



# Pathophysiology

2<sup>nd</sup> Year, 2<sup>nd</sup> Semester

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## Lecture (4): Inflammation and immunity



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## ➤ **The immune system**

### ➤ **Immunology ?**

- study of the immune system and its effects on the body and on invading microorganisms.
- ❖ **Immune system** protects the body from invasion by micro-organisms and it is linked to many different organs and cells of the body.
- ❖ The **immune system** is an intricate system of **cells**, **enzymes** and **proteins**, which together protect the body by making it resistant against microorganisms (bacteria, viruses, fungi), as well as larger organisms such as worms.

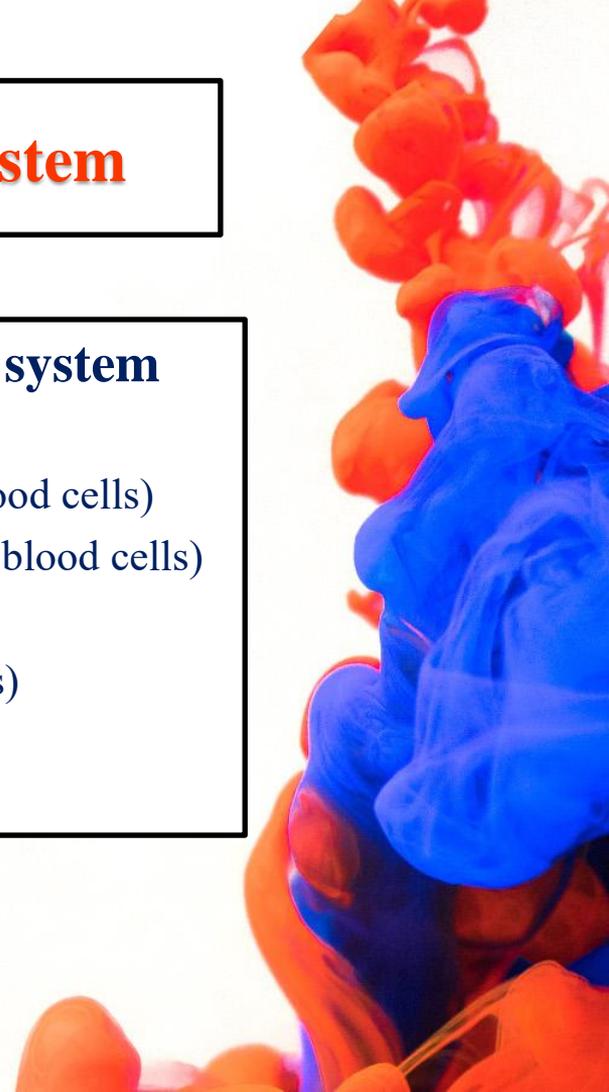
# Organs, cells, and proteins of the immune system

## The lymphatic system

- The tonsils and adenoids
- The thymus gland
- The lymph nodes
- The spleen
- The appendix
- Patches of lymphoid tissue in the intestinal tract.

## The circulatory system

- The bone marrow
- Lymphocytes (white blood cells)
- Phagocytic cells (white blood cells)
- Dendritic cells
- Thrombocytes (platelets)
- Complement proteins.





## The lymphatic system

- The lymphatic system is similar to the blood system and consists of a specialized system of **lymph vessels** (similar to blood vessels) and **specialized lymph nodes** and **tissue**.
- **Unlike** the circulatory system, the lymphatic system does not have a heart to pump the lymph around. **Instead, the lymph (which fills the lymph vessels) is pushed around the body by a combination of contractions of the smooth muscular walls of the lymph vessels, as well as the flexing and relaxing of striated muscle in the body due to the movement of the individual.**

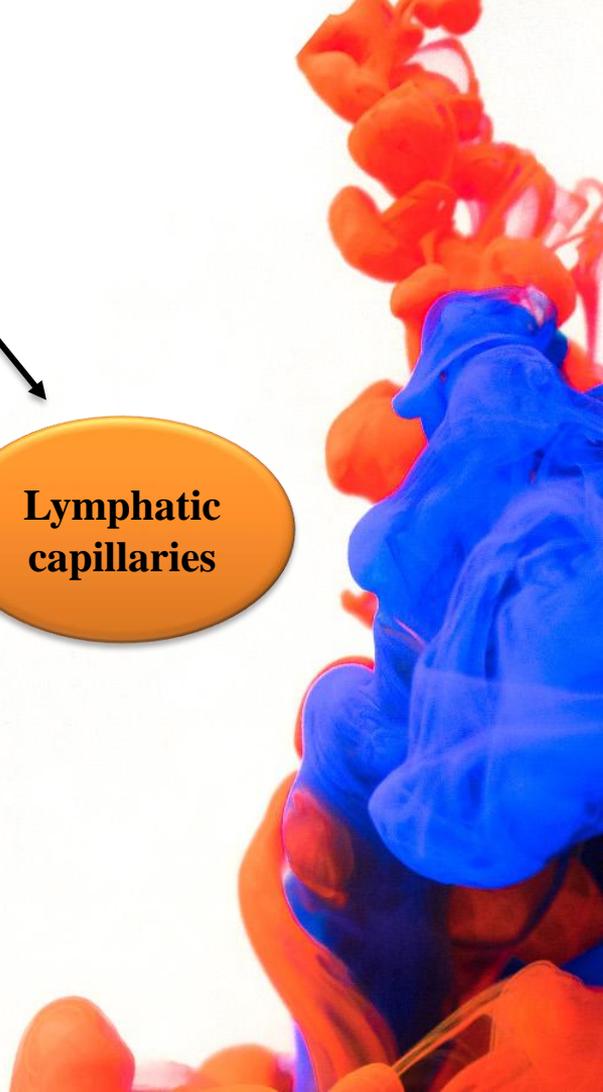
# Peripheral lymphatic system

Lymphatic  
vessels

Encapsulated  
organs

Lymphatic  
capillaries

- ✓ Spleen
- ✓ Tonsils
- ✓ Lymph nodes



Cervical lymph nodes

Thoracic duct

Lymphatics of the mammary gland

Thymus

Axillary lymph nodes

Cisterna chyli

Spleen

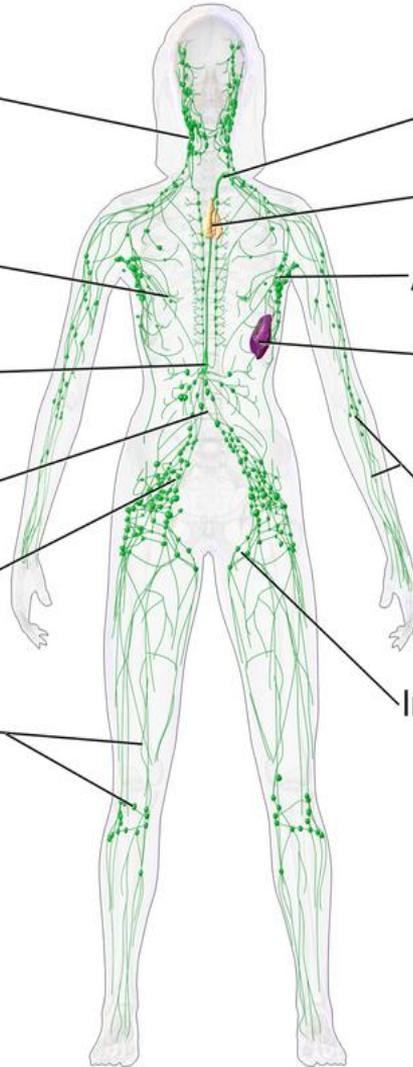
Lumbar lymph nodes

Lymphatics of the upper limb

Pelvic lymph nodes

Inguinal lymph nodes

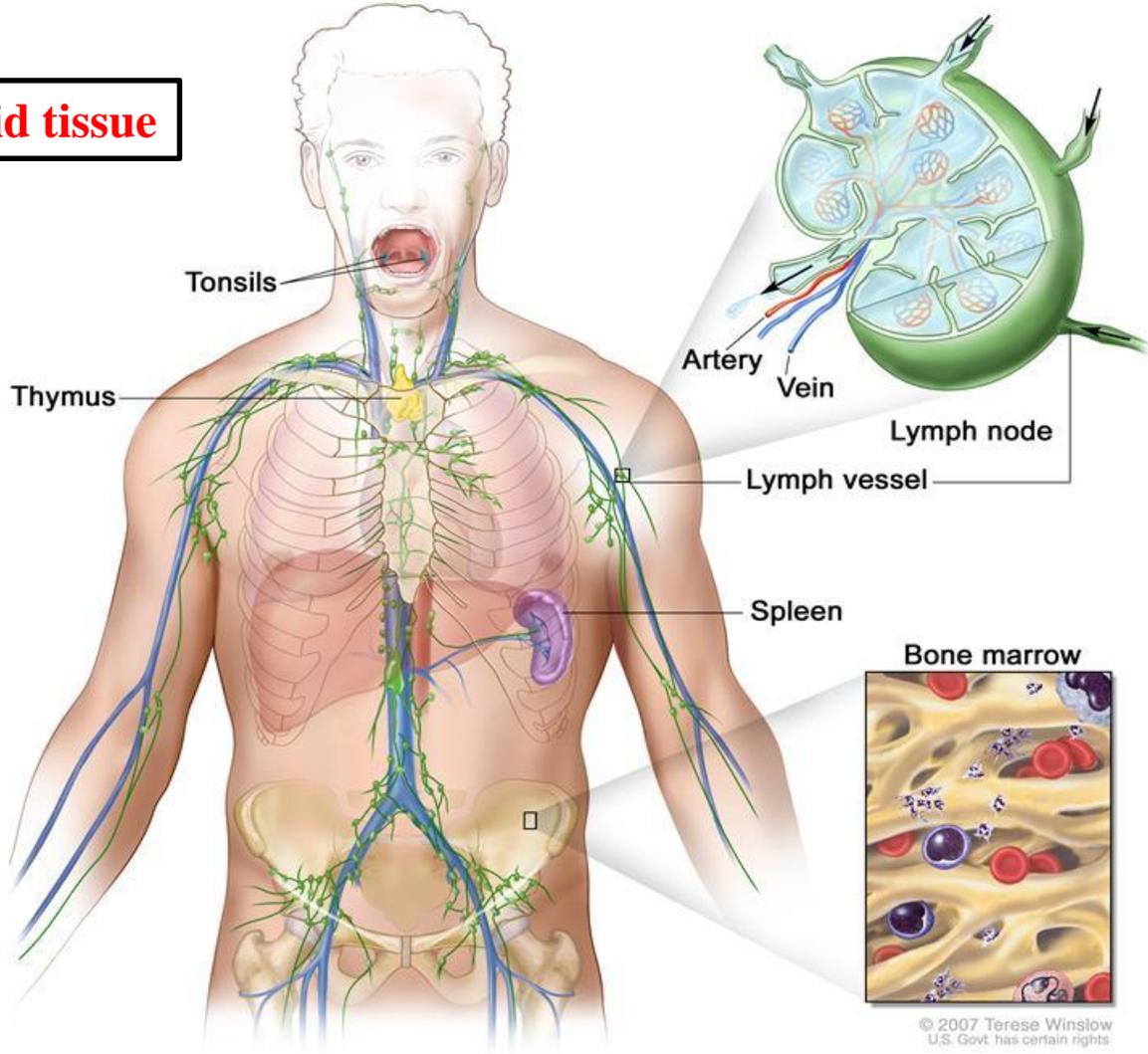
Lymphatics of the lower limb



**Lymphatic system**

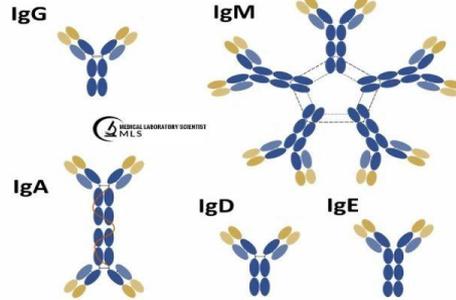
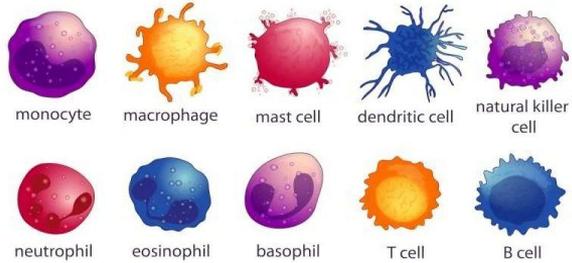


# Lymphoid tissue



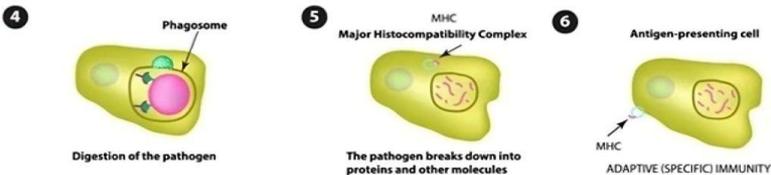
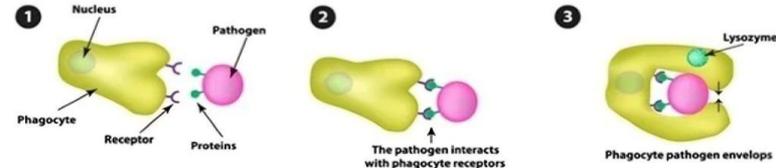
# Immune System: Innate vs. Adaptive Immunity

## IMMUNE SYSTEM CELLS

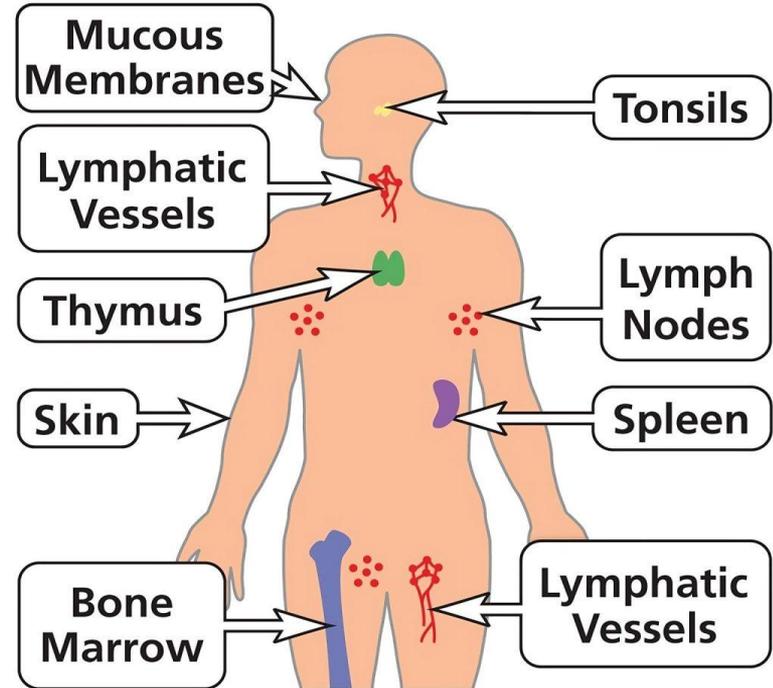


## PHAGOCYTOSIS

INNATE (NONSPECIFIC) IMMUNITY



## Immune System



# Types of immunity

**There are two types of immune defense systems:**

1. Non-specific (or innate) immunity
2. Specific (or acquired) immunity.

## **Non-specific (or innate) immunity**

1. Physical barriers
2. Mechanical barriers
3. Chemical barriers
4. Blood cells.

## **Specific (or acquired) immunity**

- lymphocytes (white blood cells)



# Non-specific (or innate) immunity

## Physical barriers

- Skin
- Mucosal membranes

## Mechanical barriers

- Cilia
- Coughing
- Sneezing
- Tears

## Chemical barriers

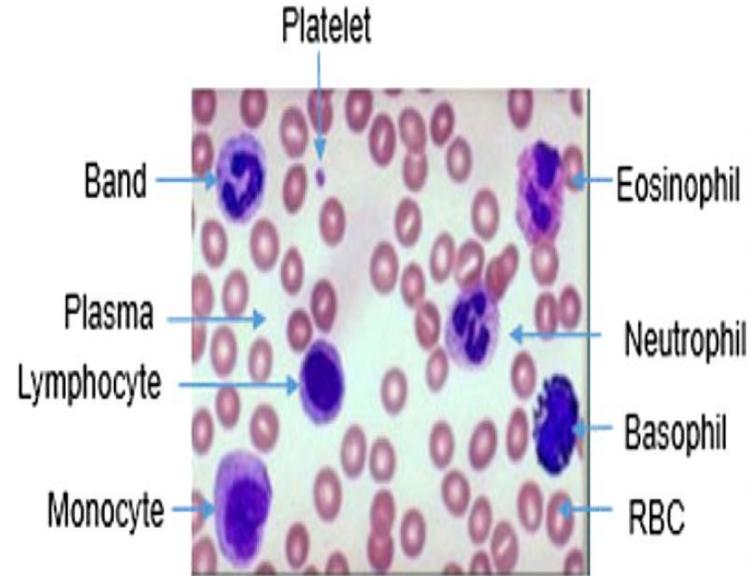
- Tears
- Breast milk
- Sweat
- Saliva
- Acidic secretions,  
including stomach acid
- Semen.



# Non-specific (or innate) immunity

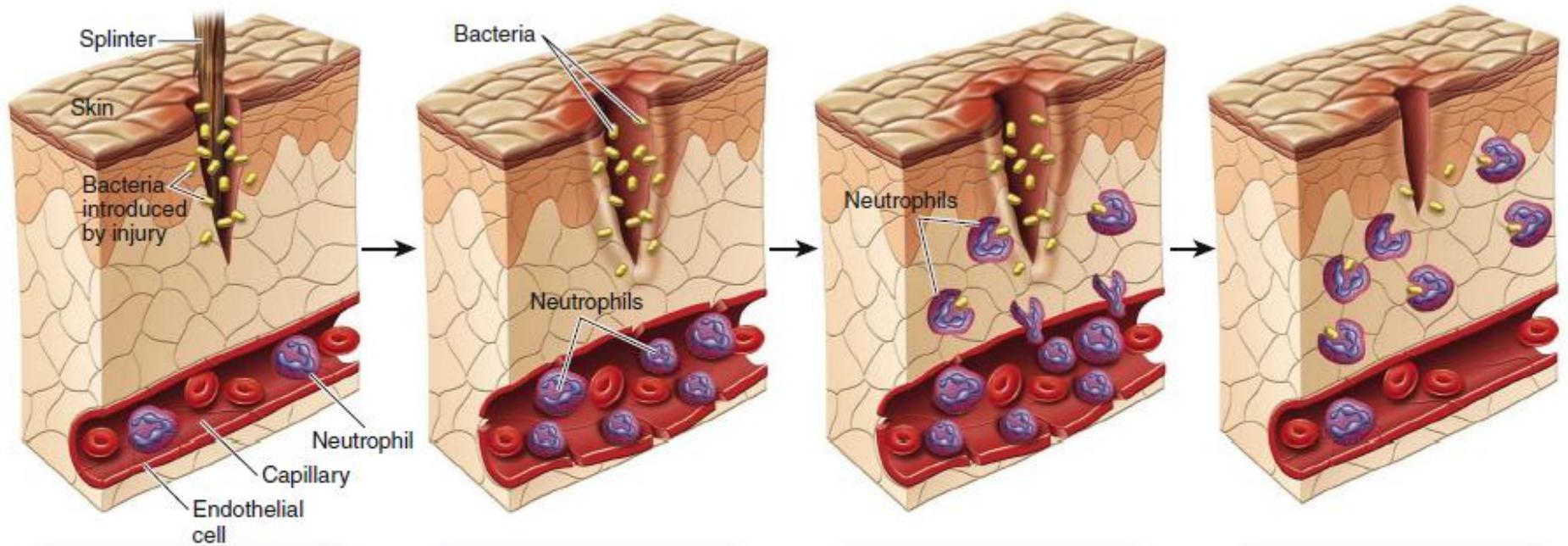
## Blood cells

- Neutrophils
- Monocytes and tissue macrophages
- Eosinophils
- Basophils
- Mast cells.



## Phagocytic cells

- Mononuclear phagocytes (these are the monocytes and macrophages)
- Polymorphonuclear phagocytes (neutrophils)
- Eosinophils.



**A** Bacteria are introduced into a wound

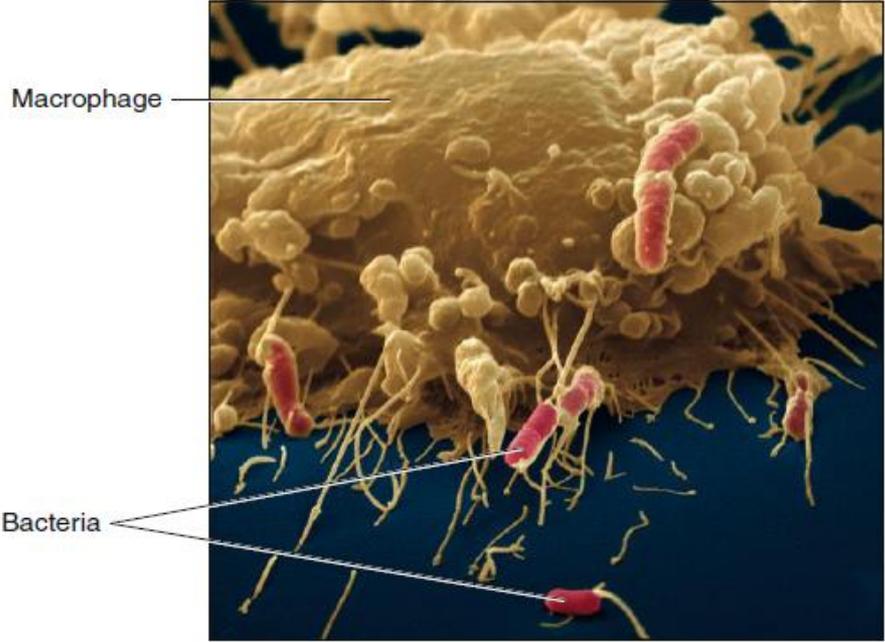
**B** Chemical mediators cause vasodilation and capillary permeability; chemoattractants recruit neutrophils to area

**C** Diapedesis results in neutrophils entering tissue where they engulf bacteria

**D** Capillaries return to normal as neutrophils continue to clear the infection

**The local inflammatory events occurring in response to a wound**

# Phagocytosis



See next slide



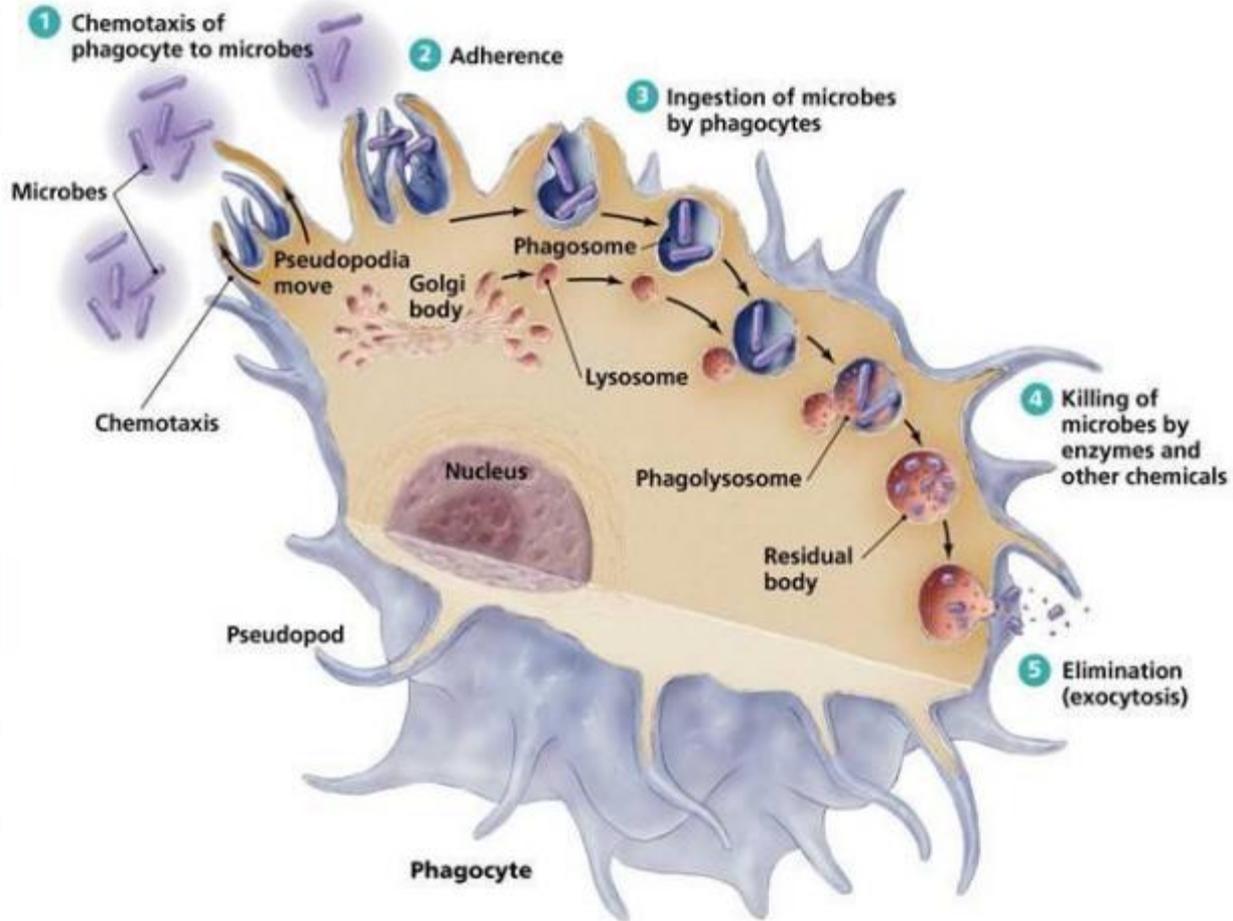
**1. Attraction**

**2. Adherence**

**3. Ingestion**

**4. Digestion or Killing**

**5. Elimination**





## Mediator cells

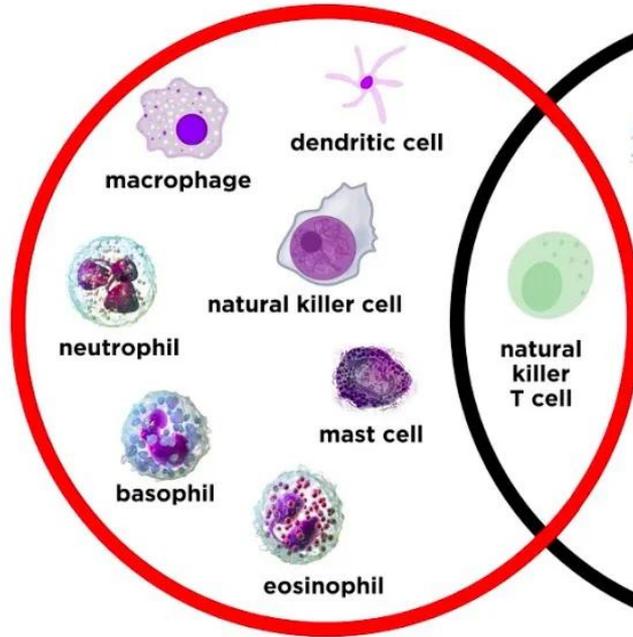
- A second group of cells of the innate immune system (the **basophils** and **mast cells**)
- described as the **helper cells** of the immune system. They do not actually destroy the invading microorganisms by phagocytosis but they help the phagocytes to do so.
- These mediator cells work by releasing various chemicals.
- **Platelets** are included because they help to block off and close any cuts and breaks in the skin, and so prevent invading microorganisms from getting inside the body.



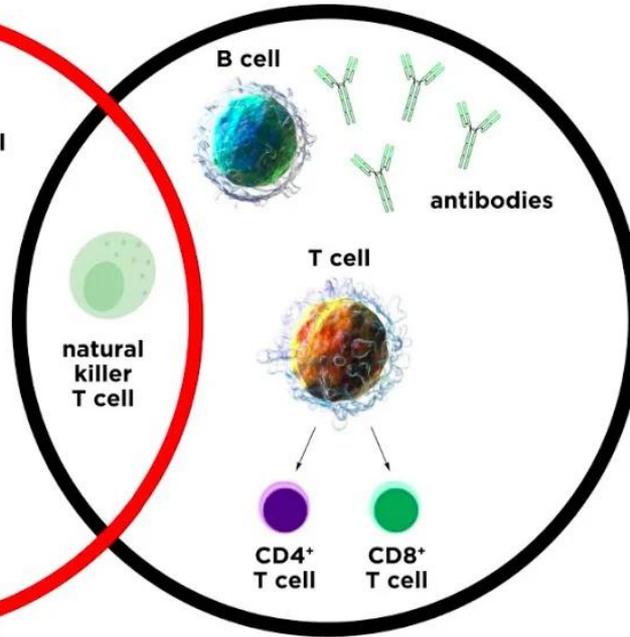
## Specific (Adaptive) immunity

- ❖ It gives the body immunity to specific pathogenic microorganisms.
- ❖ It consists of **lymphocytes** (white blood cells) that target specific invading microorganisms.
- ❖ This allows for a much more concentrated attack on pathogenic microorganisms that have broken through the body's initial defenses.

## Innate Immunity

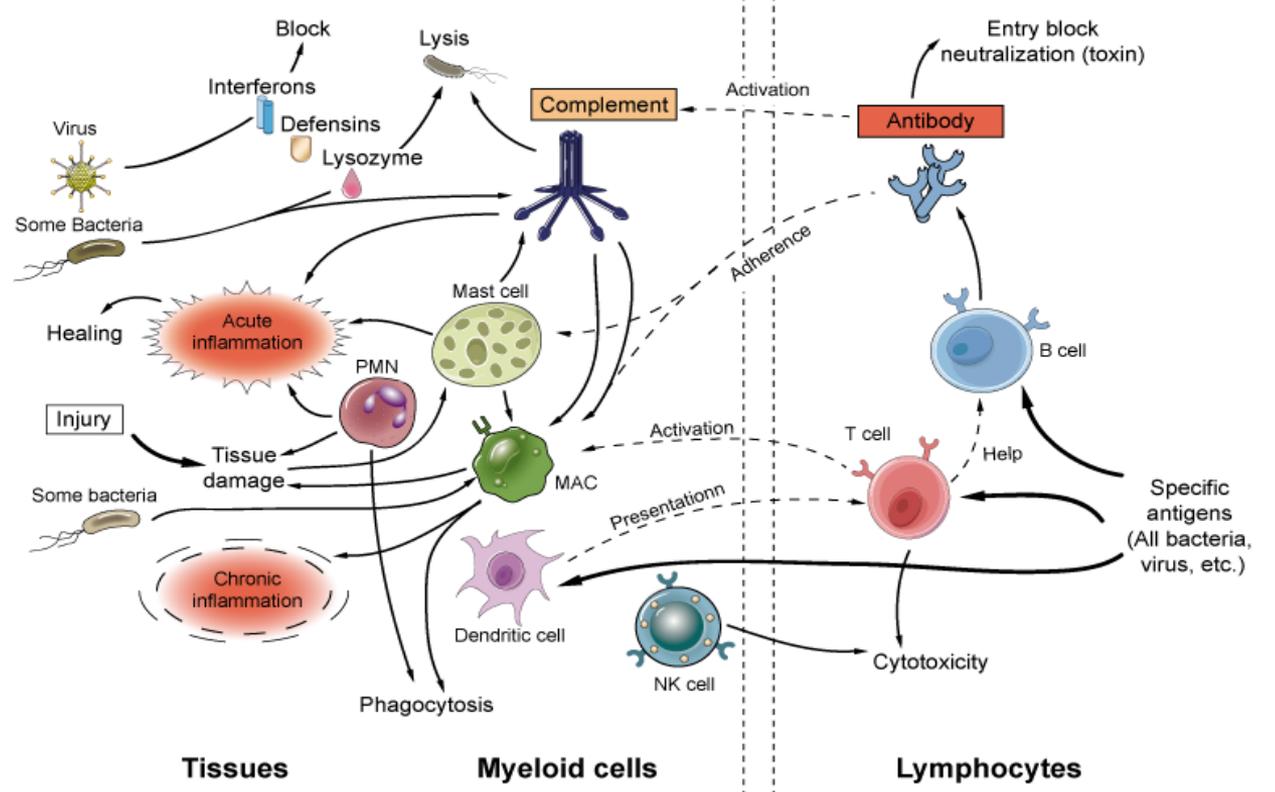


## Adaptive Immunity

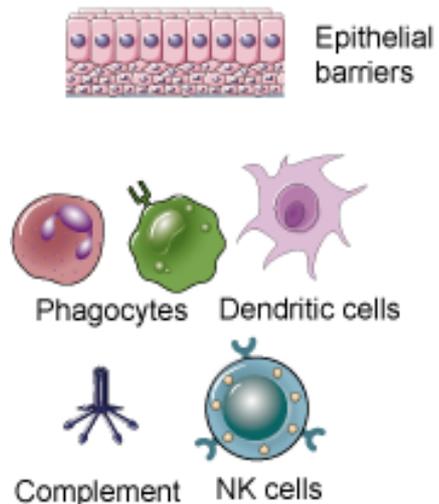




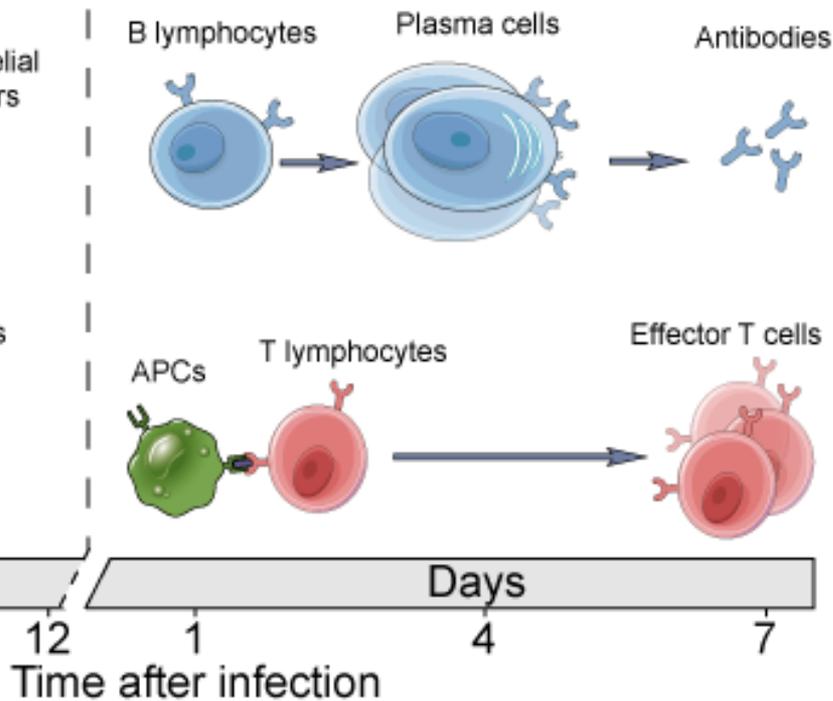
**Innate immunity** | **Adaptive immunity**



## Innate immunity



## Adaptive immunity



# Immune problems

➤ **Immunodeficiencies** - the immune system not working properly.

1. Primary immunodeficiency
2. Secondary immunodeficiency

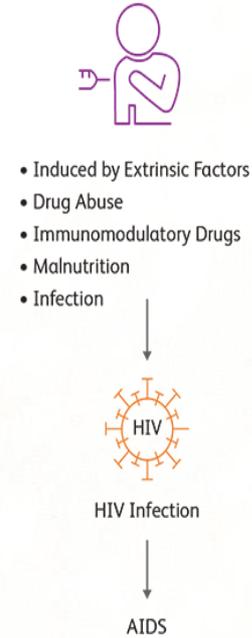
➤ **Autoimmune diseases** - the immune system in a person is working too well and attacking cells of the person's own body.

1. Diabetes
2. Rheumatoid arthritis
3. Allergy

## Primary Immune Deficiency



## Secondary Immune Deficiency



\* severe combined immunodeficiency syndrome (SCID)

# common variable immune deficiency (CVID)

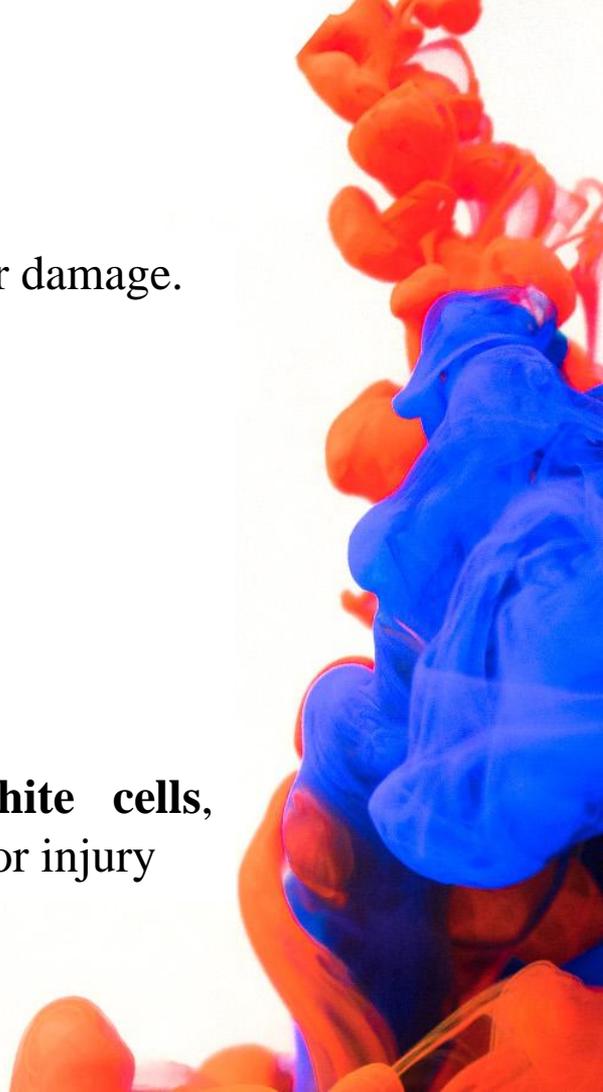
# Immune problems

**Inflammation** is the body's immediate reaction to tissue injury or damage.

**This damage can be caused by:**

- Physical trauma
- Intense heat
- Irritating chemicals
- Infection by viruses, fungi or bacteria.

The inflammatory process involves **the movement of white cells, complement, and other plasma proteins** into a site of infection or injury



# Inflammatory response

## ➤ Classic signs of inflammation:

1. Swelling
2. Pain
3. Heat
4. Redness.

## There may also be:

- Nausea
- Sweating
- Raised pulse
- Lowered blood pressure BP.



➤ Inflammation is usually initiated by injury to cells and tissues of the body and following this injury/damage, **three processes occur at the same time:**

**1. Mast cell degranulation**

**2. The activation of four plasma protein systems:**

- a. **Complement** (helps to orchestrate the inflammatory response)
- b. **Clotting** (stops bleeding and repairs damage)
- c. **Kinin** (involved in vascular permeability)
- d. **Immunoglobulins** (destroys bacteria)

**3. The movement of phagocytic cells**



**Thus, inflammation can be summed up as the presence of:**

- **Vasodilation** – redness/heat
- **Vascular permeability** – edema
- **Stimulation of nerve endings** – pain
- **Thrombosis** – clots
- **Cellular infiltration** – pus.



**Although inflammation does cause pain and other problems, it actually has beneficial properties and effects, namely:**

- The prevention of the spread to nearby tissues of infectious microorganisms and other damaging agents.
- The disposal of killed pathogens and cell debris.
- Preparation for repair of the damage.



*Thank you*

