Blood

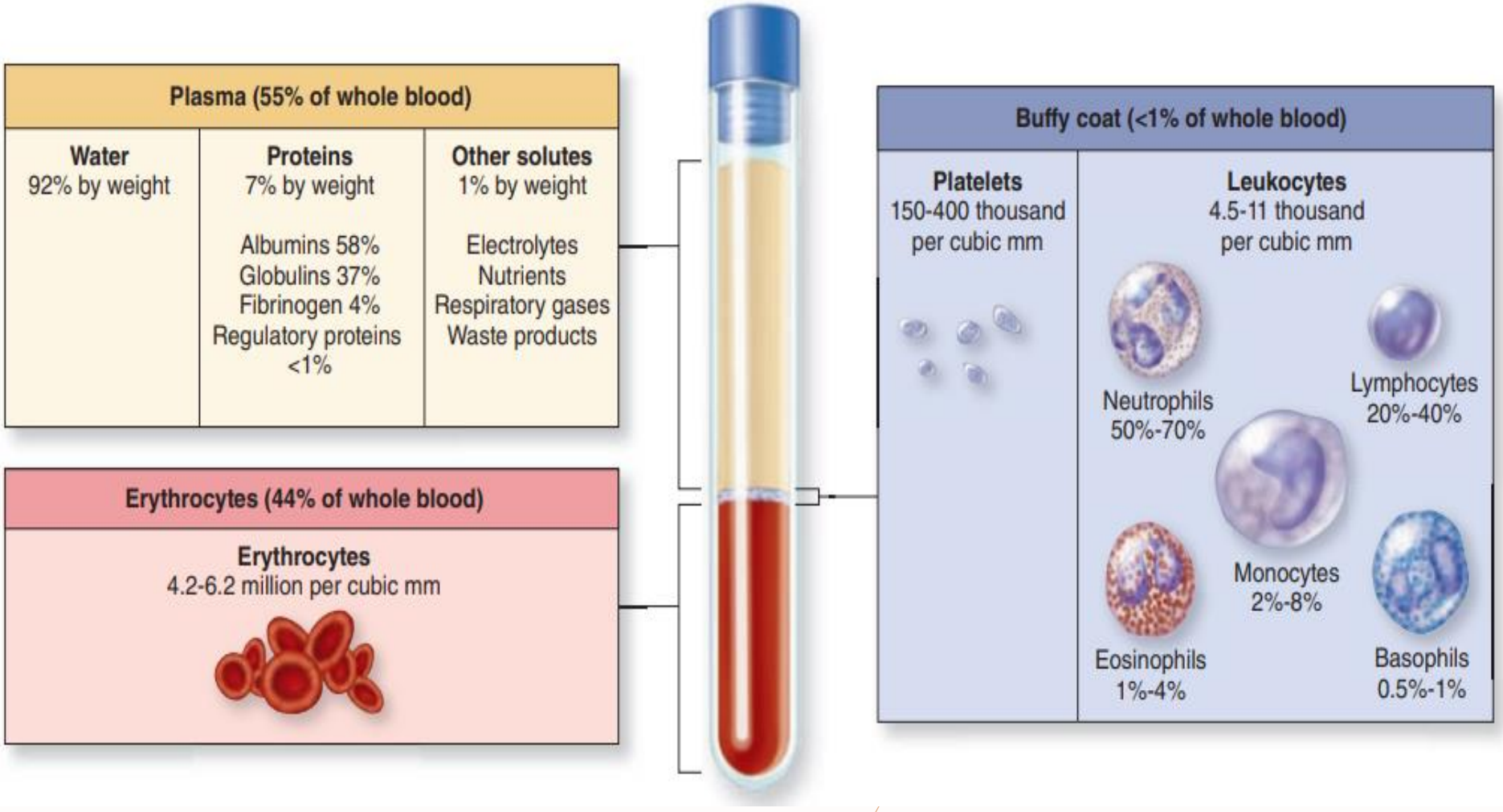
Blood is a specialized connective tissue circulates through the cardiovascular system, consisting of cells and fluid extracellular matrix called plasma.

- About 5 L of blood in an average adult.
- Blood is made up of :

1. Formed elements

- Erythrocytes (red blood cells 44% of total blood volume and is called the hematocrit.
- Leukocytes (white blood cells [WBCs]), and platelets, about 1% of the volume.

2. Plasma about 55% of total volume.


Plasma (55% of whole blood)
Water
92% by weight
Proteins
7% by weight
Albumins 58%
Globulins 37%
Fibrinogen 4%
Regulatory proteins
<1%
Other solutes
1% by weight
Electrolytes
Nutrients
Respiratory gases
Waste products
Erythrocytes (44% of whole blood)
Erythrocytes
4.2-6.2 million per cubic mm
Buffy coat (<1% of whole blood)
Platelets
150-400 thousand
per cubic mm
Leukocytes
4.5-11 thousand
per cubic mm
Neutrophils
50%-70%
Lymphocytes
20%-40%
Monocytes
2%-8%
Eosinophils
1%-4%
Basophils
0.5%-1%

Functions

1. Transport O2 , CO2 , hormones, nutrients and metabolic products.
2. Regulation of body temperature.
3. Maintenance of acid-base and osmotic balance.
4. Leukocytes are one of the body's chief defenses against infection.
5. Wound healing and controlling blood loss (blood clotting)

Plasma

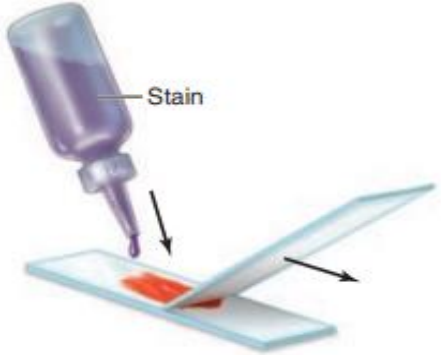
- Is an aqueous solution, pH 7.4, 92% Water.
- plasma proteins 7%, others 1% (nutrients, respiratory gases, waste products, hormones, and electrolytes).
- Plasma proteins:
  1. Albumin: the most abundant, made in the liver → maintain the osmotic pressure of the blood.
  2. Globulins (α- and β-globulins) → transport factors.
  3. Immunoglobulins (antibodies) → immune functions.
  4. Fibrinogen: also made in the liver → blood coagulation.
  5. Complement proteins → defense system in inflammation and destruction of microorganisms.

Blood cells

- Blood cells can be studied histologically in smears prepared by spreading a drop of blood in a thin layer on a microscope.
- Blood smears are routinely stained with Giemsa and Wright stain.

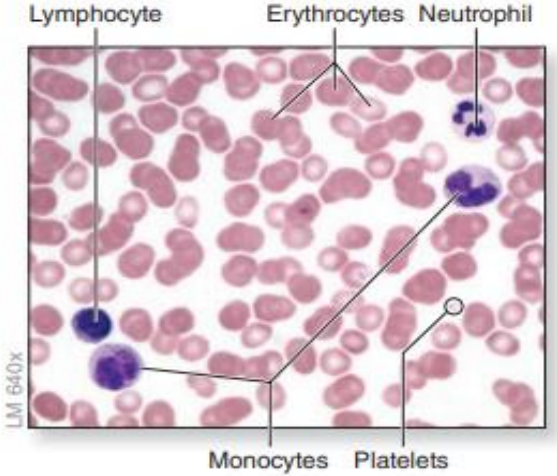
(1) Prick finger and collect a small amount of blood using a micropipette.

(2) Place a drop of blood on a slide.



(3a) Using a second slide, pull the drop of blood across the first slide's surface, leaving a thin layer of blood on the slide.

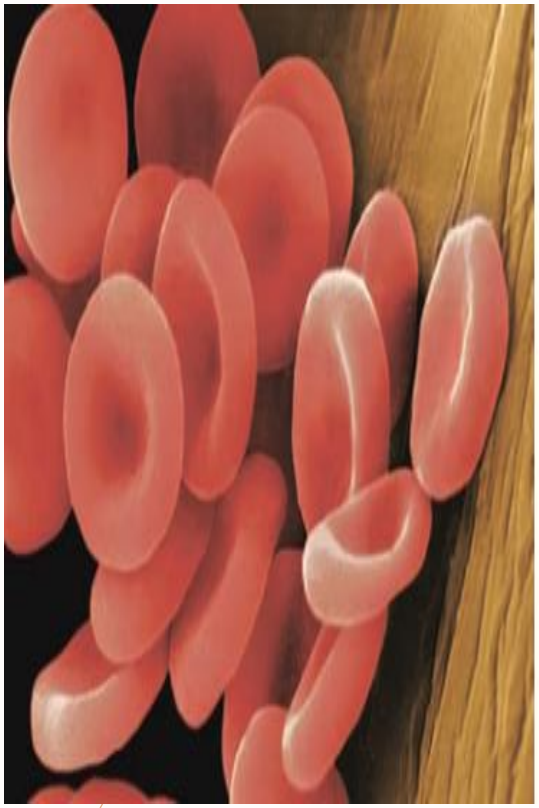
(3b) After the blood dries, apply a stain briefly and rinse. Place a coverslip on top.

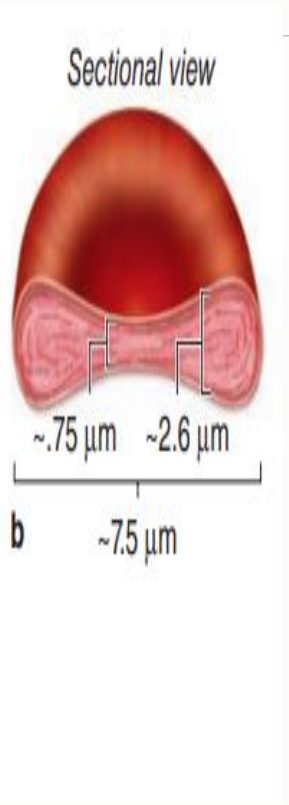


(4) When viewed under the microscope, blood smear reveals the components of the formed elements.

Erythrocytes (RBC)

- Human erythrocytes are flexible biconcave discs .
- Nuclei: RBCs lacking nuclei and all organelles and completely filled with hemoglobin.
- Diameter: approximately 7.5 µm, 2.6-µm thick at the rim, but only 0.75-µm thick in the center.





Erythrocytes (RBC)

- Concentration in blood : is approximately 3.9-5.5 million/μL in women and 4.1-6.0 million/μL in men.
- Function: transport of oxygen and carbon dioxide bound to hemoglobin.
- Life span: 120 days, when they are removed from circulation, mainly by macrophages of the spleen, liver, and bone marrow.

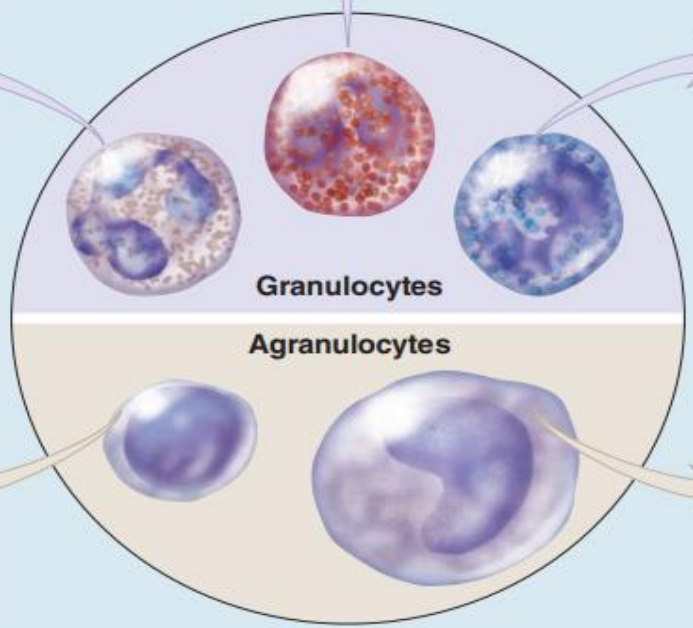
Leukocytes (WBCs)

- Two major groups, granulocytes and agranulocytes, based on the cytoplasmic granules.
- Granulocytes possess two types of cytoplasmic granules: azurophilic granules and specific granules.
- Granulocytes nuclei have two or more distinct lobes and include (neutrophils, eosinophils, and basophils).

- Agranulocytes lack specific granules, but do contain some azurophilic granules.

- Nucleus is spherical or indented and include: (lymphocytes and monocytes)

- Number of leukocytes in the blood of healthy adults 4500-11,000 /μL.



Eosinophil

Neutrophil

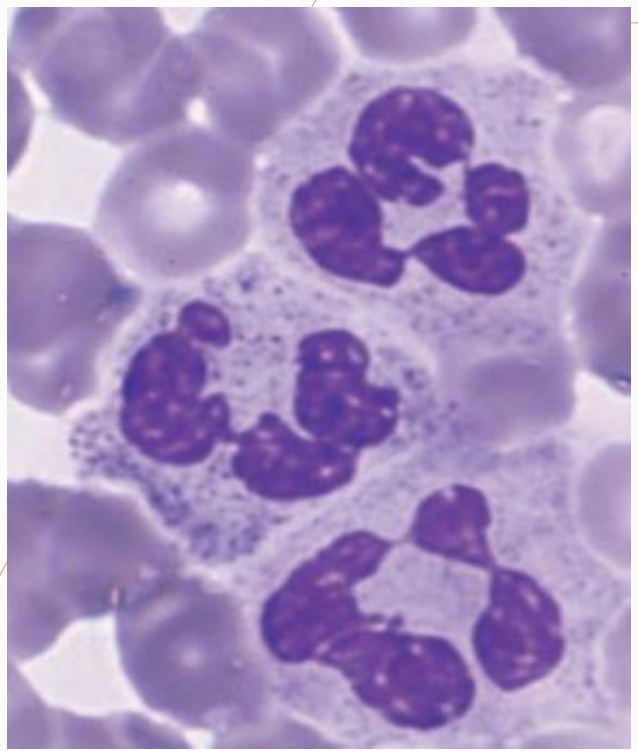
Basophil

Lymphocyte

Monocyte

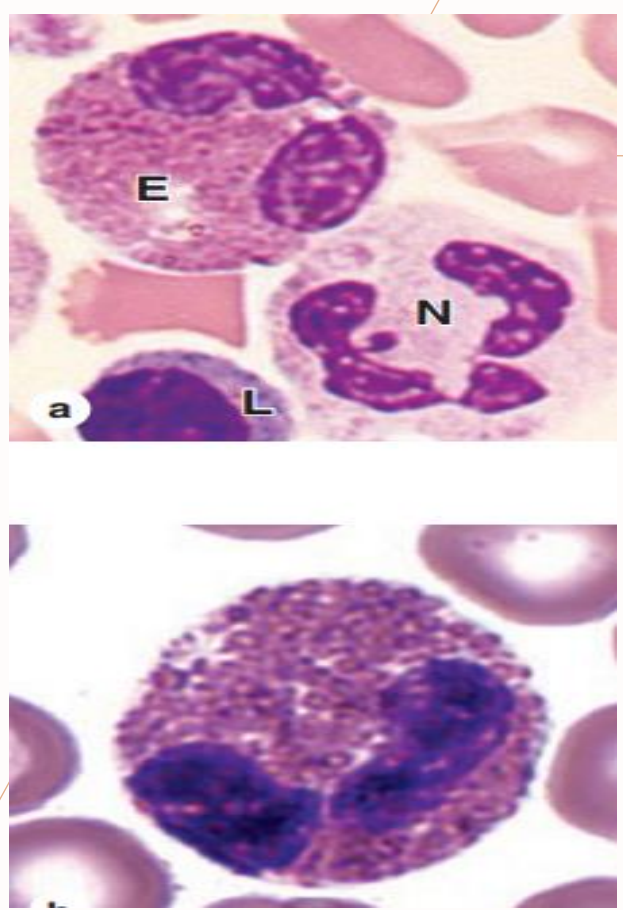
Neutrophils (Polymorphonuclear Leukocytes PMN)

- 50%-70% of total leukocytes.
- The first leukocytes to arrive at sites of infection.
- Diameter: 12-15 μm .
- Nuclei : two to five lobes
- Granules : two main types primary azurophilic granules and secondary specific granules.
- Life span : 6-8 hours in blood and 1-4 days in tissues .
- Function: kill and phagocytose bacteria.



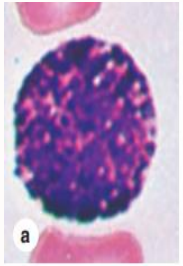
Eosinophils

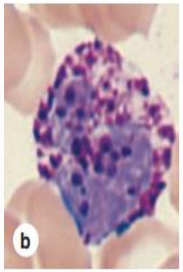
- 1-4% of leukocytes, less numerous than neutrophils
- Nucleus: bilobed
- Granules: abundant large, acidophilic stain pink or red.
- Life span: 1-2 wk
- Function: Kill helminthic and other parasites; modulate local inflammation and allergic reactions.

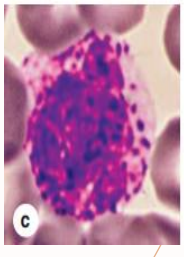


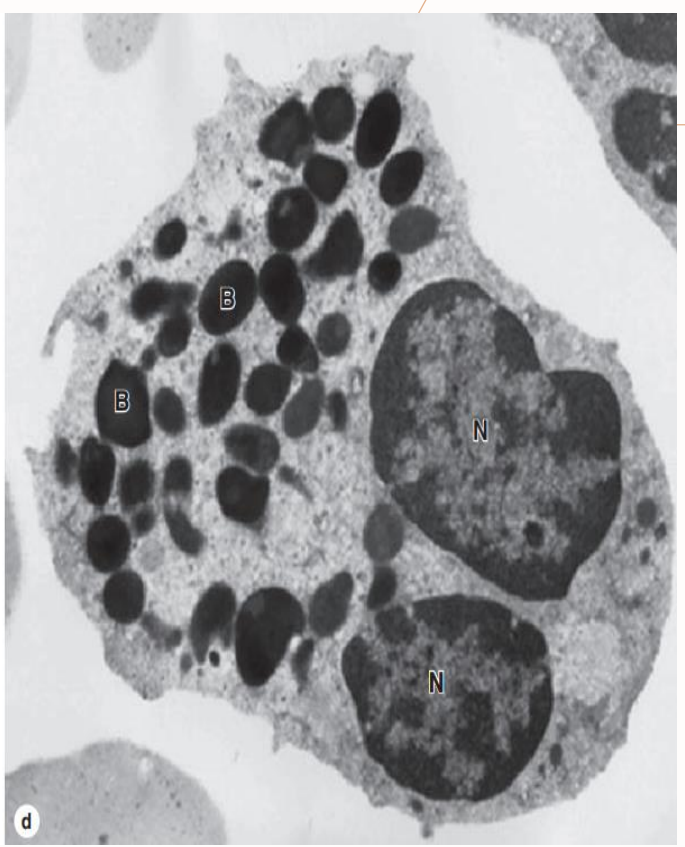
Basophils

- less than 1% of circulating leukocytes
- Diameter :12-15 μm .
- Nucleus: two irregular lobes.
- Granules: large granules overlying the nucleus usually obscure its shape (heparin and histamine).
- Life span: Several months.
- Function: release histamine during allergy.



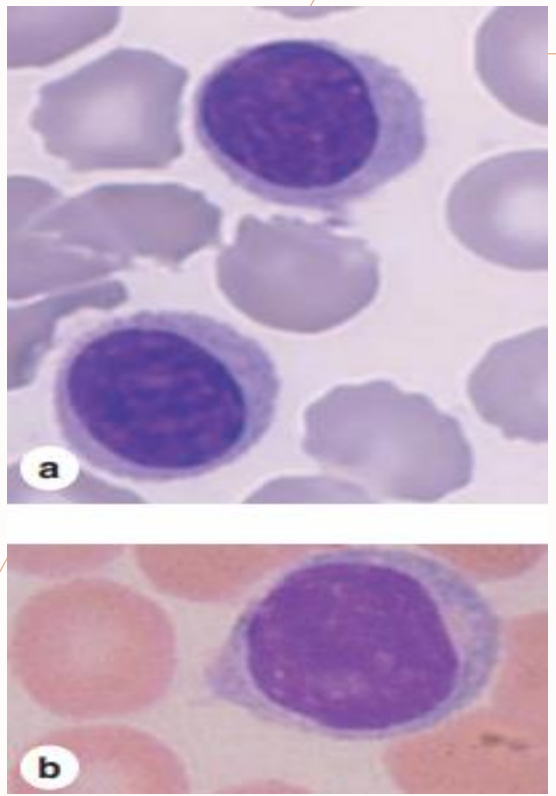






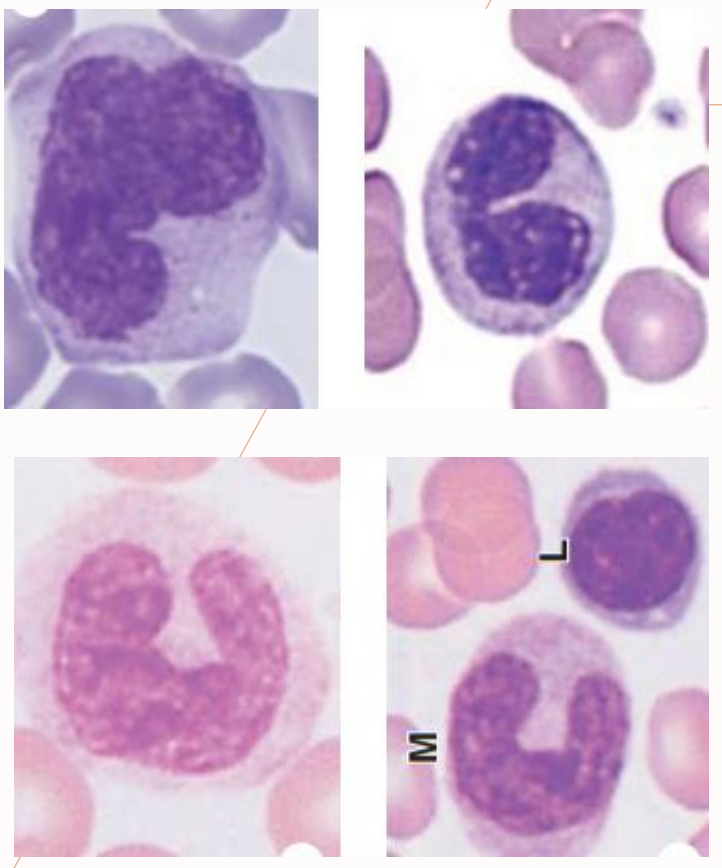
Lymphocytes

- 20 – 40% of total leukocytes.
- The most numerous agranulocyte.
- Diameter: wide range, 6 - 15 μm (small, medium and large lymphocytes).
- Nuclei: spherical
- Major classes include **B** lymphocytes, **T** lymphocytes and natural killer (NK) cells.
- Life span: Hours to many years
- Function: immune defenses against invading microorganisms and abnormal cells.



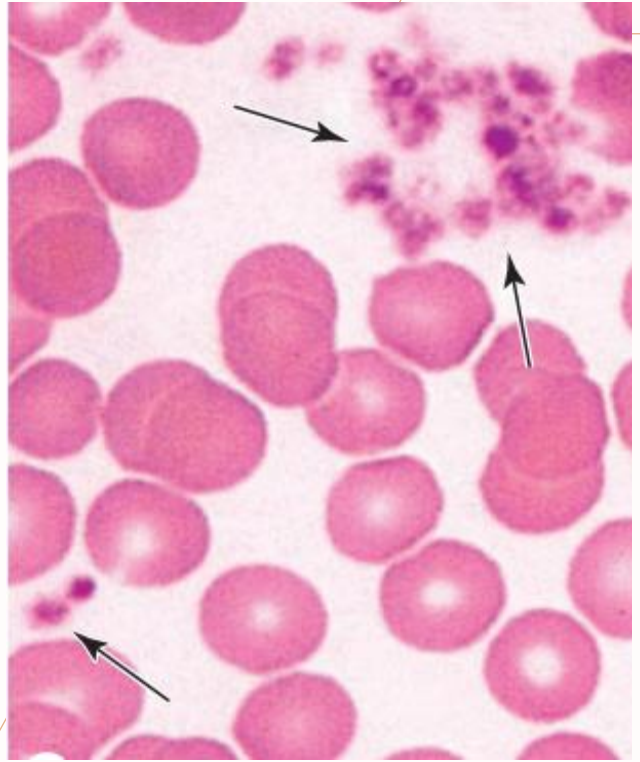
Monocytes

- 2-8% of total leukocytes.
- Diameter: 12-15 µm.
- Nuclei : large, indented, kidney or C-shaped.
- Granules: cytoplasm of the monocyte is basophilic and contains many small azurophilic granules.
- Life span : Hours to years.
- Function: involved in both acute and chronic inflammation



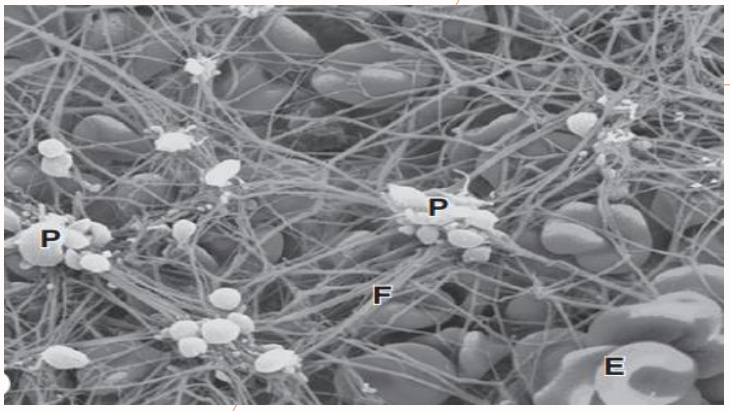
Platelets (thrombocytes)

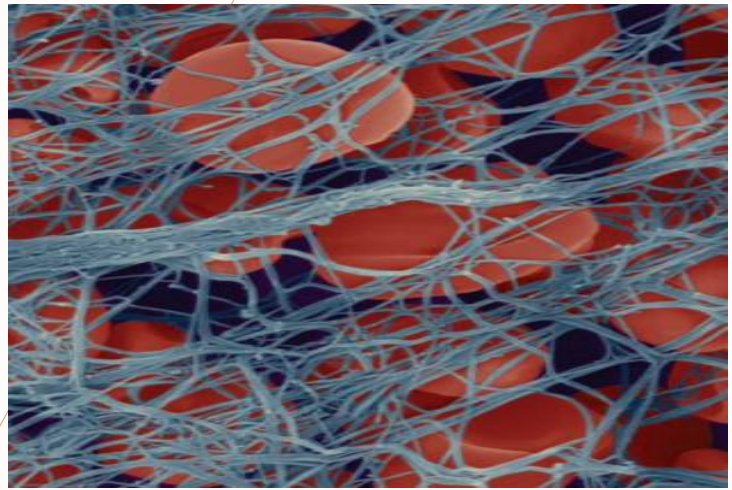
- Counts: range from 150,000 - 400,000/μL of blood.
- Diameter: 2-4 μm .
- Very small non-nucleated, cell fragments derived from megakaryocytes of bone marrow.
- Granules: alpha , delta granules, and glycogen.
- Life span : about 10 days.
- Function: promote blood clotting and reduce blood loss from the vasculature.

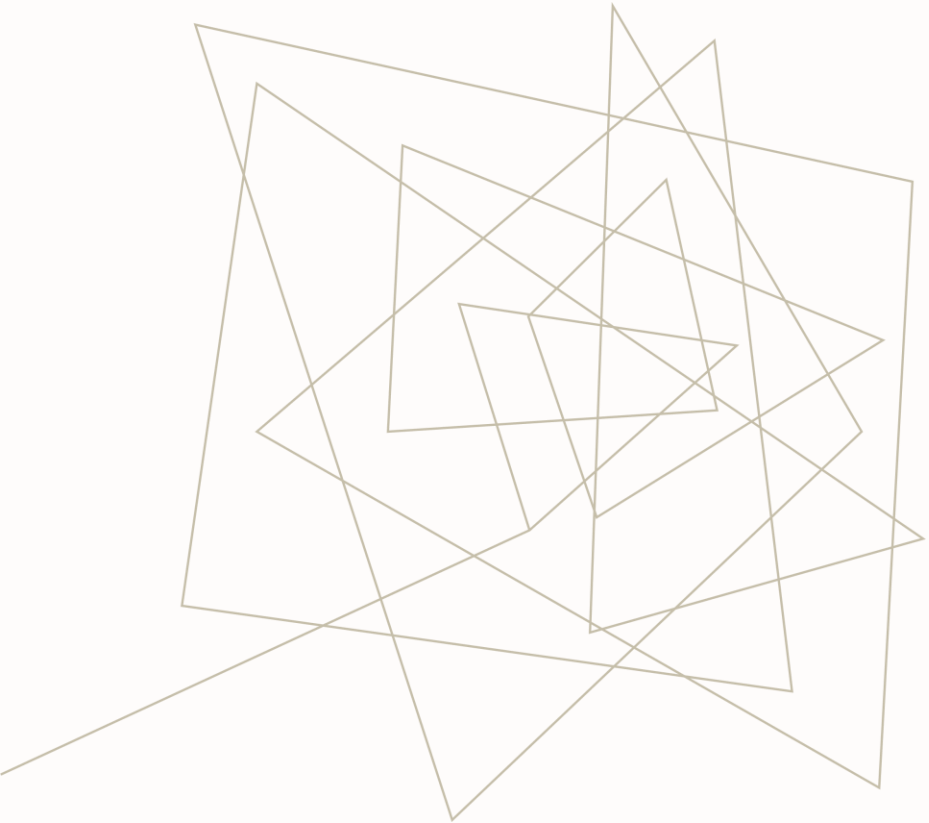


The role of platelets in controlling blood loss

- Primary aggregation (platelet plug): platelets adhere to collagen in the vascular wall and become activated.
- Secondary aggregation: further platelet aggregation increase the size of the platelet plug.
- Blood coagulation: during platelet aggregation, fibrinogen ,von Willebrand factor and other proteins released from the damaged endothelium, promote the coagulation cascade, giving rise to a fibrin meshwork trapping RBCs and more platelets to form a blood clot, or thrombus.







THANK YOU