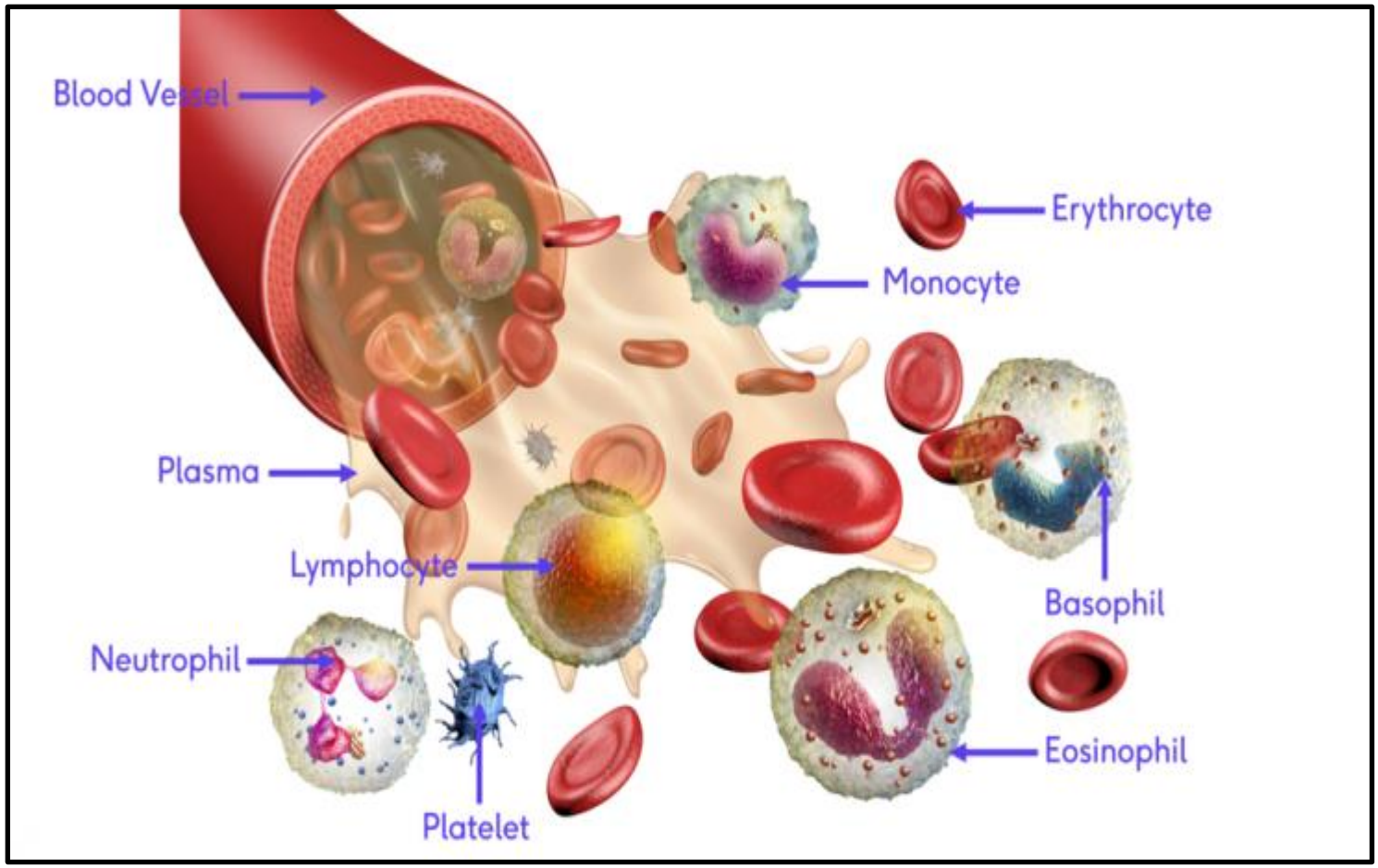
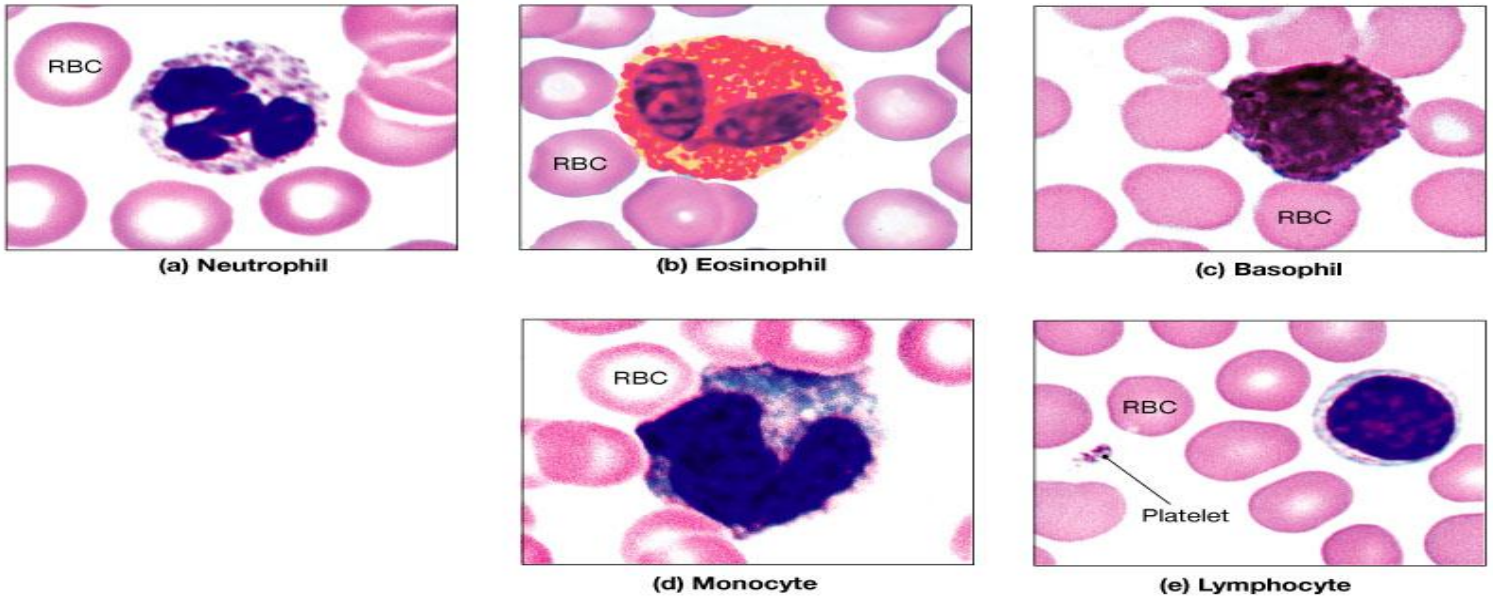
BLOOD 2


Blood Vessel
Erythrocyte
Monocyte
Plasma
Lymphocyte
Basophil
Neutrophil
Eosinophil
Platelet

Leukocytes (white blood cells or WBCs)

- Leukocytes are true cells with a nucleus and cytoplasm.
- They leave the blood and migrate to the tissues where they become functional and perform various activities related to immunity.
- **Total leukocytic count:**
  4,000 – 11,000 / cubic millimeter of blood.



Leukocytosis is the increase in number of leukocytes above 11000 / cubic millimeter which is either:

Physiological: as during pregnancy, lactation, after muscular exercise and after cold baths.

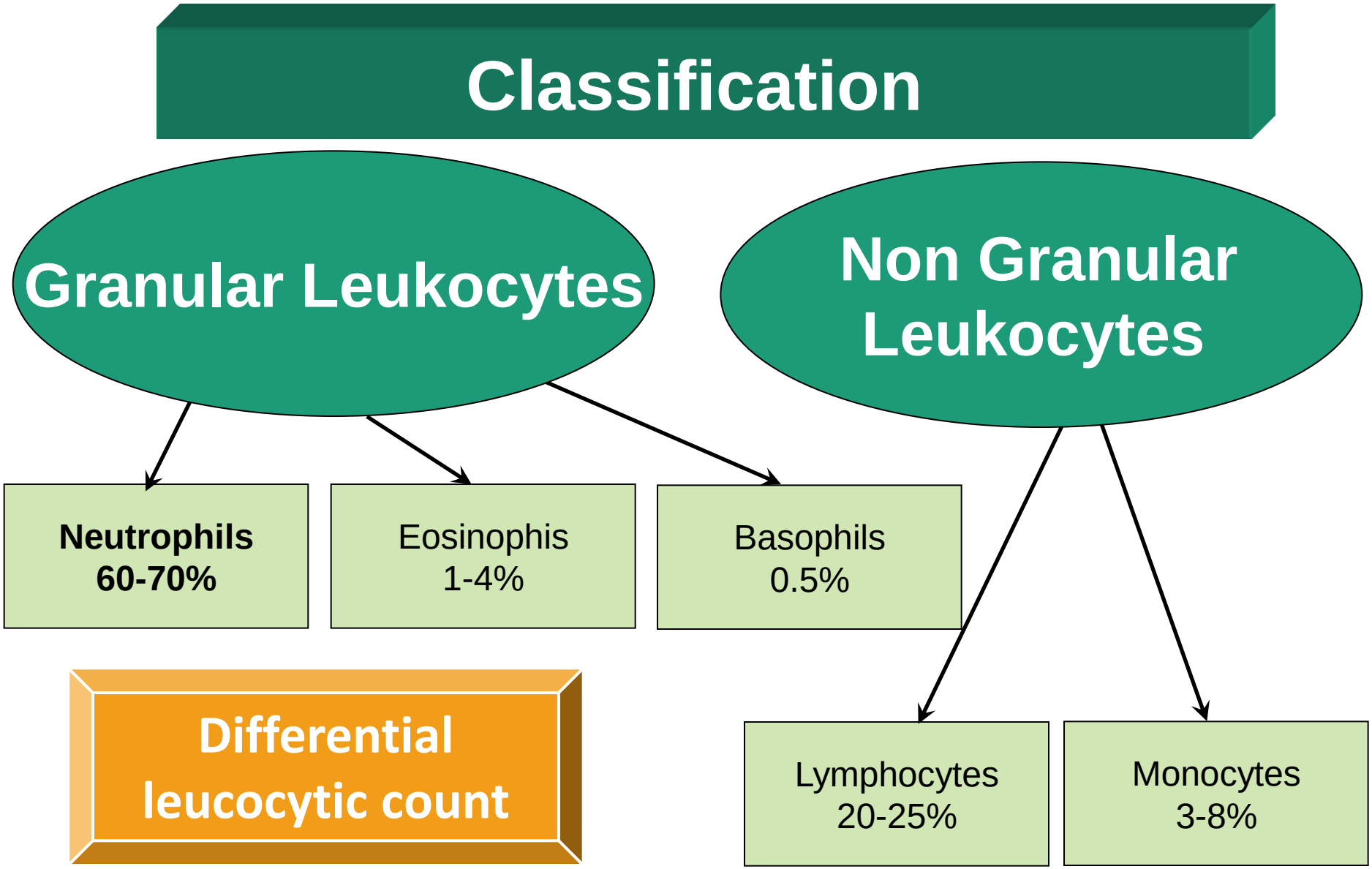
Pathological: as in acute pyogenic infections (abscess, acute follicular tonsillitis and acute appendicitis).

Leucopenia is the decrease in the number of WBCs below 4000/ cubic millimeter, it occurs in:

Influenza and typhoid fever.

Exposure to irradiation & X-ray.

According to the type of cytoplasmic granules

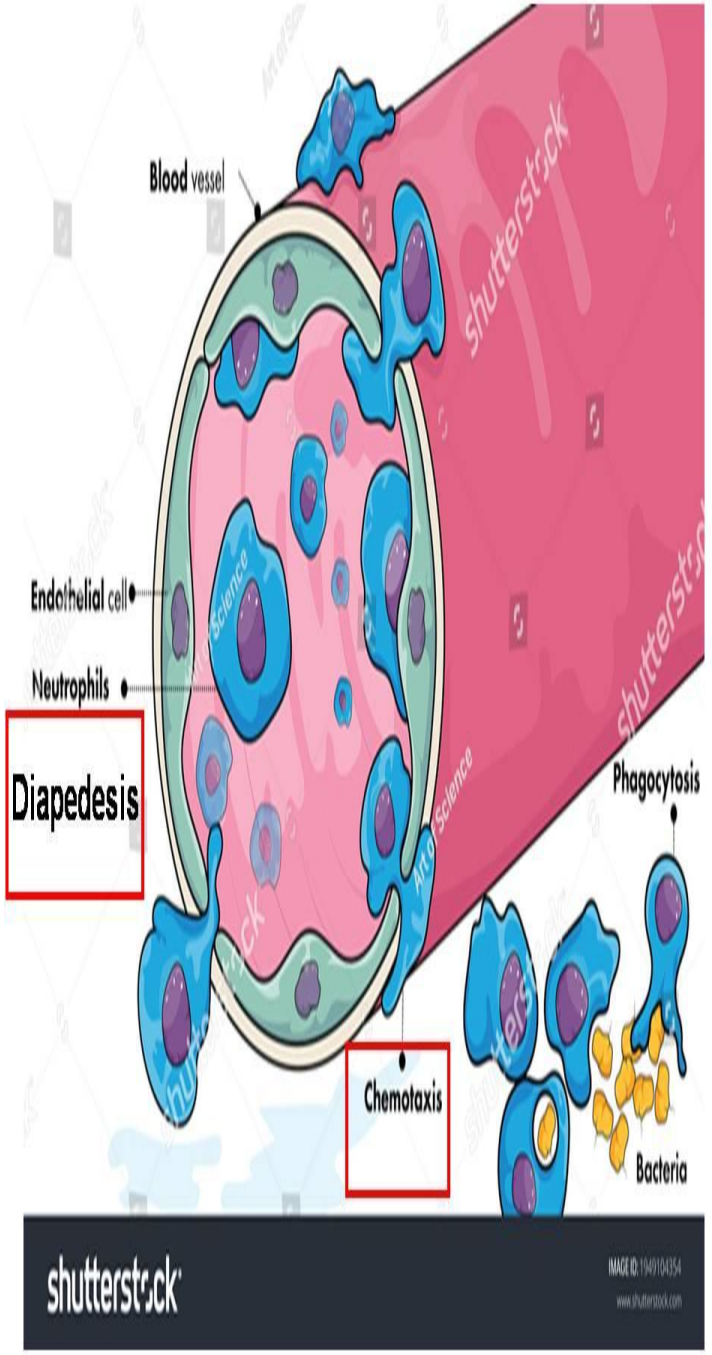


Diapedesis:

the leukocytes send extensions through the openings between the endothelial cells, migrate out of the venules into the surrounding tissue space to the site of injury or invasion.

Chemotaxis (movement in response to chemicals):

The attraction of leucocytes ***by*** chemical mediators which causes leukocytes to rapidly accumulate where their defensive actions are needed.



I- Granulocytes:

- **EM**: Their cytoplasm is rich in fine granules .

There are two types of granules:

1- The specific granules that bind *neutral, basophilic or acidophilic components* of the dye mixture.

2- The non-specific (azurophillic) granules: (lysosomes).

- Granulocytes have nuclei with 2 or more lobes.
- Life span *is few days* and dies by apoptosis (programmed cell death) in the connective tissues.

II-Agranulocytes do *not have* specific granules, but they contain azurophilic granules (lysosomes).

Neutrophils (Polymorphs, polymorphnuclear leukocyte)

- **Shape:** They are rounded cells
- **Surface:** Pseudopodia
- **Size :** 10-12 microns.
- **Life Span:** 3-5 days

-**Neutrophilia** means increase in the percentage of neutrophils above normal (as in acute pyogenic infections).

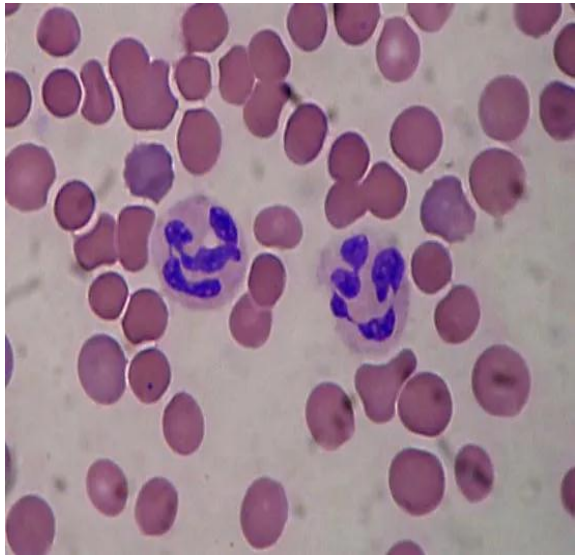
-**Neutropenia** means decrease in the percentage of neutrophils below normal (as in viral infections).

Neutrophils

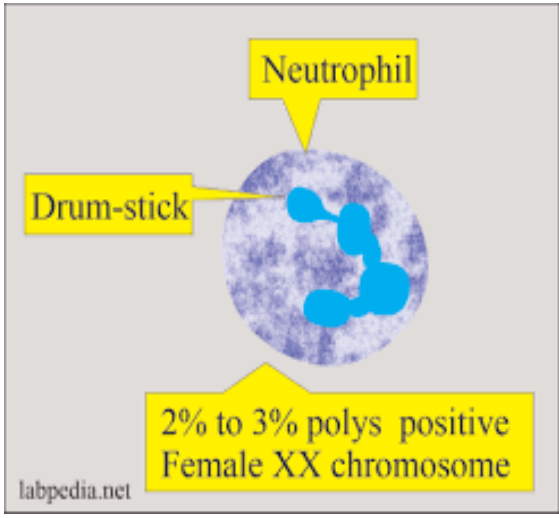
Structure:

The nucleus:

- single,
- segmented into many lobes (usually 3) connected to each other by chromatin threads



- In females, the inactive X chromosome may appear as a drumstick-like appendage on one of the lobes of the nucleus



Cytoplasm:

contains two types of granules:

a. Specific granules

-small & numerous

-*cannot be seen with LM.*

-EM: These granules are membranous vesicles containing alkaline phosphatase and bactericidal enzymes.

b. Non-specific (Azurophillic) granules

-large, less numerous

-stained purple and *can be seen with LM.*

-EM: These granules are *primary lysosomes* containing hydrolytic enzymes.

-the cytoplasm also contains glycogen, small Golgi body, few mitochondria and little endoplasmic reticulum.

- ***Function:***

1- Phagocytosis & digestion of micro-organisms especially bacteria by the specific and non specific (azurophillic) granules.

2- Release of macrophage chemotactic factor that stimulate attraction of macrophages at the site of inflammation.

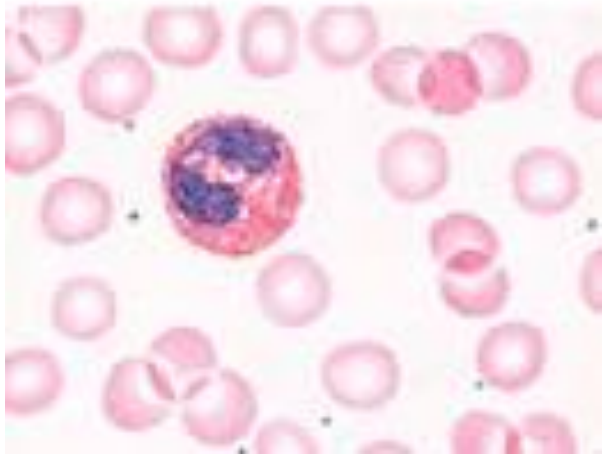
3- Release of fibroblast chemotactic factor to stimulate fibroblasts to form new collagen leading to healing.

4- Dead neutrophils, bacteria, semidigested material and tissue fluid form a viscid usually yellow collection of fluid called pus

Eosinophils

- **Shape:** rounded
- **Size** : diameter ranging from 10-12 m
- **Life Span**: 8-12 days
- **Structure**:

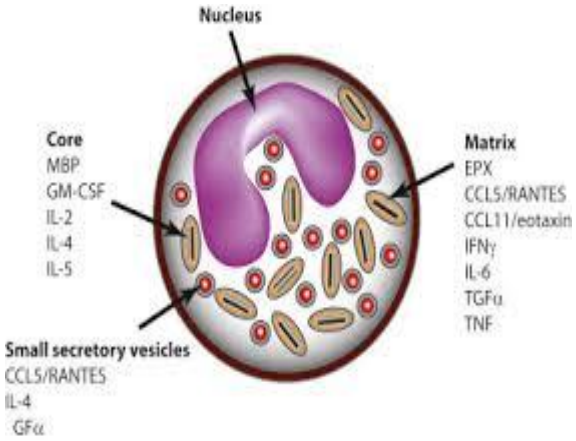
The nucleus: Single, bilobed connected by thin chromatin thread (horse-shoe shaped).



Cytoplasm: contains:

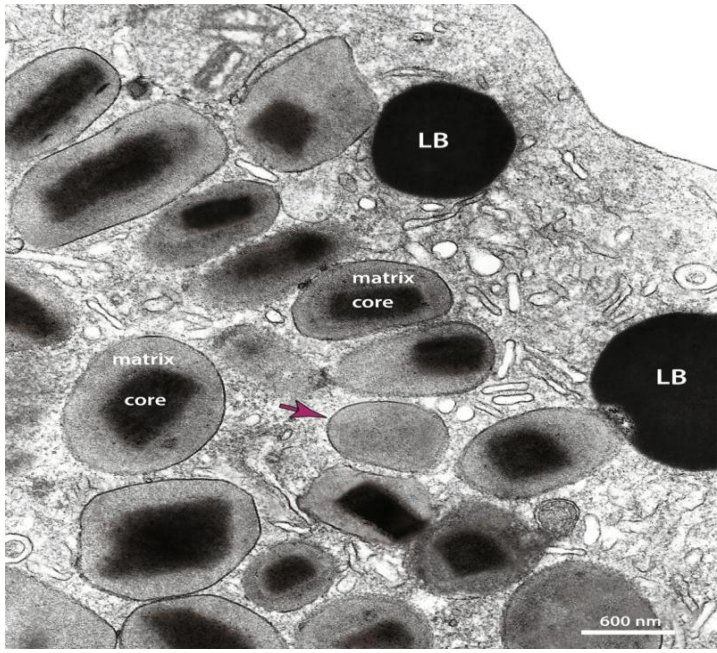
a- Specific granules: Large elongated specific granules with central crystalline dense core formed of protein called **major basic protein (MBP).**

This core is surrounded by less dense material consists of some enzymes e.g. arylsulfatase and histaminase.



b- Nonspecific granules are lysosomes containing hydrolytic enzymes.

c-Glycogen, and poorly developed endoplasmic reticulum, mitochondria and Golgi body are present.



Eosinophils

Function:

- They phagocytose antigen- antibody complexes.
- They are attracted to the sites of allergic reactions by *eosinophil chemotactic factor* which is released by mast cells to reduce their effects by releasing antihistamine (histaminase).
- Play a role in *killing parasitic* worms by *major basic protein*

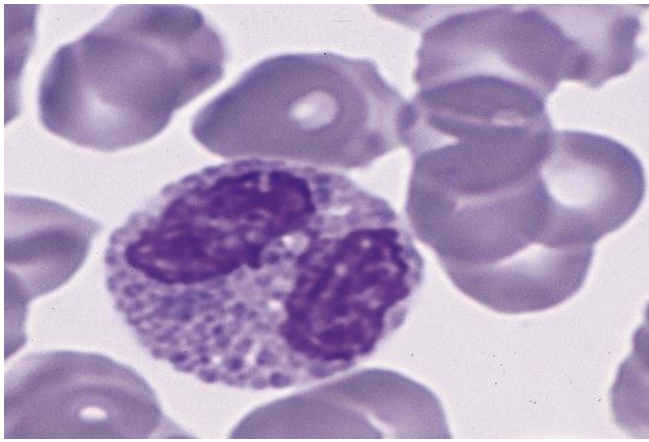
Abnormal count:

Eosinophilia: in allergic and parasitic diseases.

Eosinopenia: after cortisone treatment.

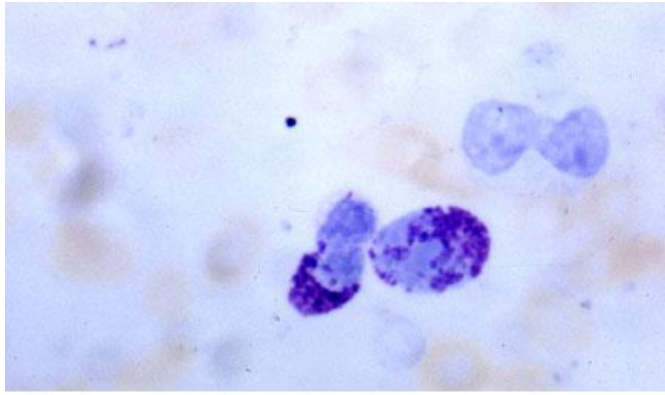
Basophils

- **Shape:** rounded
- **Size :** diameter ranging from 10-12 m
- **Life Span:** 12-15 days
- **Structure:**
- **Nucleus:** large -is often bent into a U or S shaped.
- **Cytoplasm** :



a. Specific granules: they are large, *basophilic* and *obscure the nucleus*.

-They are metachromatically stained by toluidine blue and contain heparin & histamine, like mast cells.



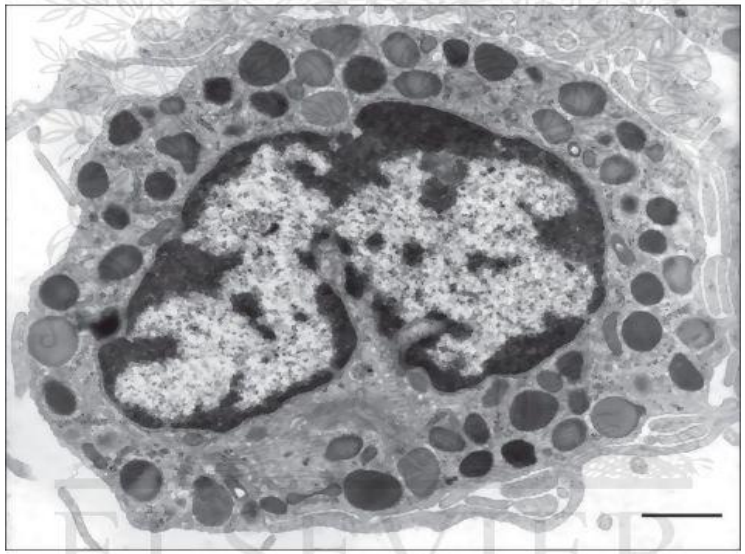
a. Nonspecific granules: they are lysosomes

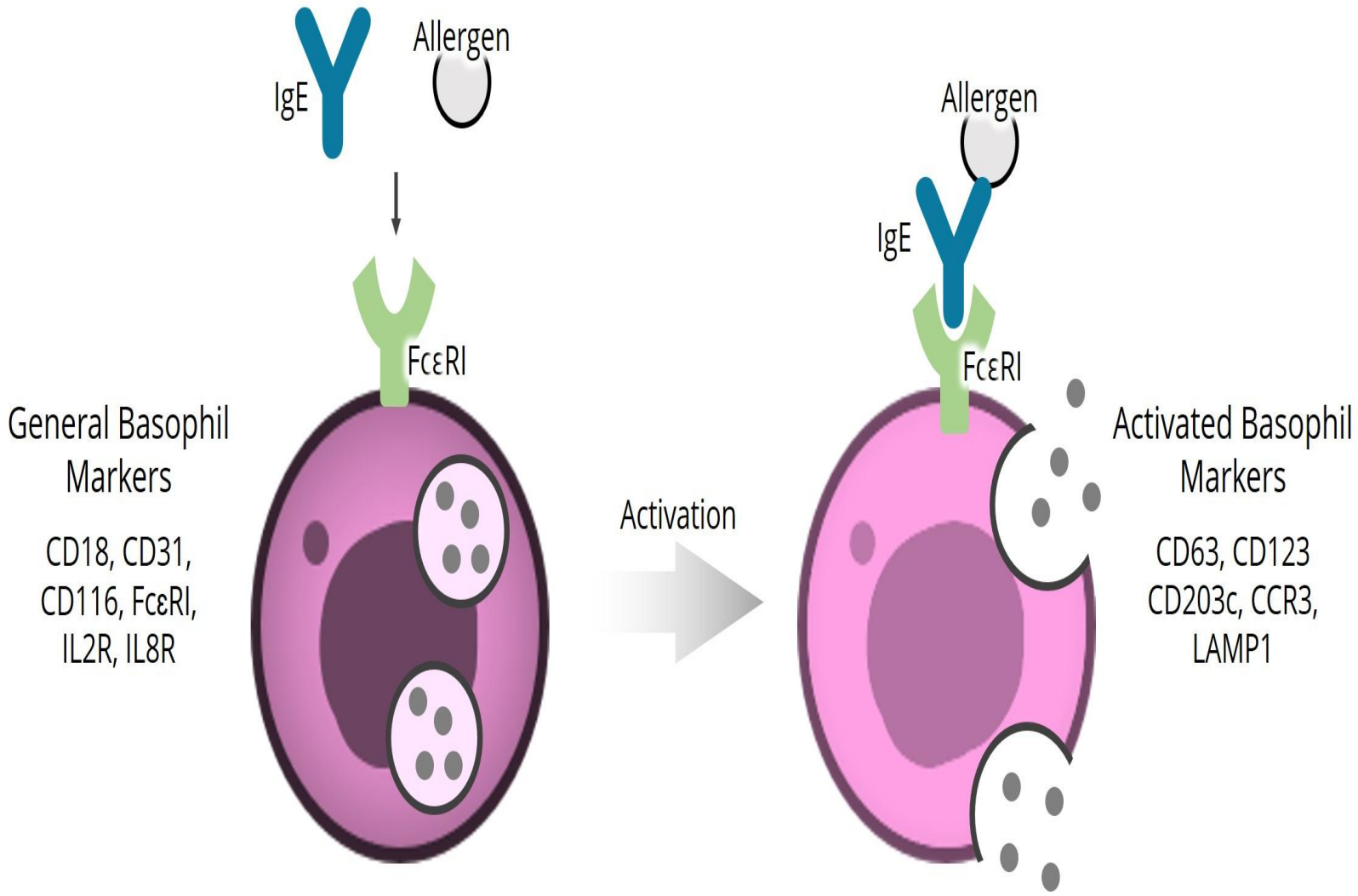
c- Varying amounts of glycogen, small Golgi apparatus, a few mitochondria and poorly – developed endoplasmic reticulum.

-The cell surface has receptors for **the plasma IgE**, which when come in contact with the antigen (in the blood); they form antigen-antibody complex resulting in degranulation of the basophils and release of its mediators.

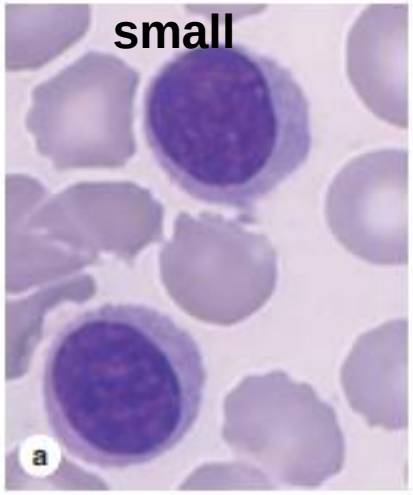
Functions:

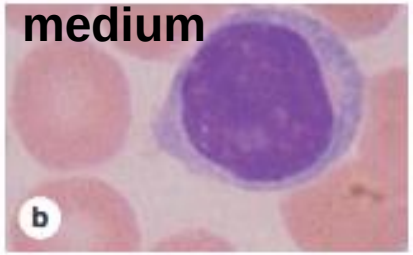
- Secretion of eosinophil chemotactic factor.
- Secretion of heparin (anticoagulant).
- Secretion of histamine (initiates allergic reactions).
- Basophilia means increase of basophils above 1% as in liver cirrhosis.

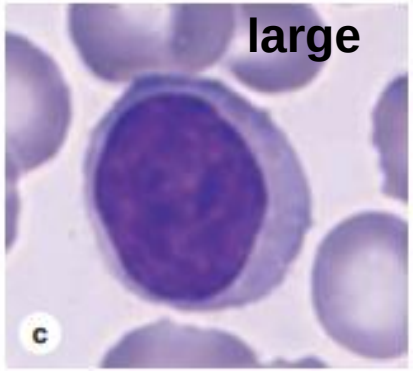


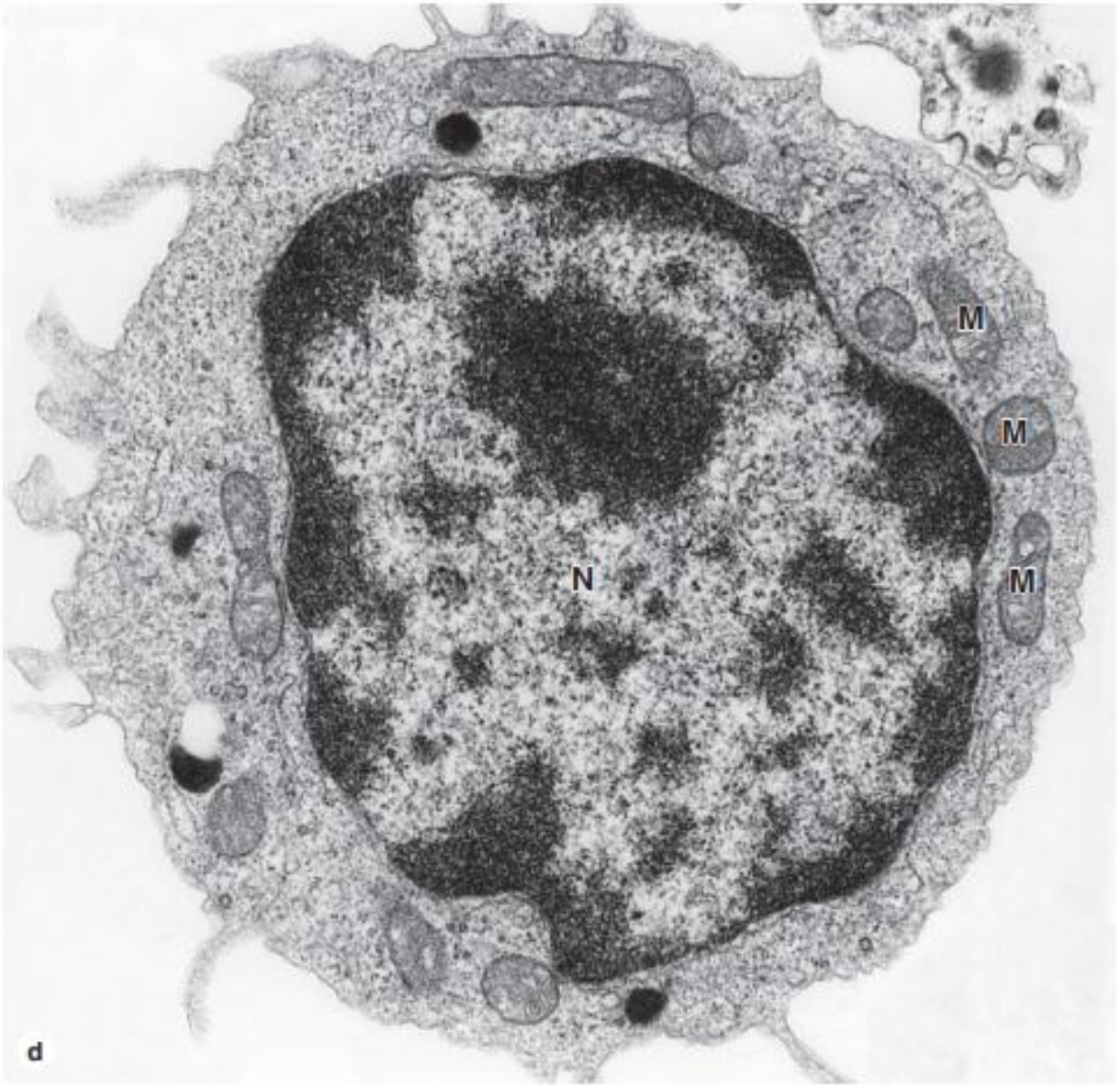

IgE
Allergen
FcεRI
General Basophil Markers
CD18, CD31, CD116, FcεRI, IL2R, IL8R
Activation
Allergen
IgE
FcεRI
Activated Basophil Markers
CD63, CD123 CD203c, CCR3, LAMP1

Lymphocytes





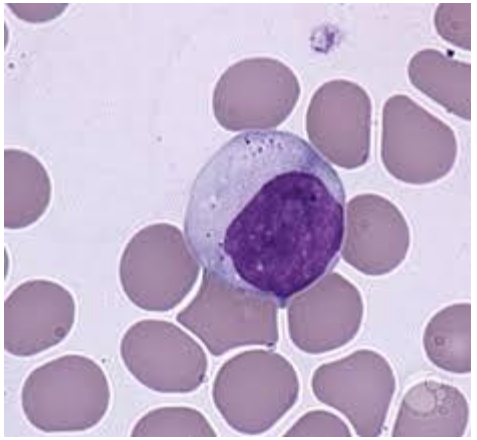




Lymphocytes

- There are different types of lymphocytes; large, medium and small lymphocytes.
- They are present in the C.T., lymph nodes, spleen, thymus, tonsils and tissue fluids.
- Lymphocytes are the only type of leukocytes that return back from the tissue to the blood.

Large lymphocytes: They are believed to be small lymphocytes activated by the specific antigens.

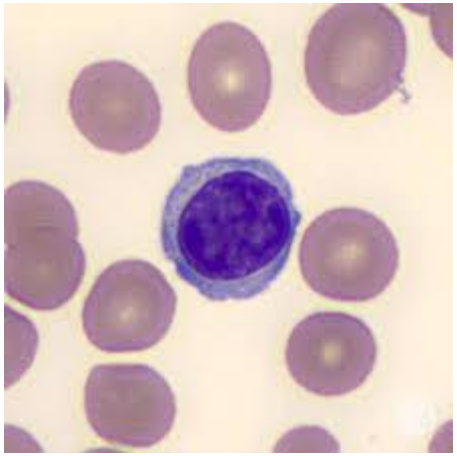


- Diameter: 12-15 μm
- Percentage: 5-10% of circulating WBCs.
- Structure:

-**Nucleus**: is large & lightly stained (active chromatin) with apparent nucleolus.

-**Cytoplasm:** is abundant, more basophilic (containing ribosomes) &non-granular. It also contains a few azurophillic granules.

Small lymphocytes: They are the commonest.



- Diameter: 7-9 µm
- Percentage: 15-20 % of circulating WBCs.
- Structure:

-**Shape:** spherical

- **Nucleus**: is large, rounded & darkly stained (condensed chromatin) with little indentation at one side. -

-**Cytoplasm:** is scanty, and appears as a narrow rim around the nucleus.

It is lightly basophilic and non-granular containing a few azurophillic granules, mitochondria, a small Golgi complex and a pair of centrioles and abundant ribosomes.

- **There are two types of small lymphocytes:**

B-lymphocytes: - They constitute 25 % of circulating small lymphocytes.

- B- Lymphocytes are produced in bone marrow .

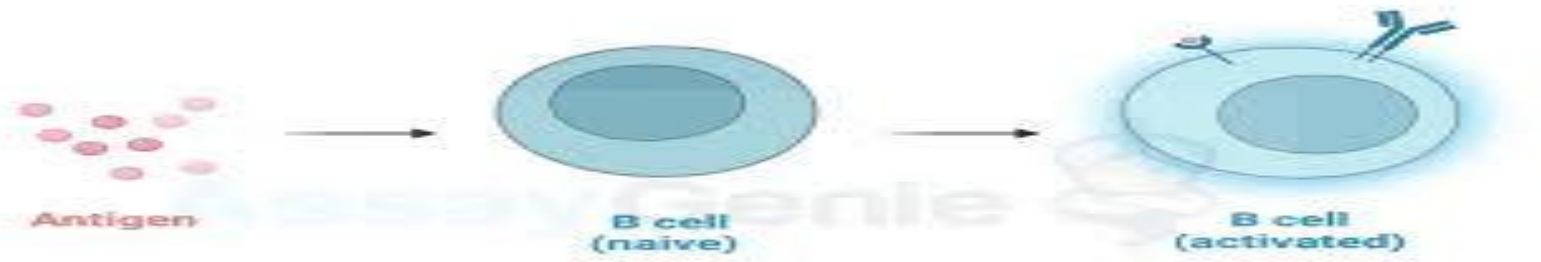
Function: They are responsible for humoral immunity.

B-lymphocytes when stimulated by specific antigen, some of B-lymphocytes differentiate into plasma cells to produce antibodies. Others generate B-memory cells, which react rapidly to a second exposure to the same antigen

T- lymphocytes:

- They originate in the bone marrow and migrate to the thymus, where they proliferate and carried by the blood to other lymphoid tissue.
- Percentage: 65-75 % of the circulating lymphocytes.
- They are responsible for cellular immunity.

Activation of B-lymphocytes



Monocytes

- **Shape:** rounded
- **Size:** 12-20 microns in diameter.
- **Life Span:** Monocytes circulate in blood about three days after which they leave blood to the connective tissues, where they differentiate into macrophages.
- **Structure:**

The nucleus:

- oval in shape with deep indentation.

- Sometimes, it takes the kidney shape.

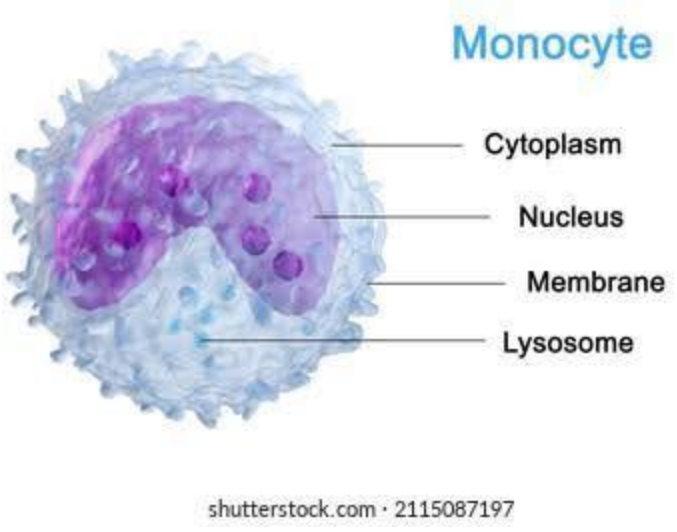
- Its chromatin is less condensed than that of lymphocytes

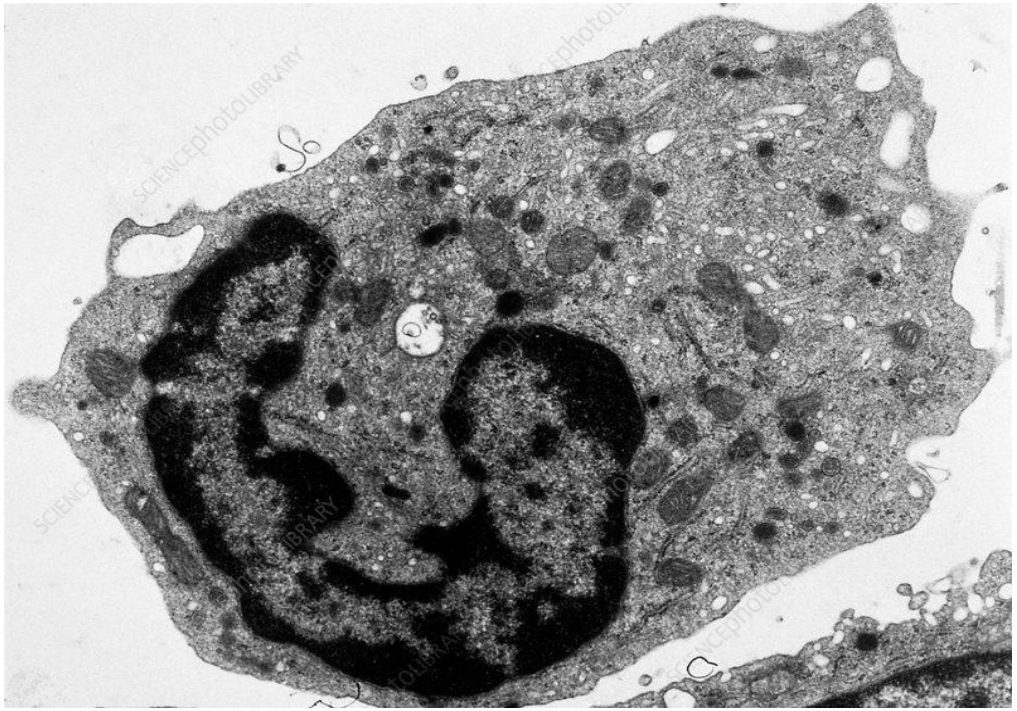
Cytoplasm: abundant and pale blue.

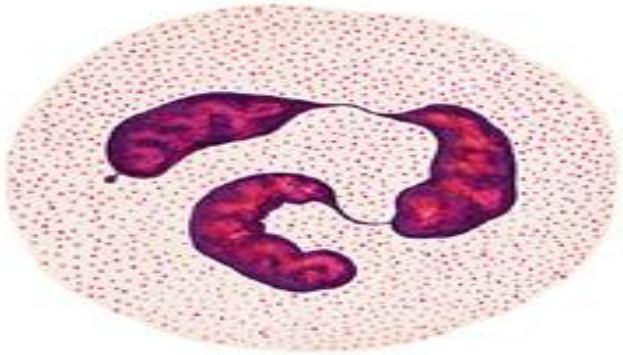
-Contains very fine azurophillic granules (lysosomes), well developed Golgi.

Function and abnormal count: In the connective tissue they *change to macrophages* which are highly phagocytic cells.

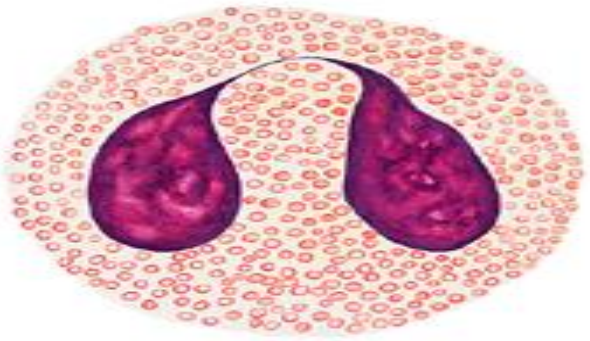
-They increase in number in malaria, typhoid, and monocytic leukemia.



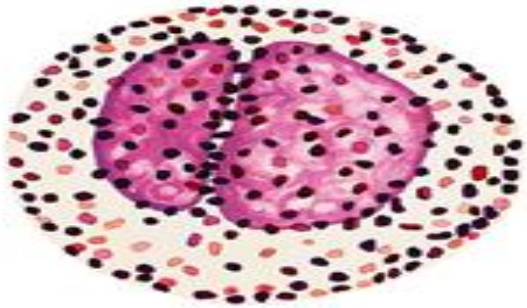




Neutrophilic granulocyte



Eosinophilic granulocyte

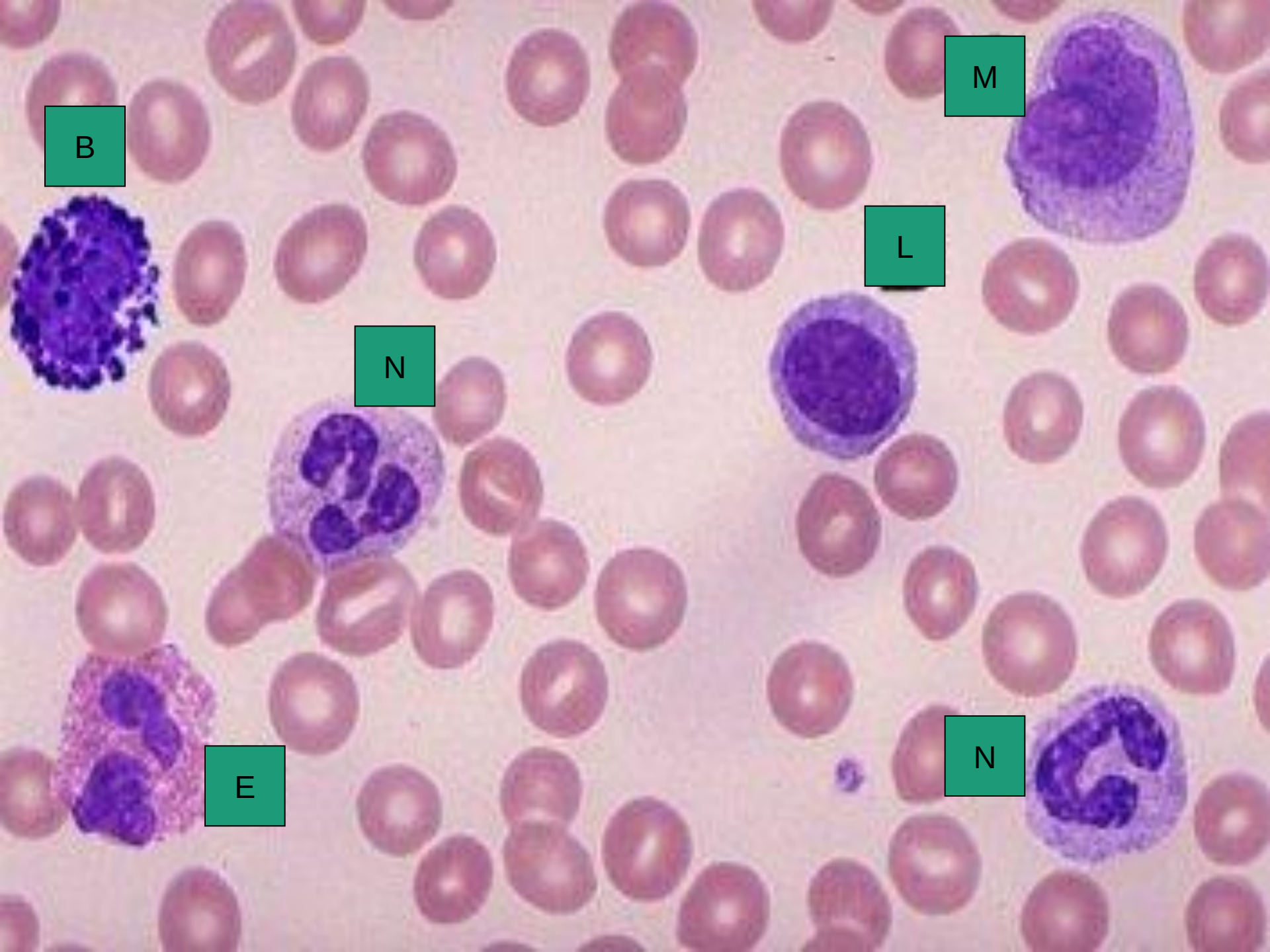


Basophilic granulocyte

Lymphocyte

Monocyte

Monocyte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Thank You