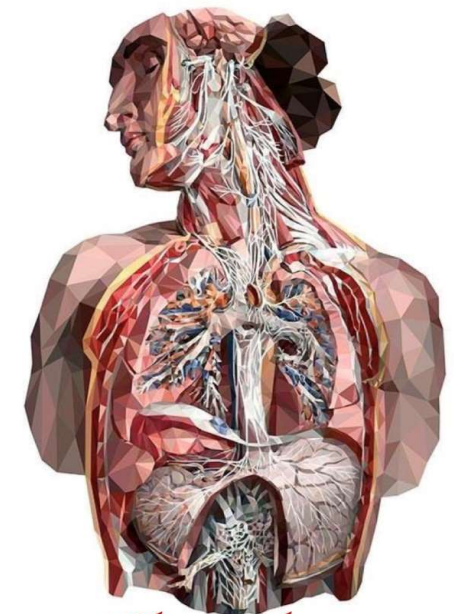


White Blood Cells (I &II)

This is the editing link, please visit it frequently:

<https://docs.google.com/document/d/1WvdeC1atp7J-ZKWOU5ukSLsEcosjZ0AqV4z2VcH2TA0/edit>

- Red : important
- Black : in male / female slides
- Pink : in girls slides only
- Blue : in male slides only
- Green : notes, Extra

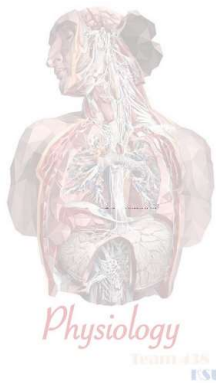


Physiology

Team 438
KSU

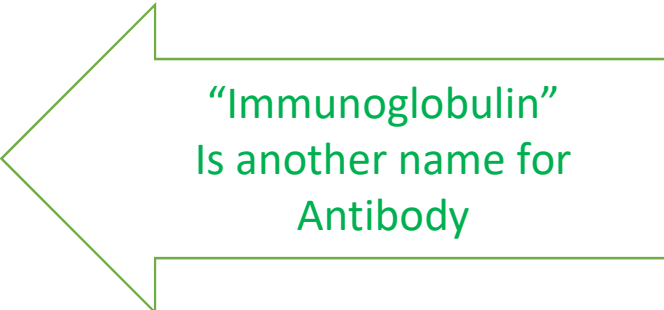
Objectives

- Describe different Types of WBC
- Recognize the general functions of WBC
- Describe genesis and site of formation of WBC
- Describe stages of neutrophil formation
- Describe the role of neutrophils in defending the body against infection
- Describe the process of phagocytosis
- ---
- Describe Eosinophils formation and functions.
- Describe Basophils formation and functions.
- Describe Monocytes and macrophage formation and functions.
- Describe Reticuloendothelial components and functions.
- Describe lymphocytes formation and maturation.
- Describe the functions of the different types of lymphocytes.
- Recognise leucocytosis and leucopenia.
- Recognize type of leukaemia.



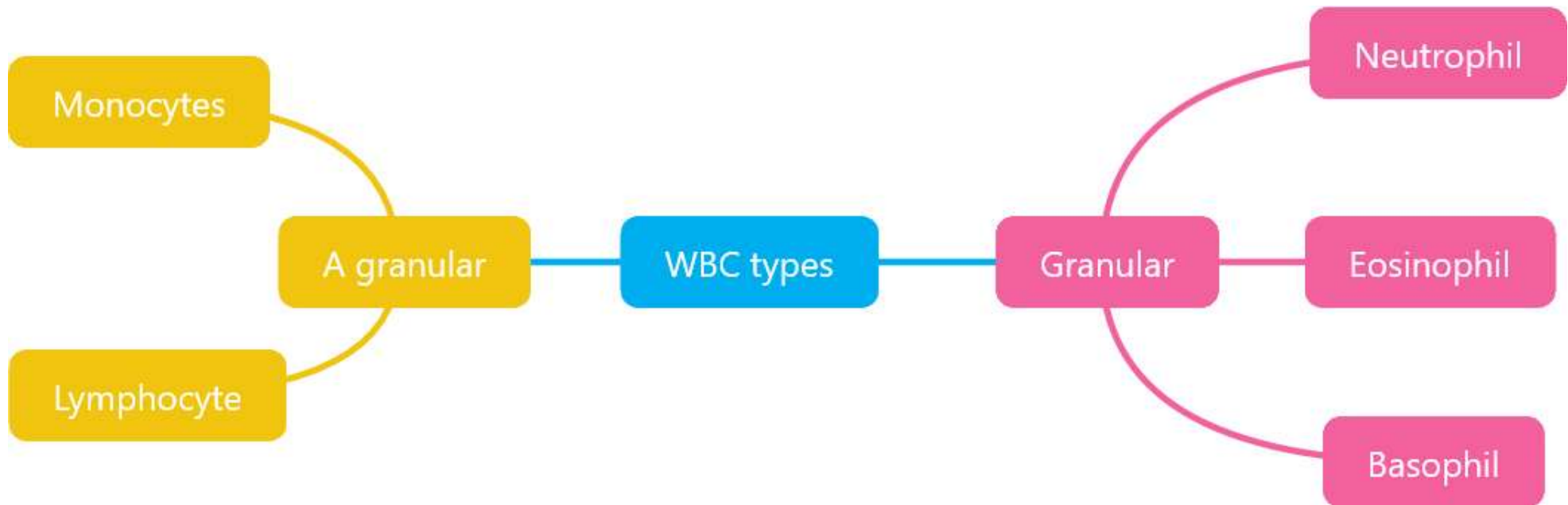
White blood cells

- Leucocytes (WBC) Formed in **bone marrow** & **lymph tissue**
- Protection against infection by:
Phagocytosis & **Secretion of antibodies.**
- The range of WBC in our bodies is = 4000 _ 11000 \ml



“Immunoglobulin”
Is another name for
Antibody

Types Of WBC




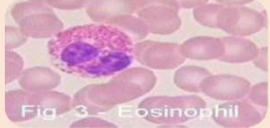
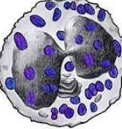
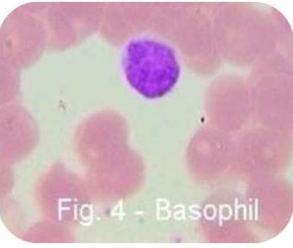


There is a lot of Granules in Basophil , so the Nucleus is hidden

A. Types Of WBC

Dr note: "I care about the percentage and colors "

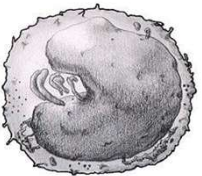
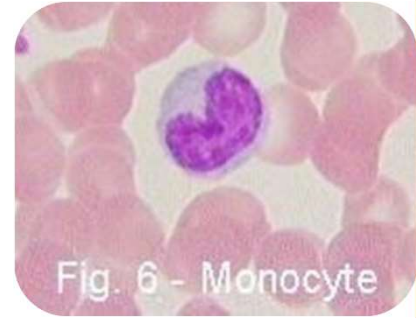

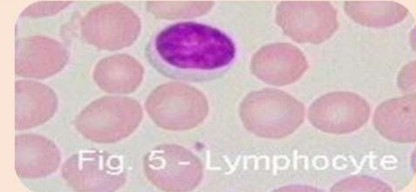
Granular "polymorphnuclear PMN"

Names	Nucleus Shape	Granules Color	Percentage	Size	Pictures
Neutrophil  <small>Fig. 8 - Neutrophil</small>	Lobulated Nucleus "many lobes"	Purple cytoplasmic	62%	10-16 um	 <small>Fig. 2 - Neutrophil</small>
Eosinophil  <small>Fig. 9 - Eosinophil</small>	2 lobe nucleus	Coarse red	2.3%	12-18 um	 <small>Fig. 3 - Eosinophil</small>
Basophil  <small>fig. 10 - Basophil</small>	Rarely Segmented nucleus	nucleus hidden by large <u>round bluish</u> granules	0.4% <p>احياناً لما يسوون تيسون تيسون بالدم ما يلقونها طبيعي جداً كون النسبة مره صغيرة وقرية للصفير</p>	10-14 um	 <small>Fig. 4 - Basophil</small>

Monocyte is the largest WBC
 Lymphocyte has a large nucleus

B. Types Of WBC

A Granular (absent of granules)

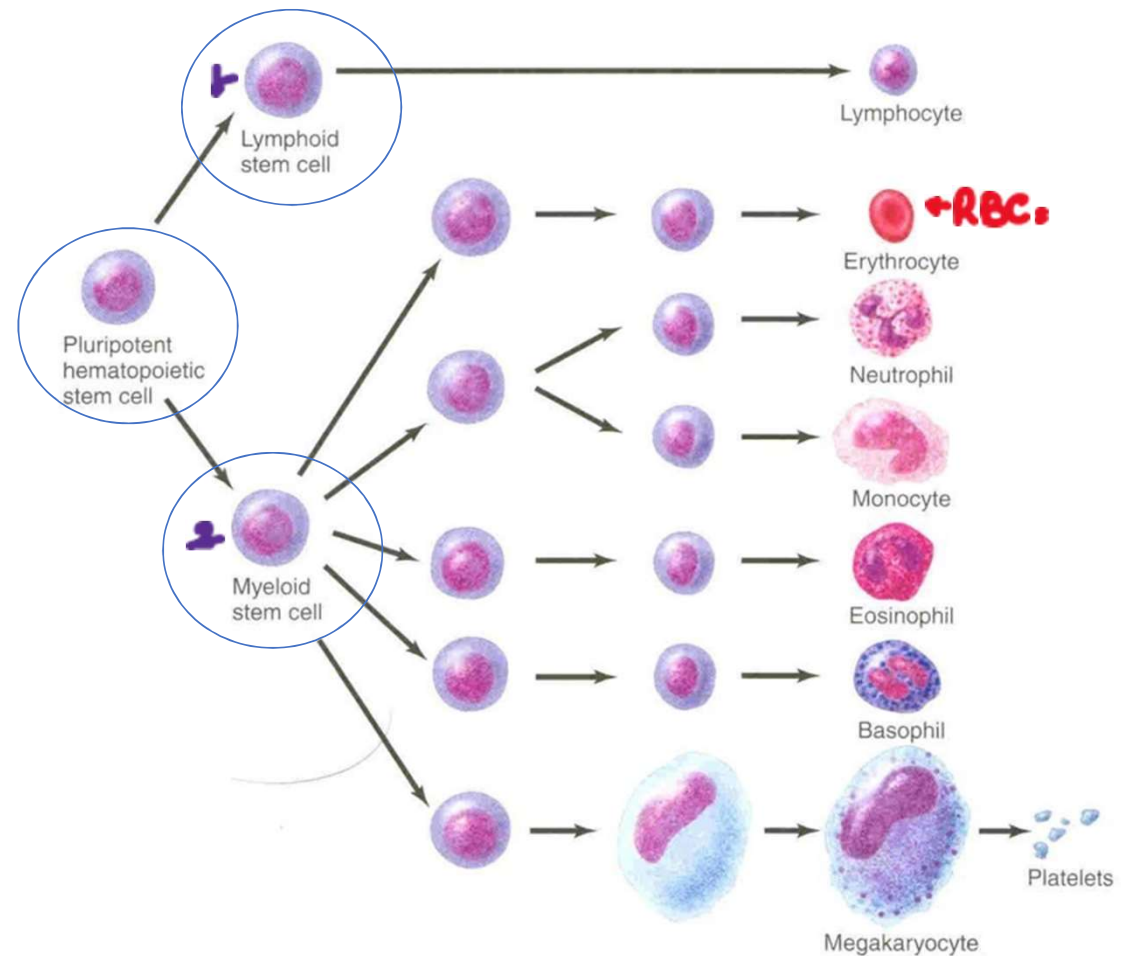
Name	Nucleus Shape	Percentage	Size	Pictures
Monocyte  <p>Fig. 12 - Monocyte</p>	Kidney Shape	5.3%	15-20um	 <p>Fig. 6 - Monocyte</p>
Lymphocyte  <p>Fig. 11 - Lymphocyte</p>	Round nucleus	30%	– small (5-8um) – – large (9-15um)	 <p>Fig. 5 - Lymphocyte</p>

Genesis “produce” of WBC

Two major lineage of WBC are formed:

1-Lymphocytic: **lymphocytes**

2- Myelocytic: **granular & monocytes**



Life span

Granulocytes= 4-5 days in tissues, During infection life span only few hours because they die after ingesting bacteria.

Monocytes = 10-20-hours then they leave blood to tissues transform into macrophage, its life span goes up to months.

Lymphocytes = weeks to months according to its type.

Sites of formation

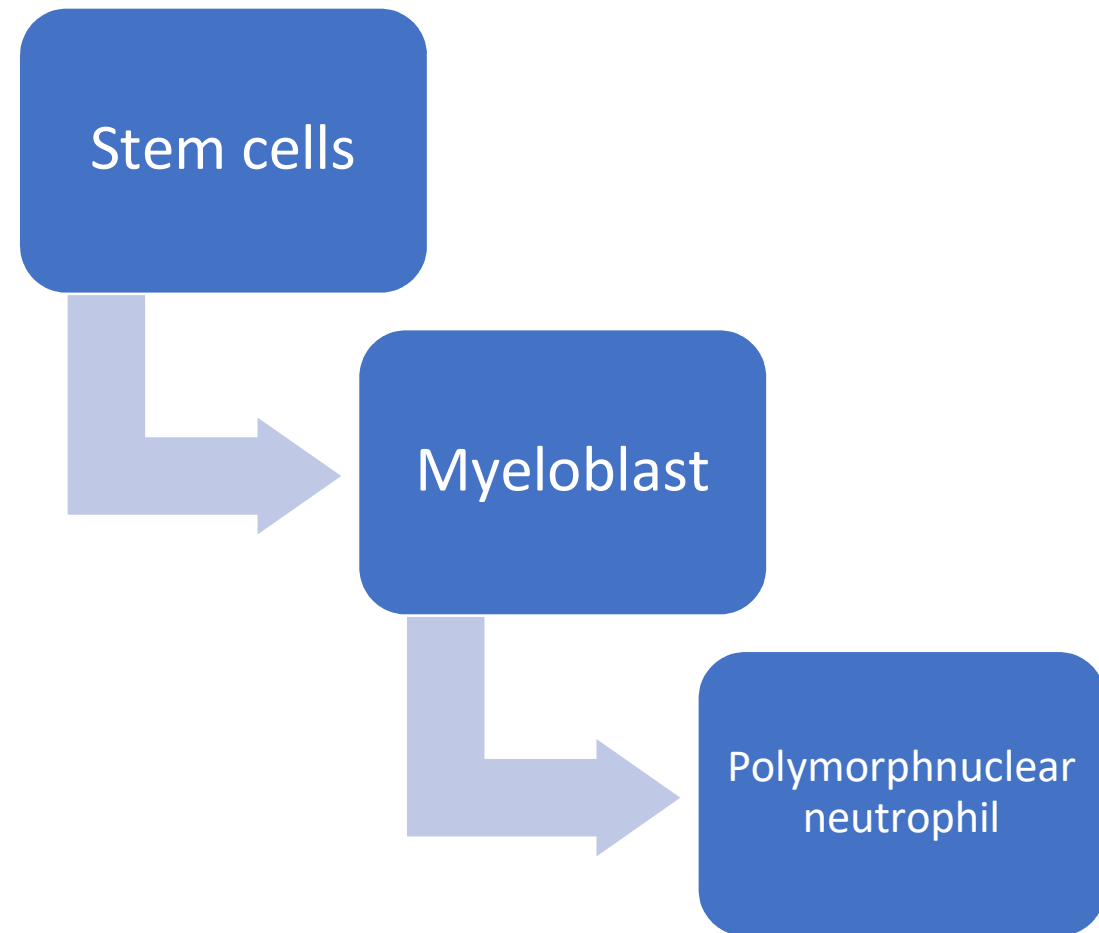
All of them (Granulocytes , Monocytes , Lymphocytes) are formed in **bone marrow** ,**BUT** Lymphocyte formed also in **thymus gland** & **lymphoid tissues**.

Neutrophil

Dr note: " اهم خطوة تعرفونها هي اول وثاني واخر خطوة الباقي غير مهم

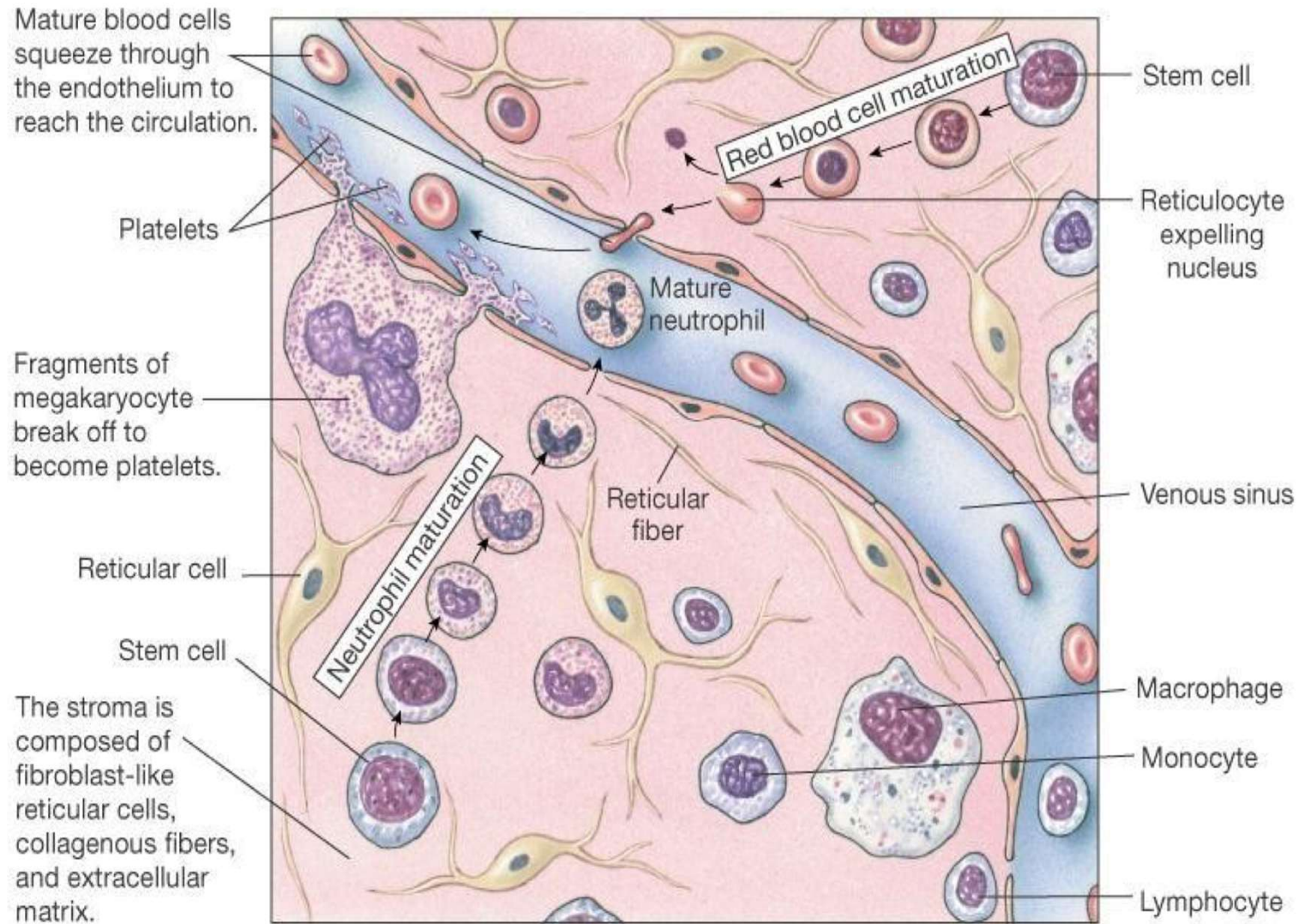
Maturation

Formation:
Neutrophil is formed in
bone marrow



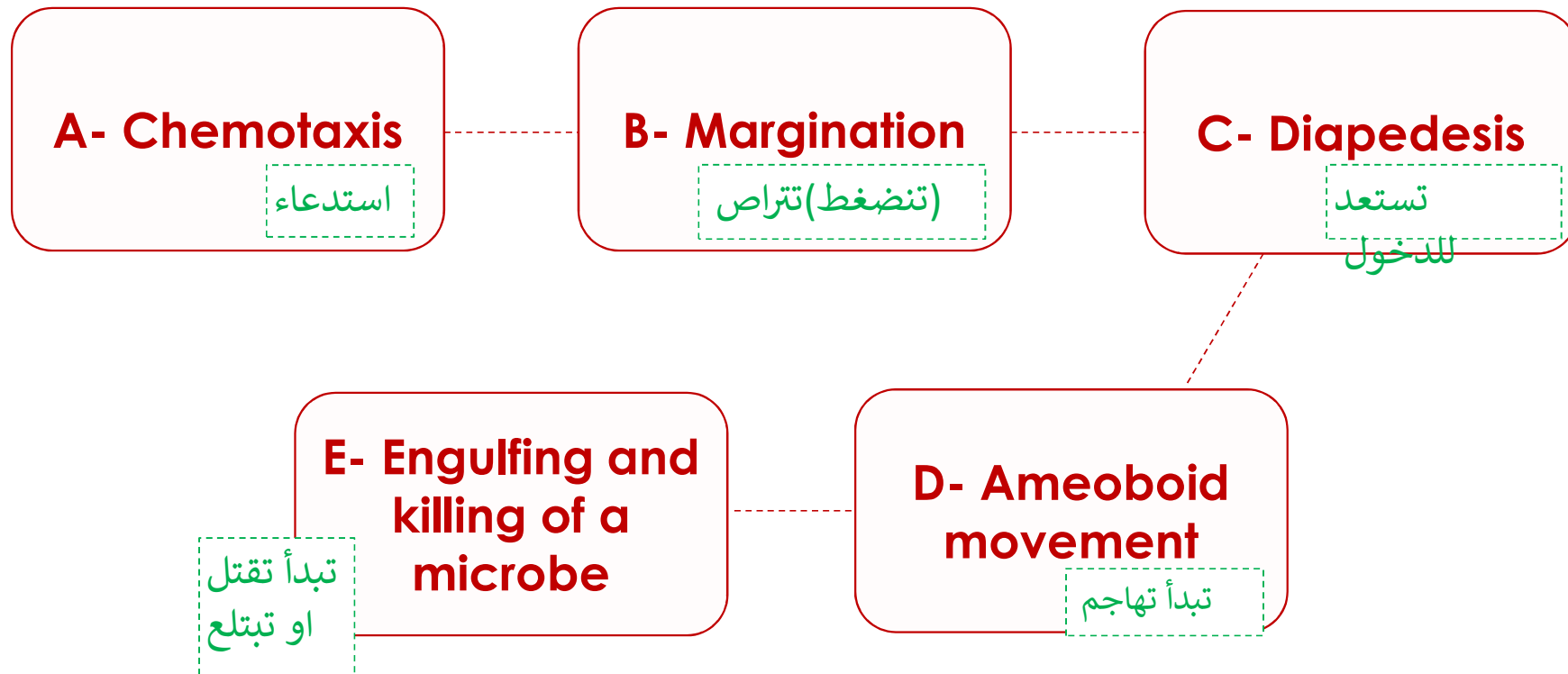
You will find the explanation of this picture in our Twitter Page

هذا البون مارو
(c) Bone marrow consists of blood cells in different stages of development and supporting tissue known as the **stroma** (mattress).



Neutrophil Function

Defense against infection: Neutrophil has the ability of **engulfing** bacteria or organism by a process of **phagocytosis**.
Steps of Phagocytosis:



Chemotaxis & Margination & Diapedesis

Definition of chemotaxis: The attraction of the neutrophils to inflamed area following chemotactic substances release from infected site.

Chemotactic substances:

- Bacterial toxin
- Degenerative products of inflamed tissue
- Complement system
- Reaction product of plasma clotting

Definition of margination: WBC marginate along the wall of blood capillaries.

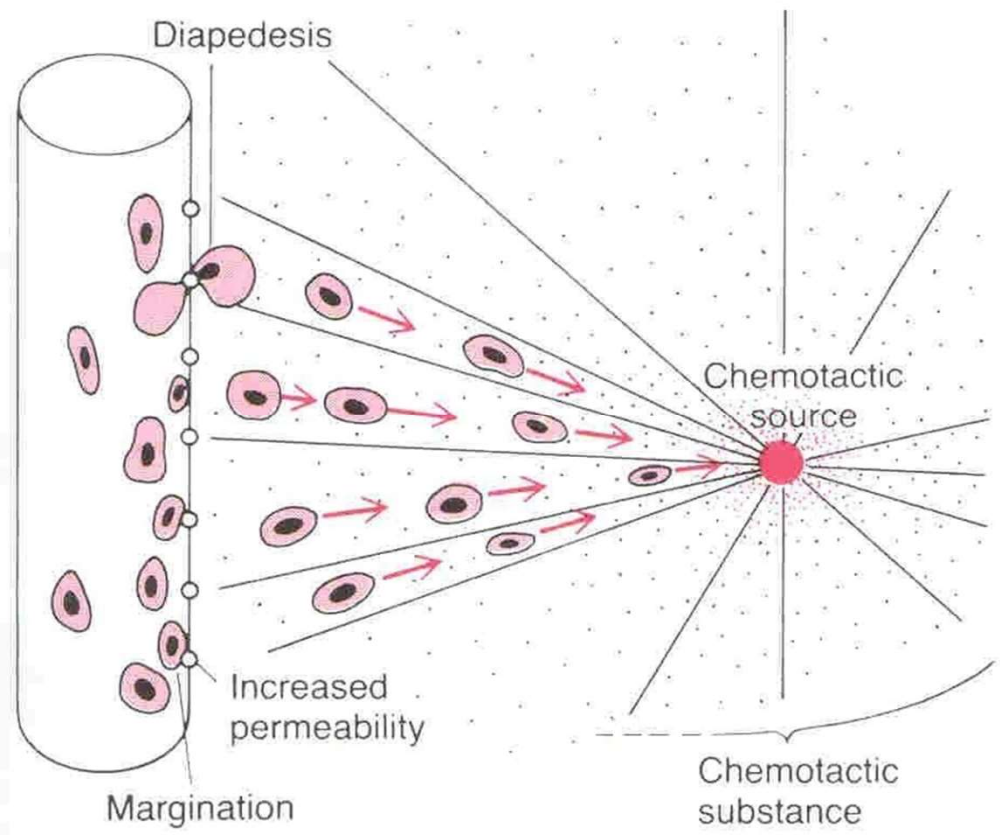
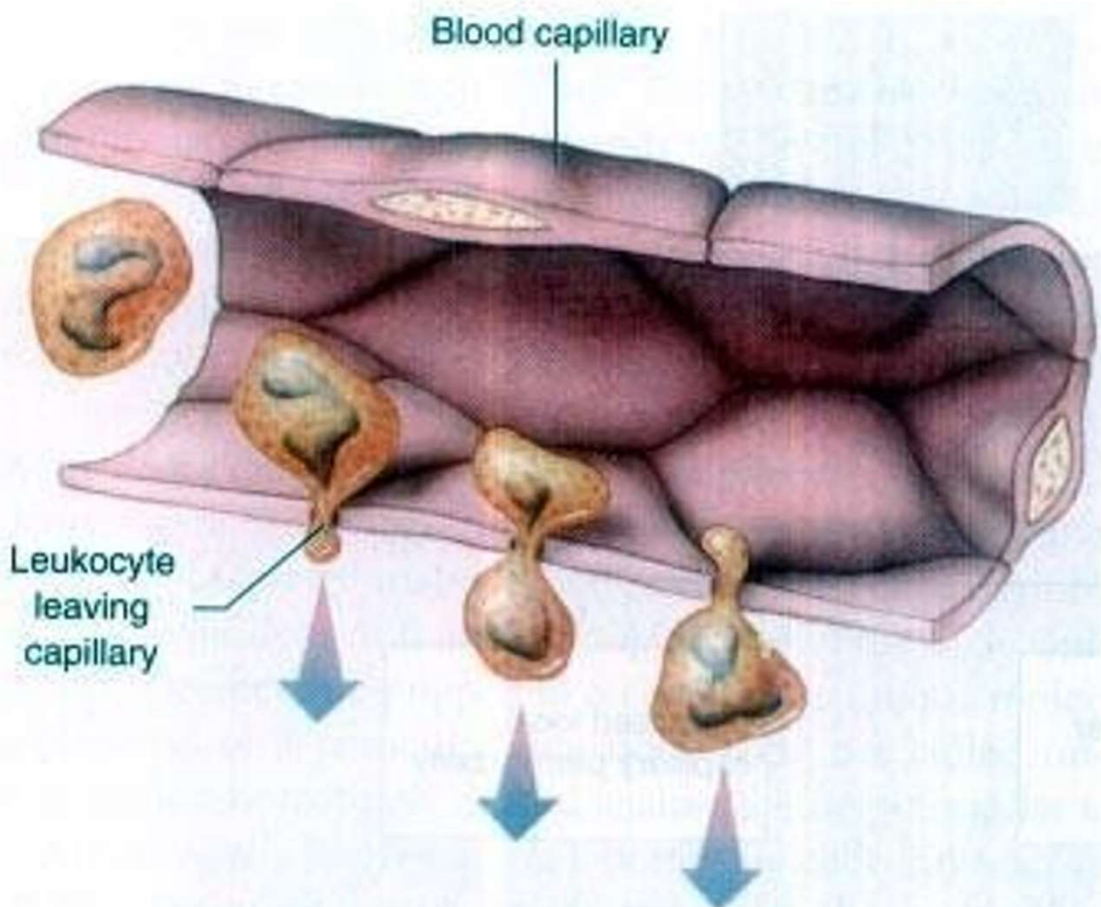
Definition of diapedesis: WBC squeezes itself through **endothelial holes** leaving blood Capillaries.

Upon reaching the site of infection neutrophils start to engulf infecting organism.

WBC move by **amoeboid motion** towards inflammation area following chemotactic substance released from site of infection



pictures of Chemotaxis & Margination & Diapedesis

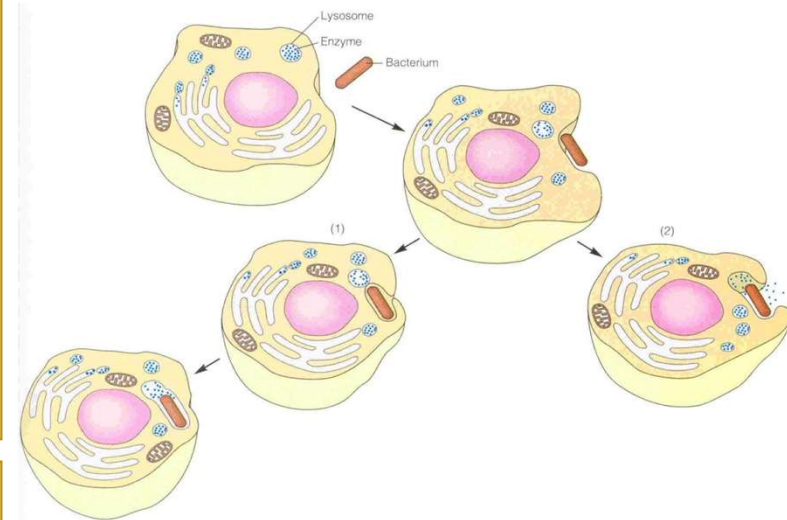


Phagocytosis

It's Selective process foreign substance recognize by:

- Rough surface
- No protective protein coat, which prevents phagocytosis
- Marked by certain substance e.g Complement 3 or antibodies making them ready for killing a process known as opsonization.

Neutrophils encircled the bacteria with pseudopodia and engulf it inside into a vacuole (phagosome), takes 3-20 bacteria



Microbial killing

Dr note: "read it"

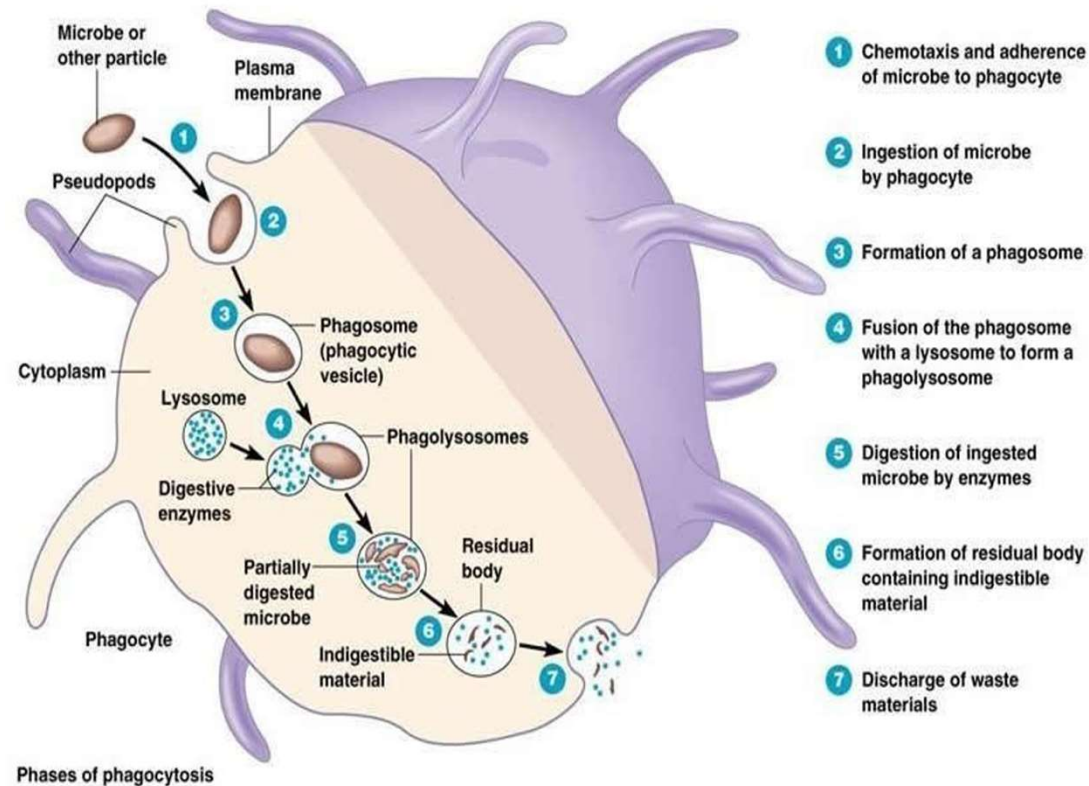
Definition: Digestion of organism inside the phagosome.

Mechanism:

Fusion of intracellular lysosomes with phagosome vacuole

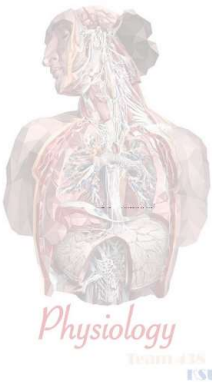
Lysosomes discharge its proteolytic enzymes such as myeloperoxidase, catalase into the vacuole, killing and digesting the engulfed bacteria.

Release of bactericidal such as superoxide, hydrogen peroxide to kill the bacteria



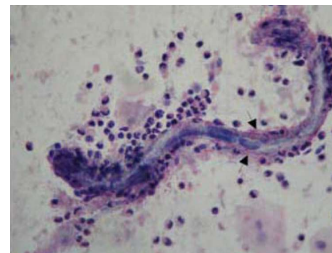
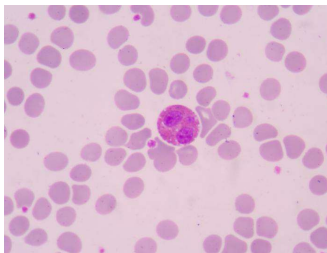
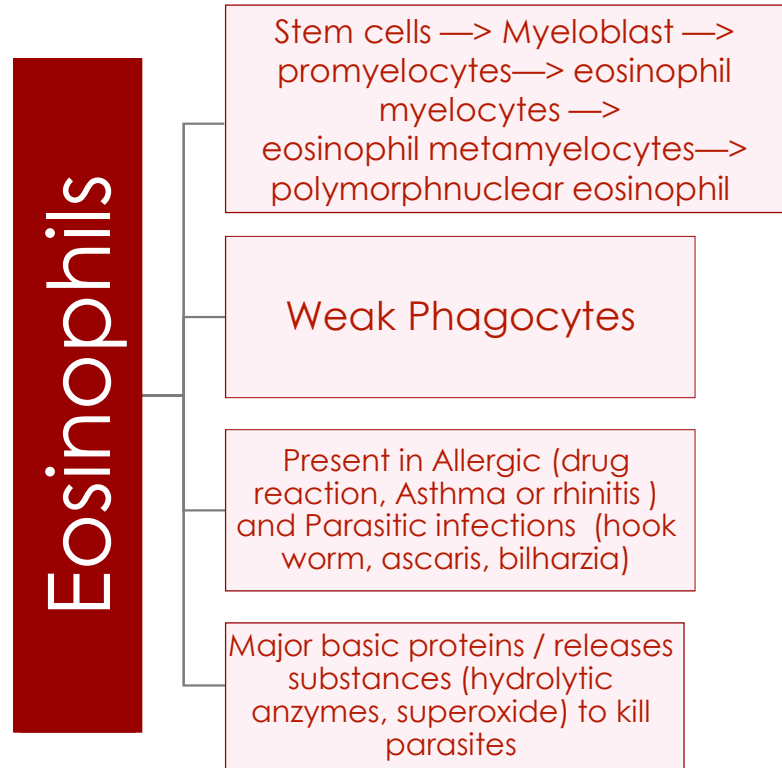
Part two Lecture content:

- Eosinophils and Basophilophils formation, maturation and function.
- Monocytes and macrophage formation, maturation and function.
- Reticuloendothelial system component and function.
- Lymphocytes formation, maturation and Function.
- Leucocytosis, leucopenia and leukemia.

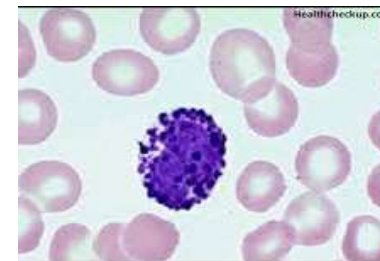
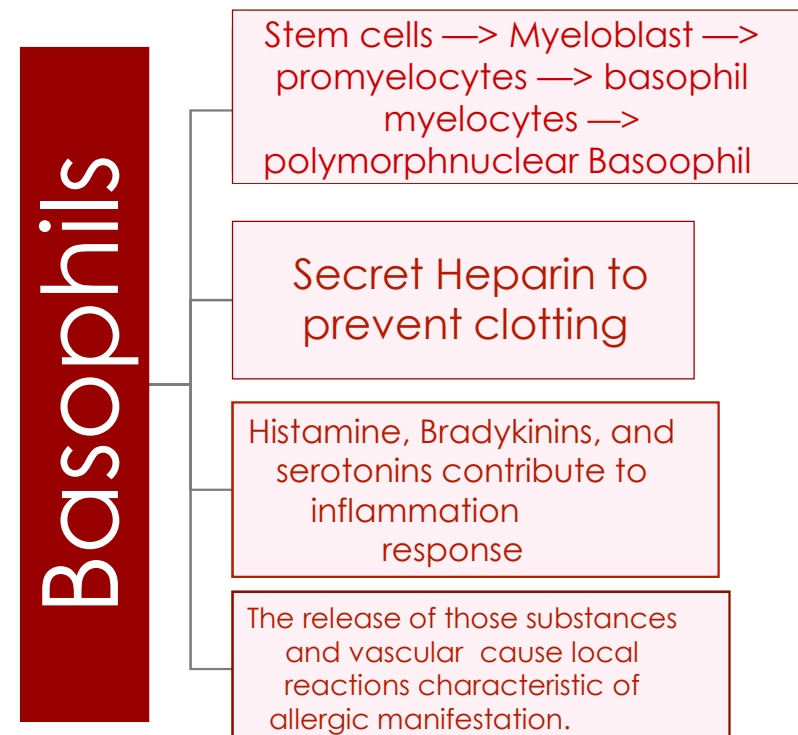


Granular WBCs

Only 1st, 2nd, and last steps are needed



Only 1st, 2nd, and last steps are needed



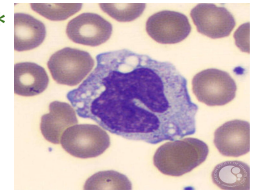
Similar to mast cell

mast cell: cell filled with basophil granules, found in connective tissue & releasing histamine & other substances during inflammatory & allergic reactions.

Monocytes and macrophages

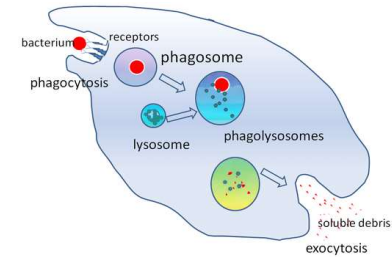
- **Formed in** : Bone Marrow, Stem cell → monoblast → promonocyte → mature monocytes released into blood.
- Life span:
 1. 10-20 hours in circulation.
 2. Then leave blood to tissues transforming into larger cells macrophage
 3. Up to a few months in tissues (Macrophages)

*تشبيه شكل الكليه

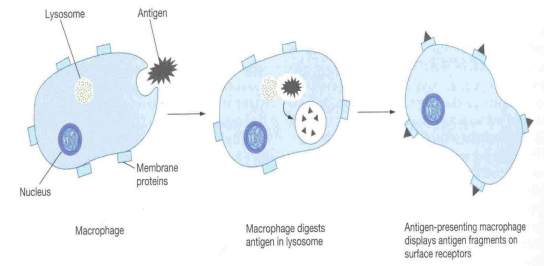


Functions

- Macrophages are a powerful phagocytic cells first line of defense.
 - Ingest up to 100 bacteria
 - Ingest larger particles as: old RBC
- Remove wastes (scavenger)
- anti-inflammatory
 - **Directly**: phagocytosis of bacteria, dead cells.
 - **Indirectly** cooperating with lymphocytes by recognizing foreign body (take in foreign body process it and present it to lymphocytes)



Anti-inflammatory :Direct.



Anti-inflammatory: Indirect.

Reticuloendothelial system

Consists of:

Monocytes

Macrophages

Endothelial cells

bone marrow, spleen, lymph node

Located in tissues →

- Skin (Histiocytes)
- Liver (Kupffer)
- Kidney (Mesangial)
- Bone marrow (Osteoclast)
- Lymph nodes
- Lung (Alveolar)
- Brain (Microglial)
- Spleen

Function:

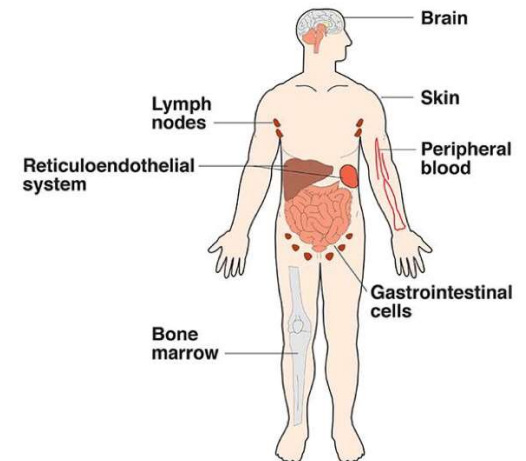
Phagocytosis

Bacterial, dead cells, foreign particles

Immune function: processing antigen & antibodies production (indirect)

Breakdown of Hb

Storage of Iron



Lymphocytes

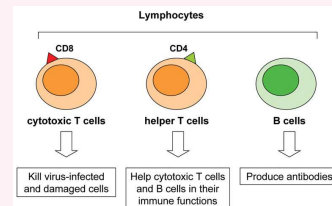
Stem cell (bone marrow) → ... → lymphocytes.

T-Lymphocytes (Thymus dependent) (**important**)
Formed in bone marrow, migrate to thymus for maturation.

Life spans 100-300 days. **تقريبًا تكمل سنة**
Circulate between blood, tissues, lymph.

Types of T-lymphocytes

1. T-cytotoxic (Tc) or killer cell (Tk).
2. T-helper (Th)
3. Memory T cells sub types.
4. Suppressor T cells sub types.

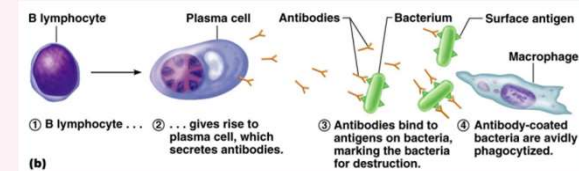


Functions:

- **Cellular immunity** (graft rejection - delayed hypersensitivity.) **مثل عند زراعة الأعضاء، ترفض العضو لذلك تؤخذ ادويه خفض المناعه***
- Role in antibody secretion.

B- Lymphocytes (thymus-independents)

Formed in: Bone marrow, germinal layer of lymph node, red pulp of spleen.



Life span 2-7 days.

Stimulated by antigen.

It transforms into large plasma cell (produce antibody).

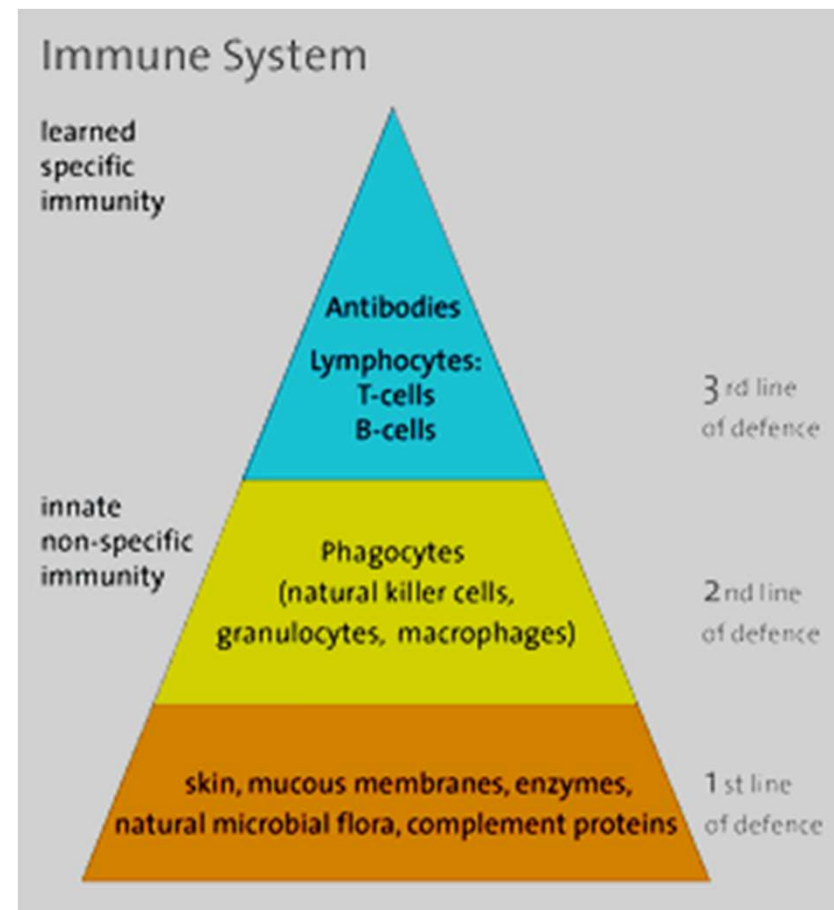
- **Function: Humoral immunity.**
- **Role in antibody secretion.**

Primary Lymphoid Organs:

(Bone marrow, Thymus)

*مش مهم بس اقروها

Secondary (or peripheral) Lymph organs: (Tonsils, Adenoids, Spleen, Lymphatic vessels, Peyer's patches, Lymph nodes, Appendix)



Types of Immunity :

1- Innate (non-specific; natural immunity) :

- 2nd line of defense
- Is present at birth
- Persists throughout life
- Quick
- Attacks all antigens fairly equally

2- Adaptive (specific; acquired immunity) :

- 3rd line of defense.
- Antigen specific.
- Responds with proliferation of cells and generation of antibodies.
- Slow (After 4 days of exposure to antigen)
- Memory (subsequent reactions are faster and more effective)

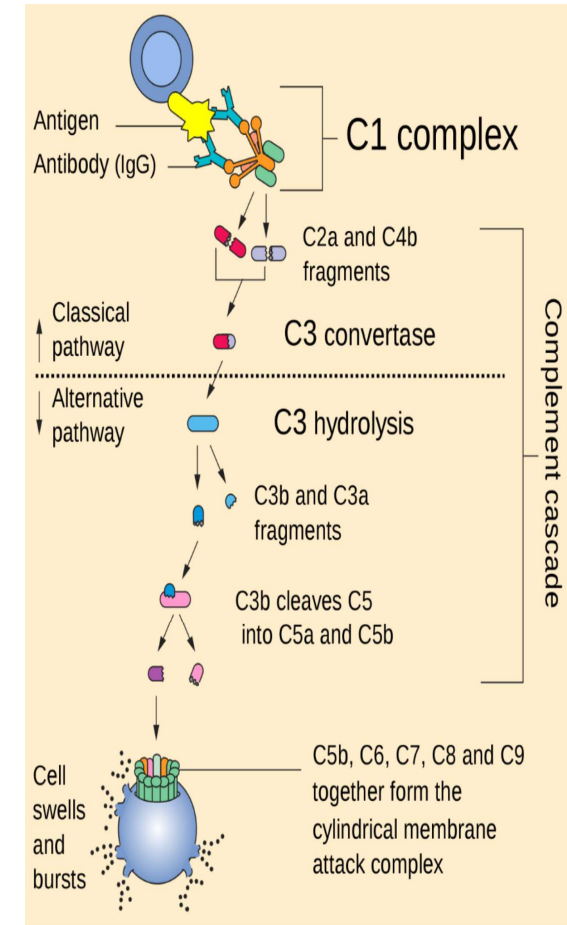
The Complement System is Part of the 1st Line of Defense

Complement system:

- Group of polypeptides, synthesized in the liver
- 1st line of defense, meeting invaders such as bacteria
- These proteins flow freely in the blood
- Quickly reach the site of invasion where they can react directly with antigens

Functions of activated Complement Proteins:

- Trigger inflammation
- Attract Phagocytes
- Opsonization (Enhancing phagocytosis)
- Membrane Attack Complex (MAC)



Leucocytosis

* **Increased** number of WBC

Physiological *

- Minimum in **early morning** and maximum in the **afternoon**.
- After physical exercise
- Stress or Adrenaline injection

Pathological *

- Bacterial infection (tonsillitis, Appendicitis)
- Worm infection.
- Allergic reactions.

Leucopenia

* **Deficiency** of the white blood cells.

Causes :

- Malnutrition.
- Drugs
- Radiation
- Typhoid fever. **Salmonella*
- Decrease in B12 and folic acid.

EXTRA INFO: **Salmonella*: infection (*salmonellosis*) is a common bacterial disease that affects the intestinal tract.

Leukaemia

* **Malignant** disease of bone marrow
WBC up to $500,000/mm^3$

Types of leukemia:

- Myeloblast leukemia (Myeloid progenitor increase)
- Lymphoblast leukemia (Lymphoid progenitor increase)
- Acute or chronic onset.
- Accompanied with anemia, bleeding

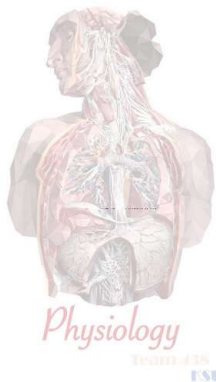
Causes:

- Chromosomal abnormality
- Chemicals
- Radiation
- Viruses

Quiz (for part one)

1) type of WBC has 2 lobe nucleus			
A) Neutrophil	B) Eosinophil	C) basophil	D) lymphocytes
2) lymphocytes are formed in			
A) bone marrow	B) lymphoid tissue	C) both a&b	D) nether a or b
3) WBC that transforms into macrophage after leaving the blood to tissues			
A) Neutrophil	B) Eosinophil	C) basophil	D) monocytes
4) the attraction of neutrophils to inflamed area			
A) chemotaxis	B) margination	C) diapedesis	D) ameoboid movement

key answers:
1) B
2) C
3) D
4) A



Quiz (for part two)

Q1- Which of the following is a function of Eosinophils:

- | | | | |
|--------------------|----------------------|-----------------|-----------------------|
| A) Secrete Heparin | B) Secrete Histamine | C) Phagocytosis | D) Produce Antibodies |
|--------------------|----------------------|-----------------|-----------------------|

Q2- Which one is a characteristic of Basophils:

- | | | | |
|----------------------|-----------------------|----------------------|--------------|
| A) Weak Phagocytosis | B) Present in Allergy | C) Heparin Secretion | D) Agranular |
|----------------------|-----------------------|----------------------|--------------|

Q3- Which of the following is a Function Reticuloendothelial system:

- | | | | |
|-------------|--------------------|-------------|----------------------|
| A) Break Hb | B) Secrete Heparin | C) Granular | D) Secrete Histamine |
|-------------|--------------------|-------------|----------------------|

Q4- Which one is a primary lymph organ:

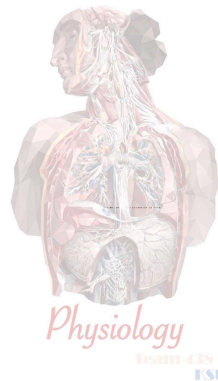
- | | | | |
|-----------|----------------|----------------|--------------------|
| A) Spleen | B) Lymph Nodes | C) Bone Marrow | D) Peyer's Patches |
|-----------|----------------|----------------|--------------------|

Q5- Complement system polypeptides are synthesized in:

- | | | | |
|-----------|---------|----------|----------------|
| A) Kidney | B) Skin | C) Liver | D) Bone Marrow |
|-----------|---------|----------|----------------|

Key answers:

1. C
2. C
3. A
4. C
5. C



Thank you

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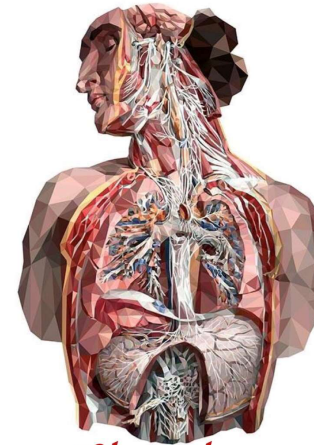
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Boys team members

Girls team members

- عمر الدوسري
- زياد الدوسري
- محمد الحمد
- فيصل القفاري
- عبدالله باسمح
- جهاد العريني

- اروى الامام
- ديما المزيد
- جود الخليفة
- جود العتيبي
- رغد المبارك
- ريناد المطوع
- ريما المطوع
- طرفة آل كلثم
- مي بابعير
- نجود العلي
- نورة المزروع



Physiology

Team 43S
KSU

Team leaders:

- عمر الشيناوي
- ايلاف المسيحل