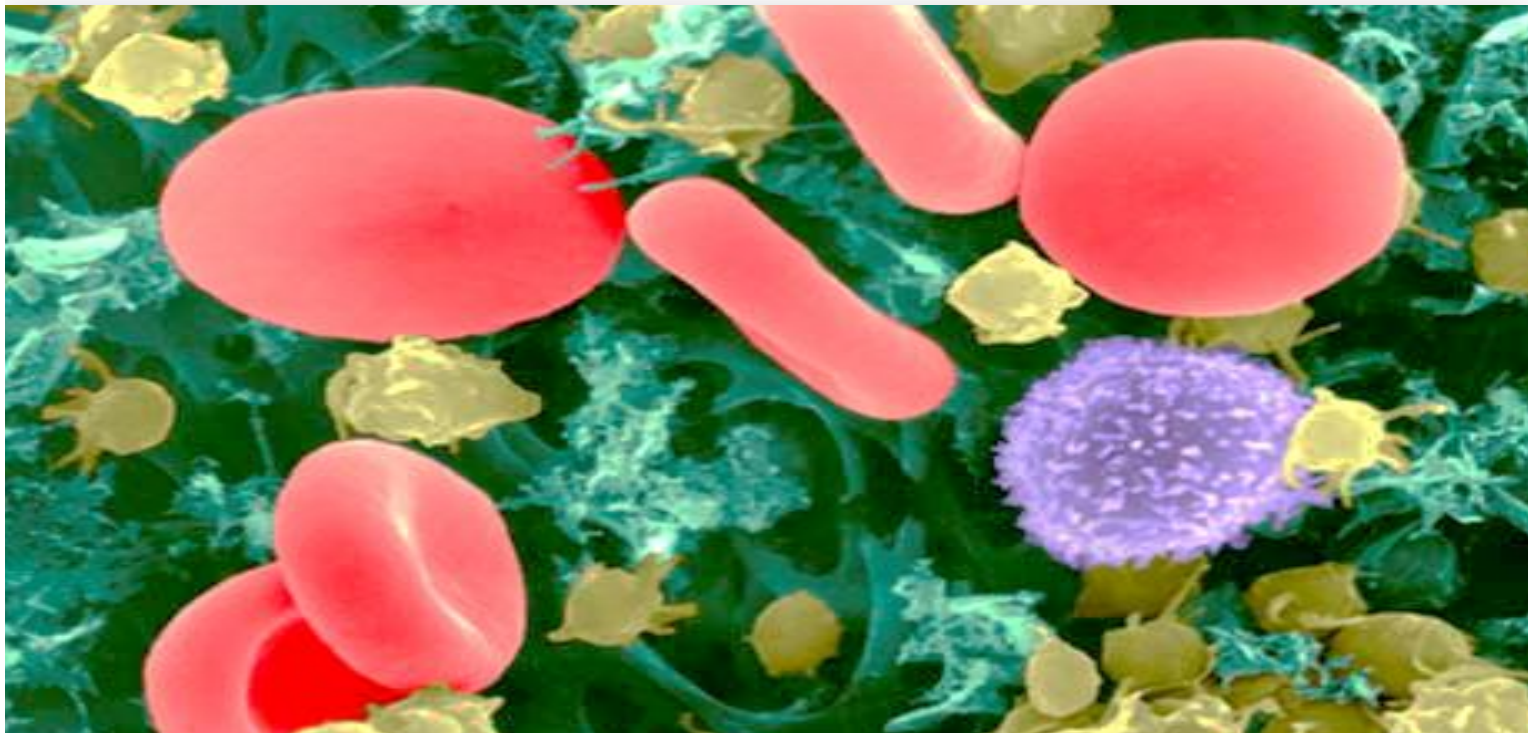


Dr. Adel AlMogren

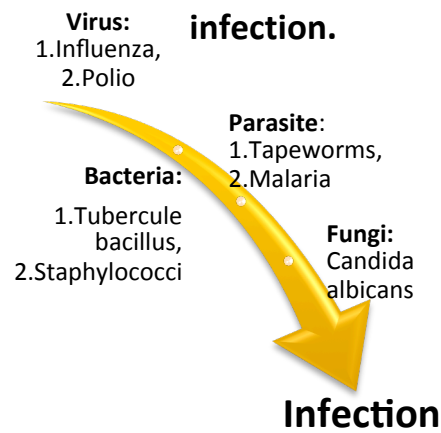
Natural Defense

Lecture 2

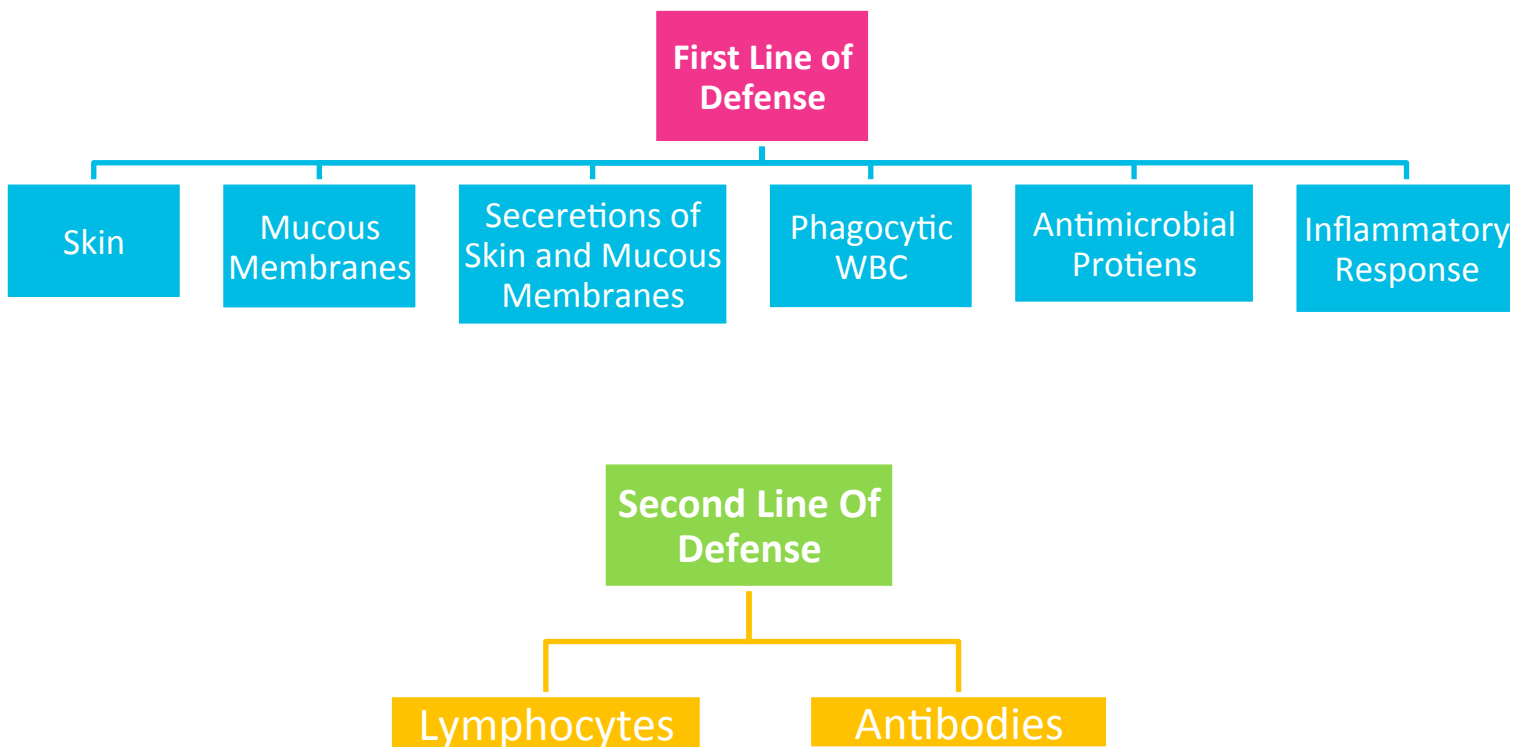


Function

- The main function of the immune system is to **protect from infection.**

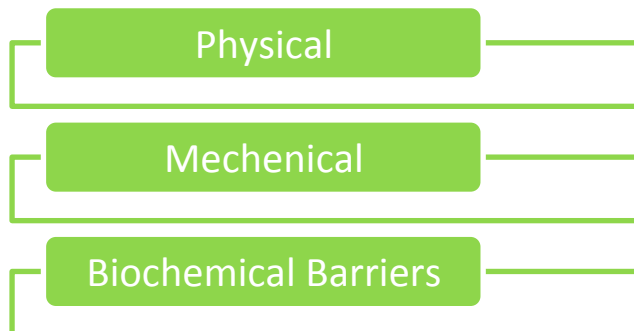


Lines of Defense



First Line of Defense

- It's natural (*innate*) immunity.



1. Physical

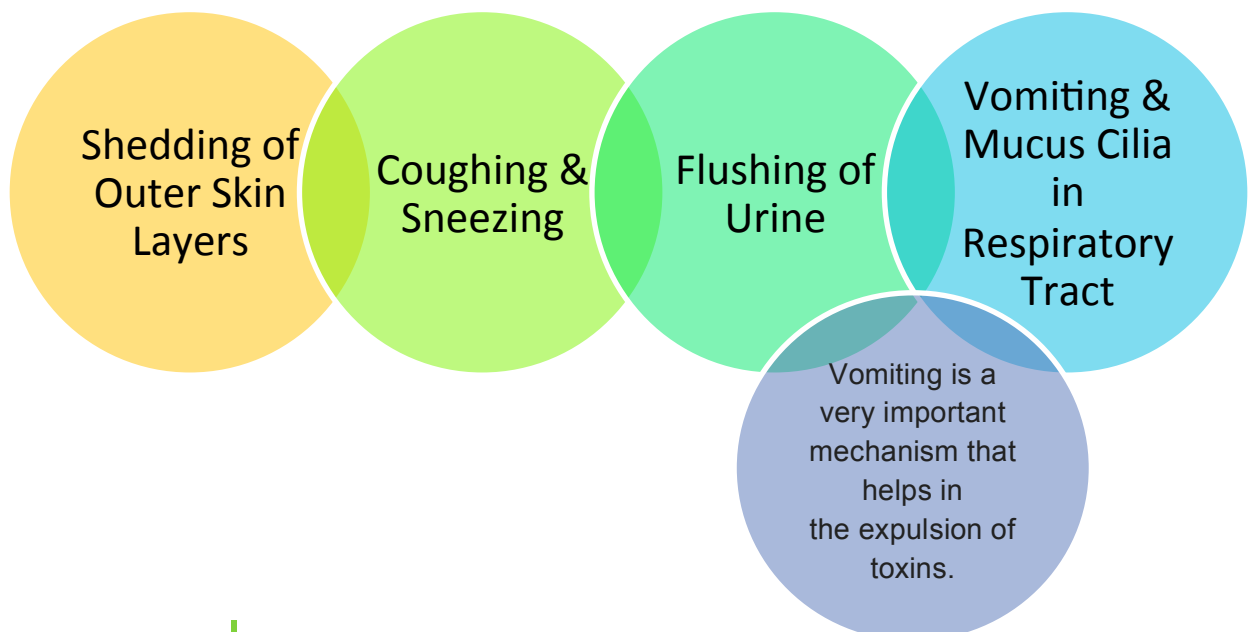
Skin (*impermeable to microbes*).

- The skin is the first thing to destroy from burns. Also, skin protects us from infections.
- People die because of large parts of skin is destroyed. A lot of fluid comes out and a lot of infections take a place. People don't die because of the burns itself, but they die because of the complication as a result of loss of the skin.

Mucous Membranes

- Lining the GIT
- Genitourinary Tract
- Respiratory Tract

2. Mechanical



3. Biochemical Barrier

Body-secretions Contain Anti-bacterial Substances	Antimicrobial Peptides	Normal Flora
<ul style="list-style-type: none">• Salvia• Tears• Sweat	<ul style="list-style-type: none">• Defensins• Hecpidins	<ul style="list-style-type: none">• Compete with pathogenic bacteria for nutrients.

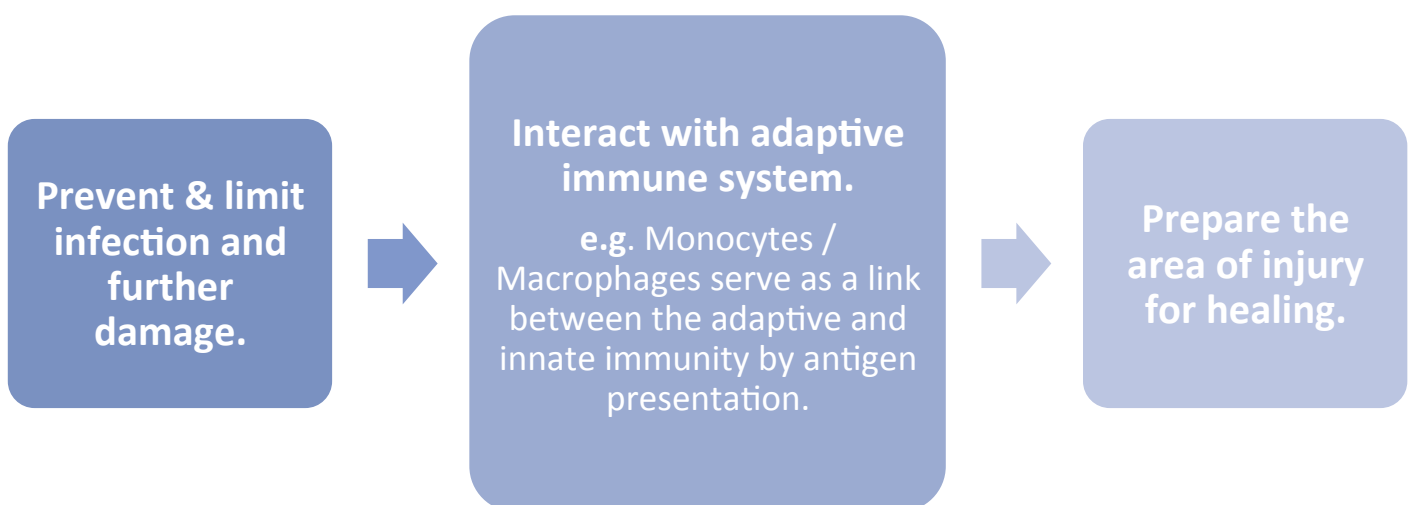
Inflammation:

- Inflammation is the *first response* of the immune system to infection or irritation. And it consists of series of *vascular & cellular* changes that occur in response to various stimuli.
- Inflammation is good because it can tell you that you need help.

Inflammation: It's initiated when the microbe has an array of pro-inflammatory molecules.

e.g. Lipopolysaccharides

Goals of Inflammation



Notes:

- Inflammation is an important part of healing. If there no inflammation there is no healing, the bacteria will keep spreading.
- To go and see doctor, it protects you from invaders organism.
- Inflammation is good, but it can be damaging, because wherever there is inflammation there is tissue damage.
- If is the inflammation in vital organ it can lead to permanent damage, **e.g.** nervous system.
- Inflammation in an organ which is your own, if the immune system attacks it and inflames it, it will destroy that organ.
- Inflammation is good and bad both.
- Lipopolysaccharides it is very strong stimulation of the immune system, it could also serve as antigen.
- LPS comes from the cell wall of gram negative bacteria.
- If there no inflammation and the bacteria still spreading there will be no repair.

The Complement System

- Consists of a group of serum proteins that circulate in inactive form once they become activated they produce important biological effects that initiate inflammation.
- The Complement System makes a hole in the bacterial cell wall when it is activated.
- This system plays an important role in Innate and Adaptive Immunity.
- There are 9 component complements and they are mainly produced in the liver.
- They are circulating in our system in an inactive form.
- They are only required when there is an inflammation or destruction of something.

Pathways of Activation:

The Complement System Has 3 Pathways of Activation:

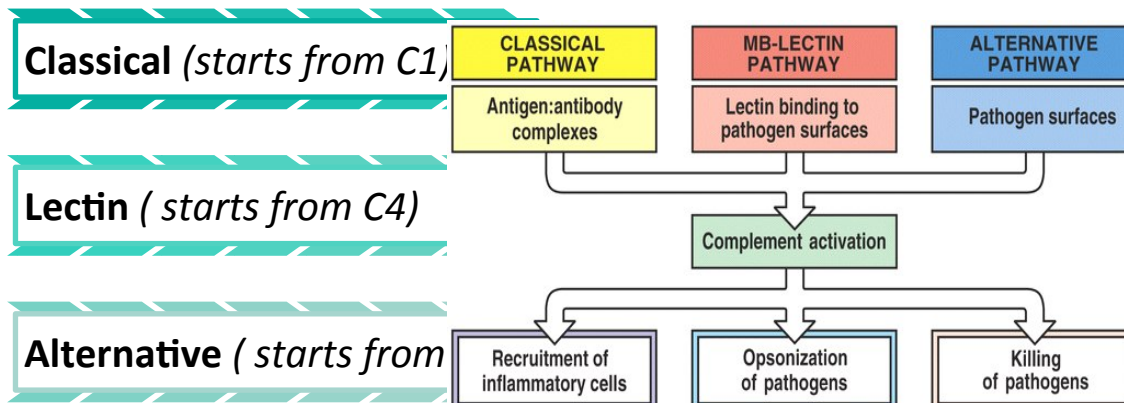


Figure 2-18 Immunobiology, 6/e. (© Garland Science 2005)

1. Classical: **Requires antigen-antibody binding.**
(C1-C4-C2-C3-C5-C6-C7-C8-C9)
2. Lectin: **Activated by mannan binding protein, binding manose group of bacterial carbohydrates.**
(-C4-C2-C3-C5-C6-C7-C8-C9)
3. Alternative: **Activated by bacterial products.**
(-C3-C5-C6-C7-C8-C9)

❖ **Why does C4 come before C2 in the sequence?**

Because it was discovered after C3 but it works in the place of C2.

Functions of Activated Complement System:

1. **Recruitment of inflammatory cells:** attracting more cells to the site of inflammation.
2. **Opsonization of pathogens:** makes the bacteria suitable for the phagocytes to eat and destroy.
3. **Killing of pathogens:** by making a hole in the cell wall of bacteria.

Lytic Pathway

- When C1 is activated it becomes an enzyme for C4, and C4 becomes an enzyme for C2 and so on.
- When C1 is activated it breaks down C2-3-4-5 into A and B.

	A Cell	B Cell
Site	Released In The Tissue	Attached To The Bacterial Cell Wall
Function	Attracting Other Cells of The Tissue	Opsonization

Biological Effects of Complement Activation

Anaphylatoxin: (C3a, C5a)

- Induce *histamine* release from mast cells.
- Release *chemotactic agents*.

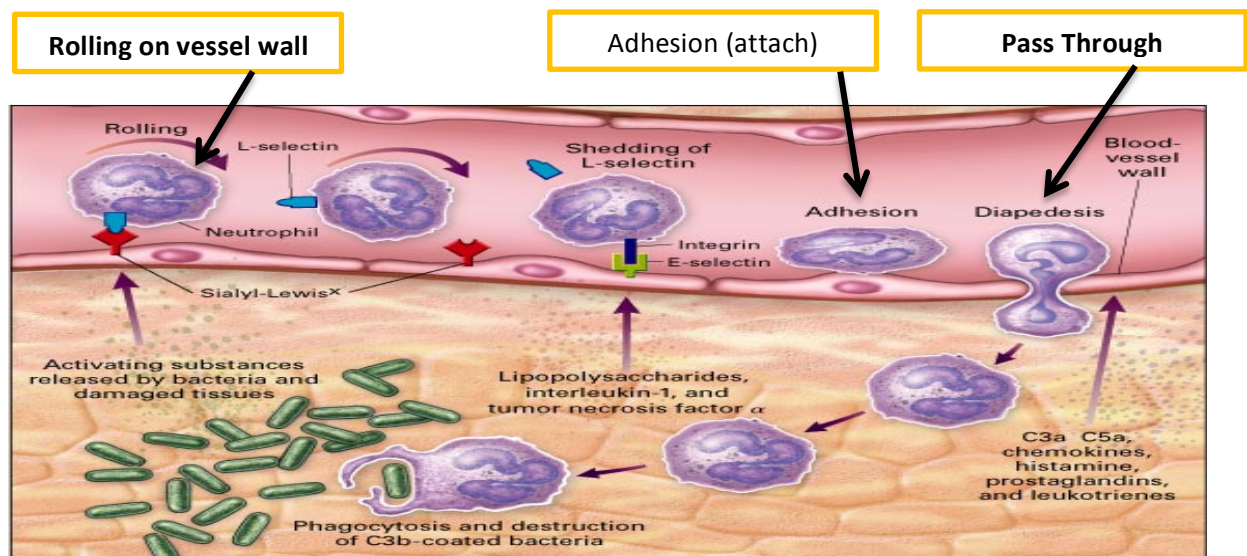
Opsonization: (opsonin, C3b)

- Coating bacteria enhances phagocytosis.

Cause Direct Cell Lysis

- Destruction of bacteria.

Process of Chemotaxis

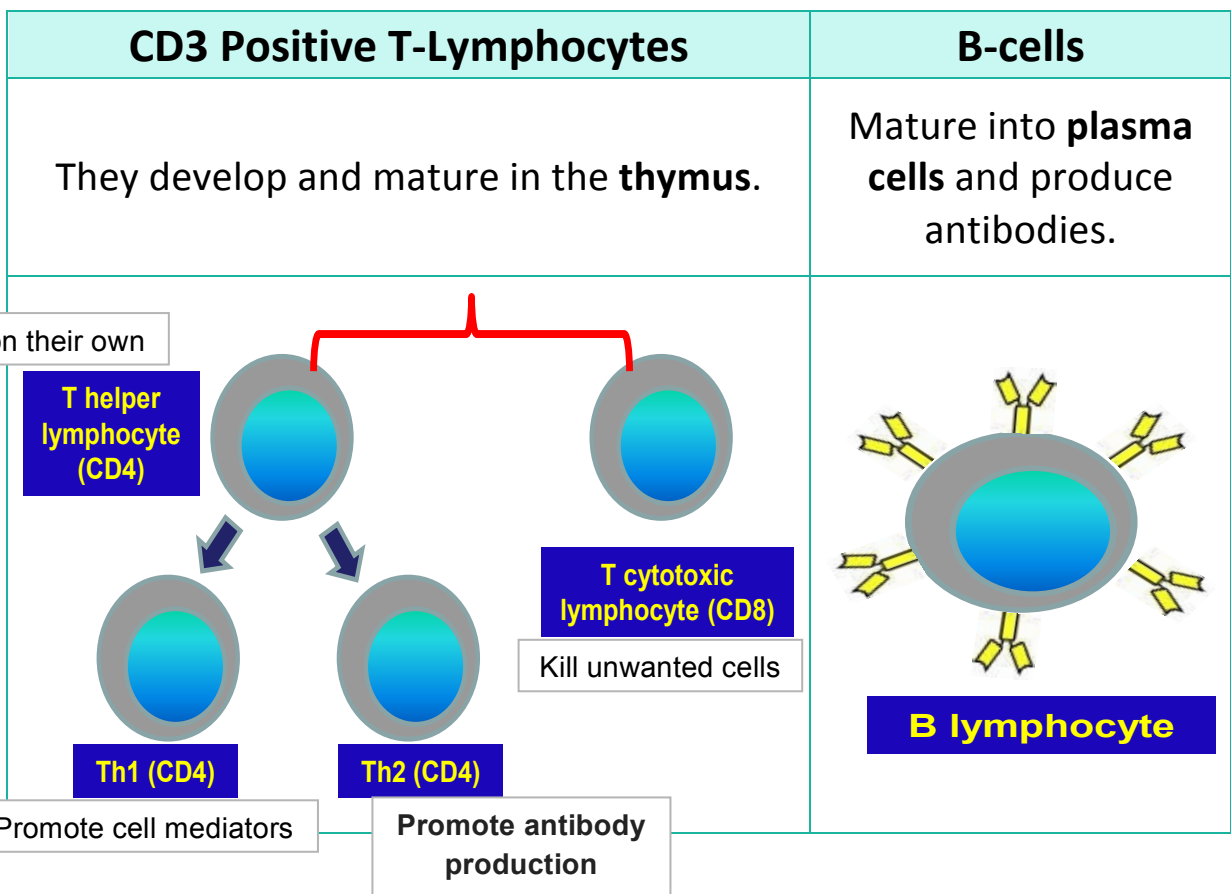
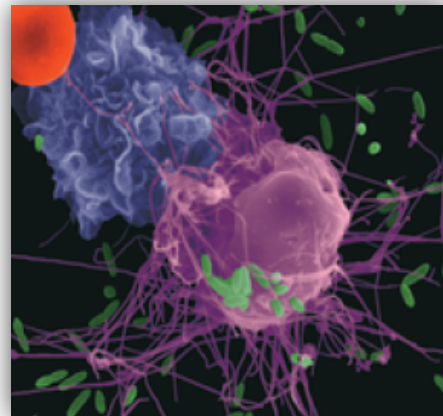


Types of Cells Attracted To Site of Infection That Mediate Inflammation

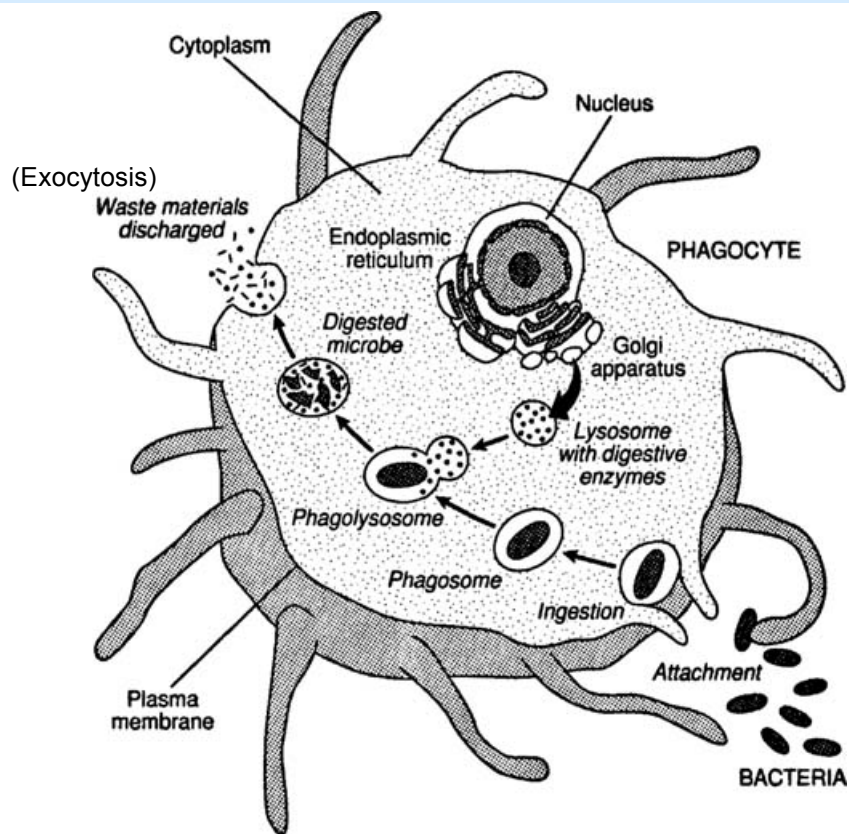
- ❖ **Monocytes:** become macrophages when they leave the blood and enter the tissues.
- ❖ **Neutrophils:** phagocytic cells.
- ❖ **Eosinophil:** allergy and parasitic infections.
- ❖ **Natural Killer (NK) cells:** kill tumor cells and virus infected cells.

Phagocytosis: The process by which a cell ingests and destroys foreign material.

- Phagocytic cells (**neutrophils & macrophages**) at site of infection start the process of **phagocytosis**.



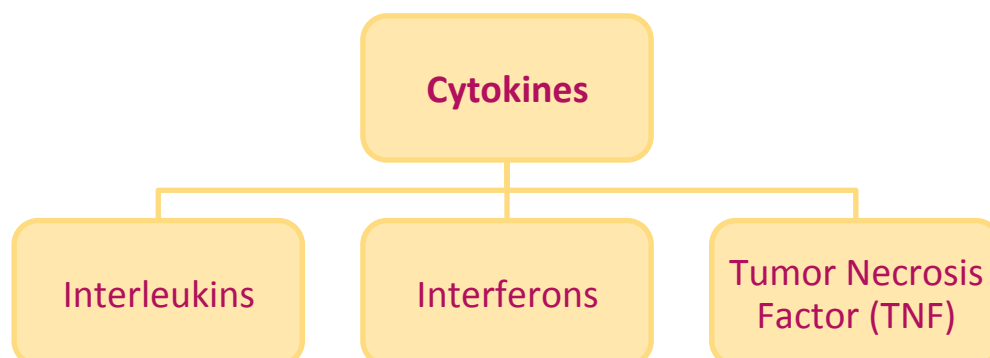
Process of Phagocytosis



Cytokines

Cytokines: Soluble molecules, produced by different cells, which control cell functions.

e.g. activation or inhibition



Interleukins:

- Produced primarily by macrophages and lymphocytes in response to a pathogen.
e.g. IL-1, IL-2, IL-3...

Interferons:

- Protects against *viral* infections.
- Produced and released by virally infected cells in response to viral infections.

Tumor Necrosis Factor (TNF):

- Secreted by macrophages.
- Induces fever by acting as an **endogenous pyrogen** (a substance released from inside the body that produces fever).
- Increases synthesis of inflammatory serum proteins.

Remember:

- Non-specific (**innate immunity**) acts as a first line of defense against invading pathogens.
- Innate immunity is an important *initial step* for generation adaptive immune response
- Inflammation is vital for controlling infection and limiting tissue damage.