غيـــداء آل مصـــمع
عبدالرحمن الحيسوني
Revised by

MED437
KING SAUD UNIVERSITY

PHYSIOLOGY

- Females & Males Slides
- Only Found in Males' slides
- Only Found in Females' slides
- Vary Important Notes
- Notes
- Extra Information

BLOOD PHYSIOLOGY

White Blood Cells (WBC)

محاضرتين مع بعض من البنات
و محاضرة الأولاد

Objectives

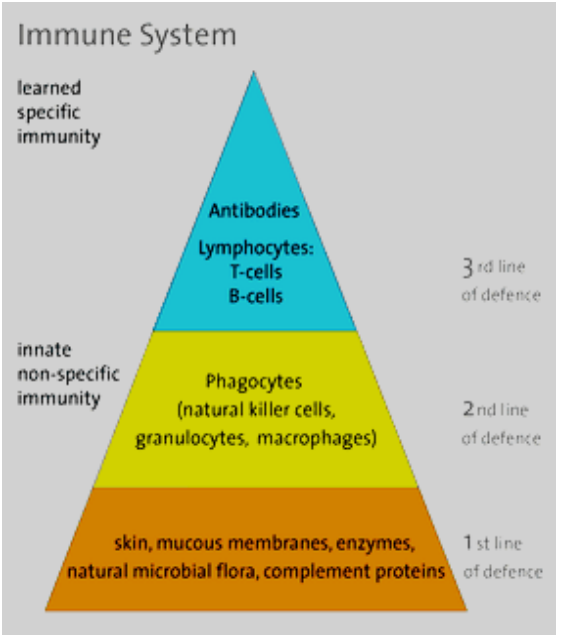
At the end of this lecture student should be able to:

1- Describe different Types of WBC
2- Recognize the general functions of WBC
3- Describe genesis and site of formation of WBC.
4- Describe stages of neutrophil formation
5- Describe the role of neutrophils in defending the body against infection
6- Describe the process of phagocytosis
7- Describe Esinophils formation and functions
8- Describe Basophils formation and functions
9- Describe Monocytes and macrophage formation and functions.
10- Describe Reticuloendothelial componants and functions
11- Describe lymphocytes formation and maturation
12- Describe the functions of the different types of lymphocytes.
13- Recognise leucocytosis and leucopenia.
14- Recognize type of leukaemia
15- Outline components of the immune system
16-Describe the structure of the different types of WBCs.
17-Outline differential WBCs count.
18-Describe the role of the WBCs in immune responses and defending against infection.

Immune System

- The immune system is a system of barriers, cells, tissues and organs that work to fight invaders.

- Another important component of the immune system is the complement system.



The major functions of the immune system are:

1. Differentiate self from non-self.
2. Eliminate foreign substances, cells and pathogens.

Organization of the immune system

- Cells
- Primary (or central) lymphoid organs
- Secondary (or peripheral) lymphoid organs
- Blood vasculature and lymph systems
  - connect the different organs

Major organs

Primary Lymphoid Organs

- Bone marrow
- Thymus

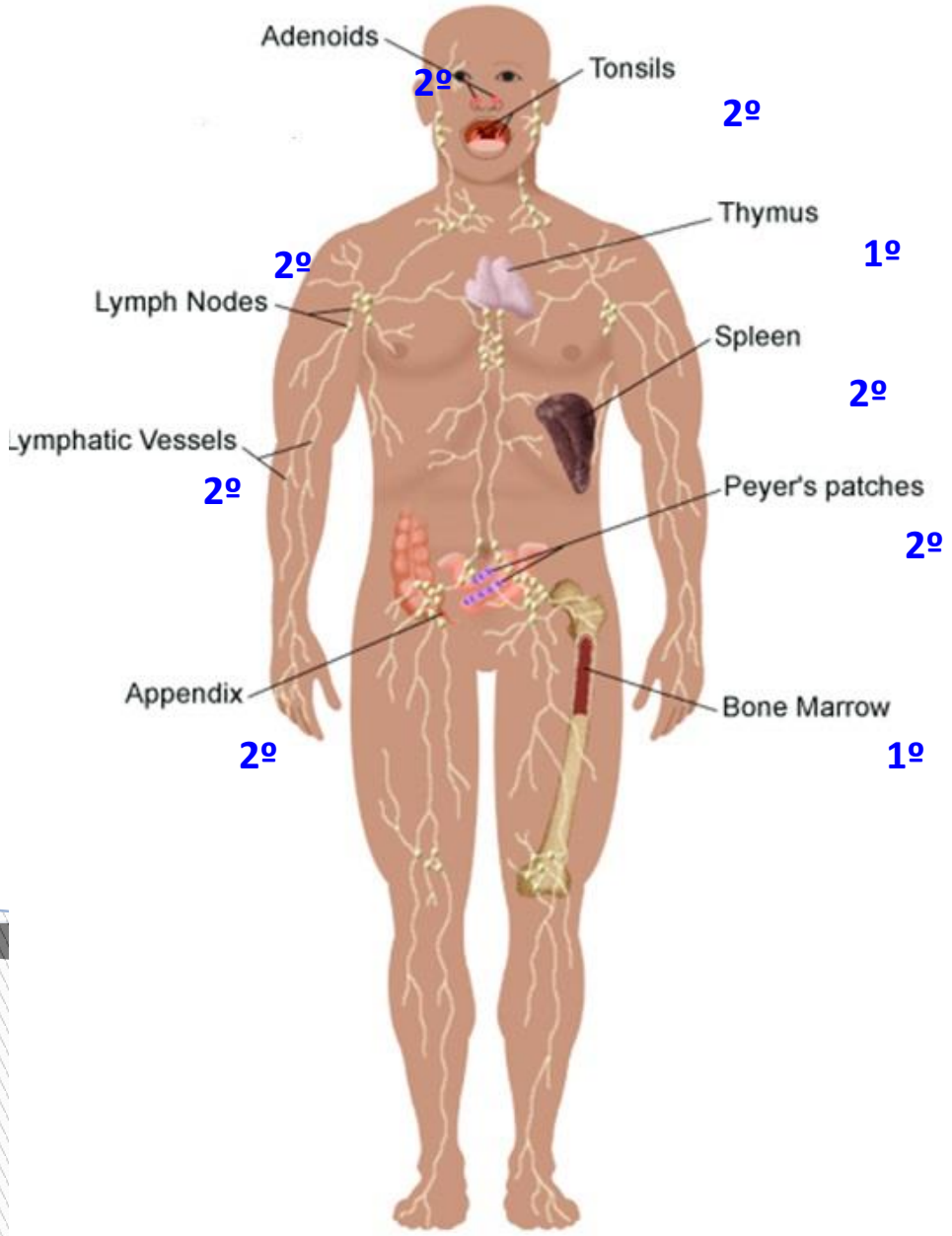
1. Immune cells mature to become *immunocompetent* in these organs.
2. Most cells mature to immune cells within the bone marrow and, after release, begin a life of patrol in the blood. The exception is the pre-T cell, which first undergoes maturation in the thymus before circulating in blood.

Secondary (or peripheral) Lymph organs

- tonsils
- adenoids
- spleen
- Lymph nodes
- Lymphatic vessels
- appendix
- peyer's patches

1. These are the organs where mature immune cells participate in specific immune defense reactions.

Major organs



Types of Immunity

Immune system

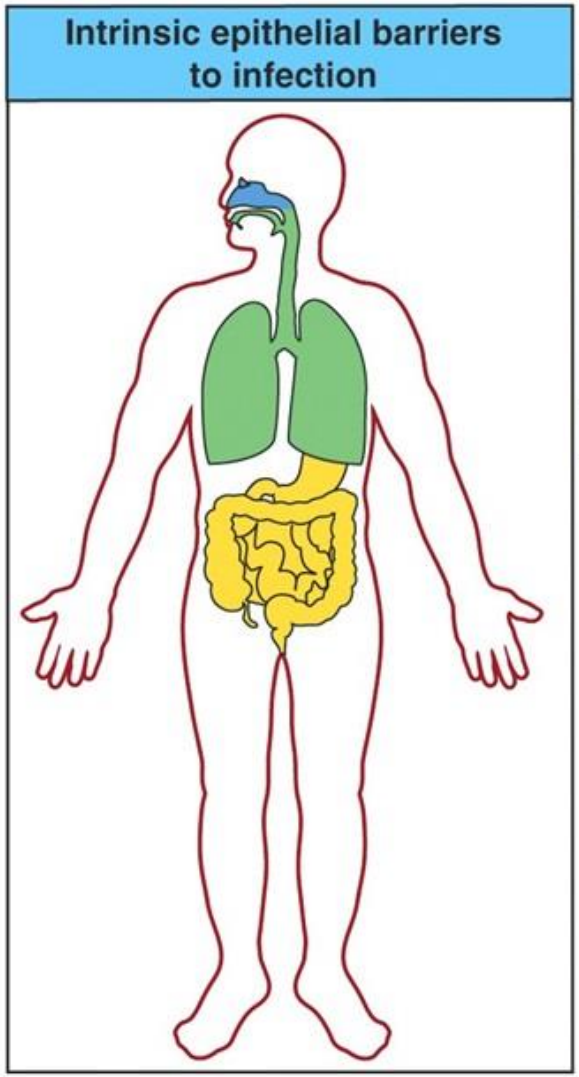
Innate (non-specific; natural) immunity

1. Second line of defense
2. Is present at birth
3. Persists throughout life
4. Can be mobilized rapidly and act quickly
5. Attacks all antigens fairly equally

Adaptive (specific; acquired) immunity

1. Third line of defense.
2. Antigen specificity. It is activated by thousands of diverse antigens.
3. Responds with the proliferation of cells and the generation of antibodies.
4. Responds slowly, being fully activated about 4 days after the immunologic threat.
5. Exhibits immunologic memory, so that repeated exposure to the same infectious agent results in improved resistance against it.

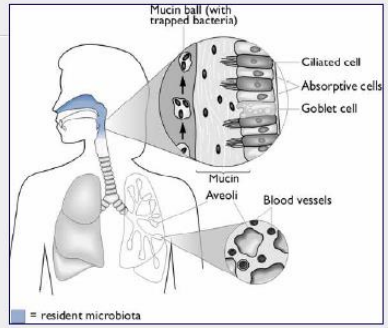
First line or defence – Epithelial Barriers

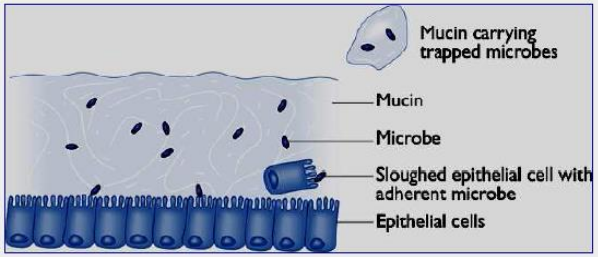


	Skin	Gut	Lungs	Eyes/nose
Mechanical	Epithelial cells joined by tight junctions			
	Longitudinal flow of air or fluid		Movement of mucus by cilia	
Chemical	Fatty acids	Low pH		Salivary enzymes (lysozyme)
		Enzymes (pepsin)		
	Antibacterial peptides			
Microbiological	Normal flora			

Barriers

- Physical barrier (esp. skin)
- Mechanical action (flushing, cilia)
- Trapping of microbes in mucus
- Rapid turnover of cells
- Chemical defenses (lysozyme, defensins, lactoferrin)





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

complement system:

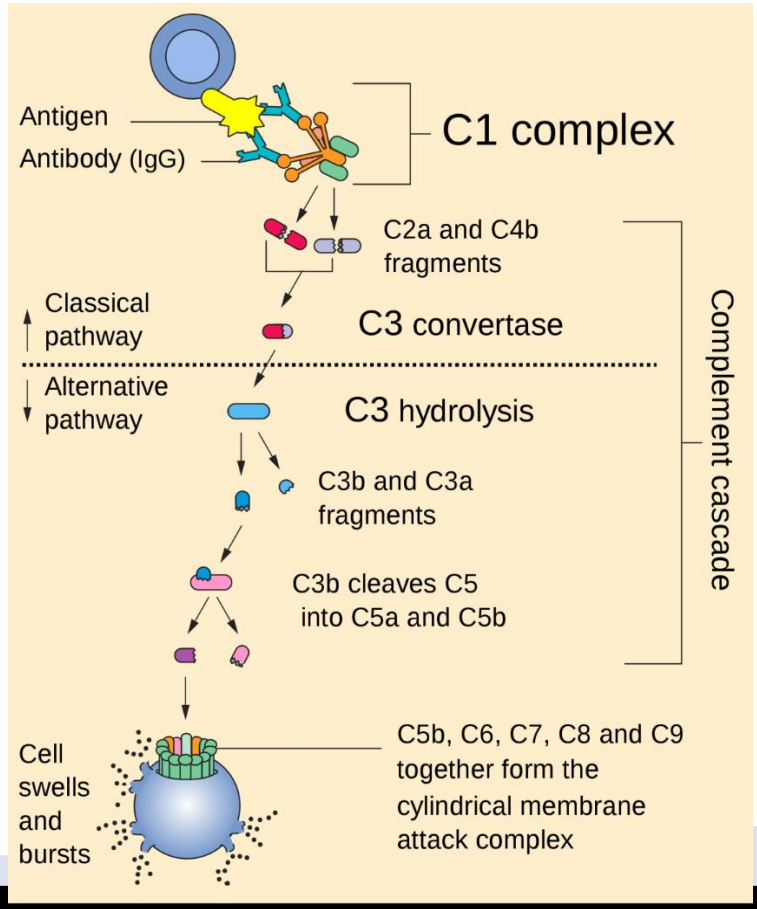
1- **The first part of the immune system that meets invaders such as bacteria**

2-it is a group of proteins.

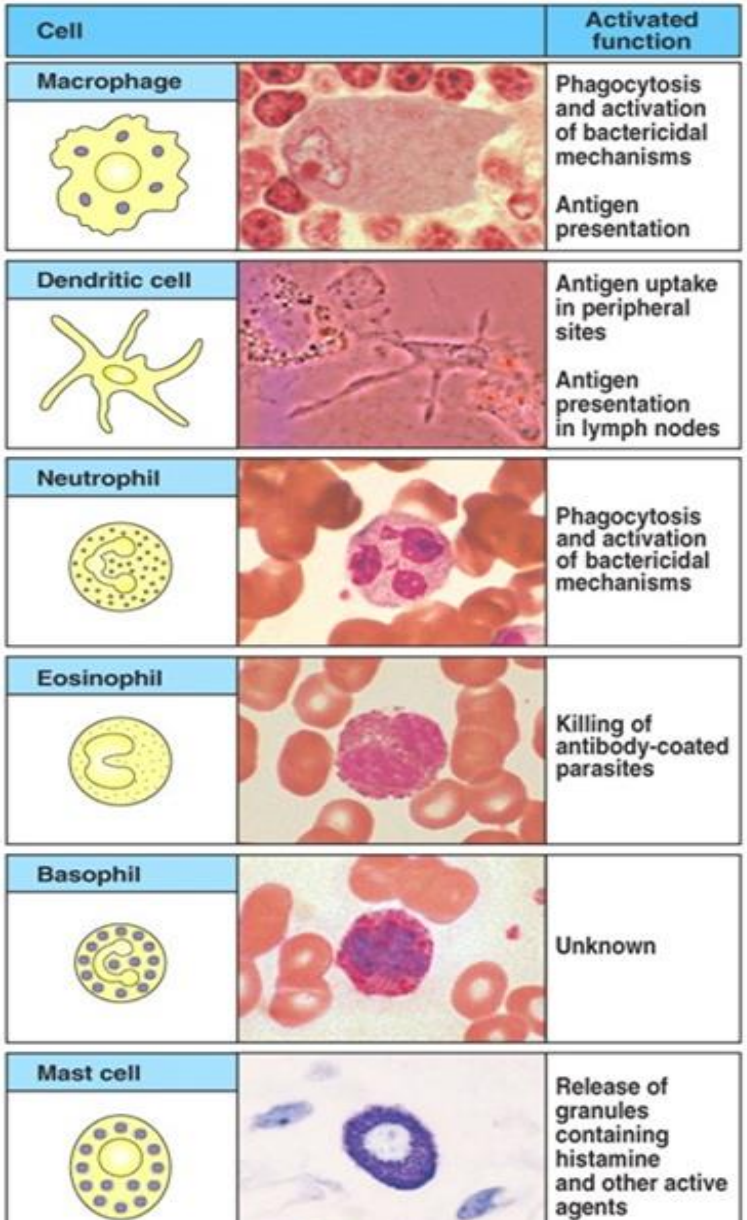
3- These proteins flow freely in the blood and can quickly reach the site of an invasion where they can react directly with *antigens (* molecules that the body recognizes as foreign substances).

functions of complement proteins (When activated):

1. **Trigger inflammation.**
2. **Attract eater cells such as macrophages to the area.**
3. **Coat intruders so that eater cells are more likely to devour (swallow and eat) them (a process called as opsonization).**
4. **Kill intruders.**

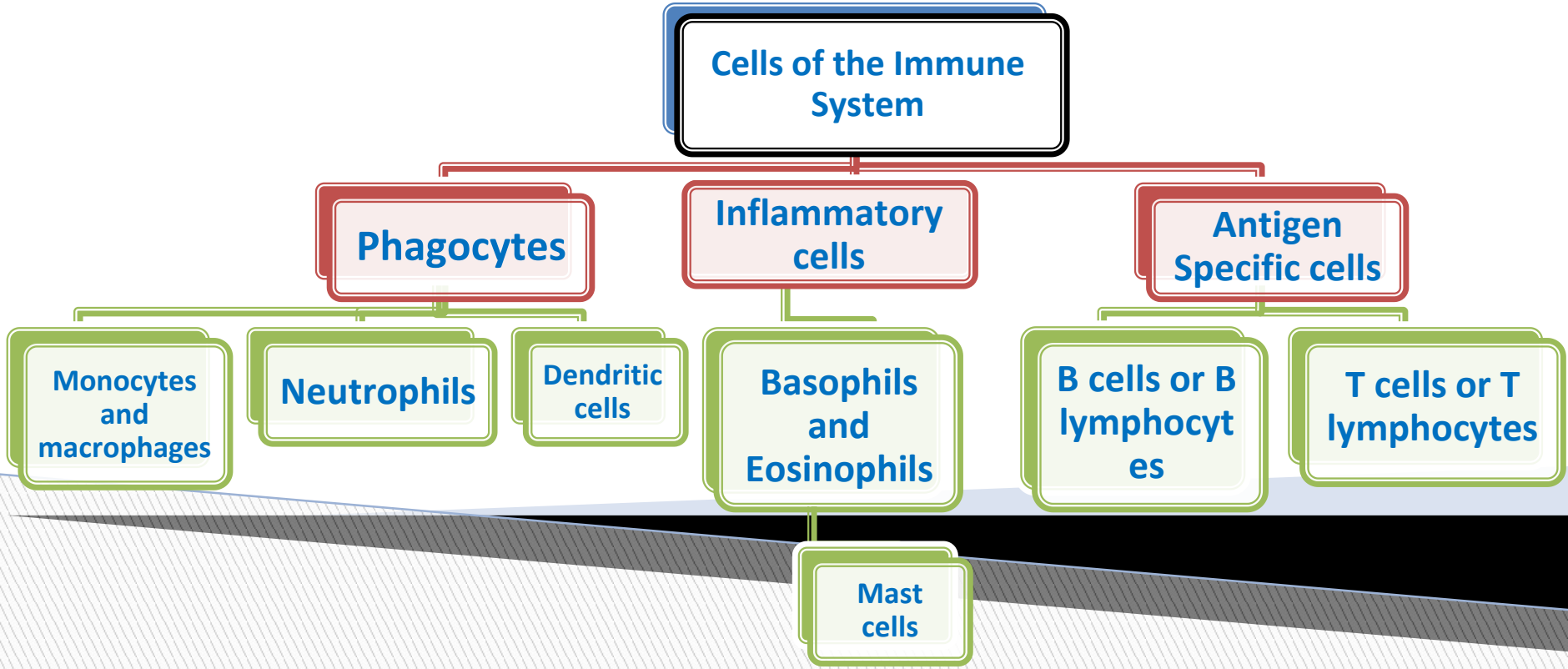


Cellular Elements of the Innate Immune System (2nd line of defense)

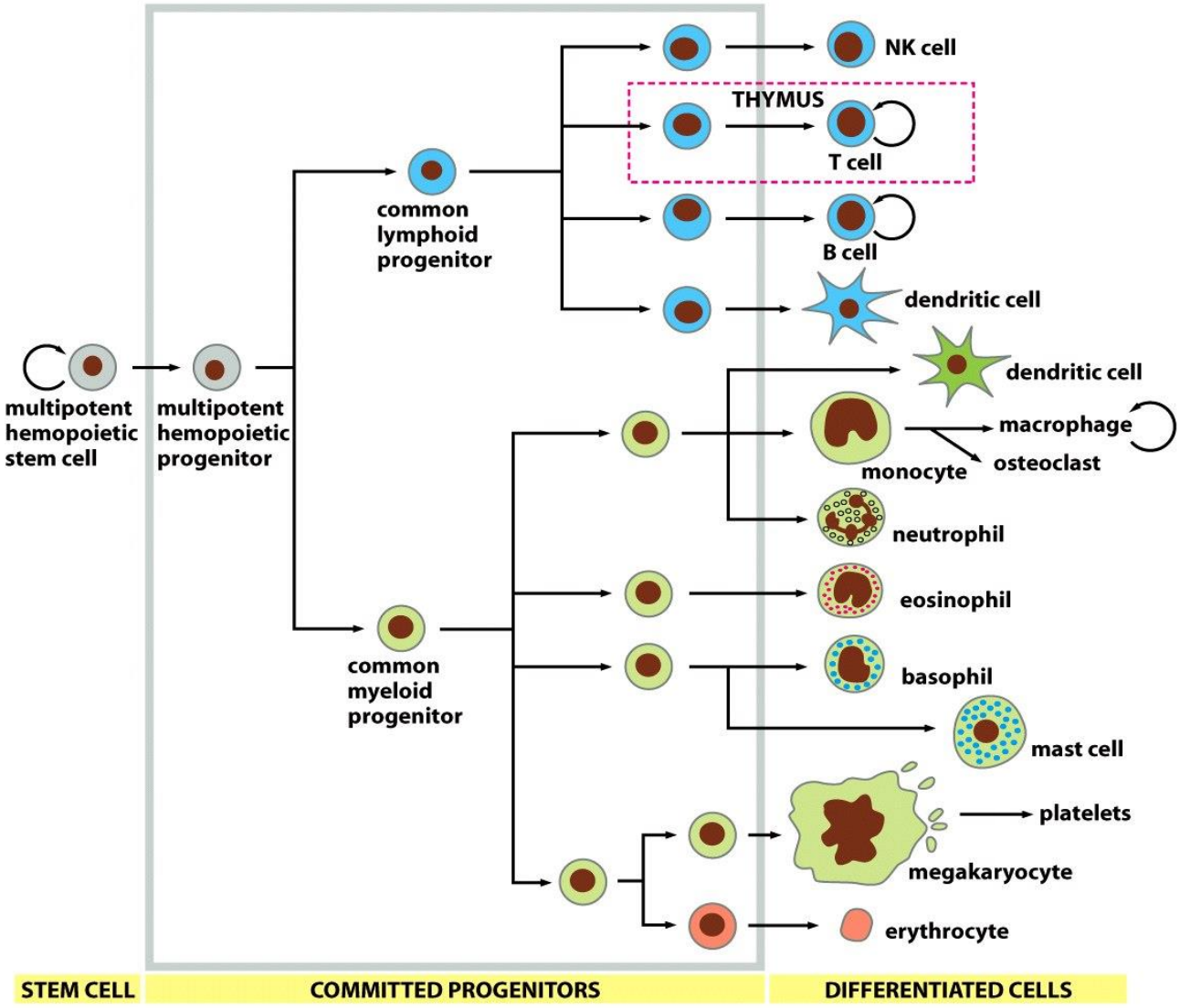


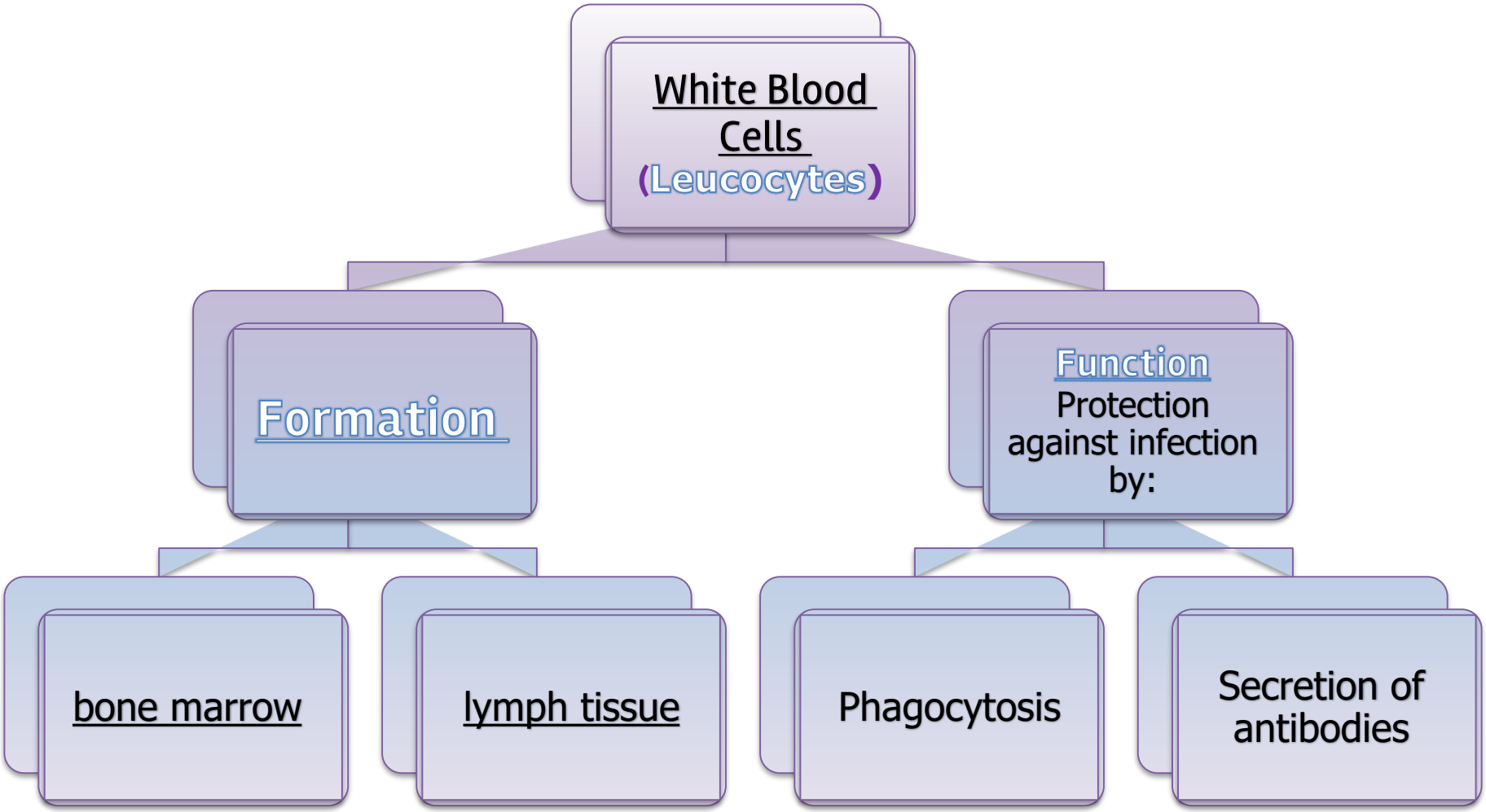
Cells of the Immune System

The cells of the immune system work together with different proteins to seek out and destroy anything foreign or dangerous that enters our body.



Cells of the Immune System



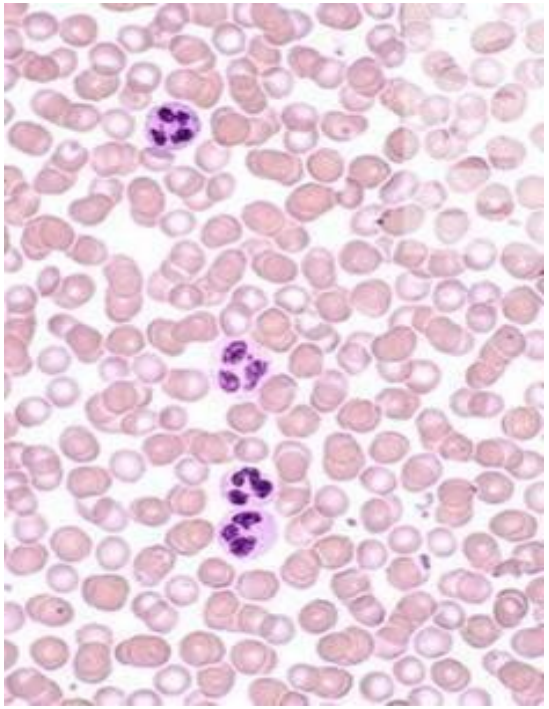

White Blood Cells
(Leucocytes)
Formation
bone marrow
lymph tissue
Function
Protection against infection by:
Phagocytosis
Secretion of antibodies

Remember

أقل

red blood cells
(5-6-million/ml)

white blood cells
4000-11000/ml



المخطط يختصرالسلايدات القادمة

Types of WBC

Granular
(polymorphnuclear PMN)
PMNs; because of multiple(lobes) nuclei

Neutrophil
- 62%
- lobulated nucleus
basic stain
2-5
- Purple
cytoplasmic granules

Eosinophil
- 2.3%
- 2 lobe nucleus
eosin stain
- coarse red granules

Basophil
- 0.4%
- rarely segmented nucleus
- nucleus hidden by large round
bluish granules
سميناها كذا على حسب اسم الصبغة

A granular
granules ما فيها

Monocytes
5.3%
kidney shape nucleus
(make macrophage system)

Lymphocyte
30%
round nucleus
Small large
1-T lymphocyte
2-B lymphocyte
3-Natural killer cells (NKCs)

Genesis of WBC:
Myelocytic
(granular+monocytes)

sites of formation:
bone marrow

Genesis of WBC:
Lymphocytic

sites of formation:
- Bone marrow
- Thymus
- Lymphoid tiss

مو مهم تحفظوا الحجم عشان كذا ما حطيتها ركزوا على النسب والأشكال والألوان (كلام د.نيرفانا)

الألوان لتسهيل الحفظ (ما له دخل سلايدات الأولاد والبنات)

Types of WBC

مو مهم تحفظوا الحجم عشان كذا ما حطيتها بالمخطط
ركزوا على النسب والأشكال والألوان
(كلام د.نيرفانا)

1- Granular (polymorphnuclear PMN):

Neutrophil	Eosinophil	Basophil
62%.	2.3%	0.4%.
10-16um	12-18um	10-14um
lobulated nucleus 2-5.	2 lobe nucleus.	rarely segmented nucleus.
Purple cytoplasmic granules	coarse red granules	nucleus hidden by large round *bluish* granules

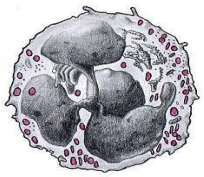


Fig. 8 - Neutrophil

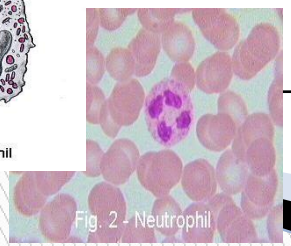


Fig. 2 - Neutrophil

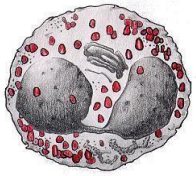


Fig. 9 - Eosinophil

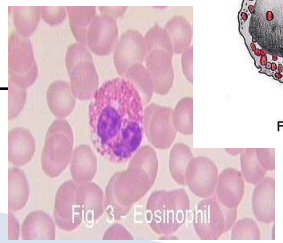


Fig. 3 - Eosinophil

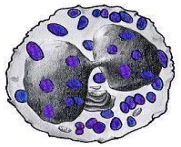


fig. 10 - Basophil

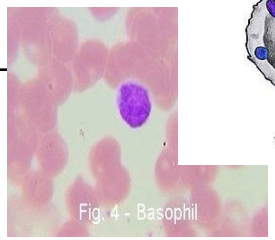


Fig. 4 - Basophil

مو مهم تحفظوا الحجم عشان كذا ما حطيتها
ركزوا على النسب والأشكال والألوان
(كلام د.نيرفانا)

Types of WBC cont.

2. **A granular**

Monocytes	Lymphocyte
5.3%	30%
15-20um	small (5-8um) large (9-15um)
kidney shape nucleus	round nucleus

Fig. 12 - Monocyte

Fig. 11 - Lymphocyte

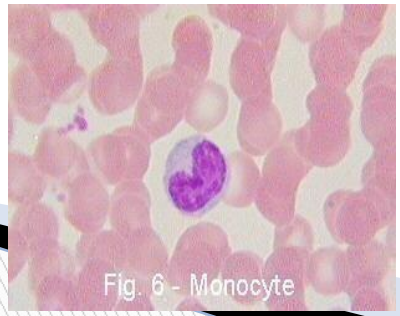


Fig. 6 - Monocyte

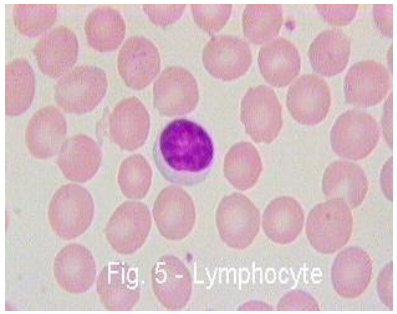


Fig. 5 - Lymphocyte

Physiological Variations in WBCs Count

Age:

Infants: about 20,000 /mm^3

Children:10,000 to 15,000/mm^3

Adults: 4,000 and 11,000/mm^3

Sex: males have more WBCs than females.

Diurnal variation: Minimum in early morning and maximum in the afternoon.

Exercise: Increases slightly.

Sleep: Decreases.

Emotional conditions like anxiety: Increases.

Pregnancy: Increases.

Menstruation: Increases.

Parturition: Increases.

Male Slide

WBCs Concentrations (Normal Counts) and Life Span

Percentage of Total WBCs	Approximate Normal Range (/µL)	Cells
	4000 - 11000	Total WBCs
60 –70% (62%)	3000 - 6000	Neutrophils
1 – 4% (2.3%)	150 - 300	Eosinophils
0.4% (0.4%)	0 - 100	Basophils
20 – 40% (30%)	1500 - 4000	Lymphocytes
2 – 8% (5.3%)	300 - 600	Monocytes (Macrophages)

الألوان ما لها دخل بسلايدات الأولاد والبنات ,د.نيرفنا ما ركزت على أعدادهم بالتفصيل

Life span of WBCs

Granulocytes Neutrophil, Eosinophil, Basophil	Monocytes	Lymphocytes
in tissues **4-5 days** During Infection: only few hours (they die after ingesting bacteria)	• In blood: **10-20** hours • Leave to the tissue: - transform into macrophage – stay up to **months**	• **weeks** to **months** according to its type • B > few weeks T > year (100-300day)

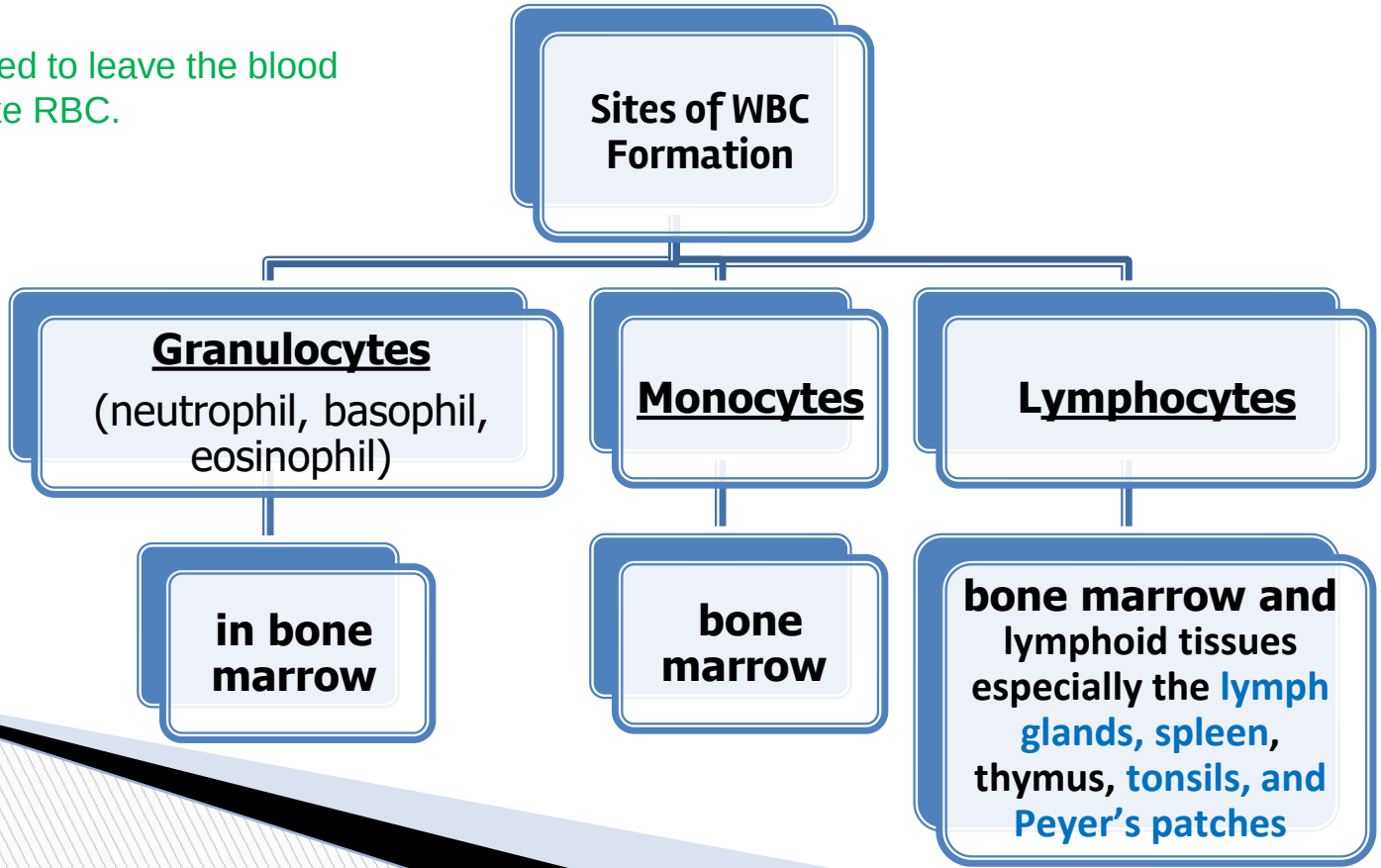
Genesis of WBC (Leucopoiesis)

Two major lineage of WBC are formed :

Myelocytic: **beginning with myelobast and giving rise to granular leucocytes and monocytes**

Lymphocytic: **beginning with lymphoblast and giving rise to lymphocytes**

the WBC need to leave the blood to work unlike RBC.



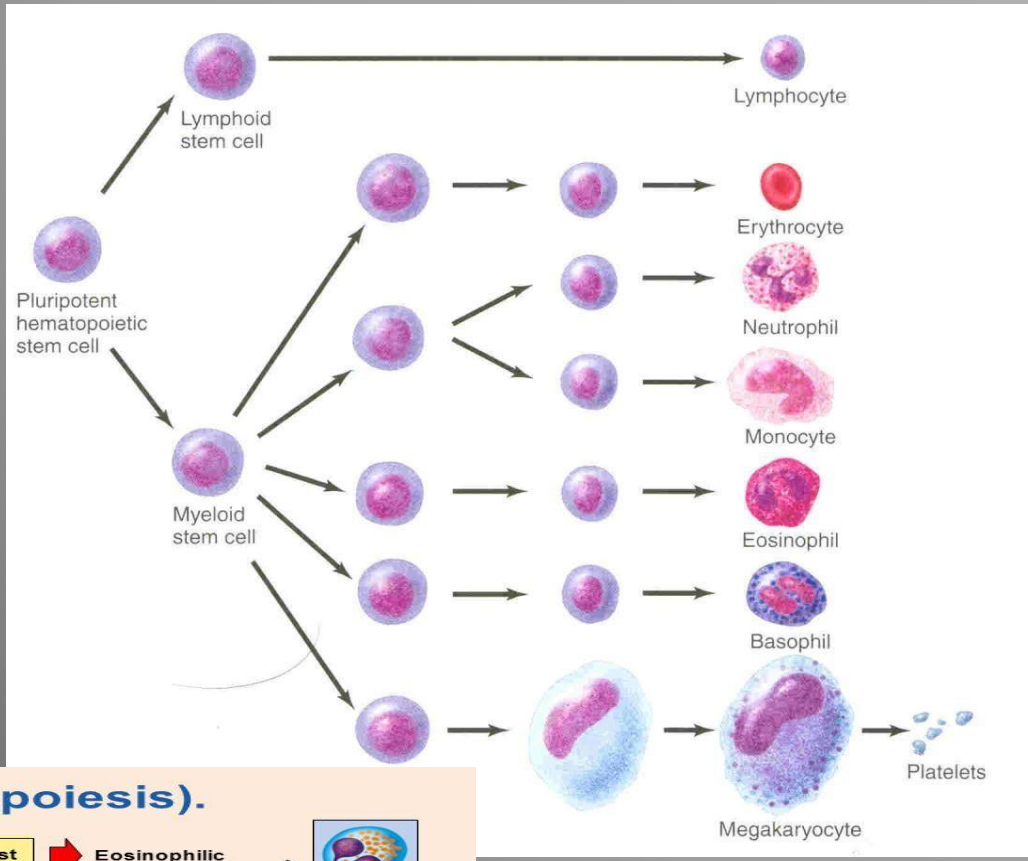
Genesis of WBC

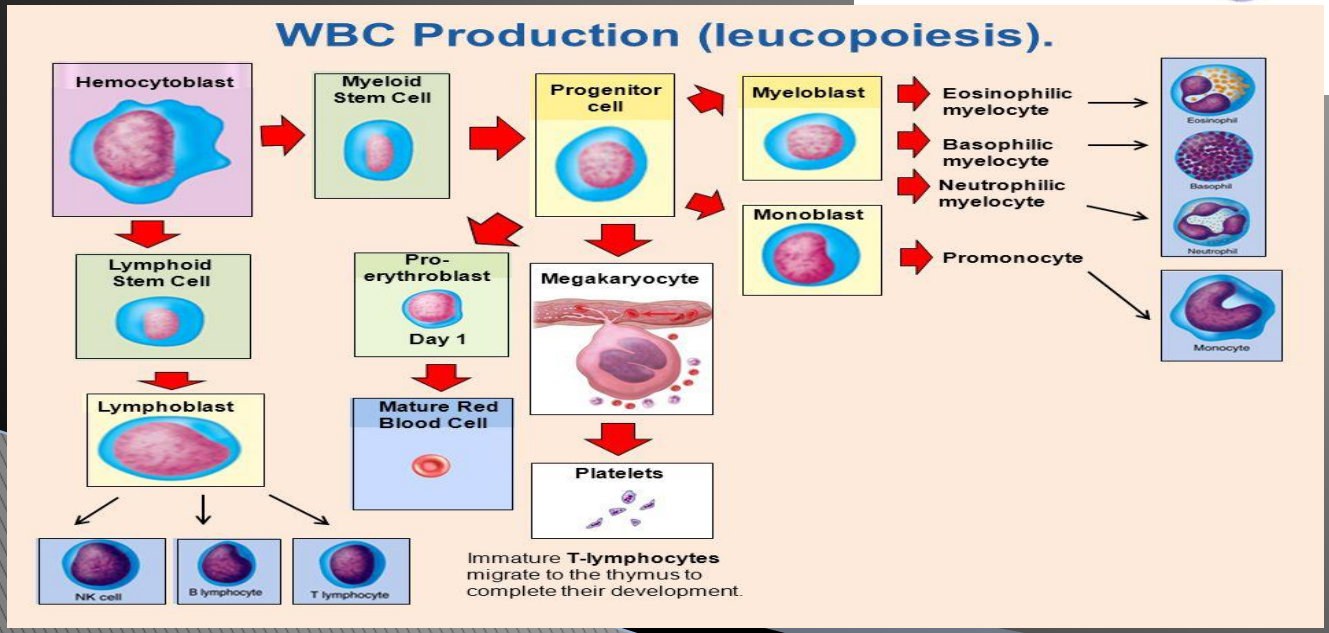
- WBCs formed in the bone marrow are stored within the marrow until they are needed in the circulatory system. Various factors cause them to be released.

- Normally, about three times as many white blood cells are stored in the marrow as circulate in the entire blood.

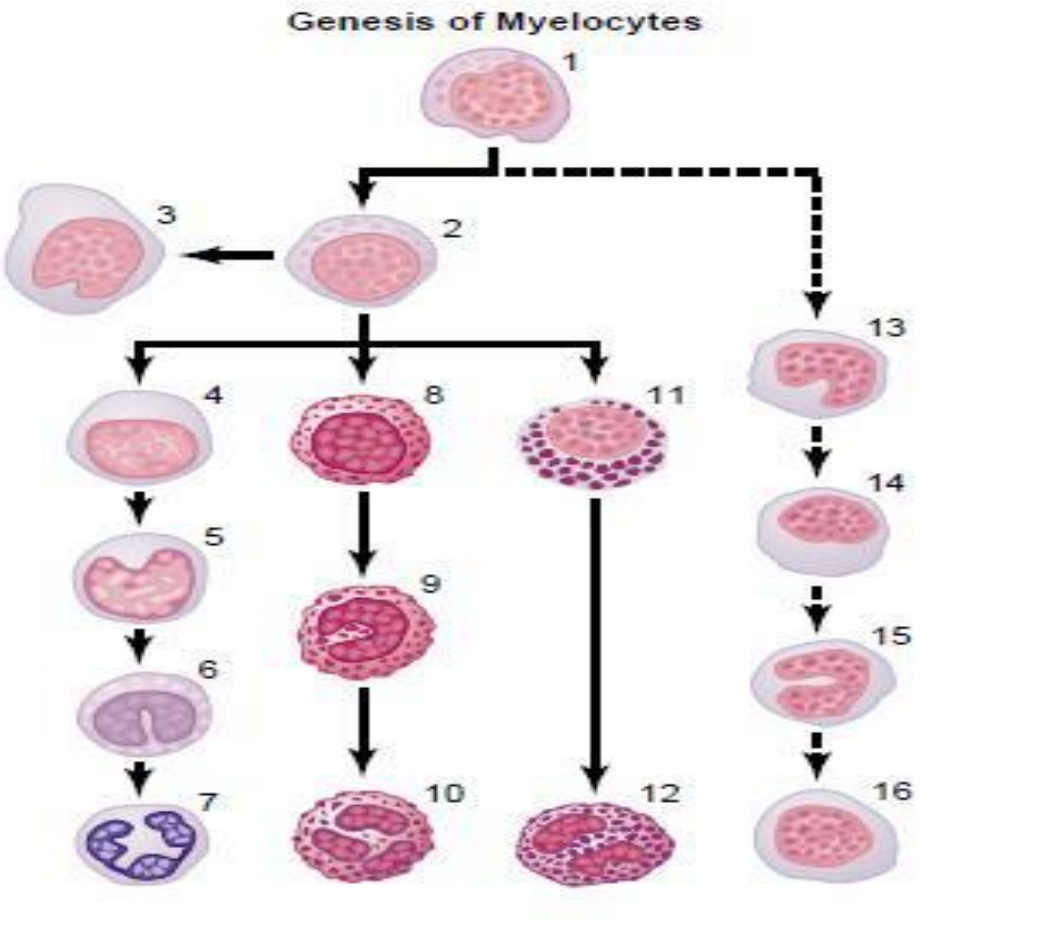
- The lymphocytes are mostly stored in the various lymphoid tissues, except for a small number that are temporarily being transported in the blood.

Genesis of WBC





Genesis of WBC Leucopoiesis

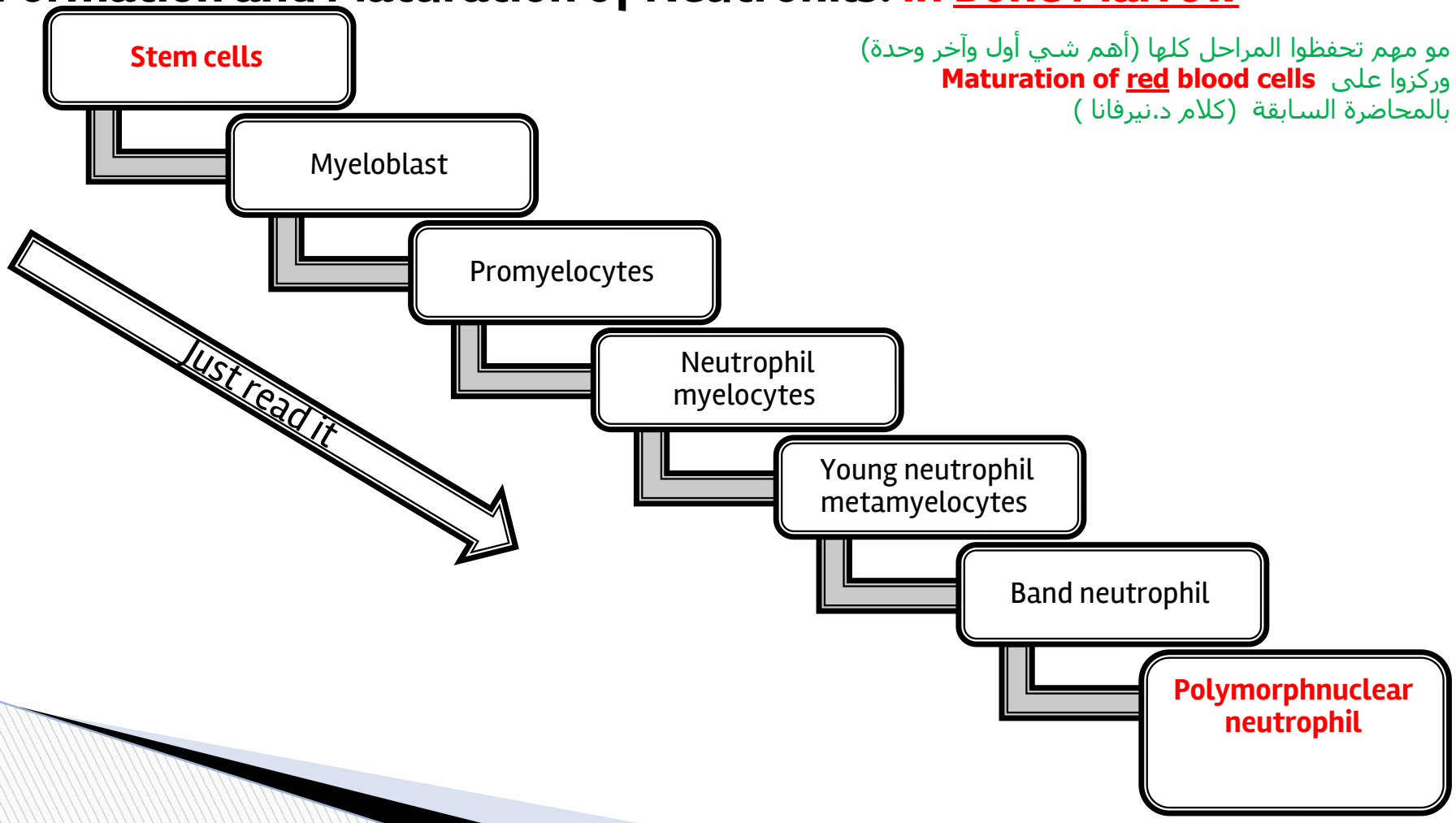


Genesis of white blood cells. The different cells of the myelocyte series are 1, myeloblast; 2, promyelocyte; 3, megakaryocyte; 4, neutrophil myelocyte; 5, young neutrophil metamyelocyte; 6, "band" neutrophil metamyelocyte; 7, polymorphonuclear neutrophil; 8, eosinophil myelocyte; 9, eosinophil metamyelocyte; 10, polymorphonuclear eosinophil; 11, basophil myelocyte; 12, polymorphonuclear basophil; 13–16, stages of monocyte formation.

White Blood Cells

NEUTROPHILLS

Formation and Maturation of Neutrohils: in Bone Marrow



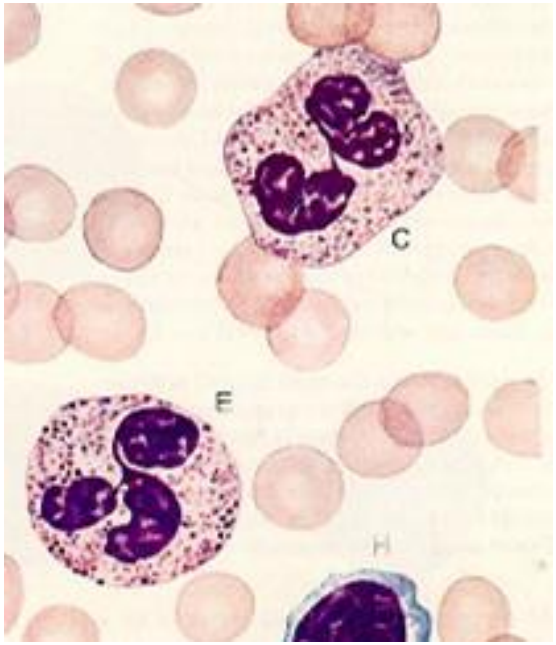
مو مهم تحفظوا المراحل كلها (أهم شي أول وآخر وحدة)
وركزوا على **Maturation of red blood cells**
بالمحاضرة السابقة (كلام د.نيرفانا)

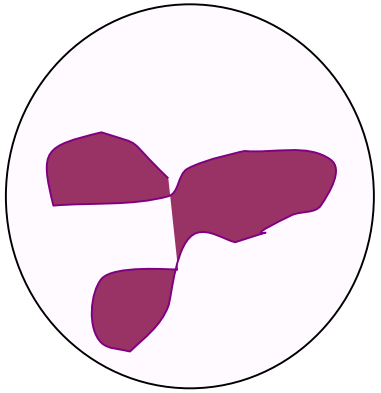
White Blood Cells

NEUTROPHILLS

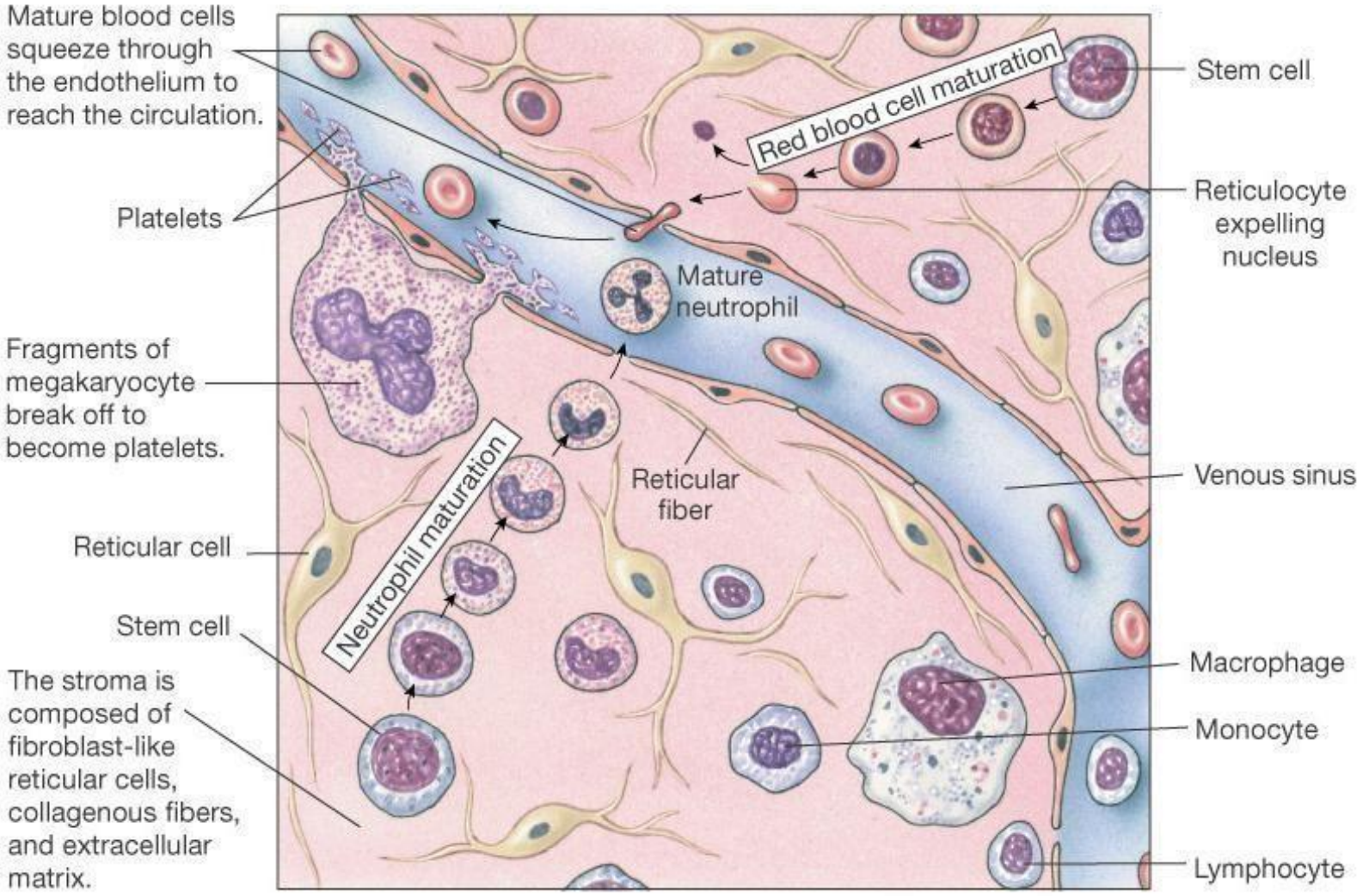
- Polymorphonuclear.
- They contain small granules of both acidic and basic.
- They constitute the first line of defence against bacterial infection.
- Very important at “clearing” bacterial infections.

Cells infected by bacteria usually get dealt with by Neutrophils





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

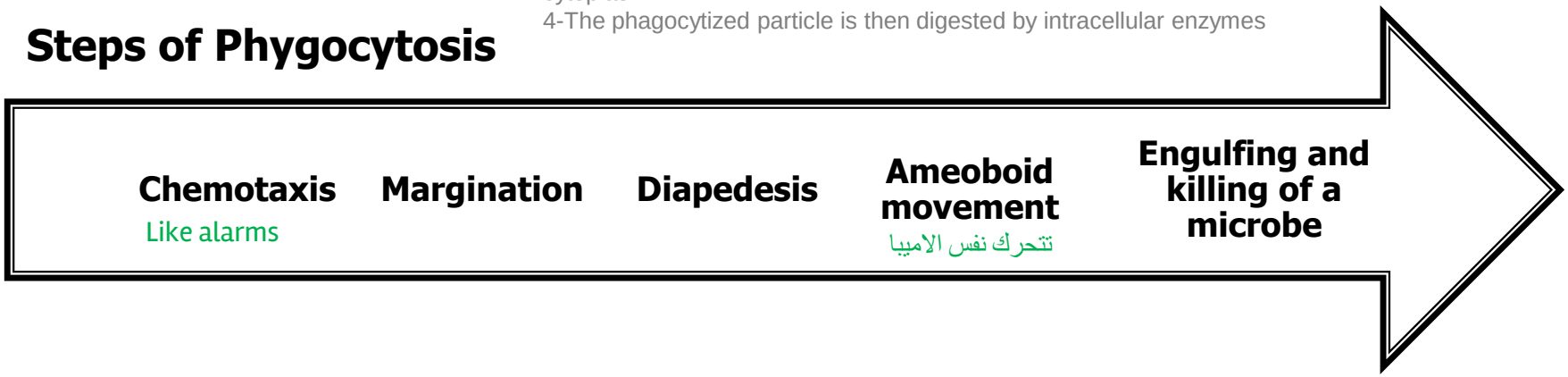


Neutrophil Function

Defense against infection:
Neutrophil has the ability of engulfing bacteria or organism by a process of phyagocytosis

Neutrophil Phagocytosis
1-neutrophil attaches itself to the particle and projects pseudopodia in all directions around the particle.
2-pseudopodia meet one another on the opposite side and fuse, creating an enclosed chamber that contains the phagocytized particle.
3-the chamber moves to the inside of the cytoplasmic cavity and breaks away from the outer cell membrane to form a free-floating *phagocytic vesicle* (also called a *phagosome*) inside the cytoplasm.
4-The phagocytized particle is then digested by intracellular enzymes

Steps of Phygocytosis



Females slide

Chemotaxis

The attraction of the neutrophils and monocytes to move to inflamed area following chemotactic substances release from infected site.

The chemotactic agents include a component of the complement system (C5a); leukotrienes; and polypeptides from lymphocytes, mast cells, and basophils.

Chemotactic substances:

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

Chemotaxis is effective up to 100 micrometers away from an inflamed tissue. Therefore, because almost no tissue area is more than 50 micrometers away from a capillary, the chemo- tactic signal can easily move hordes of WBCs from the capillaries into the inflamed area.

Margination & Diapedesis

neutrophils تحريك وصف ال

There are gabs inbetween the endothelial capillaries where the neutrophils squeeze through

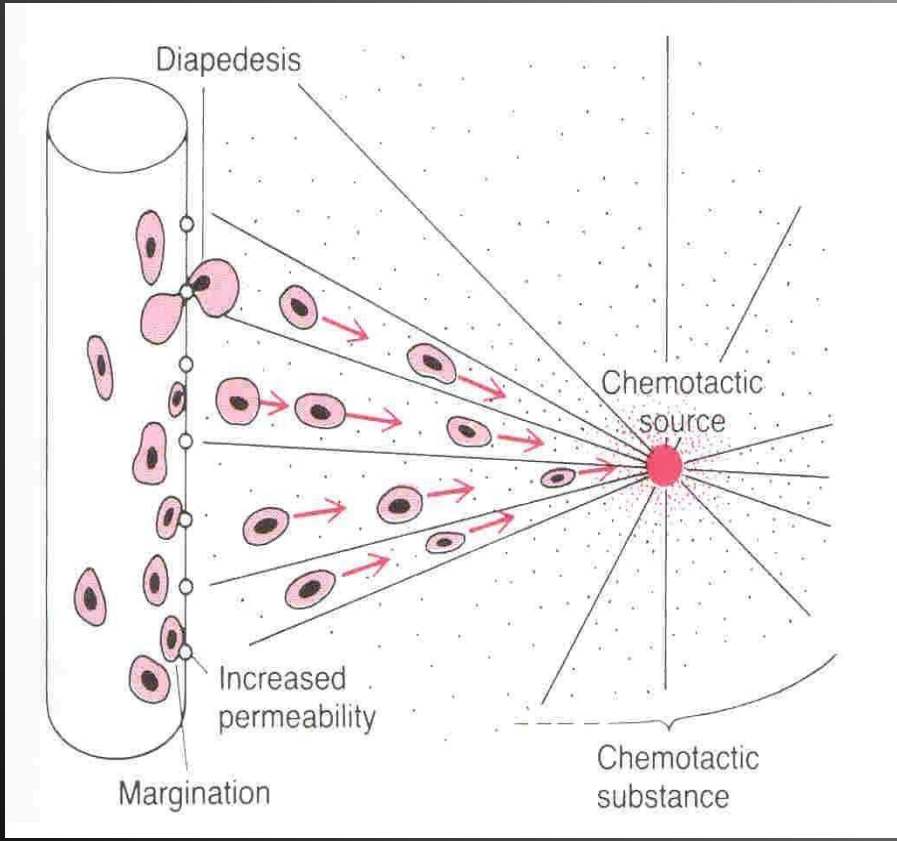
1- WBCs **marginate (aggregate and stick)** along the wall of blood capillaries.

2- WBC squeezes itself through endothelial holes leaving blood capillaries (**diapedesis**)

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

4- Upon reaching the site of infection neutrophils start to **engulf** infecting organism

Chemotaxis, margination & diapedesis



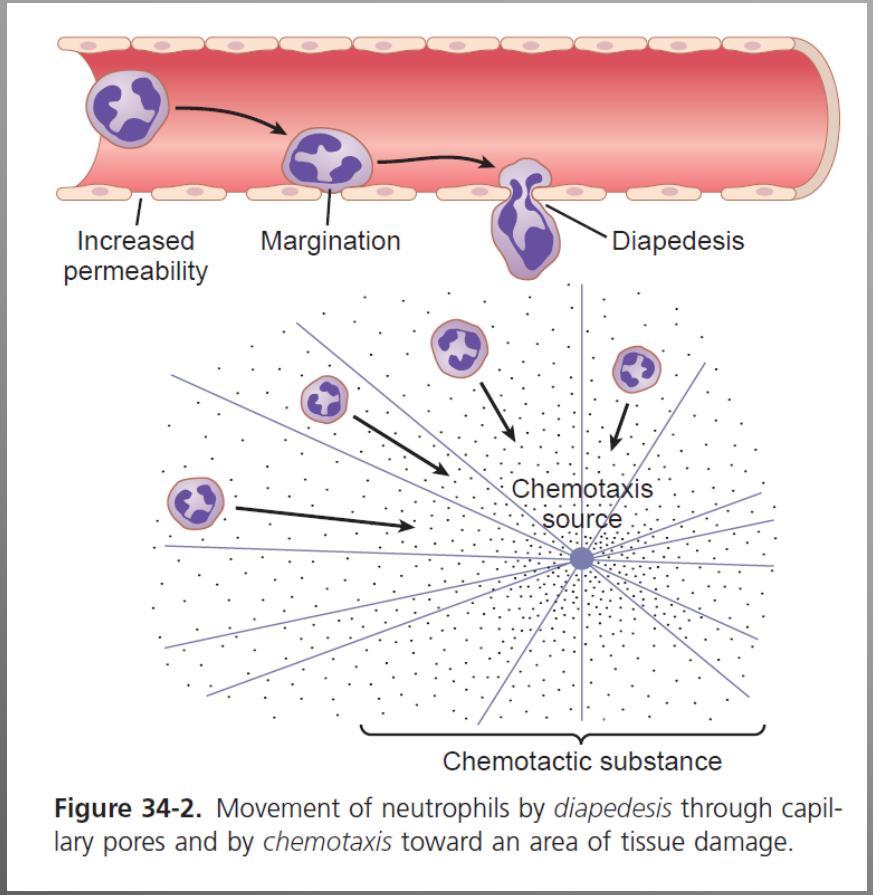


Figure 34-2. Movement of neutrophils by *diapedesis* through capillary pores and by *chemotaxis* toward an area of tissue damage.

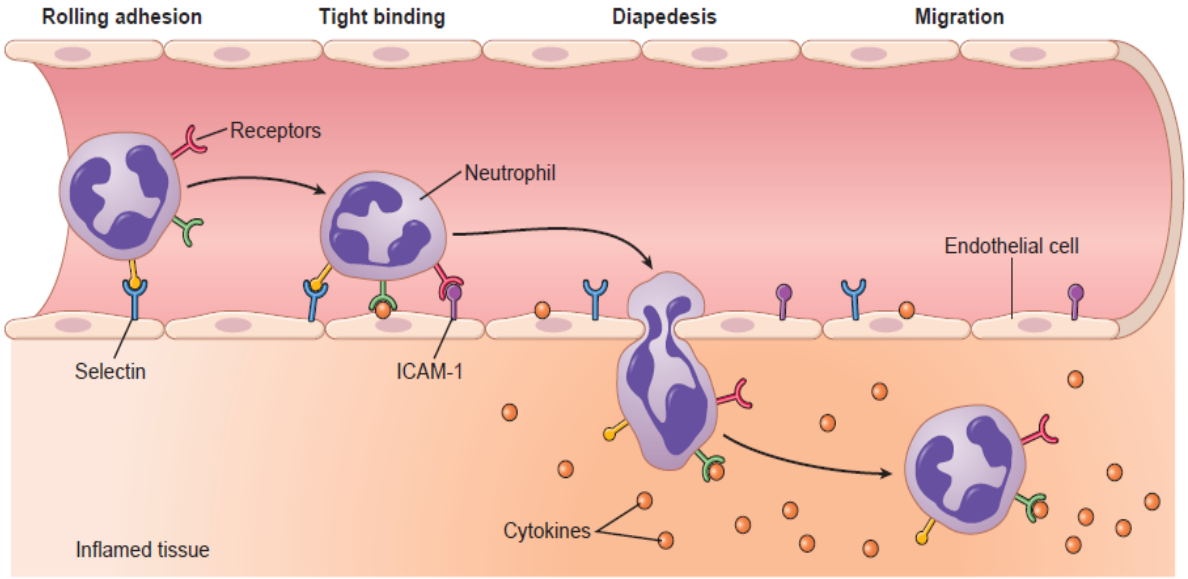
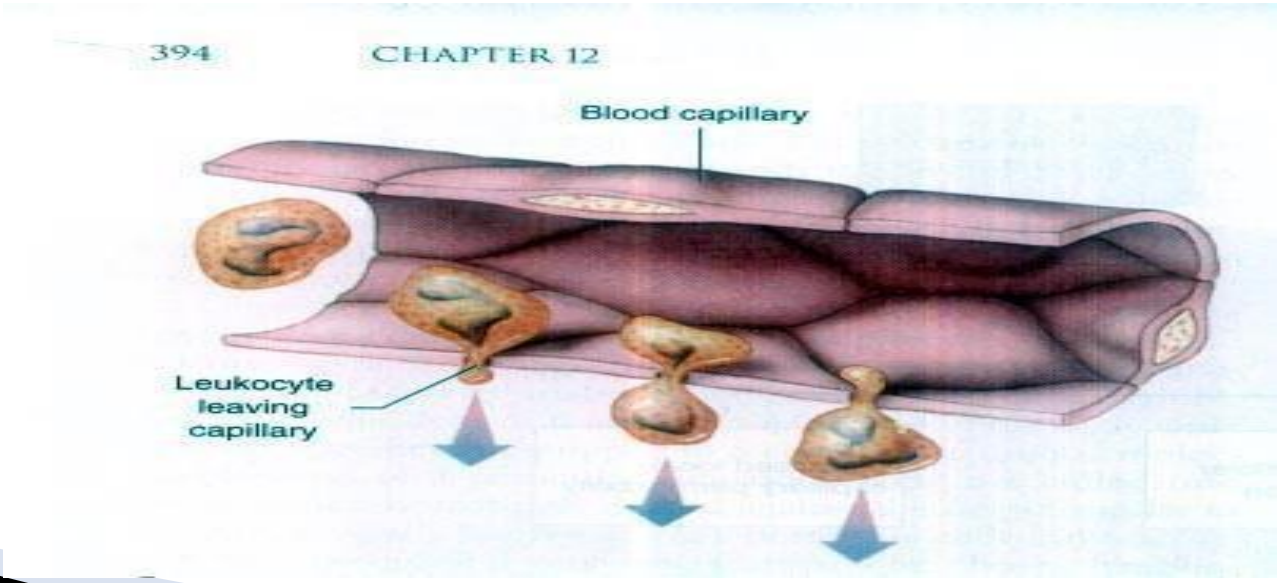


Figure 34-6. Migration of neutrophils from the blood into inflamed tissue. Cytokines and other biochemical products of the inflamed tissue cause increased expression of selectins and intercellular adhesion molecule-1 *(ICAM-1)* in the surface of endothelial cells. These adhesion molecules bind to complementary molecules/receptors on the neutrophil, causing it to adhere to the wall of the capillary or venule. The neutrophil then migrates through the vessel wall by diapedesis toward the site of tissue injury.



Phagocytosis and Opsonization

Phagocytosis: means cellular ingestion of the offending agent.

opsonization is the coating of the invader

Selective process: foreign substance **recognize** by:

-Rough surface

-No protective protein coat, which prevents phagocytosis.

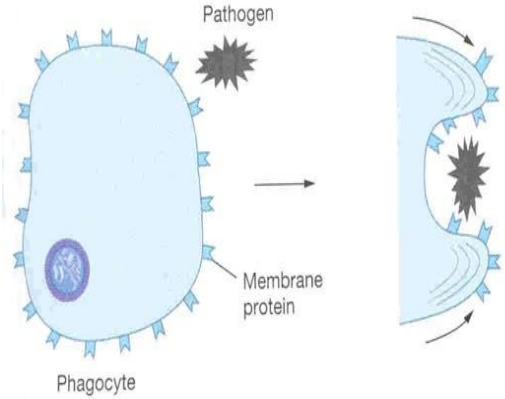
-Marked by certain substance **(opsonization)** مثل name tagللتعرف عليها

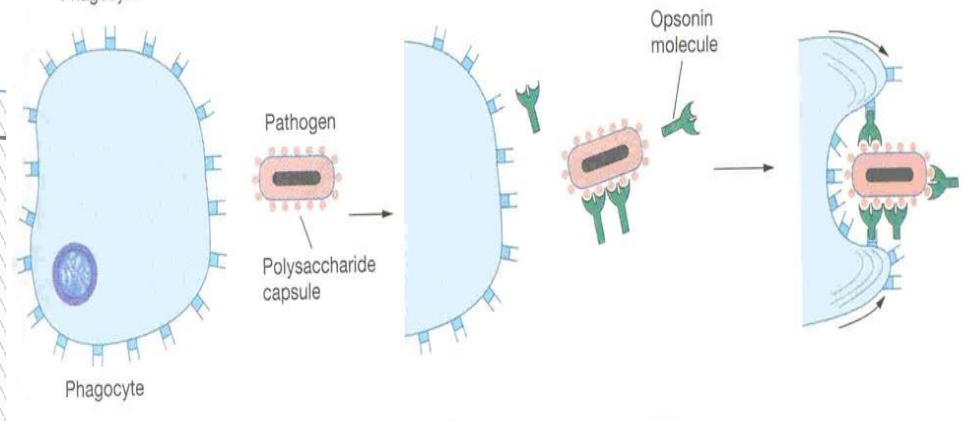
e.g Complement 3 or antibodies making them ready for killing.

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

Opsonization: Complement 3b or antibodies like IgG making them ready for killing a process known as opsonization.
Some plasma factors act on the bacteria to make them "tasty" to the phagocytes (opsonization). The principal opsonins that coat the bacteria are immunoglobulins of a particular class (IgG) and complement proteins.

Opsonization and Phagocytosis





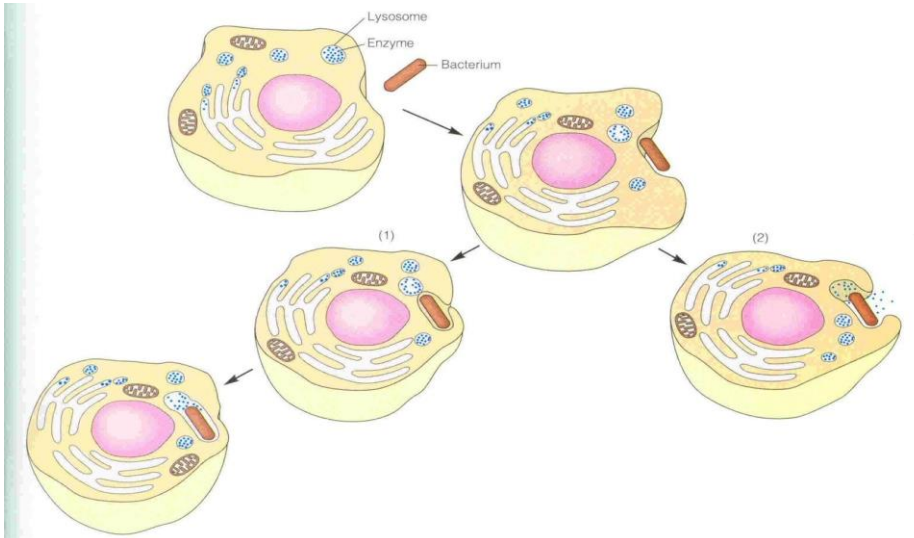


Figure 15.2

Phagocytosis by a neutrophil or macrophage. A phagocytic cell extends its pseudopods around the object to be engulfed (such as a bacterium). (Blue dots represent lysosomal enzymes.) (1) If the pseudopods fuse to form a complete food vacuole, lysosomal enzymes are restricted to the organelle formed by the lysosome and food vacuole. (2) If the lysosome fuses with the vacuole before fusion of the pseudopods is complete, lysosomal enzymes are released into the infected area of tissue.

Microbial killing

killing effect results from several powerful *oxidizing agents* formed by enzymes in the membrane of the phagosome or by a special organelle called the *peroxisome.* ese oxidizing agents include large quantities of *superoxide*− (O2−), *hydrogen peroxide* (H2O2), and *hydroxyl ions* (OH), which are lethal to most bacteria, even in small quantities.

Digestion of organism inside the phagosome:

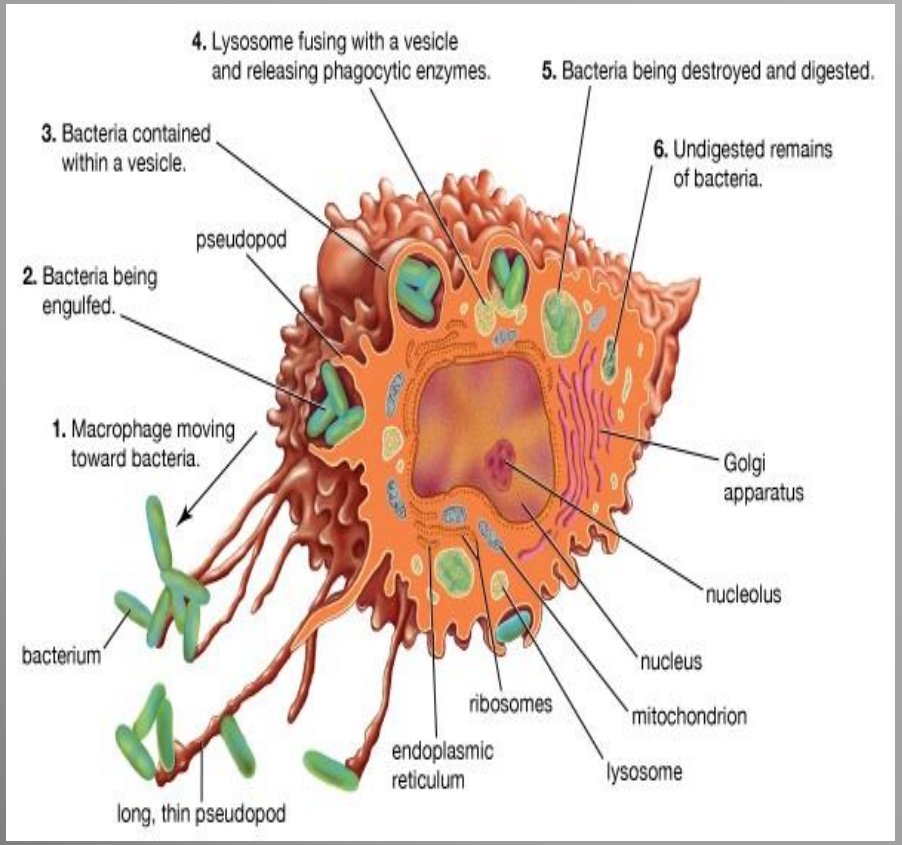
1- Fusion of intracellular **lysosomes** with **phagosome** vacuole

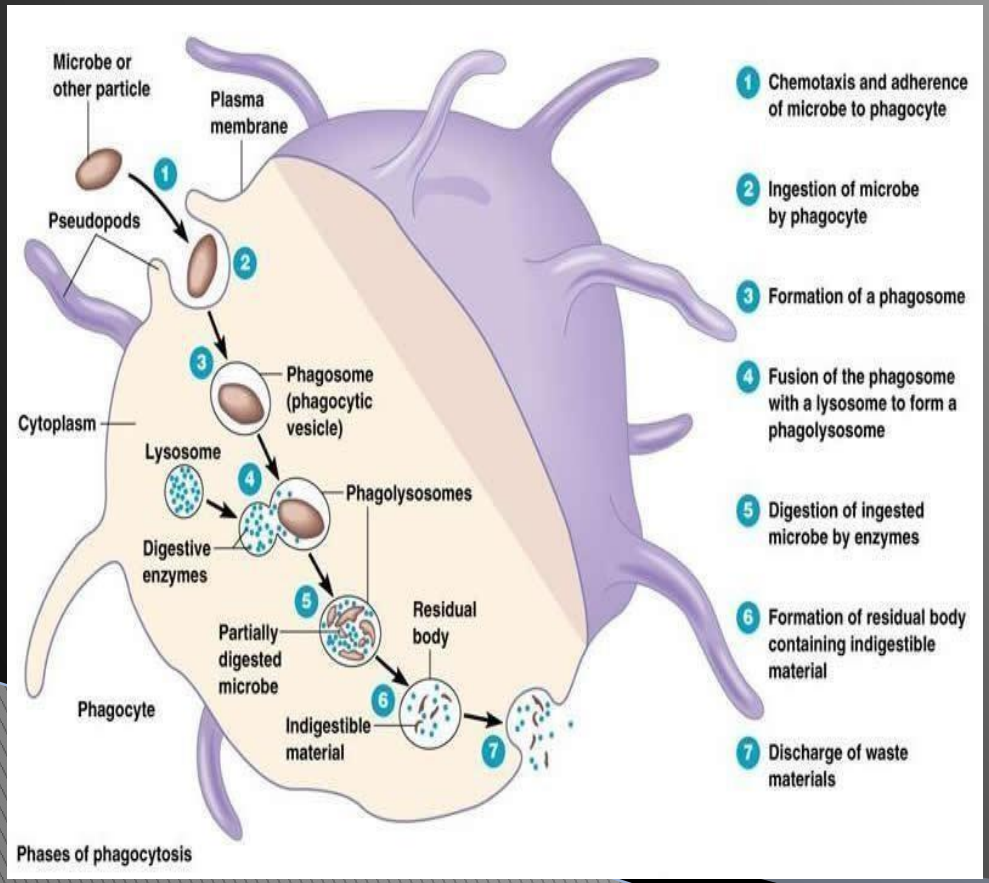
2- **Lysosomes** discharge its **proteolytic** enzymes such as myeloperoxidase, catalase into the vacuole, killing and digesting the engulfed bacteria.

And\or Release of **bactericidal** such as superoxide, hydrogen peroxide to kill the bacteria

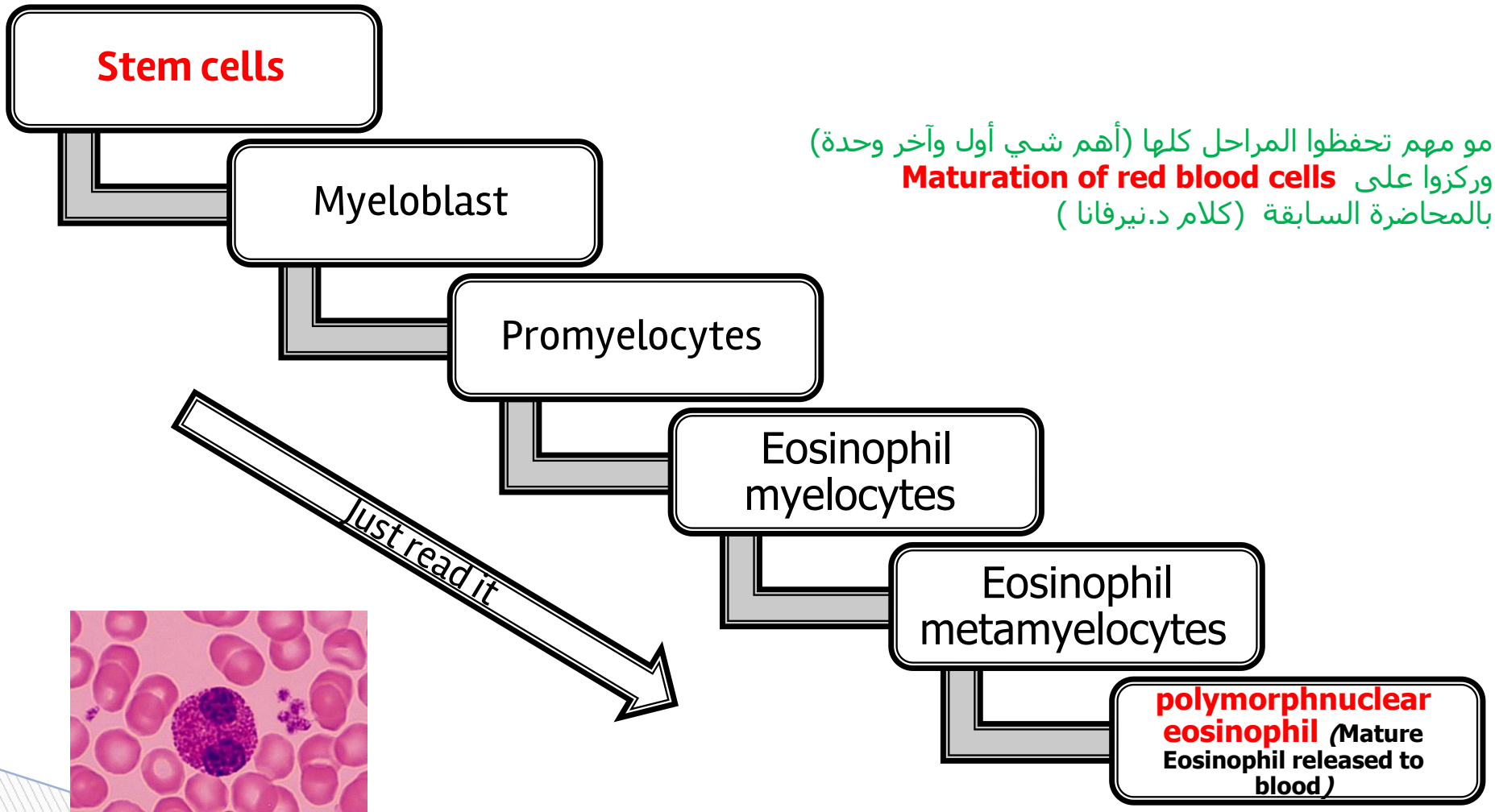
Some bacteria, notably the tuberculosis bacillus, have coats that are resistant to lysosomal digestion and also secrete substances that partially resist the killing effects of the neutrophils and macrophages.These bacteria are responsible for many of the chronic diseases, an example of which is tuberculosis.

Microbial killing





Formation and Maturation of Eosinophils: in Bone Marrow



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وركزوا على **Maturation of red blood cells**
بالمحاضرة السابقة (كلام د.نيرفانا)

Eosinophil Function

1- they are weak phagocytes.

2- they are often produced in large numbers in people with parasitic infections, and they migrate in large numbers into tissues diseased by parasites., e.g., ascaris, hook worm, bilharzia. Eosinophils attach themselves to the parasites by way of special surface molecules and release substances that kill many of the parasites ex:(hydrolytic anzymes,superoxide)

3- They are increased in allergic conditions by the release of eosinophil chemotactic factor released from the mast cells and basophiles.

4- Eosinophils phagocytose the antigen-antibody complexes and release substances to neutralize the histamine. ex: (asthma, rhinitis, drug reaction)

4-They may produce profibrinolysin → fibrinolysin which digest fibrin clot.

Formation and Maturation of Basophils: in Bone Marrow

Stem cells

Myeloblast

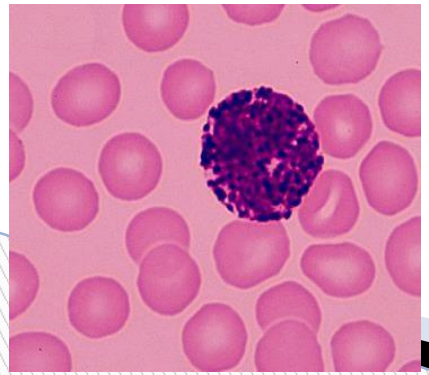
Promyelocytes

Basophil myelocytes

Just read it

Basophil metamyelocyt

Polymorphnuclear Basophil
(Mature Basophils released to blood)



large round cytoplasmic polysaccharide granules which take base dye (methylene blue) and stain blue in color.

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Basophils Functions:

1–Both mast cells and basophils secrete:

histamine (to prevent clotting), **heparin**, **bradykinin**, **Serotonin** (5HT) (contribute to inflammation response), slow-reacting substance of anaphylaxis (a mixture of three leukotrienes) and a number of lysosomal enzymes.

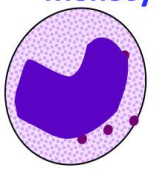
The release of those substances cause local and vascular reactions characteristic of allergic manifestation

2–They are increased in allergic reaction: immediate-type hypersensitivity (allergic) reactions.

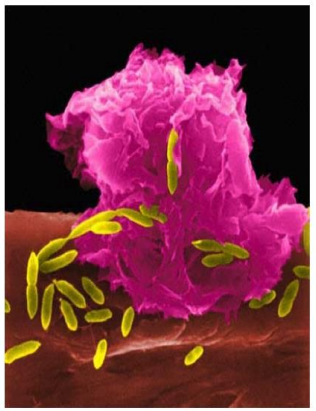
Monocytes\ Macrophages

- Monocytes leave the **blood stream** to **tissues** and turn into macrophages.
- Monocytes are **young** macrophages.
- Monocytes are **big eaters**.
- 15-20 **µm -** Active cells 60-80 **µm**

- Monocytes contain **agranular** cytoplasm, but when they convert into **macrophages** and enter tissue, they **swell** and their cytoplasm become filled with a **large number** of **lysosomes**.
- Monocytes are **slower** to respond to invaders than neutrophils, but they are **larger**, have **greater capacities**, and **live longer**.



Macrophage Phagocytosing E coli



Monocytes\ Macrophages

- 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).

- Functions of monocytes/macrophages:

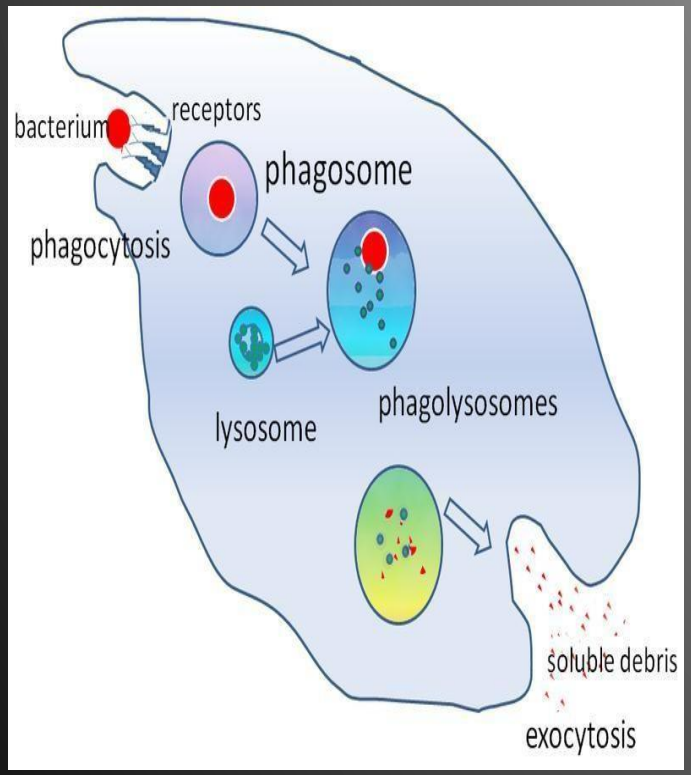
- First line of defense.
- Phagocytosis and killing of microorganisms. They are more Efficient than Neutrophils **(**100 bacteria **vs** 3-20 by Neutrphil, larger particles like old RBCs & malarial parasites**)**.
- Activation of T cells and initiation of the immune response by presenting the antigen to these cells.
- gets rid of waste and survives.

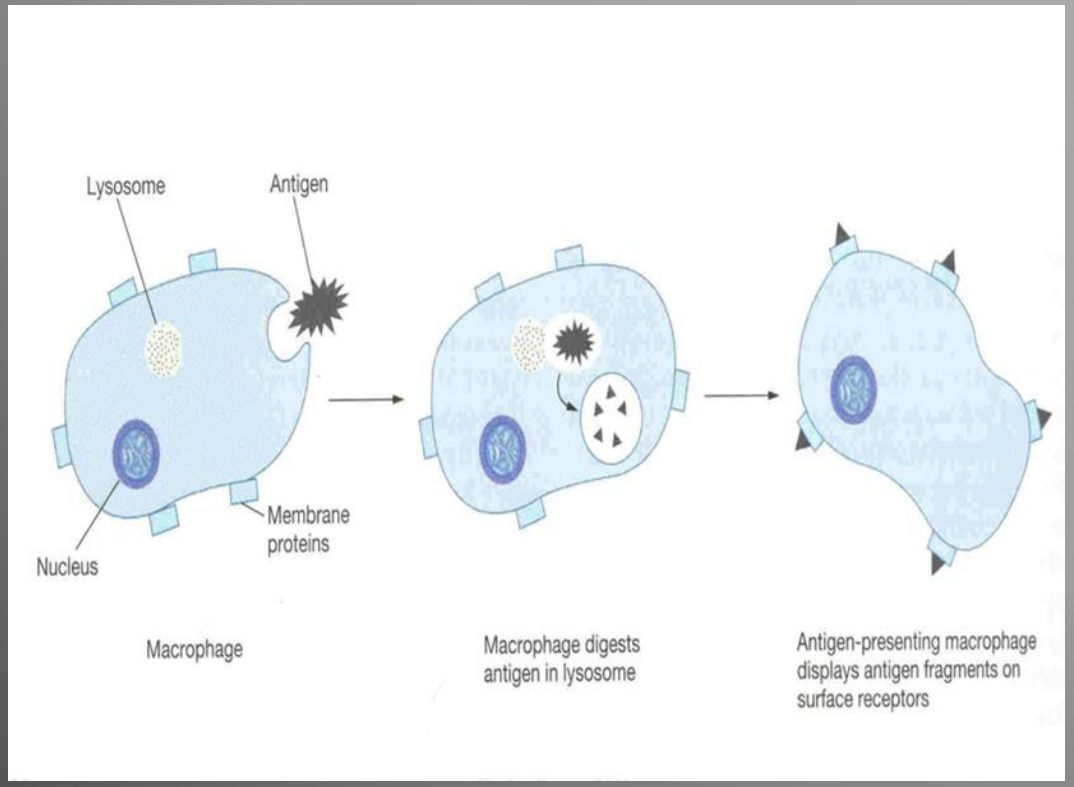
- Monocytes secrete:

- Interleukin-1 (IL-1).
- Colony stimulating factor (M-CSF).
- Platelet-activating factor (PAF).

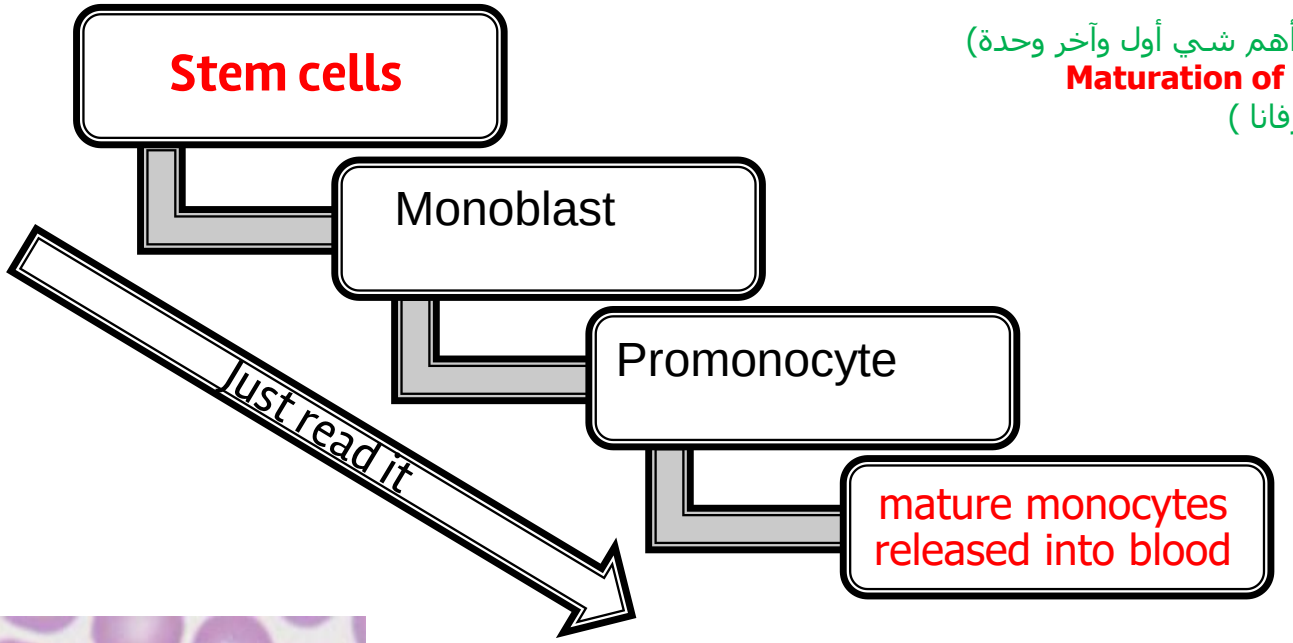
Direct anti Inflammatory

Indirect anti-inflammatory





Formation and Maturation of Monocytes and Macrophages:
in Bone Marrow



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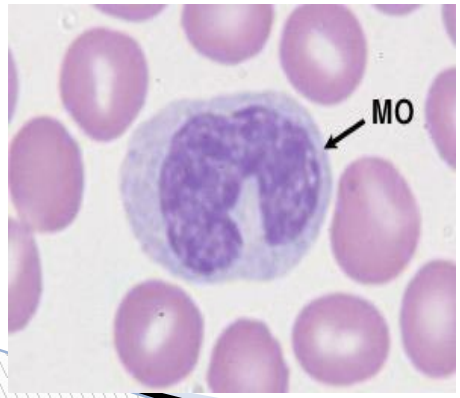


Stay for **10-20 hours** in circulation

Then **leave blood to tissues transforming** into larger cells **macrophage**

Macrophage life span is longer upto **few months** .

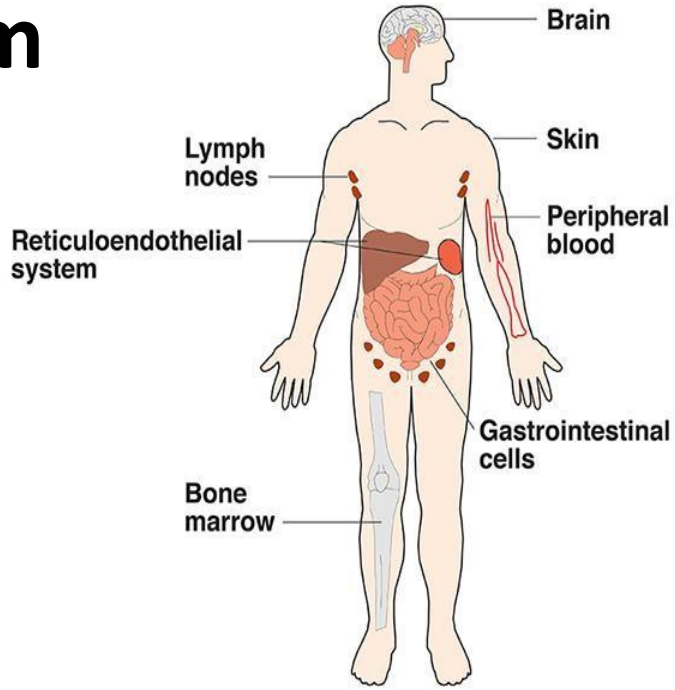
Monocytes\ Macrophages

- There are two types of macrophages; motile and fixed.

- There are **tissue-specific macrophages**; fixed macrophages (monocyte-macrophage system; reticulo-endothelial system)

- Alveolar macrophage
- Peritoneal macrophage
- Kuppfer cells ⟶ in liver sinuses
- Osteoclasts ⟶ in bone
- Microglial cells ⟶ in brain
- Histiocytes ⟶ in skin and subcutaneous tissue
- Mesengial cells ⟶ in the kidneys
- Few specialized endothelial cells in ⟶ bone marrow, spleen and lymph nodes

Reticuloendothelial System



Consist of:

Monocytes

Macrophage

Endothelial cells
(bone marrow,spleen, lymph node)

Located in:

all tissues especially: skin

(histocytes), liver (kupffer), spleen, bone marrow,

lymph nodes, lung

رح ناخذه بالتفصيل بسنة ثاني بس ركزوا عالنقاط
الرئيسية (كلام د.نيرفانا)

Functions of Reticuloendothelial system

-Phagocytosis: Bacterial, dead cells, foreign particles.

-Breakdown of Hb

-Immune function: processing antigen and antibodies production (indirect)

-Storage of iron

in the liver and bone marrow in the form of fe3 (mostly),fe2

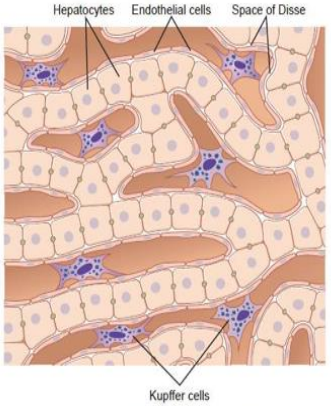


Figure 34-4. Kupffer cells lining the liver sinusoids, showing phagocytosis of India ink particles into the cytoplasm of the Kupffer cells.

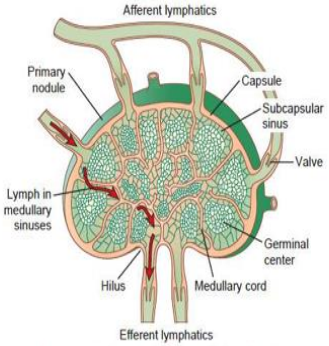
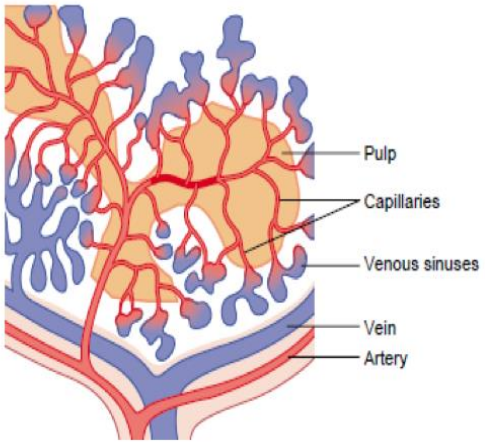
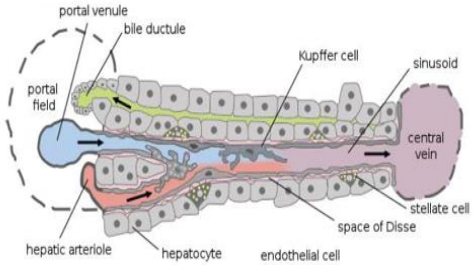
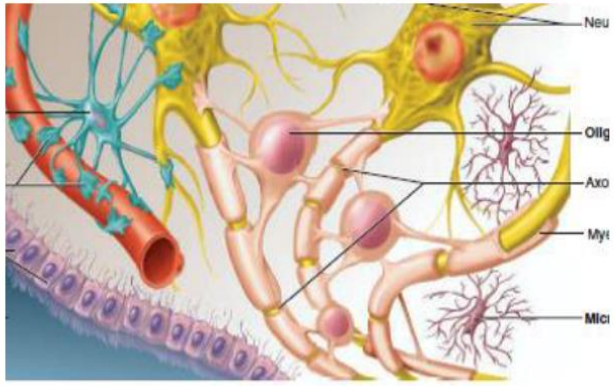
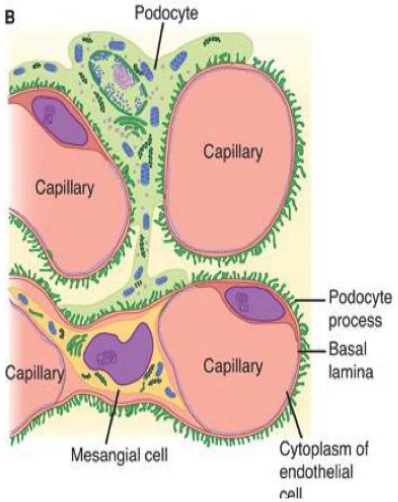


Figure 34-3. Functional diagram of a lymph node.









Macrophage and Neutrophil Responses During Inflammation

Neutrophils = microphages

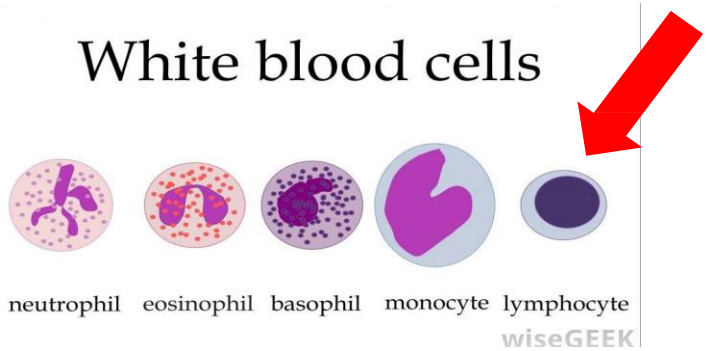
- **1st line of defense** –Tissue macrophages, barriers and complement system.
- **2nd line of defense** –Neutrophil invasion of the inflamed area.
- **3rd line of defense** –Monocytes–macrophage invasion of inflamed area.
- **4th line of defense** –Increased production of granulocytes and monocytes by the bone marrow.

LYMPHOCYTES Function and types

Types:

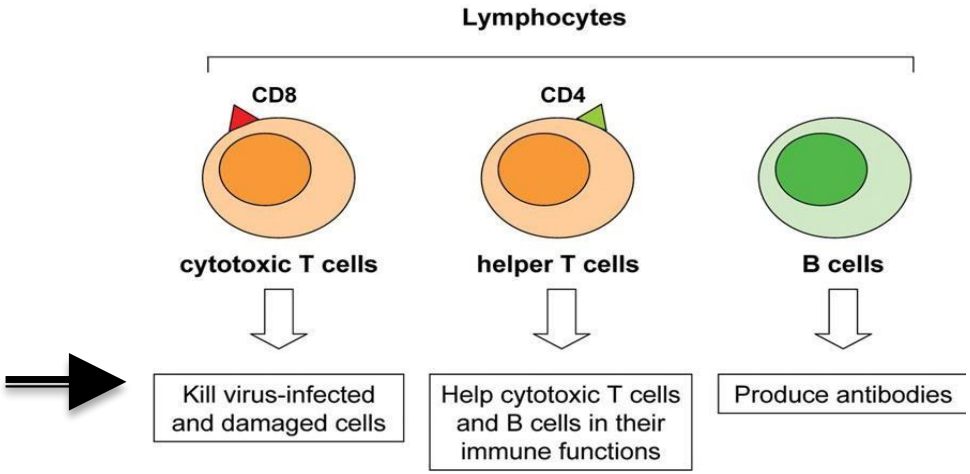
1-Thymus dependent (T-lymphocytes*)*

2 -Thymus independent *(*B-lymphocytes*)*



LYMPHOCYTES ARE RESPONSIBLE FOR ADAPTED/ACQUIRED IMMUNITY

Function:



Lymphocytes Formation and Maturation:

Formed in bone marrow, thymus, lymphoid tissues

T lymphocyte and B lymphocyte produced by the bone marrow however, T get maturated in the thymus and the B cells in the bone marrow then they go to the lymphoid organs like spleen Lymph nodes…etc

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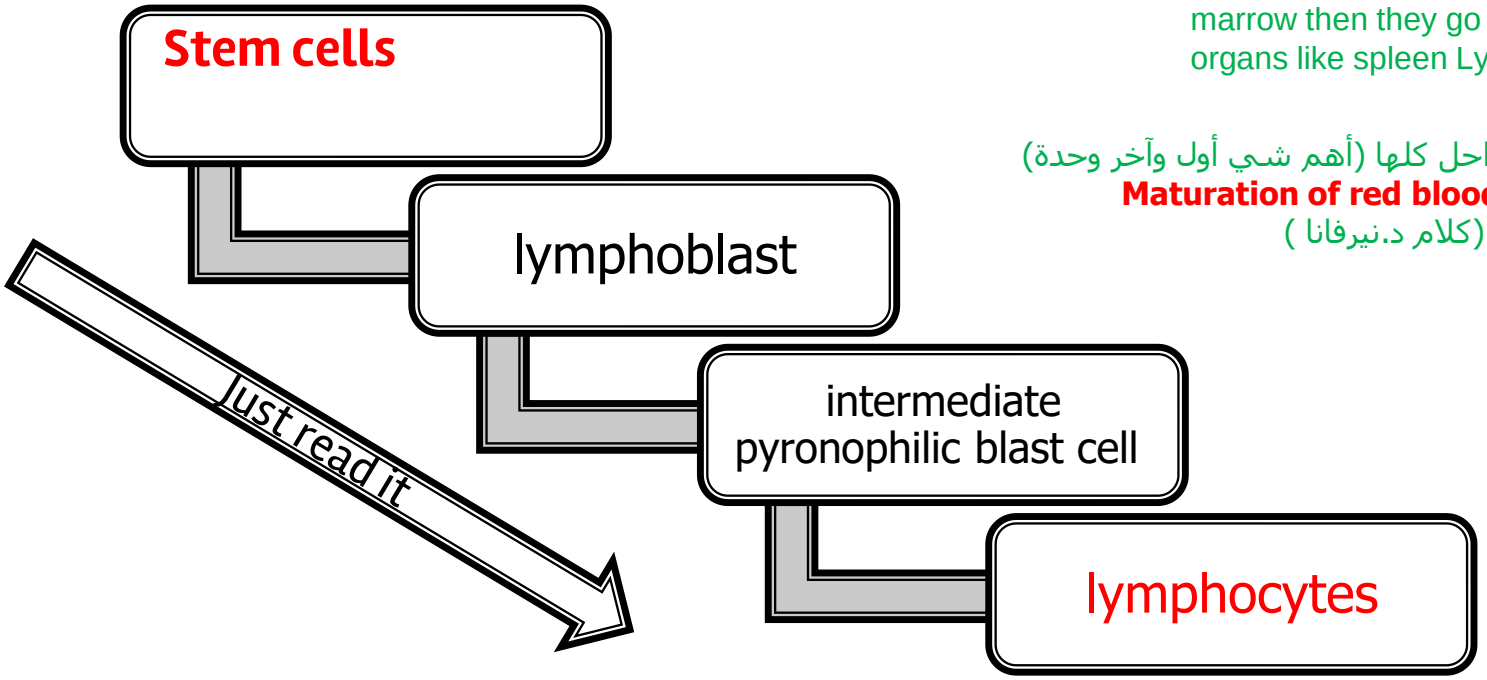


Life Span Of Lymphocytes range from weeks to months according to its type.

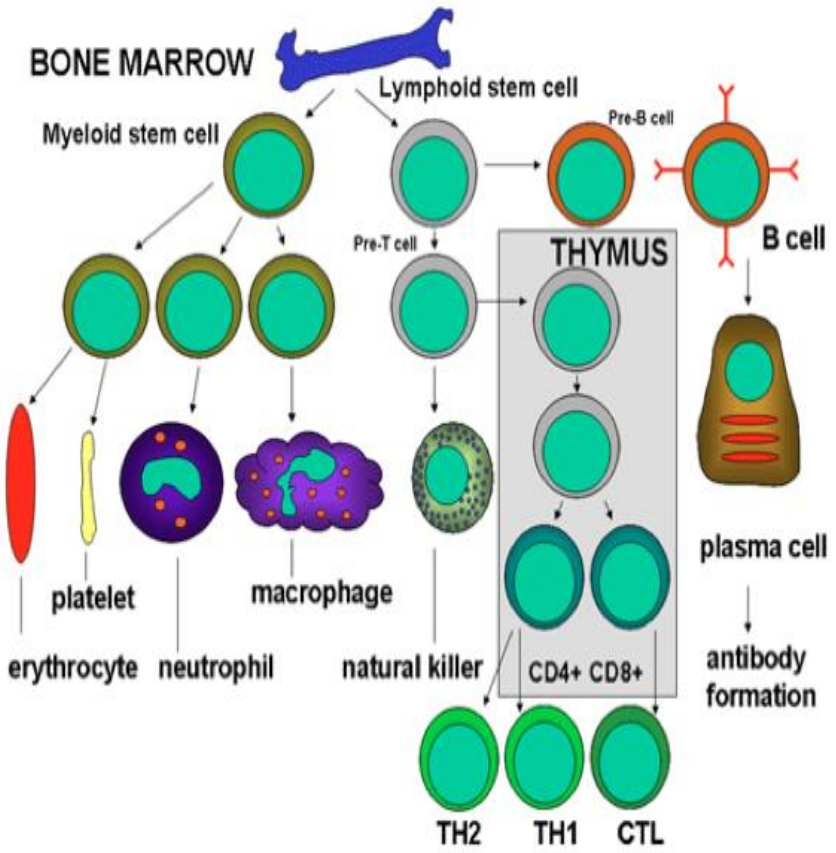
Both types of lymphocytes are derived in the embryo from (pluripotent hematopoietic stem cells) that form common (lymphoid progenitor cells).

Lymphocytes – T and B cells

•Lymphocytes migrate to the lymphoid organs.

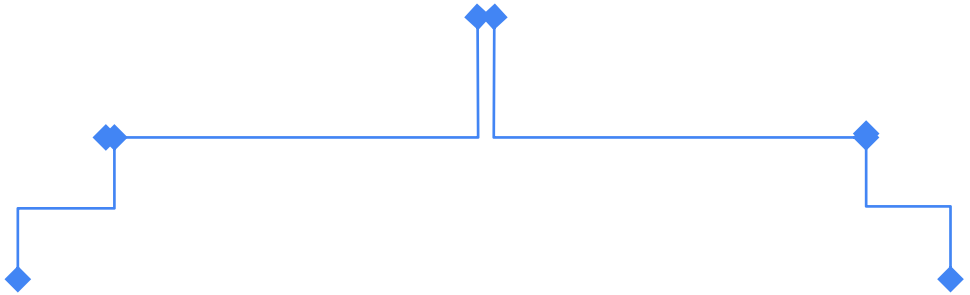
•On the surface of each lymphocyte are receptors that enable them to recognize foreign substances. These receptors are very specialized - each can match only one specific antigen.

•It might seem limiting that the receptors of each lymphocyte cell can only match one specific type of antigen, but the body makes up for this by producing so many different lymphocyte cells that the immune system can recognize nearly all invaders.



from the males slides

Preprocessed of lymphocytes



The T lymphocyte :

preprocessed in the **thymus** gland, and thus they are called “T” lymphocytes.
They are responsible for cellular or **cell-mediated** immunity

The B lymphocyte :

preprocessed in the **liver** during **mid–fetal life** and in the **bone marrow** in **late fetal life** and **after birth**.
They are changed to plasma cells and are responsible for **humeral immunity** or antibody- immunity.

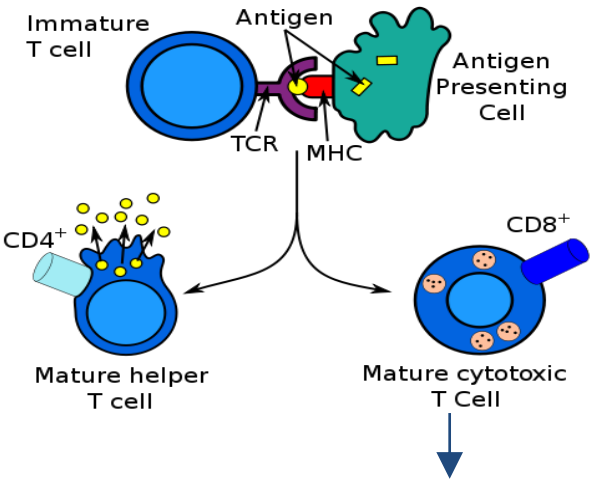
T–Lymphocytes

(Thymus dependent)

Formed in: bone marrow or lymphoid tissue migrate to thymus for maturation hence these lymphocytes are called T cells.

Life spans: 100-130 days.

Circulate between: blood, tissues, lymph.



Types of T-lymphocytes:

T-helper

T-cytotoxic

Natural killer

Activates B cells.

Kills virally infected cells.

Functions

مثل عند رفض الزراعة للاعضاء والدم

Cellular immunity (graft rejection , delyed hypersensitivity.)

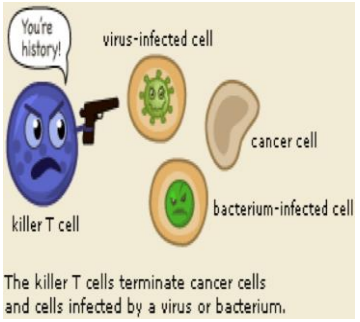
Role in antibody secretion.

T cells

A **cytotoxic T cell** (also known as **T_C**, **cytotoxic T Lymphocyte**, CTL, **T-killer cell**, cytolytic **T cell**, CD8+**T-cell** or **killer T cell**)

Killer T cells

- **Attacking** cells that are infected by viruses and sometimes also by bacteria. It can also attack cancer cells.
- **Has receptors** that are used to search each cell that it meets. If a cell is infected, it is swiftly killed.



The killer T cells terminate cancer cells and cells infected by a virus or bacterium.

Infected cells are recognized because tiny traces of the intruder, antigen, can be found on their surface.

Helper T cells

- major **driving force** and the main regulators of the immune defense.
- Their primary task is to **activate B cells and killer T cells** but the helper T cells must be activated first.

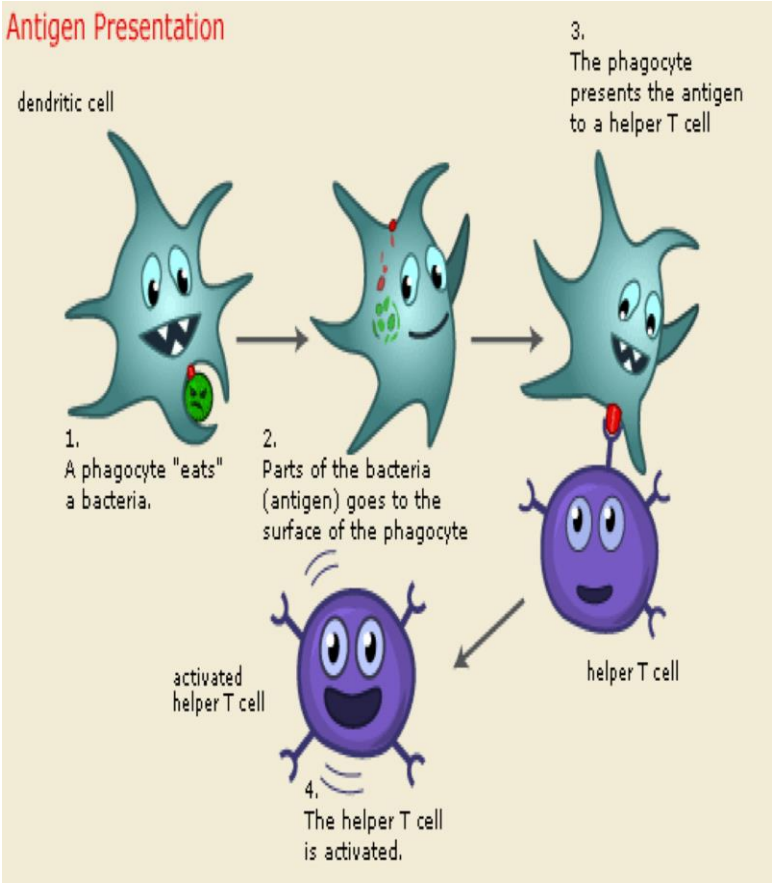
HOW CAN HELPER T CELL GET ACTIVATED?

when a **macrophage or dendritic cell** which has eaten an invader, travels to the nearest lymph node to present information about the captured pathogen.

The phagocyte displays an antigen fragment from the invader on its own surface**, a process called *antigen presentation*.**

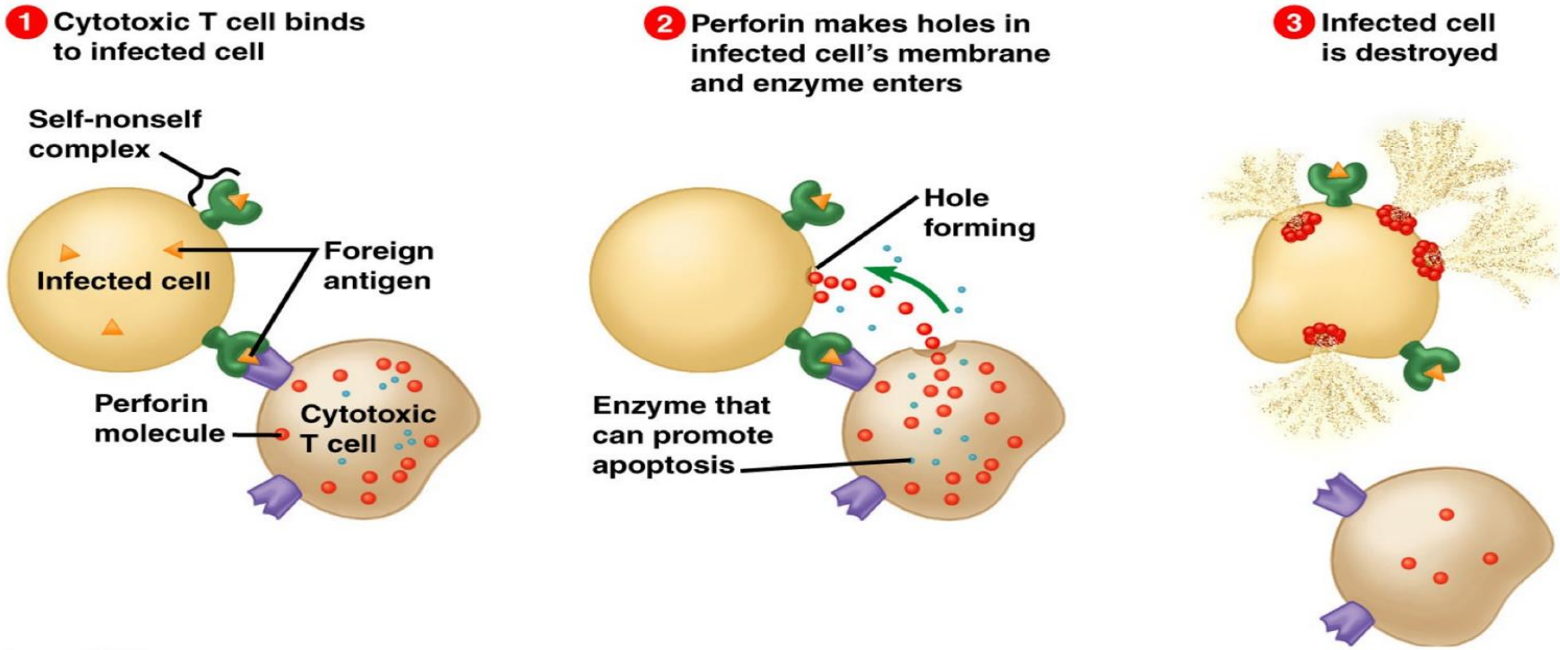
When the receptor of a helper T cell recognizes the antigen, the T cell is activated.

Once activated, helper T cells start to divide and to produce proteins that activate B and T cells as well as other immune cells.



from the males slides

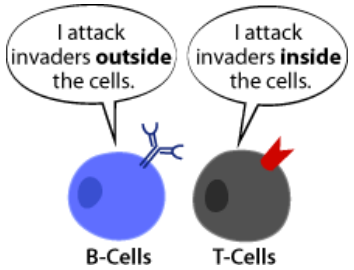
Killer T cells



B– Lymphocytes

(thymus–independents)

First discovered in **Bird Bursa**



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

Life span 2-7 days

It **transforms** into large plasma cell (produce antibody)

Function: Humoral immunity.

Stimulated by antigen transforming ⟵ B-lymphocyte تتعرض لantigene فتتحول إلى plasma cell which produces the antibodies ثم يحدث تفاعل بين antibodies , antigenes ونتخلص منهم اثنينهم

B–Cells

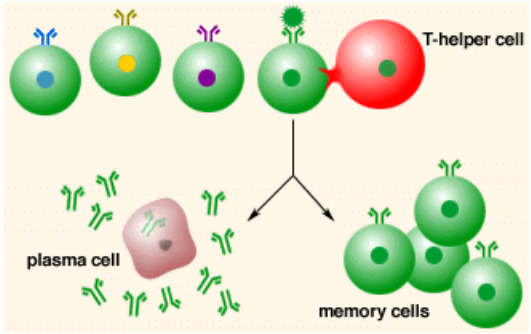
B-lymphocytes search for an antigen that matches their receptors, when it finds a suitable antigen it connects to it and sets off a signal then goes to a T-helper cell. The T-helper cell gives the B-cell a protein that enables it to clone itself into 2 types of B-cells:

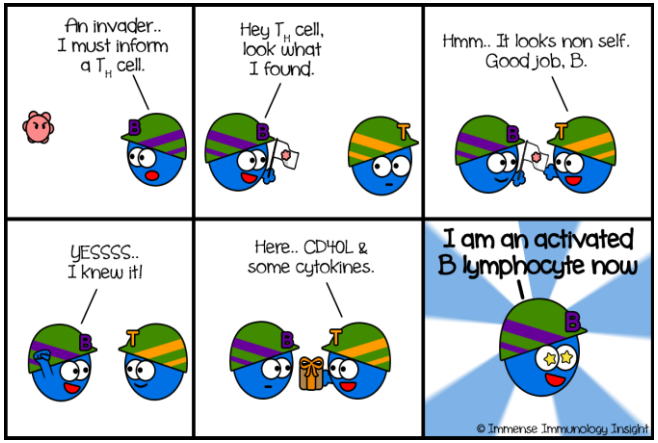
plasma cell → produces specific proteins called antibodies

B memory cells → have a prolonged lifespan and can "remember" specific intruders

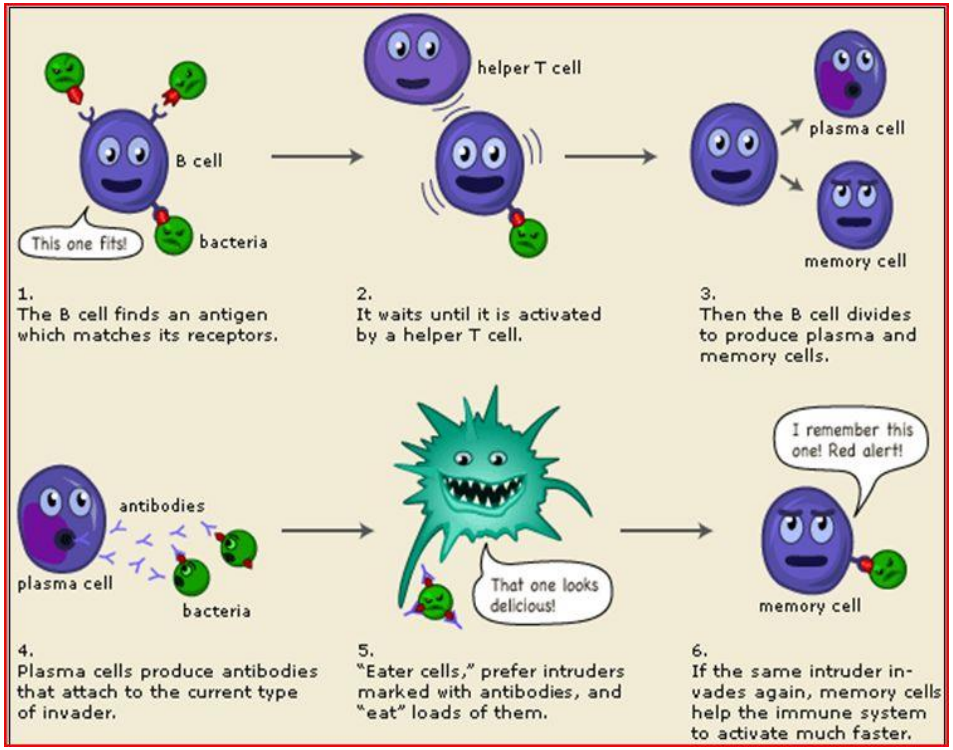
T-cells are also able to produce memory cells with an even longer span than B memory cells, so when the same intruder tries to act the body for a second time-both B and T cells will help activate the immune system faster and wipe out the invaders before the infected human feels any symptoms

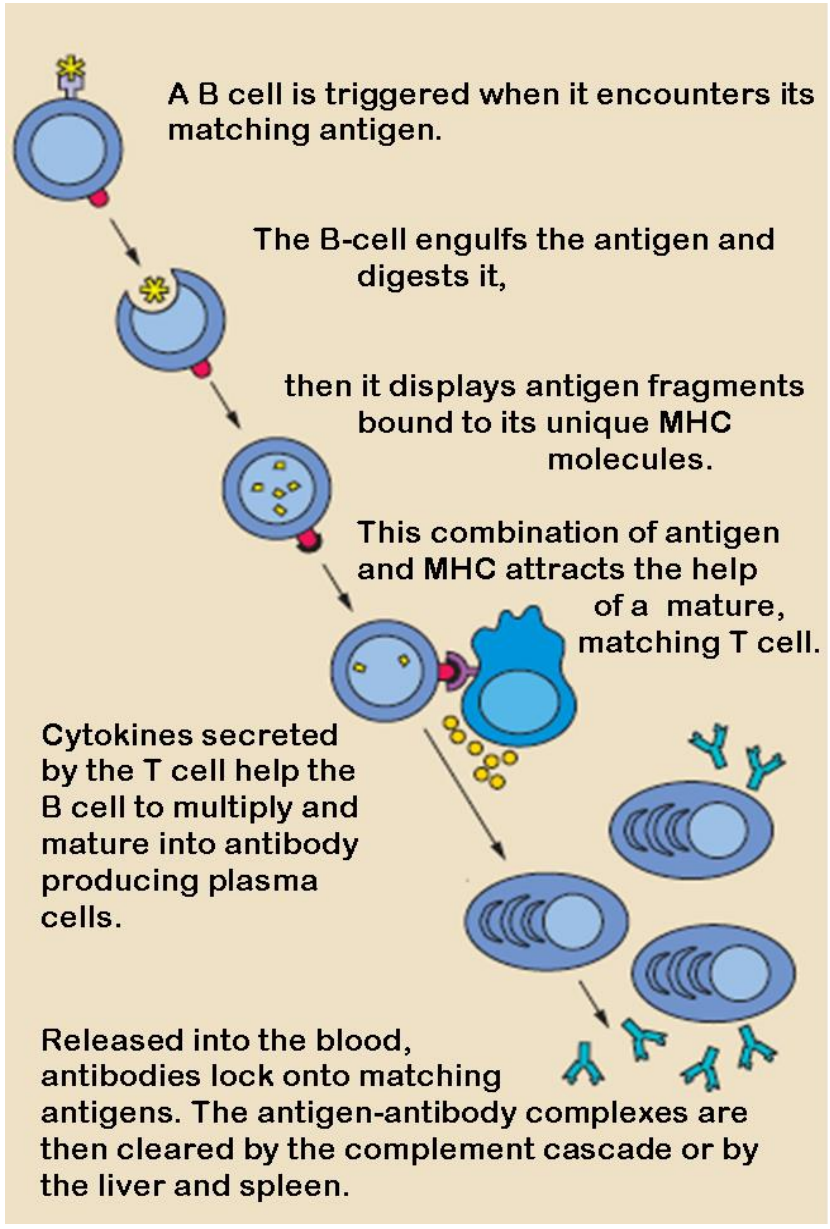
body achieves immunity against this type of invader





From male slides


B cell
This one fits!
bacteria
helper T cell
plasma cell
memory cell
1.
The B cell finds an antigen which matches its receptors.
2.
It waits until it is activated by a helper T cell.
3.
Then the B cell divides to produce plasma and memory cells.
antibodies
plasma cell
bacteria
That one looks delicious!
I remember this one! Red alert!
memory cell
4.
Plasma cells produce antibodies that attach to the current type of invader.
5.
"Eater cells," prefer intruders marked with antibodies, and "eat" loads of them.
6.
If the same intruder invades again, memory cells help the immune system to activate much faster.


A B cell is triggered when it encounters its matching antigen.
The B-cell engulfs the antigen and digests it,
then it displays antigen fragments bound to its unique MHC molecules.
This combination of antigen and MHC attracts the help of a mature, matching T cell.
Cytokines secreted by the T cell help the B cell to multiply and mature into antibody producing plasma cells.
Released into the blood, antibodies lock onto matching antigens. The antigen-antibody complexes are then cleared by the complement cascade or by the liver and spleen.

Leucocytosis

Increased number of WBCs

occurs in the following conditions:

Pathological Leukocytosis

Causes	Definition	Condition
Infections: of all types as acute or chronic, bacterial, viral or fungal. Inflammation as rheumatic fever Tissue damage as trauma, burn Malignant tumors Smoking.	An increase in the number of neutrophils	Neutrophilia
Allergic conditions as asthma, hay fever, skin allergy Parasitic infection Leukemia	an increase in the number of eosinophils	Eosinophilia
Allergic conditions as asthma, hay fever, skin allergy Leukemia	an increase in the number of basophils	Basophilia
Chronic infection as in tuberculosis Leukemia	an increase in the number of momocytes	Monocytosis
Chronic bacterial and viral infections Leukemia	an increase in the number of lymphocytes	Lymphocytosis

from the males slides

Leucopenia (Leukopenia)

decrease in the total leucocyte count below 4.000/mm^3.

In this condition the body is not protected against infections and death may occur.

It is caused by:

- **Bone marrow depression by radiation, drugs, and cancer chemotherapy.**
- **Some bacterial infections as typhoid fever, brucellosis.**
- **Some viral infections as AIDS, influenza, hepatitis.**
- Malnutrition (**decrease B12, folic acid**)

بالعادة لما يكون فيه Feverتزيد ال WBCإلا هذا النوع لو كان الشخص عنده Feverوقلت WBCرح يشكوا typhoid fever بال

Leukaemia

Cancer of white cells due to chromosomal abnormality caused by chemicals, radiation, and viruses
It is a malignant disease of bone marrow causing marked increase in WBCs , WBC more than $50x10^3$

Types of leukaemia:
Myeloblast leukaemia → myeloid cells
Lymphoblast leukaemia →lymphocytic cells Acute or chronic onset

Leukemia is associated with anemia and bleeding tendency (due to decrease in bone marrow area responsible for RBCs and platelet synthesis respectively).

from the female slides

Choose the correct answer

Quiz

1

- **All of the following are granular WBC EXEPT**

1) neutrophil
2) basophil
3) lymphocyte
4) Eosinophil

2

- **The monocyte formation site is:**

1) bone marrow
2) thymus
3) lymphoid tissues

3

The attraction of the neutrophils to inflamed area is:

1) Margination
2) chemotaxis
3) Diapedesis

4

- **Monocytes stey in the blood**

1) weeks
2) months
3) 10–20 days
4) 10–20 hours

5

- **Humoral immunity is the function of:**

1) T–lymphocye
2) B–lymphocye
3) monocytes
4) Basophil

6

- **Leukaemia is considered as:**

1. Cancer of white cells due to uncontrolled growth of cells
2. Cancer of white cells due to chromosomal abnormality
3. Increase in WBC
4. Decrease in WBC

1) 3
2) 1
3) 2
4) 4
5) 2
6) 2

Thank you & good luck

Boys team members:

- أنس السويداء
- محمد الحسن
- محمد الجمعة
- محمد القحطاني
- محمد المحيميد
- محمد الصويغ
- خالد العقيلي
- خالد الدوسري
- خالد شويل
- عبدالجبار اليماني
- عمر الفوزان
- فهد الحسين
- سعد الهداب
- سعد الفوزان
- نواف اللويمي
- انس السيف
- سعود العطوي
- نايف المطيري
- نواف اللويمي
- نواف هلال
- عبدالرحمن العقيل
- عبدالله الربيعة
- عبدالله الزيد
- عبدالله العمر
- عبدالله المعيذر

Girls team members:

- مها العمري
- هديل عورتاني
- ريما العنزي
- روتانا خطيب
- لجين عزيز الرحمن
- العنود المفرج
- ريم القرني
- عهد القرين
- العنود المنصور
- مها النهدي
- بلقيس الراجحي
- سارة البليهد
- ميعاد النفيعي
- نورة البسام
- عبير العبدالجبار
- وجدان الشامري
- الجوهرة الشنيفي
- العنود المنصور

Team Leaders:

-مها بركة -طارق العميم