

Anatomy and Physiology

For

The First Class

2nd Semester

HEMATOLOGIC SYSTEM

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Leucocytes = White blood cells
(WBC)

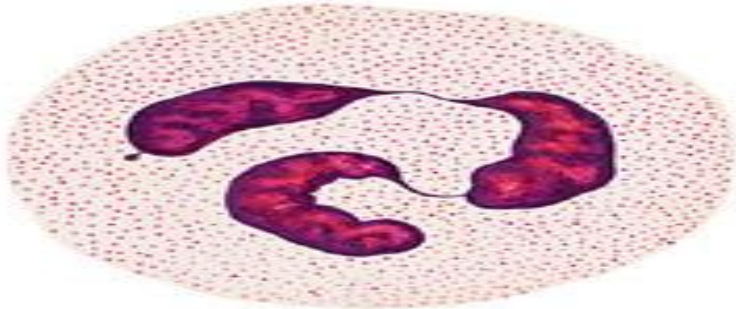
Leucocytes = White Blood Cells (WBC)

- Leucocytes are the largest blood cells.
- They account for only about 1% of the blood volume.
- **Leucocytes are different from erythrocytes in several ways:**
 1. They are true cells, each leucocyte having a nucleus, mitochondria, and other organelles.
 2. They do not contain Hb.
 3. Leucocytes can actively move while erythrocytes do not have mobility of their own.
 4. Normally erythrocytes do not leave the vascular system but leucocytes can leave vessels and enter the surrounding tissue.
 5. Most leucocytes have a relatively short life span.

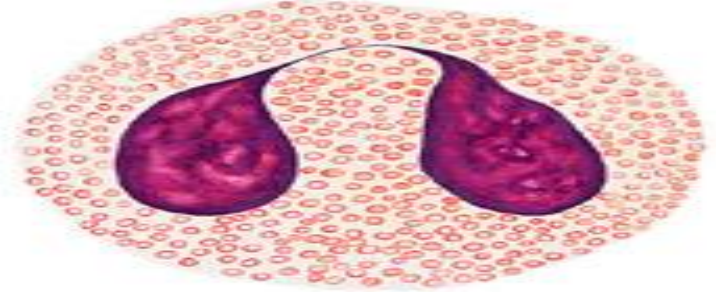
Types of WBC

- There are two main types:
 1. **Granulocytes** which contain granules in their cytoplasm and they *Neutrophils, eosinophils and basophils.*
 2. **Agranulocytes**
 - *Monocytes and lymphocytes.*
- There are about 7500 μl (range 5000-10000 μl).
- **Neutrophils** represent **60-70%** of total WBC. And about **20-30% lymphocytes**. While **eosinophils** are about **3%**, **basophils 1%** and **monocytes about 5%**.

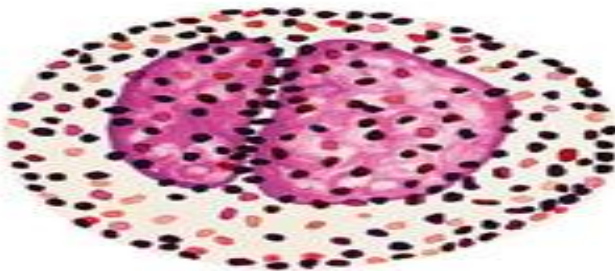
The 5 types of human leukocytes. Neutrophils, eosinophils, and basophils have granules that stain specifically with certain dyes and are called granulocytes. Lymphocytes and monocytes are agranulocytes; they may show azurophilic granules, which are also present in other leukocytes.



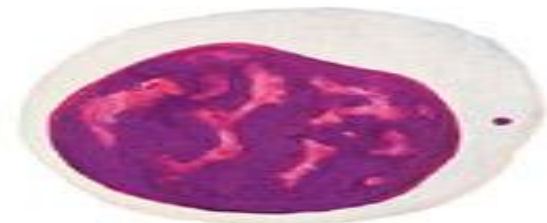
Neutrophilic granulocyte



Eosinophilic granulocyte



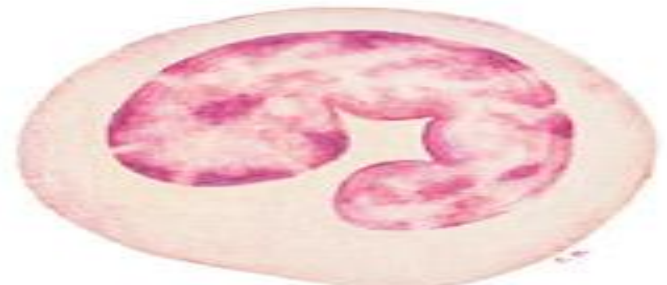
Basophilic granulocyte



Lymphocyte



Monocyte



Monocyte

Granulocytes

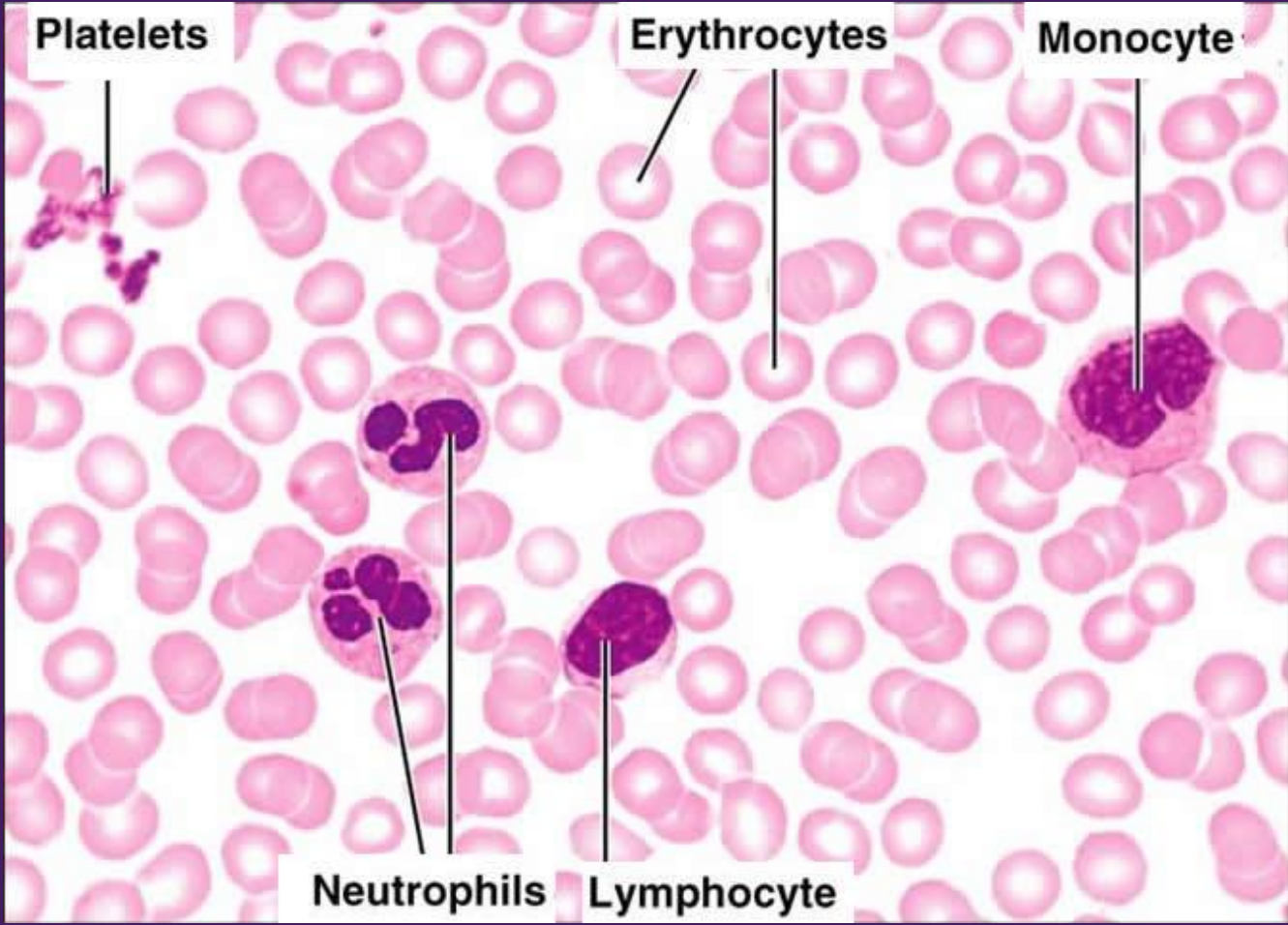
1. Neutrophil

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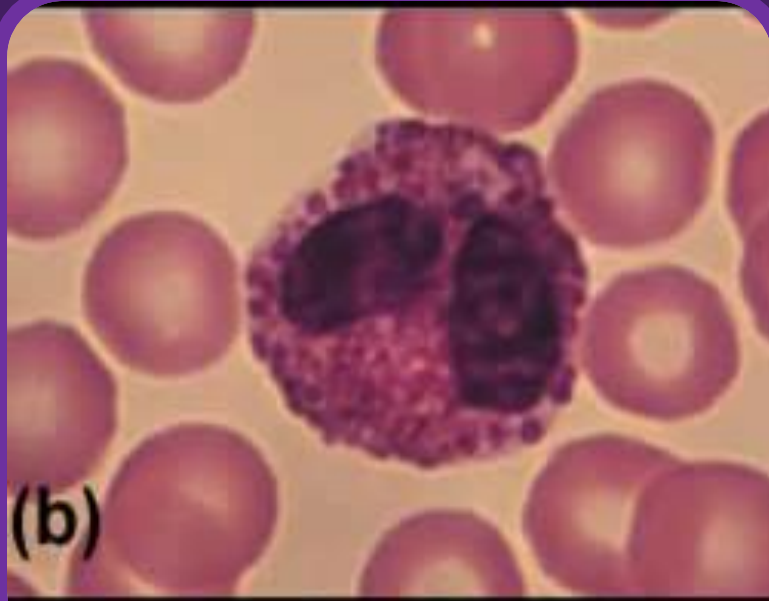
Neutrophils (Polymorphonuclear leukocytes)

- Constitute 60-70% of circulating leukocytes.
- They are 12-15 μm in diameter with nucleus consisting of 2-5 lobes.
- The cytoplasm of the neutrophil contains 2 main types of granules (**specific granules** and **azurophilic granules**).
- **Specific granules** are small granules and contain *alkaline phosphatase, collagenase, lactoferrin, lysozyme* and several *non enzymatic antibacterial* proteins.
- **Azurophilic granules** are lysosomes and contain *acid phosphatase, α -monosidase, myeloperoxidase, lysozyme, cationic antibacterial proteins, collagenase, elastase, nucleotidase* and *others*.
- Neutrophils have short half life 6-7 hours in blood and 1-4 days in the tissues.
- Neutrophils have phagocytic activity against bacteria and other small particles.
- During phagocytosis, superoxide (O_2^-) and hydrogen peroxide (H_2O_2) are formed that kill microorganisms.
- Myeloperoxidase with O_2^- form a powerful killing system.



2. Eosinophil

Σ. Εοσινοφίλι

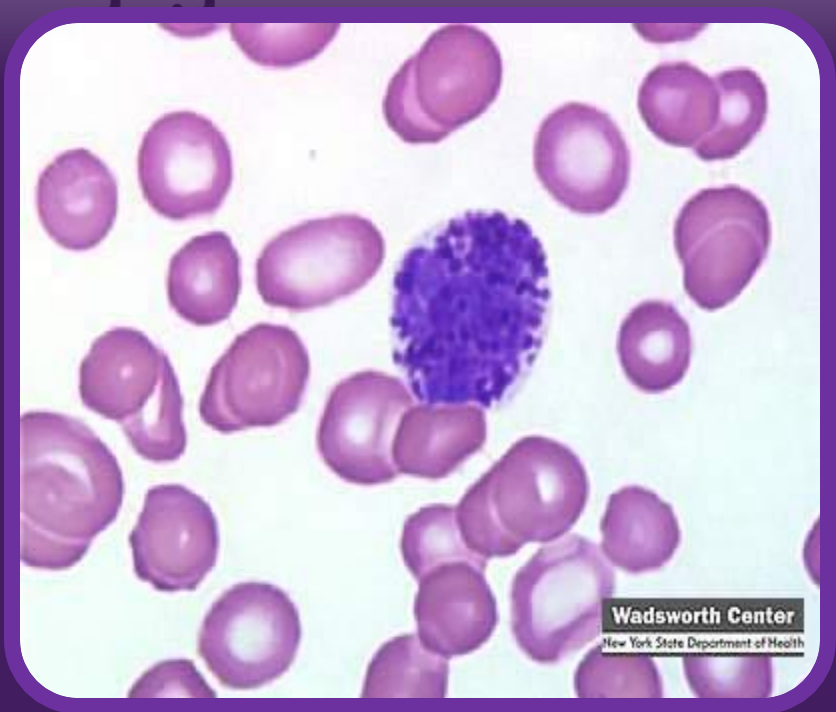
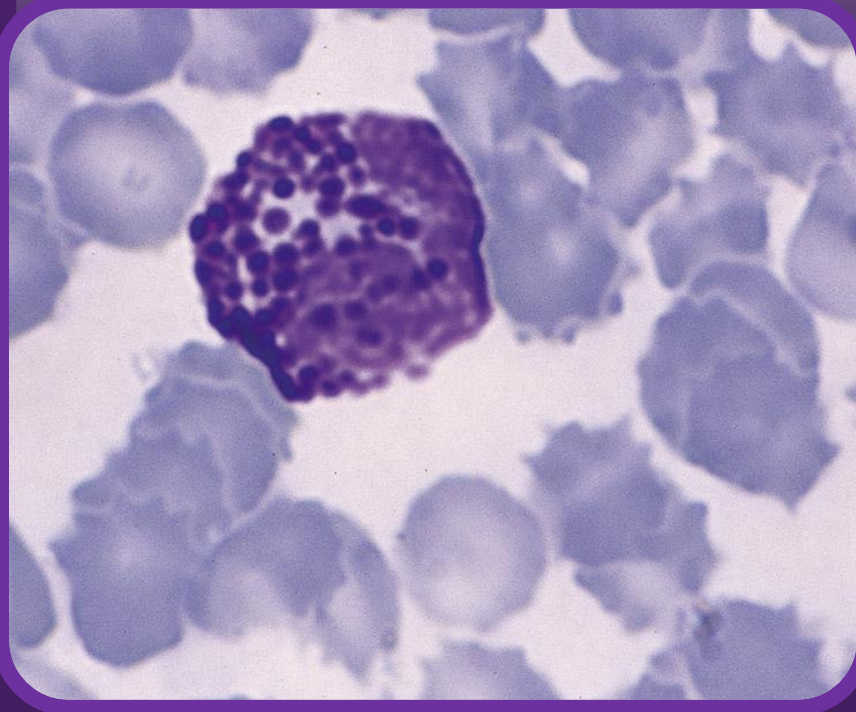


Eosinophils

- Eosinophils constitute 2-4% of leukocytes in normal blood.
- Life span in circulation is about 10 hours and 10 days in tissues.
- These cells have bilobed nucleus.
- The cytoplasm of eosinophil contains large granules that are stained by eosin.
- The granules contain many types of enzymes e.g. *peroxidase*, *RNAase*, *phospholipase*, and others, additionally the granules contain a protein called the **major basic protein**. This protein has ability to kill parasitic worm.
- An increase in the number of eosinophils in the blood is associated with **allergic reaction** and **parasitic infection**.

3. Basophils

3. Basophils



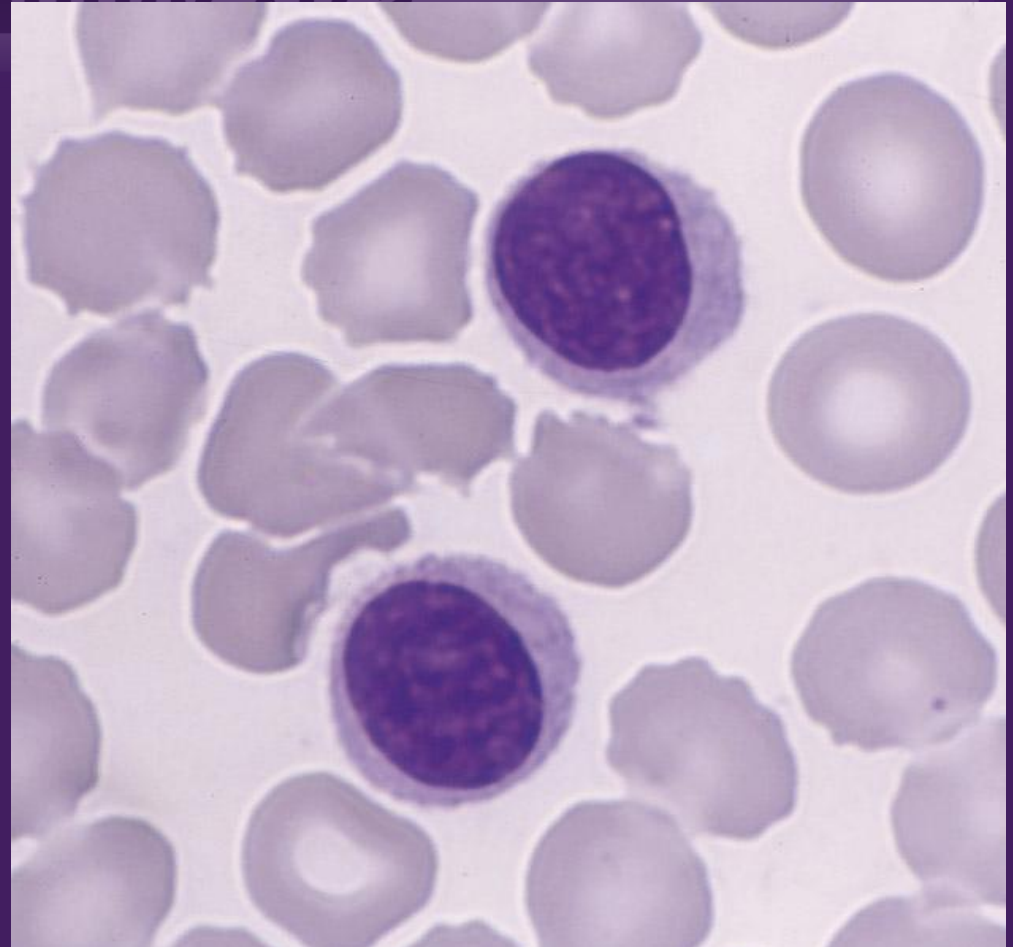
Basophils

- Basophils make up less than 1% of blood leukocytes.
- There are about 12-15 μm .
- The nucleus is divided into irregular lobes or S shaped.
- The cytoplasm contains very large granules that are stained with basic dye.
- The granules contain mainly **histamine** and **heparin**.
- These cells play an important role in the **allergy**.

Agranulocytes

1. Lymphocyte

1. Γλωβροκύττα
υδατοκύτταρα

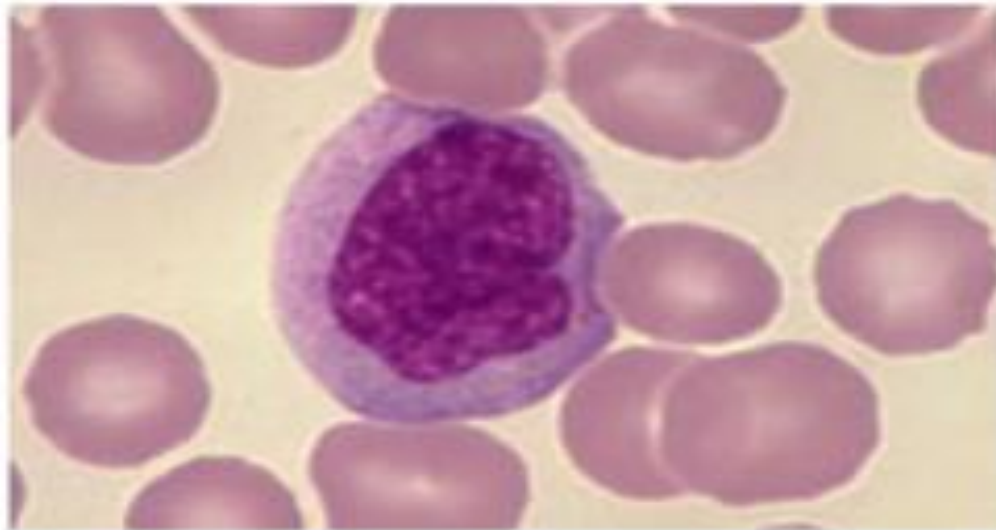


Lymphocytes

- Lymphocytes are spherical cells
- There are small lymphocytes with diameter of 6-8 μm and large lymphocytes with diameter up to 18 μm .
- The nucleus of lymphocyte are large and rounded.
- The cytoplasm of the small lymphocytes is scanty and in blood smear it appears as a thin rim rounded the nucleus. And it is slightly basophilic.
- Lymphocytes vary in life span; some live only a few days and other survive for many years.
- Lymphocytes are classified according to their function to; **B lymphocyte**, **T lymphocyte**, and **Natural Killer cell**.
- All types of lymphocytes are related to immune reactions in **defending against invading microorganisms, foreign macromolecules, and cancer cells.**

2. Monocyte

Σ: ΜΟΝΟΚΥΤΕ



(e)

Monocytes

- These are the largest of the white blood cells.
- The nucleus is horseshoe- or kidney-shaped.
- The cytoplasm of monocyte is basophilic and contains very fine azurophilic granules (lysosomes).
- Blood monocytes migrate into the tissues and develop into macrophages.
- Macrophages engulf large particles and pathogens (large cell eater).
- The life span in the circulation is few days but 60-120 days in the tissues.
- They account 4-11%
- The main function monocyte is phagocytosis but also has ability to secret certain substances like interlukins e.g. interlukin 1 (IL-1).
- Macrophages have important functions in inflammation and immunity.

Leukopoiesis

Phase	Stem Cells	Progenitor Cells	Precursor Cells (Blasts)	Mature Cells
Early morphologic	Not morphologically distinguishable; have the general aspect of lymphocytes		Beginning of morphologic differentiation	Clear morphologic differentiation
Mitotic activity	Low mitotic activity; self-renewing; scarce in bone marrow	High mitotic activity; self-renewing; common in marrow and lymphoid organs; mono- or bipotential	High mitotic activity; not self-renewing; common in marrow and lymphoid organs; monopotential	No mitotic activity; abundant in blood and hematopoietic organs
<p>The diagram illustrates the differentiation of a pluripotent cell into lymphoid and myeloid multipotential cells. The lymphoid multipotential cell migrates to lymphoid organs and differentiates into a lymphocyte-colony-forming cell (LCFC), which then becomes a lymphoblast and finally B and T lymphocytes. The myeloid multipotential cell remains in the bone marrow and differentiates into four types of colony-forming cells: Monocyte-colony-forming cell (MCFC), Granulocyte-colony-forming cell (GCFC), Eosinophil-colony-forming cell (EoCFC), and Basophil-colony-forming cell (BCFC). These further differentiate into promonocytes, neutrophilic myelocytes, eosinophilic myelocytes, and basophilic myelocytes, which finally mature into monocytes, neutrophilic granulocytes, eosinophilic granulocytes, and basophilic granulocytes.</p>				