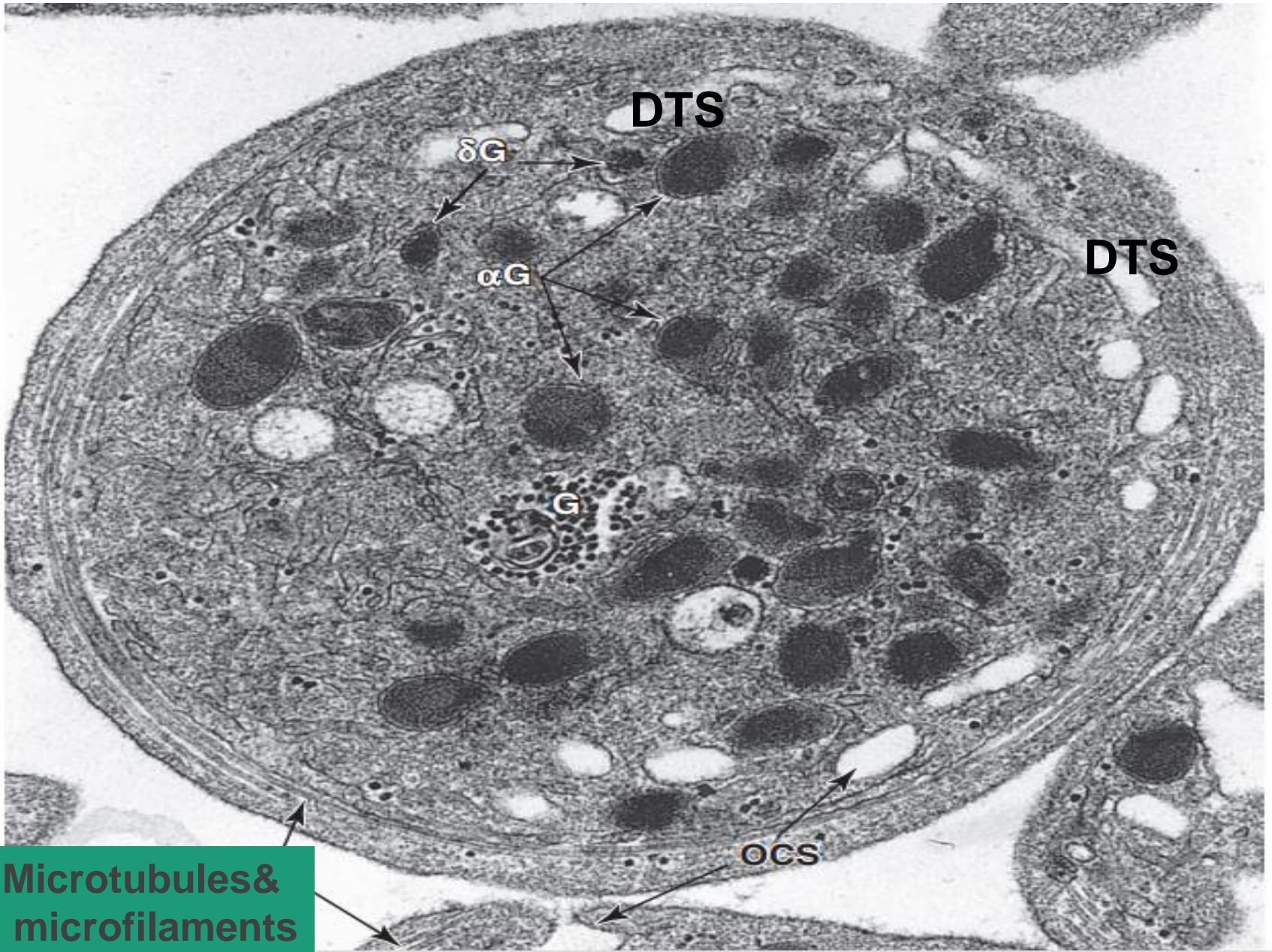


- **E/M:** platelets are surrounded by cell membrane, covered by a thick glycocalyx (cell coat) which is involved in adhesion and activation during blood coagulation.
- The **hyalomere** reveals peripheral marginal bundles of microtubules (to maintain the oval shape), and microfilaments (help in platelet movement and aggregation).
- Also in the hyalomere are two systems of membrane channels ,
1- open canalicular system of vesicles: plasma membrane contains a network of numerous invaginations into the platelet interior, connected to the exterior through small pores. This feature gives the platelet a much greater surface area than would normally be found on such a small cell.



2- Dense tubular system: Platelets contain a second channel system, derived from megakaryocyte smooth endoplasmic reticulum, known as the dense tubular system (DTS). The DTS stores calcium and a variety of enzymes involved in platelet activation; in contrast to the OCS, the DTS does not associate with the plasma membrane.

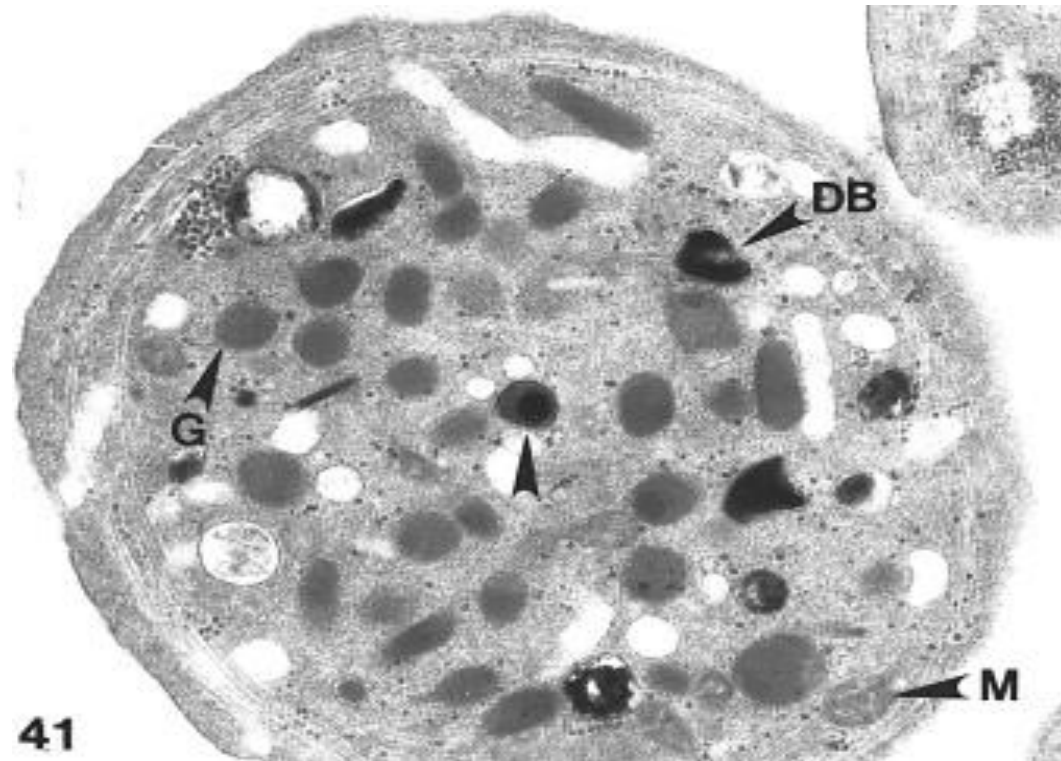




- Together, these two membranous systems facilitate the extremely rapid exocytosis of proteins from platelets (degranulation) upon adhesion to collagen or other substrates outside the vascular endothelium.
- The **granulomere** contains one or two mitochondria, numerous small clear vesicles, glycogen and varying numbers of membrane bounded granules named **alpha granules, dense bodies** and **lysosomal granules**.



- **Dense granules** are the smallest granules (~150 nm) and appear as dense bodies on electron microscopy due to their high calcium and phosphate content. There are about 3–8 dense granules per platelet. In addition they contain high concentrations of adenine nucleotides and serotonin.



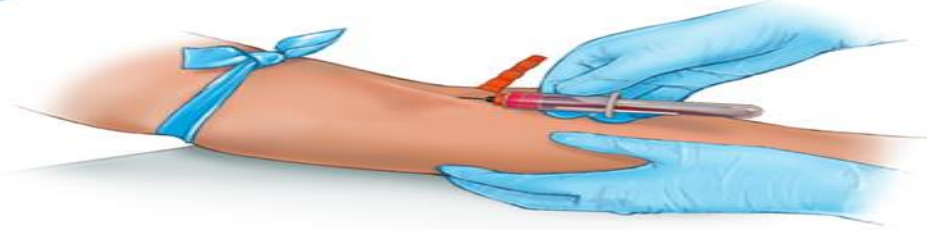
- **Alpha (α) granules** are the largest (~200–400 nm) and most prevalent and heterogenous platelet granules. There are about 50–60 granules per platelet, and they are responsible for the granular appearance of the cytoplasm in peripheral blood smears (stained with Romanowsky stains). These granules contain the majority of platelet factors involved in hemostasis and thrombosis. α -granules also contain a variety of adhesion molecules involved in platelet-vessel wall interaction such as fibronectin and vitronectin
- **Lysosomes** represent the third category of platelet granules, with a size intermediate between α - and dense granules (~200–250 nm); they contain an intraluminal acidic pH with hydrolytic enzymes

- What is platelet-rich plasma?

Platelet-rich plasma consists of two elements: plasma, or the liquid portion of blood, and platelets,

Platelet-rich plasma (PRP) injection

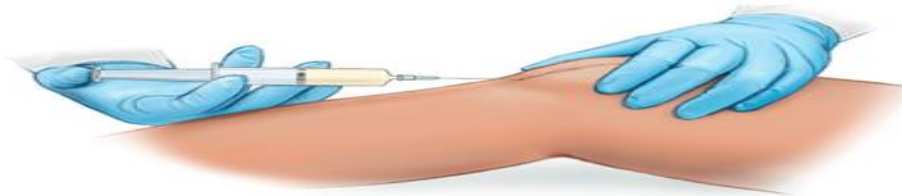
1 Your own blood is drawn.



2 The blood sample is put into a centrifuge.



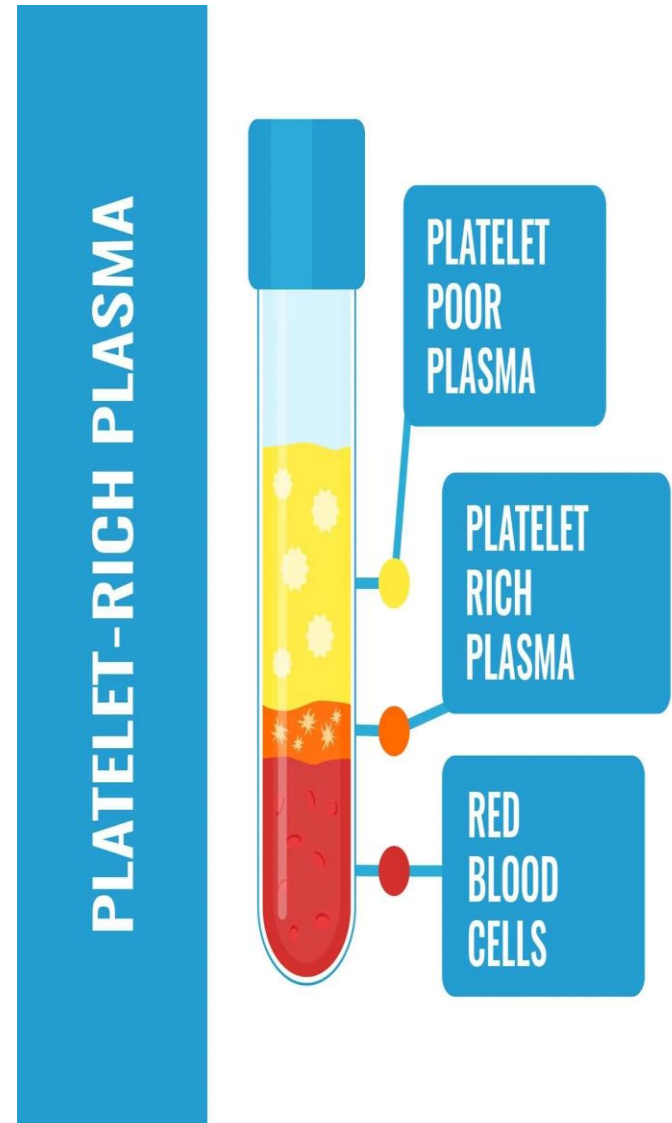
3 Platelet-rich plasma is injected into your tissues to promote wound healing.



What is a PRP injection?

After creating platelet-rich plasma from a patient's blood sample, that solution is injected into the target area, such as an injured knee or a tendon. In some cases, the clinician may use ultrasound to guide the injection. The idea is to increase the concentration of specific bioproteins or hormones, called growth factors, in a specific area to accelerate the healing process.

The mechanism behind PRP injections is not completely understood. Studies show that the increased concentration of growth factors in platelet-rich plasma may stimulate or speed up the healing process, shortening healing time for injuries, decreasing pain and even encouraging hair growth.



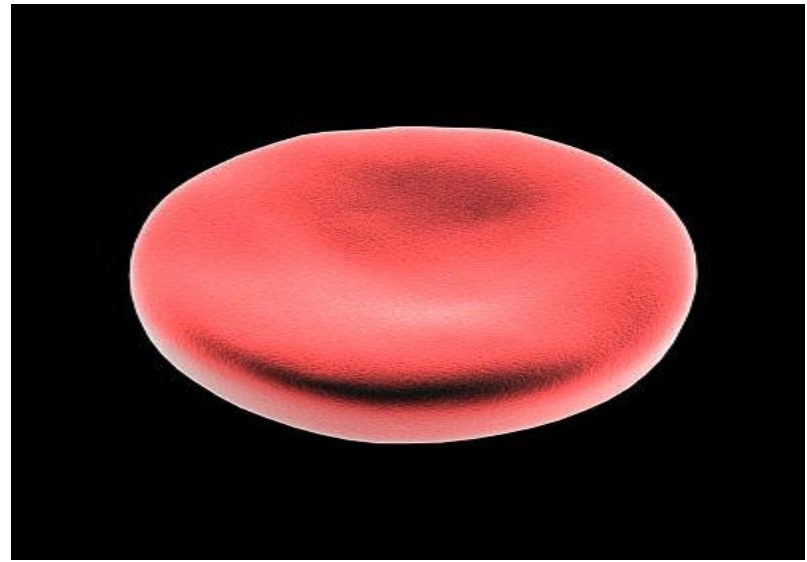
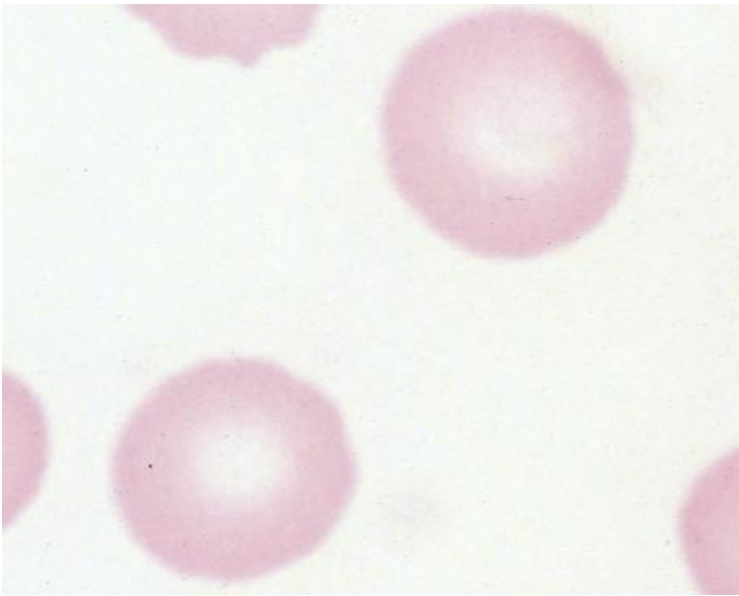
Erythrocytes (RBCs)

- **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**.

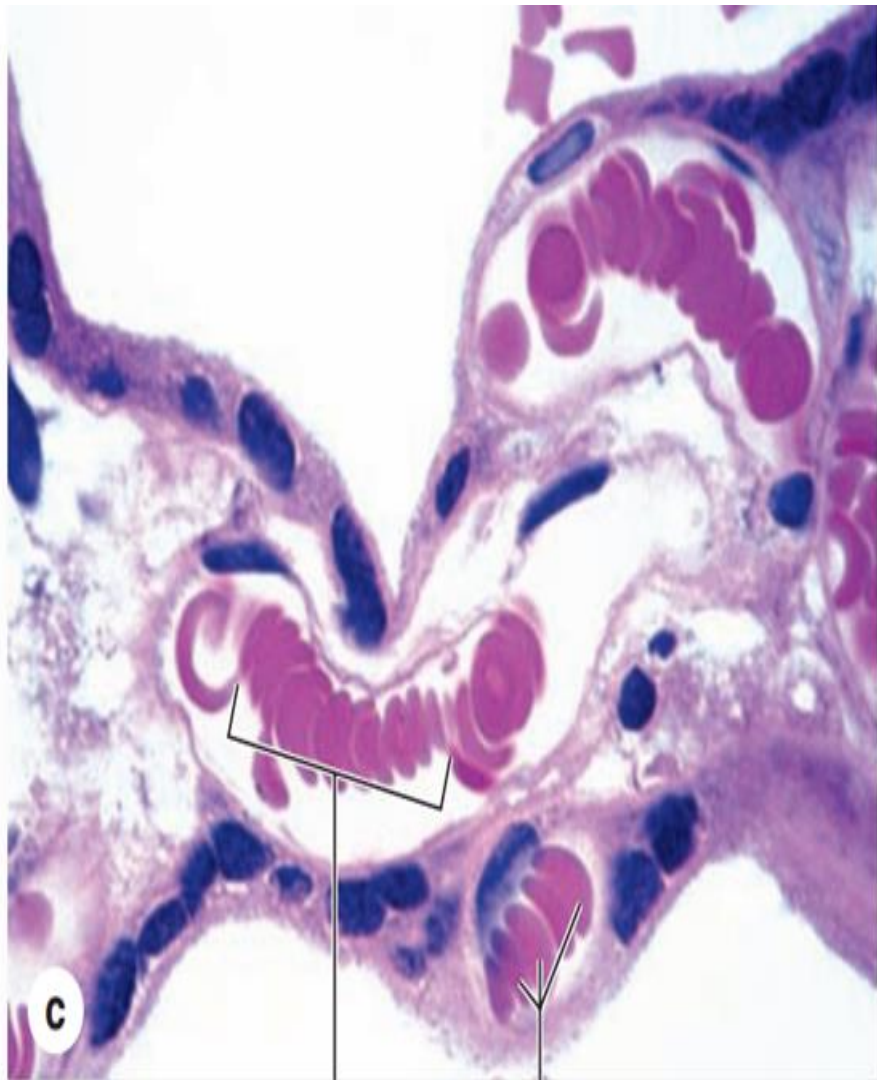
Increase in their number is known as **polycythemia**.





- **Shape** : biconcave discs to increase the surface area for exchange of gases. They are soft and plastic and can change their shape as they pass through small capillaries.
- In larger blood vessels RBCs often adhere to one another loosely in stacks called rouleaux





Rouleaux Erythrocytes

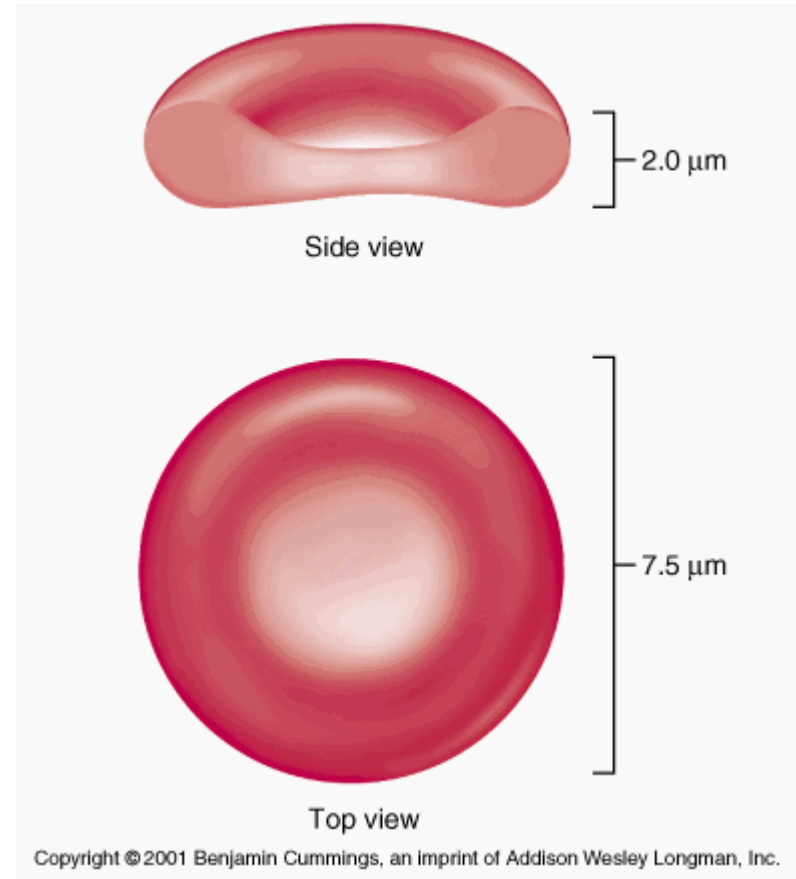


- **Size of RBCs:**

They are approximately 7.5 μm in diameter, 2.6 μm thick at the rim, but only 0.75 μm thick in the center.

- **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

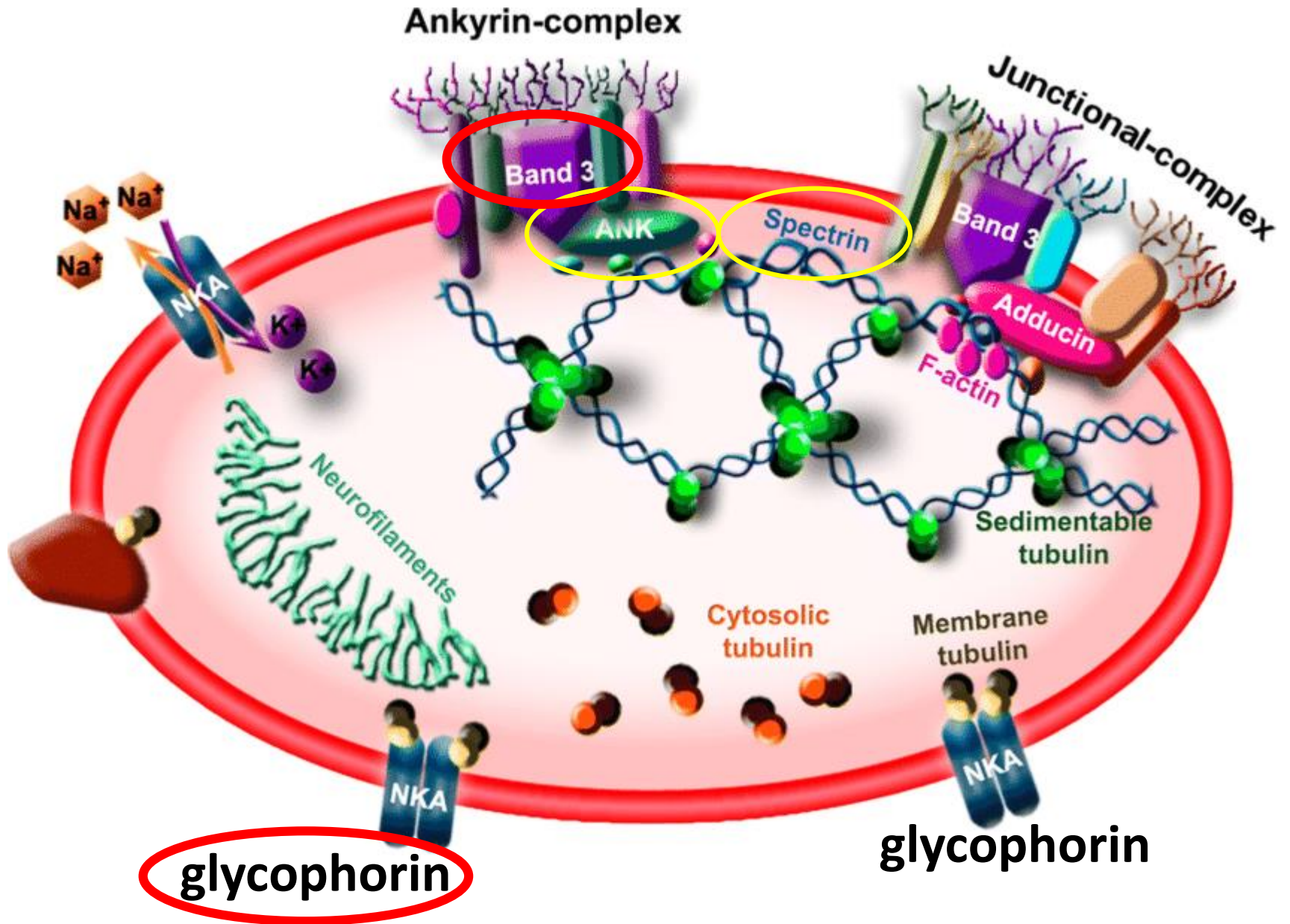


- **Colour:** Red colour due to their content of hemoglobin.
- Hemoglobin = the iron ("heme"), oxygen transport protein, ("globin").
- Normally, the erythrocytes in a dry smear of peripheral blood stain deep pink or salmon colour

- 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.



- Structure:



- The plasmalemma of the erythrocyte consists of about 40% lipid, 10% carbohydrate, and 50% protein. Most of them are integral membrane proteins, including **glycophorin and band 3 protein**, (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**, dimers which form a lattice bound to underlying actin filaments, and **ankyrin**, which anchors the lattice to the glycophorins and band 3 proteins. This submembranous meshwork 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.
- Lacking mitochondria, erythrocytes rely on anaerobic glycolysis for their minimal energy needs. Lacking nuclei, they cannot replace defective proteins.

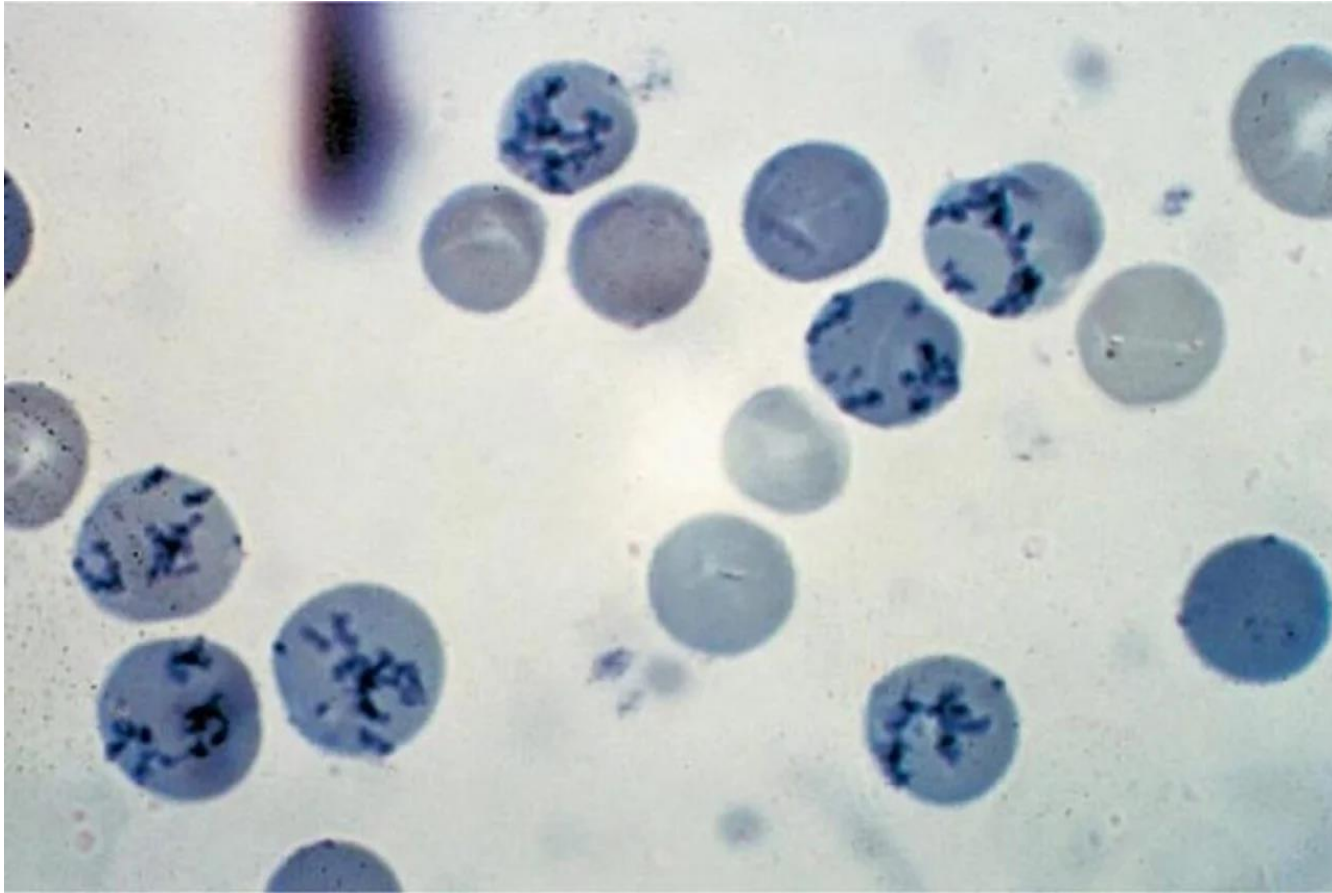
- Mature RBCs are highly specialized to transport O₂ & Co₂. Iron molecules in Hb bind with O₂ and most of the O₂ in the blood is carried to tissues in the form of **oxyhemoglobin**. Co₂ from the cells and tissues is carried to the blood with Hb (**carbaminohemoglobin**). These reactions are reversible.
- **Life-span of RBCs:** 100-120 days. By this time defects in the membrane's cytoskeletal lattice or ion transport systems begin to produce swelling or other shape abnormalities. Senescent or worn-out RBCs displaying such changes are removed from the circulation, mainly by macrophages of the spleen, liver, and bone marrow.



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.

Reticulocytes:



Thank You

