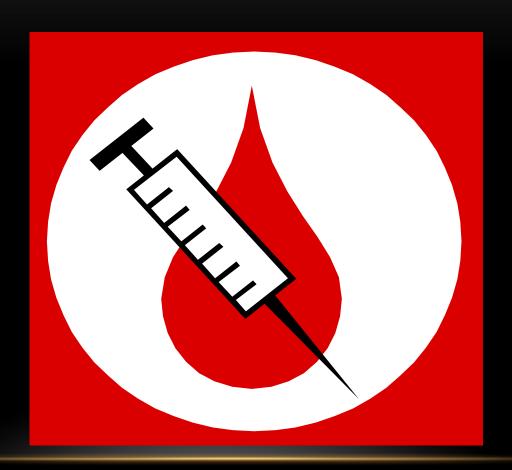
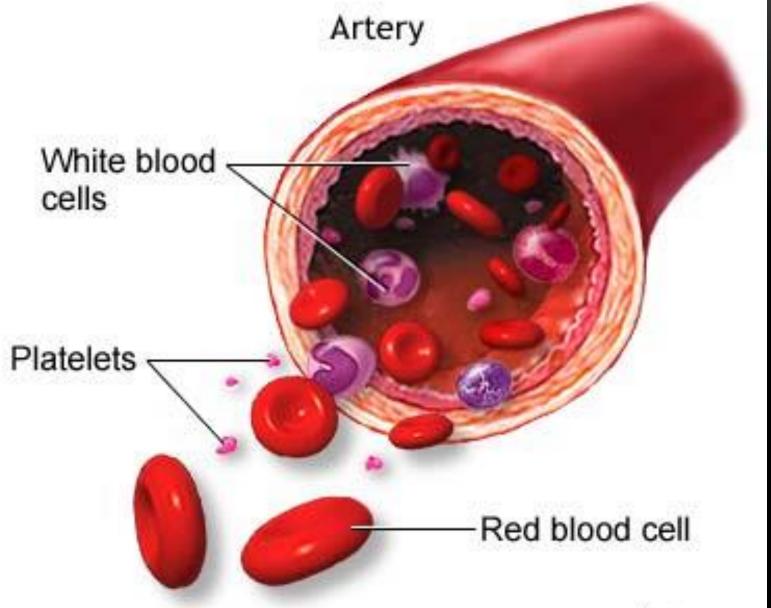
BLOOD







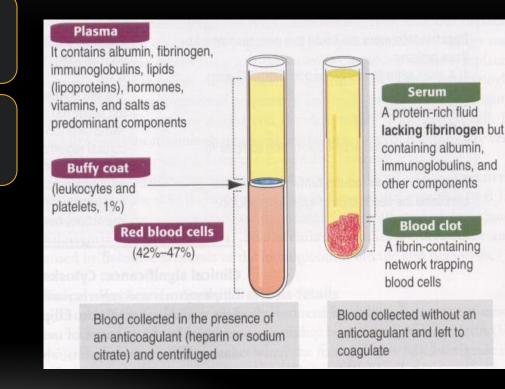


Components

Plasma

Formed elements

- Erythrocytes (RBC's)
- Leukocytes (WBC's)
- Thrombocytes (Platelets)



Composition of Plasma

Water 90%

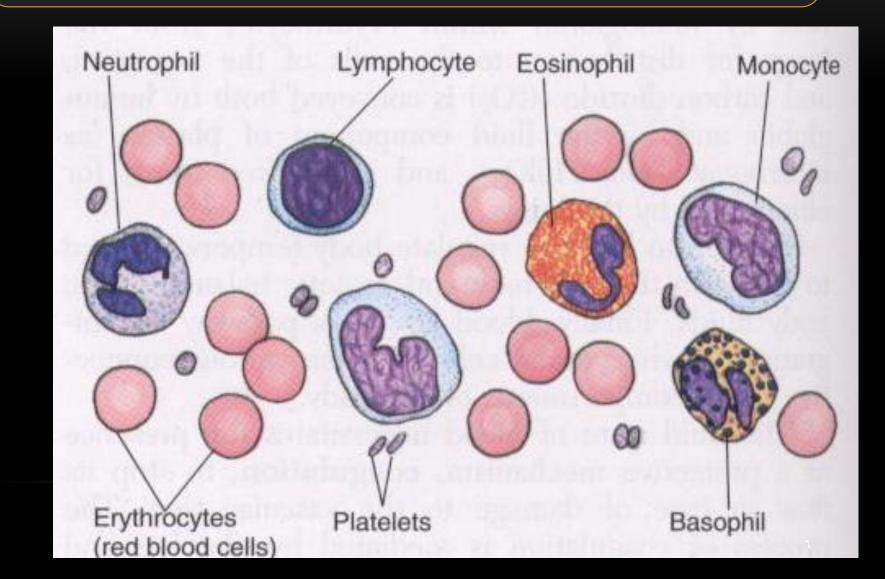
Plasma proteins (7%)

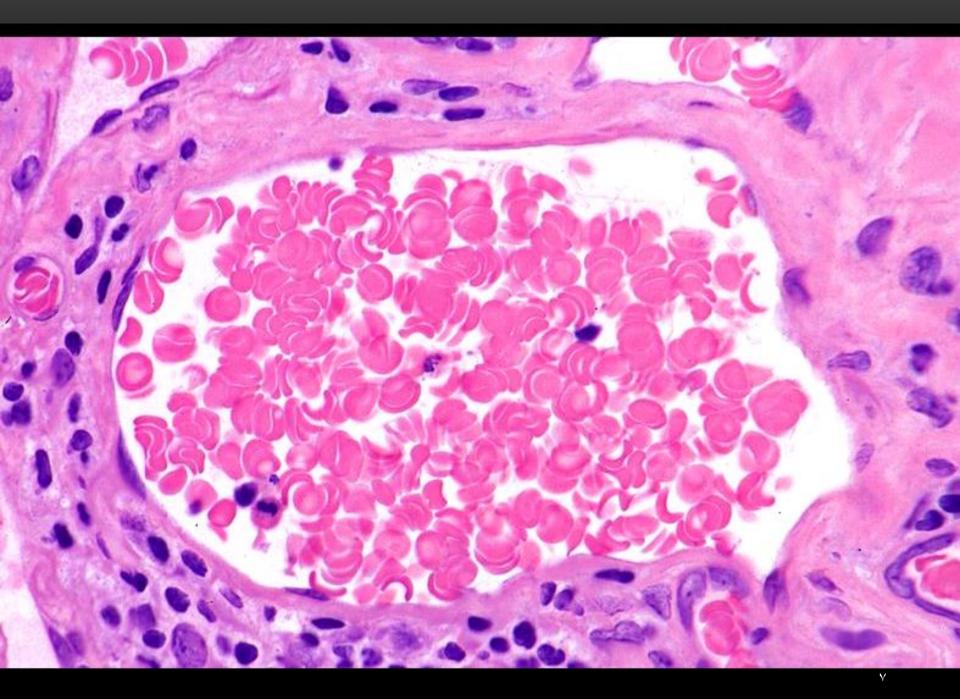
- Albumin = maintains the osmotic pressure of the blood
- Globulin: α , β =fibronectin prothrobin; lipoproteins
- Globulin: γ = immunoglobulin
- Fibrinogen
- Complement proteins essential inflammatory processes and destruction of microorganisms

Inorganic salts (0.9%):

Organic compounds (\sim 2%): amino acids, vitamins, hormones ...etc.

Formed Elements





Erythrocyte



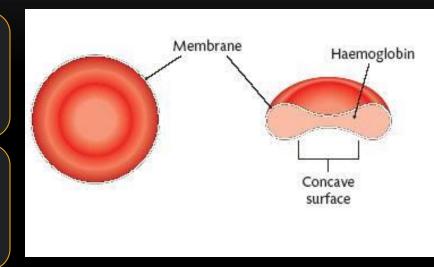
Erythrocytes ...1

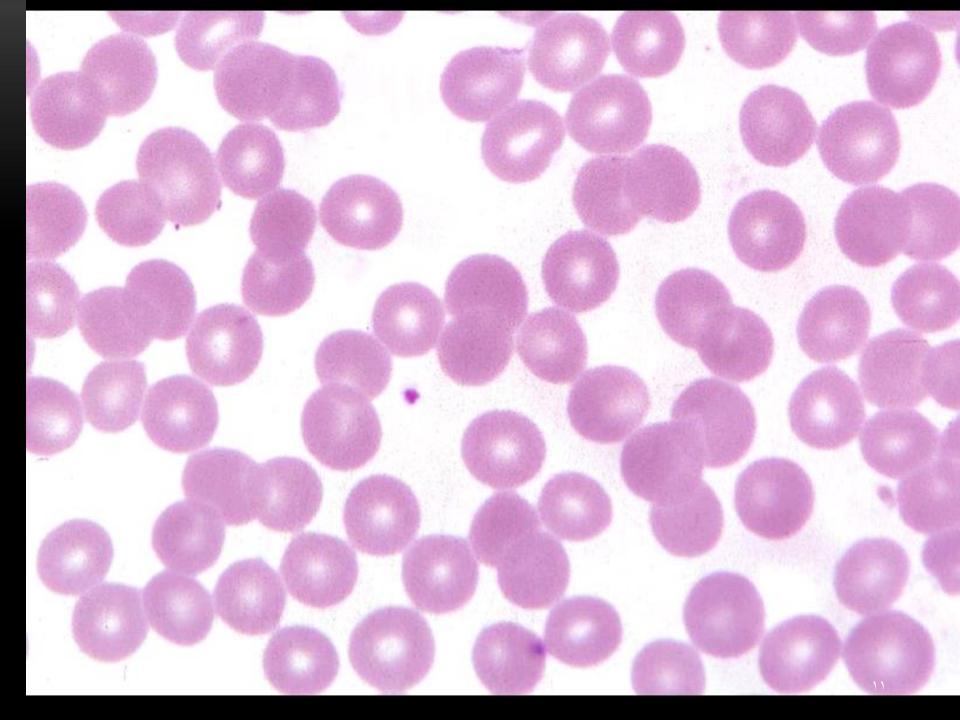
Anucleated flexible cells packed with hemoglobin.

Biconcave, diameter 7.5 μ m, the narrowest point at the center = 0.8 μ m.

The shape provides large surface-to-volume ratio.

Normal concentration: 3.9-5.5 million/ μ L in women and 4.1-6 million / μ L in men.





Erythrocytes ...2

Plasmalemma consists of:

- Lipids 40%
- Proteins 50% (25% integral proteins).
 - Peripheral proteins determine the shape of the cell.
 - Spectrin forms a meshwork enforcing the RBC membrane.
- Carbohydrates 10%

Cytoplasm contains several enzymes essential for glucose metabolism.

Erythrocytes ...3

When Hb combines with $O_2 \Rightarrow$ Oxyhemoglobin.

When Hb combines with $CO_2 \Rightarrow$ Carbaminoemoglobin.

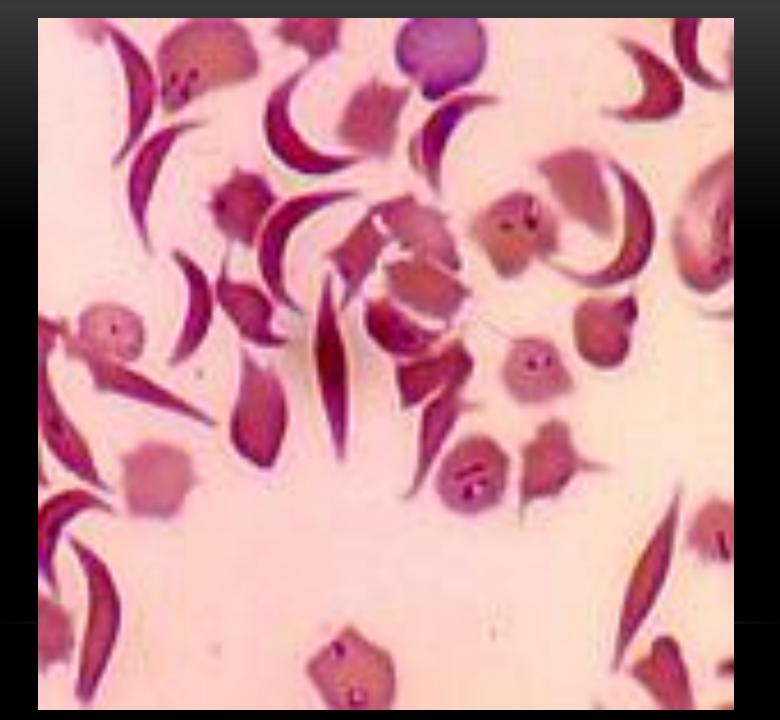
When Hb combines with CO ⇒ Carboxyhemoglobin. It is IRREVERSIBLE.

ERYTHROCYTES ...4

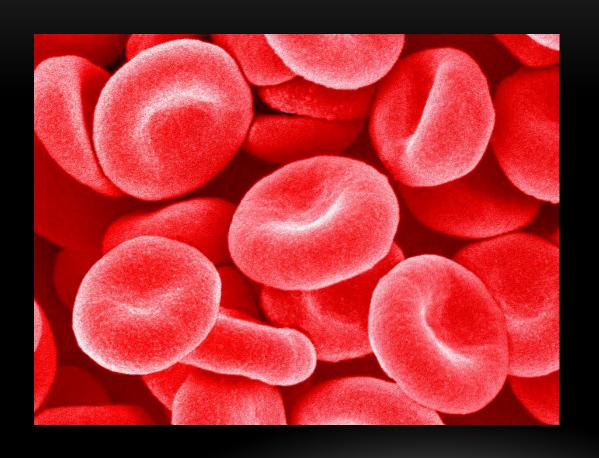
- RBC's lose their organelles during maturation.
- Recently released RBC contains residues of RNA ⇒ reticulocyte (reticulocytosis).
- RBC survives for ~ 120 days.
- Old RBC's are removed by macrophages in the spleen.

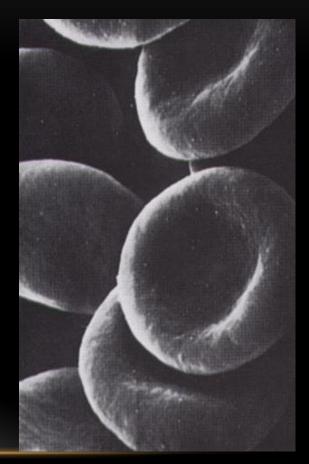
ERYTHROCYTES...5

- Macrocytes = RBC's diameter $>9 \mu m$.
- Microcytes = RBC's diameter <6 μm.
- Anisocytosis = Great variation in the size of RBC's.
- **Anemia** = Concentration of hemoglobin is below normal value.
- **Hypochromic anemia** = The cellular concentration of Hb is below normal.
- Sickle cell anemia.



Erythrocyte... SEM





Erythrocyte...



BACK

White Blood Cells (WBC's) Leukocytes

Considered as transient connective tissue cells, and penetrate the tissue by <u>diapedesis</u>.

According to the types of granules in the cytoplasm:

- Granulocytes: possess specific and azurophilic granules
 - Neutrophils
 - Basophils
 - Eosinophils
- Agranulocytes: possess azurophilic granules
 - Monocytes
 - Lymphocytes

Total number = $6000-10000 \text{ cell/}\mu\text{L}$

Neutrophils ...1

Constitute 60-70% of WBC's.

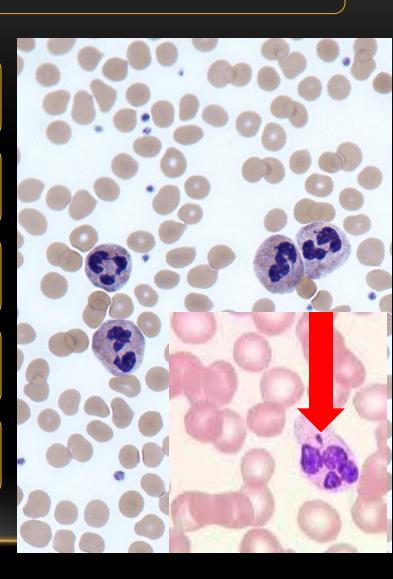
Diameter 12-15 μm.

Multilobed nucleus (3-5 lobes).

Barr body in females is attached to one lobe (X chromosome).

Cytoplasm contains glycogen and 2 types of granules:

- Specific: small widely scattered.
- Azurophilic: lysosomes.



Neutrophils ...2

Neutrophils life span ~ 6 hours in the blood and up to 4 days in connective tissue.

They phagocytose bacteria and small particles.

They show ameboid movement on adhering to solid substance.



Neutrophils ...3

Specific granules	Azurophilic granules
-Alkaline phosphatase	-Acid phosphatase
-Collagenase	- α-mannosidase
-Lactoferrin	-Arylsulfatase
	-β-Galactosidase
-Lysozyme	-β-Glucuronidase
-Antibacterial basic proteins	-Cathepsin
	-5'-Nucleotidase
	-Elastase
	Collagenase
	Myeloperoxidase
	-Lysozyme
	-Cationic antibacterial proteins "

Neutrophils

Eosinophil ...1

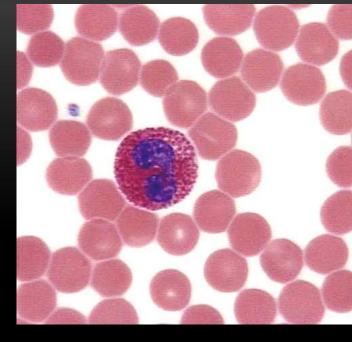
Constitute 2-4% of WBC's.

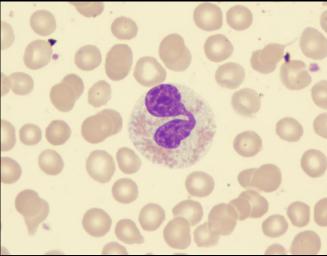
Contains bilobed nucleus.

Specific granules:

- Internum: the crystalline core
 - Lies parallel to the long axis.
 - Contains *major basic protein* which helps in killing parasites.
- <u>Externum</u> or matrix: les dense and surrounds the internum.

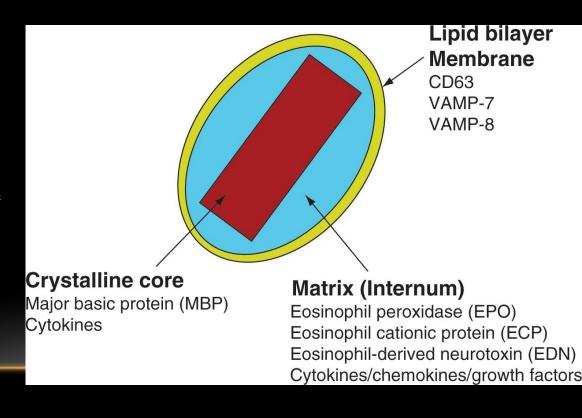
Cortisol decreases the number of eosinophils in allergy.

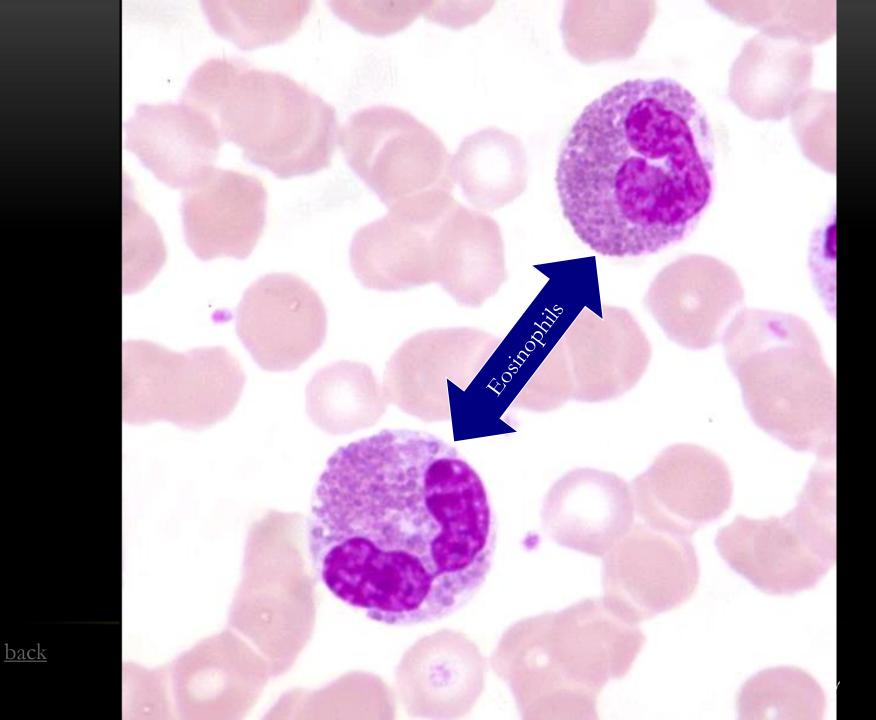




Eosinophils ...2

- Specific granules contain:
 - Acid phosphatase
 - Arylsulfatase
 - β-Glucuronidase
 - Cathepsin
 - Phospholipase
 - RNAase
 - Eosinophilic peroxidase
 - Major basic protein





Basophil ...1

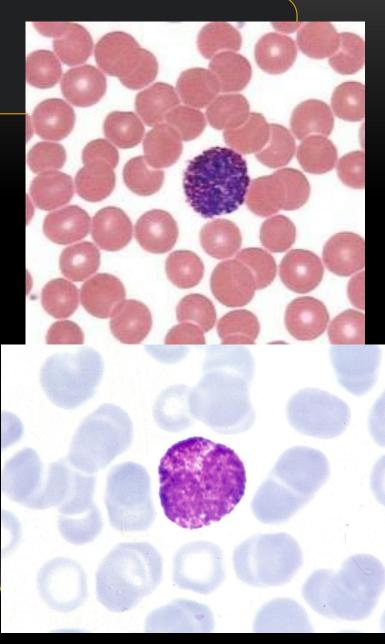
Constitute 0-1% of WBC's.

The nucleus is masked by the granules.

Specific granules are fewer and more irregular than other WBC's

Specific granules are metachromatic.

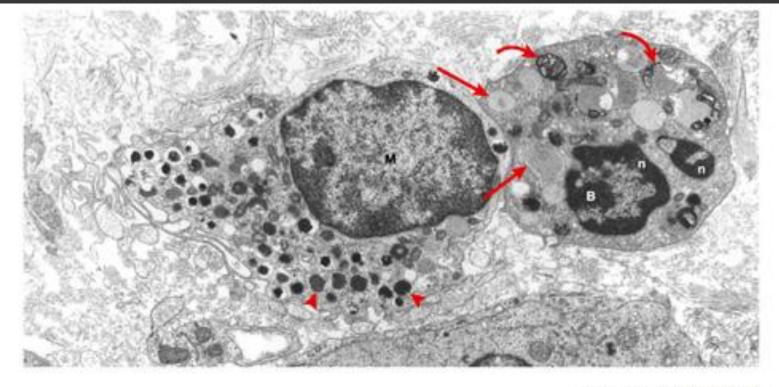
A Compare basophil and mast cell.



Basophil ...2

Basophil specific granules contain:

- Eosinophilic factor.
- Heparin
- Histamine
- Peroxidase
- Retinoic acid
- Cytokines



Nature Reviews | Immunology

transmission electron micrograph showing a mast cell (M) and basophil (B) in the ileal submucosa of a patient with Crohn's disease. The mast cell is the larger, mononuclear cell; it has a more complex plasma-membrane surface and cytoplasmic granules (arrowheads) that are smaller and more numerous than those (arrows) of the basophil. In this section plane, the basophil has two nuclear lobes (n). Several basophil cytoplasmic granules are visible that contain whorls of membrane (curved arrows).

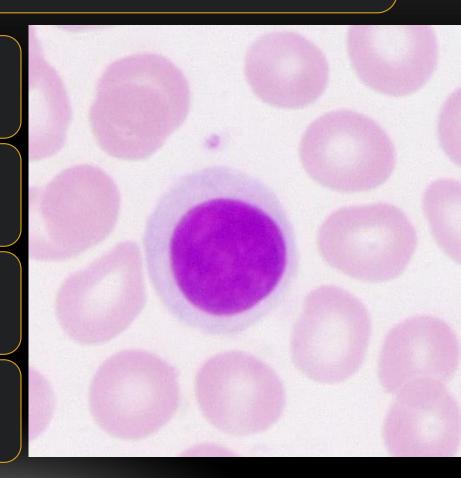
Lymphocytes ...1

Can be classified into several groups according to markers on their surfaces.

Their functions are related to immune reactions.

Morphologically they can be classified into small (6-8 μ m) medium (10-14 μ m) and large (> 18 μ m).

Large lymphocytes are considered activated cells.



Lymphocytes ...2

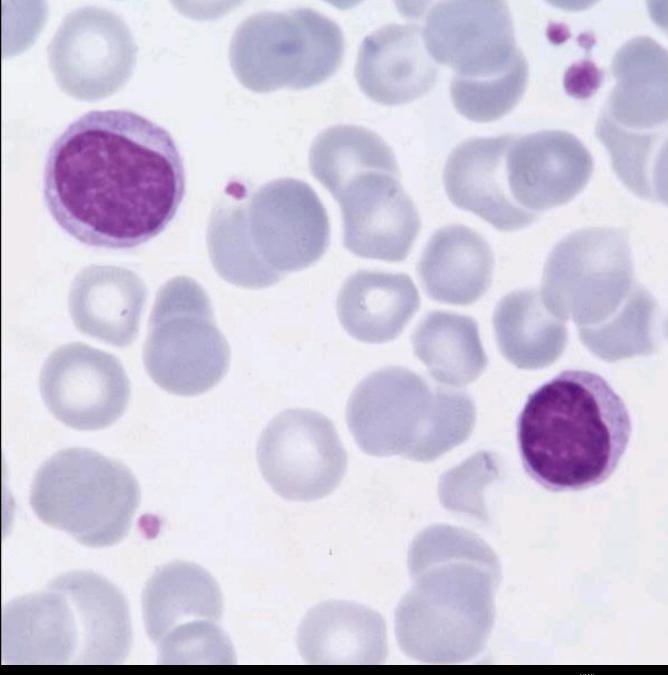
Most of the circulating lymphocytes are small.

Small lymphocytes:

- Spherical darkly stained indented nucleus.
 - Nucleolus can be seen in E.M.
- Scanty basophilic cytoplasm.
 - Cytoplasm may contain few azurophilic granules.
 - Cytoplasm contains few mitochondria and small Golgi.

Life span days-years.

Lymphocytes



Monocyte

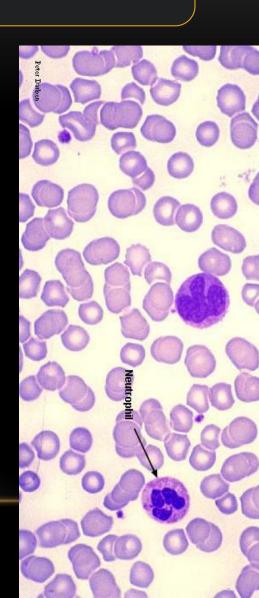
Diameter 12-20 µm.

Nucleus:

- eccentric, deeply indented (kidney shaped).
- Contains 1-2 nucleoli.

Cytoplasm:

- Basophilic, bluish gray.
- Contains fine azurophilic granules.
- Contains few rER, polyribosomes, many small mitochondria and Golgi.



Monocyte

Platelets ...1

Dsiklike, anucleated cellular fragments.

Originate from a large cell called megakaryocyte.

Their number $200000-400000/\mu L$.

Usually appear in clusters.

The cell is coated with GAG and glycoproteins.

The peripheral part of the platelet is called <u>hyalomere</u> and the central part is called <u>grnulomere</u>.

Actin and myosin are seen in the hyalomere.



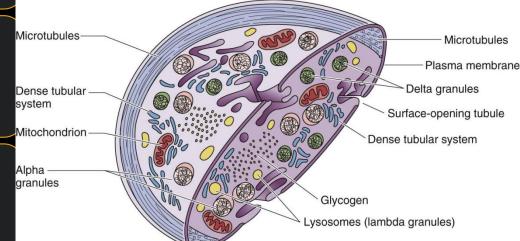
Platelets ...2

Around the periphery of the platelet, microtubules form ⇒ *marginal bundle*.

In the hyalomere irregular tubes form \Rightarrow *dense tubular system*.

Active substances are liberated through the *open canalicular system*.

The granulomere contains Δ , α , λ granules.



Platelets ...3

α granules: the commonest and largest granules seen in L.M. They contain:

• Fibrinogen, platelet derived growth factor, and some proteins.

 Δ granules: They contain:

- Ca⁺⁺, pyrophosphate, ADP, ATP
- They take up serotonin from the plasma.

 λ granules: they contain lysosomal enzymes.

