



# Introduction to Immunology

Lecture-1-

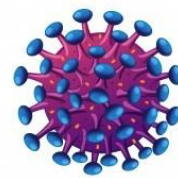
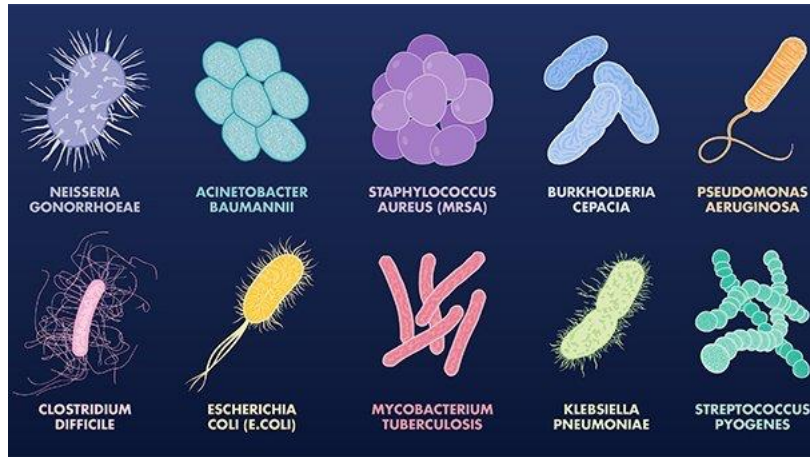
By

Harmand Ali

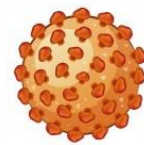
- Why?
- Where?
- When?
- Who?
- What?

- To control and fight against the threats!

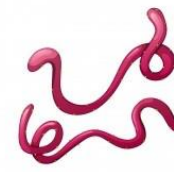
  - ❖ External threats



HIV



Hepatitis B



Ebola Virus



Adenovirus



Influenza



Bacteriophage

H.Pylori

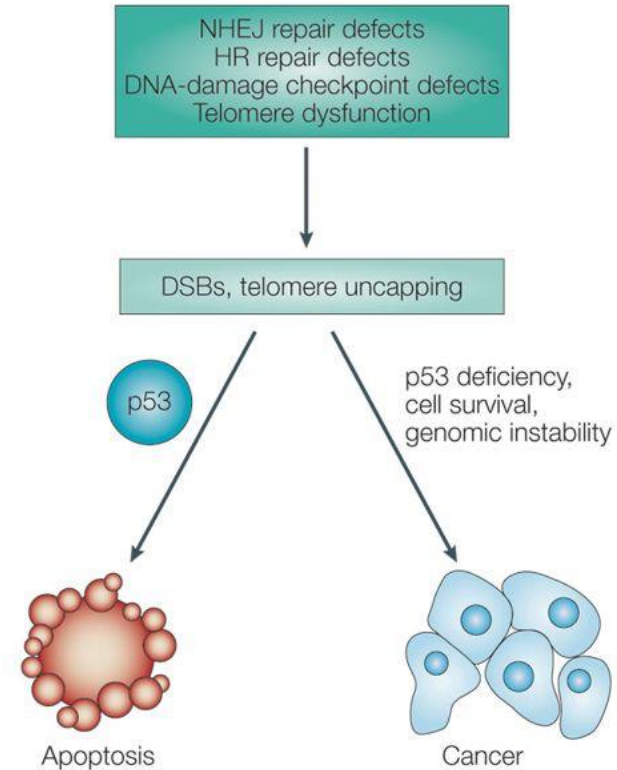
# Pollution



## ❖ Internal threats

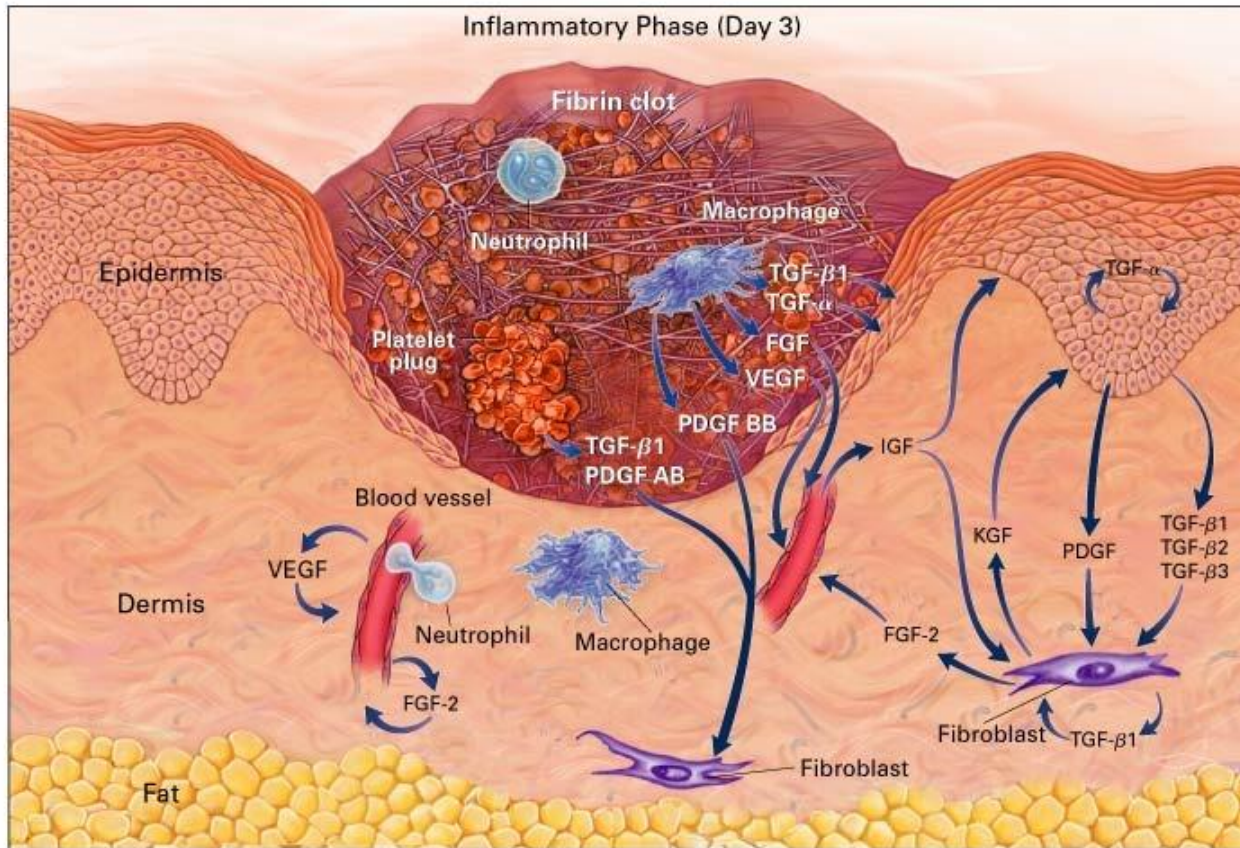
Apoptosis (Programed Cell death!)

**Cancer!** Failure of normal cell death



- **Promotion of normal bodily functions.**

Example/ wound repair and tissue clean up!



# The Aims of the Course

**This course will try to provide answers for the following questions:**

1. What is the immunity? What is the immune system? What are the main roles of the immune system?  
What are the basic types of immunity and the components of each?
2. What are the basic cellular components and organs that participate and form the immune system? What are the phagocytic cells and how they can phagocytose the foreign bodies?
3. What are the basic immunologic barriers that participate in the process of body defense?
4. What is the meaning of antigens, epitops, antibodies? How antigens and antibodies interact with each others? What are the important applications of antigen-antibody interaction?

5. What is the complement system? What are the complement proteins? How they become active? What are the consequences of their activation?
6. What are the inflammation processes? How body defense differentiate self from non- self antigens? What is the MHC and what are their types and roles? What are the autoimmune diseases?
7. What is the meaning of allergy, tolerance and hypersensitivity? What are the main types of hypersensitivity?
8. What is the meaning of immunodeficiency? What are the causes? What are the types? What are the main consequences of immune deficiency of the body in general? AIDS.
8. How the body defense mechanisms able to fight infectious agents? Tumor? And how these agents can escape or overcome the immune system?



# Immunology

- **Immunity**: The ability of the body to **fight, remove, control** or **slow down** the effects of foreign invaders, harmful extrinsic (bacteria, viruses,.....) and intrinsic agents (tumour cells...).
- **Immunology**: The study of body protection mechanisms from different types of foreign macromolecules or invading organisms (**such as viruses, proteins, worms, parasites....**) in addition to the body responses to these agents.

## Immunology history

- Since 1901 there have been 20 Nobel Prizes for immunological research.
- Examples: Discovery of human blood groups (1930) and Transplantation



# Immune system:

The sum of organs, tissues, cells and body defense mechanisms that participate in the process of immunity, in addition to a set of interacting specialized cells and proteins which designed to identify and destroy foreign invader.

**\*\* The immune system have the ability to differentiate between (“self”) and “non-self” through a highly specialized receptors present**



## **The Nature of Disease**

- Pathogenic Organisms
- Genetic Disorders
- Toxic Chemicals
- Other Environmental Factors
- Physical Damage to Organs
- Nutritional Disorders

## **Types of Pathogenic Organisms**

- Viruses; Bacteria; Protozoan; Fungi; Animal; Parasites

# Types of Immunity

The process of body defense mechanisms can be done in two different essential types:

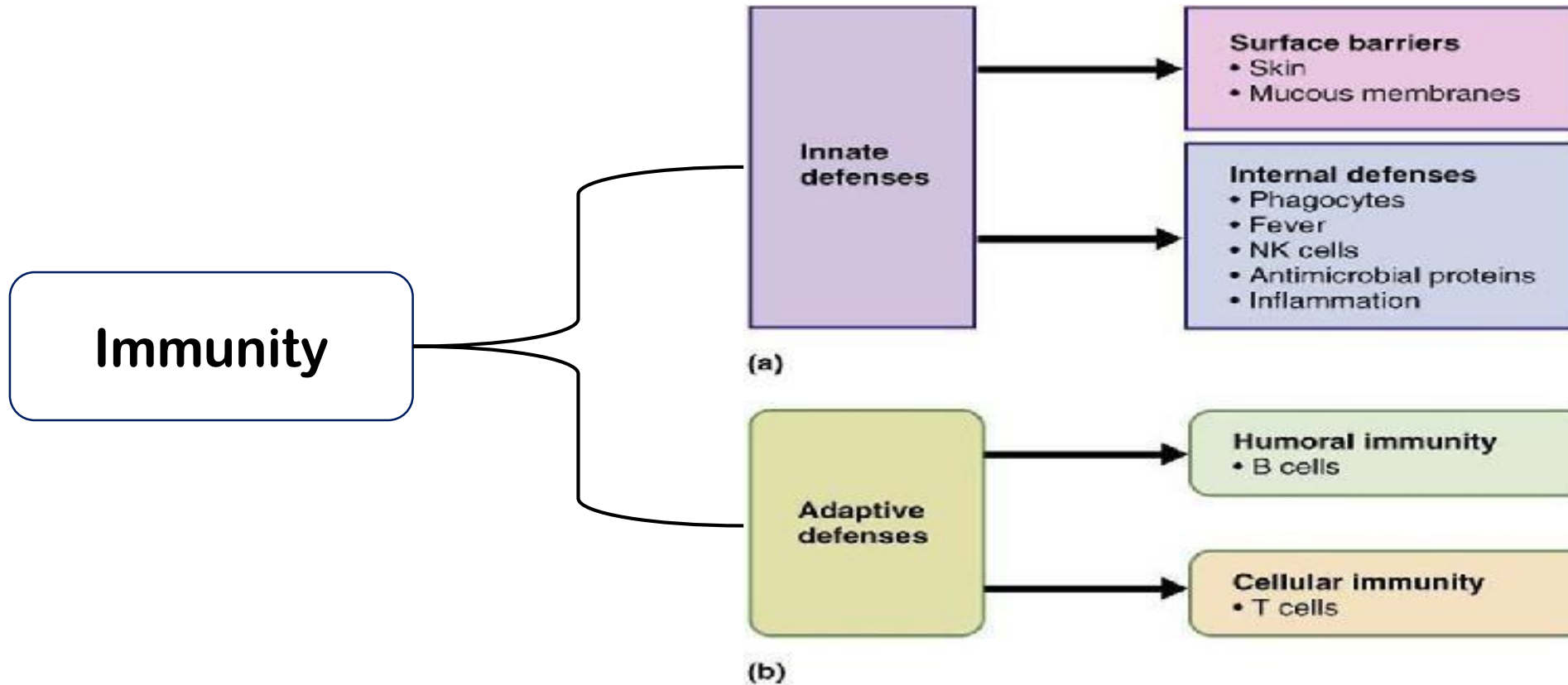
1)The **innate** (natural or nonspecific) immunity.

2)The **adaptive** (acquired or specific) immunity.

\*These two systems perform many of their functions by cooperative interactions

Types of Resistance	Examples
Nonspecific (innate)	Mucous membranes Phagocytic cells Enzymes in secretions Interferon
Specific (acquired)	
Naturally acquired	Placental transfer of antibody (passive) Recovery from disease (active)
Artificially acquired	Administration of antitoxin (passive) Vaccination (active)

# Immune System



# Immunity

## Innate immunity

### Components

Macrophages

Granulocytes

Natural killer cells Complement

Other chemicals: HCl, lysozyme

### Characteristics

\*Action is immediate

\*Response is non-specific

\*Response is not enhanced on repeated exposure to pathogen

## Adaptive immunity

### Humeral

### Cell-mediated

### Components

antigen presenting cells

T-cells

B-cells

Antibodies

Complement

### Characteristics

\*Action requires days to develop

\*Response is specific

\*Response is enhanced on repeated exposure to pathogen

# The immune system

## Immune system

### Innate (non-specific) immunity

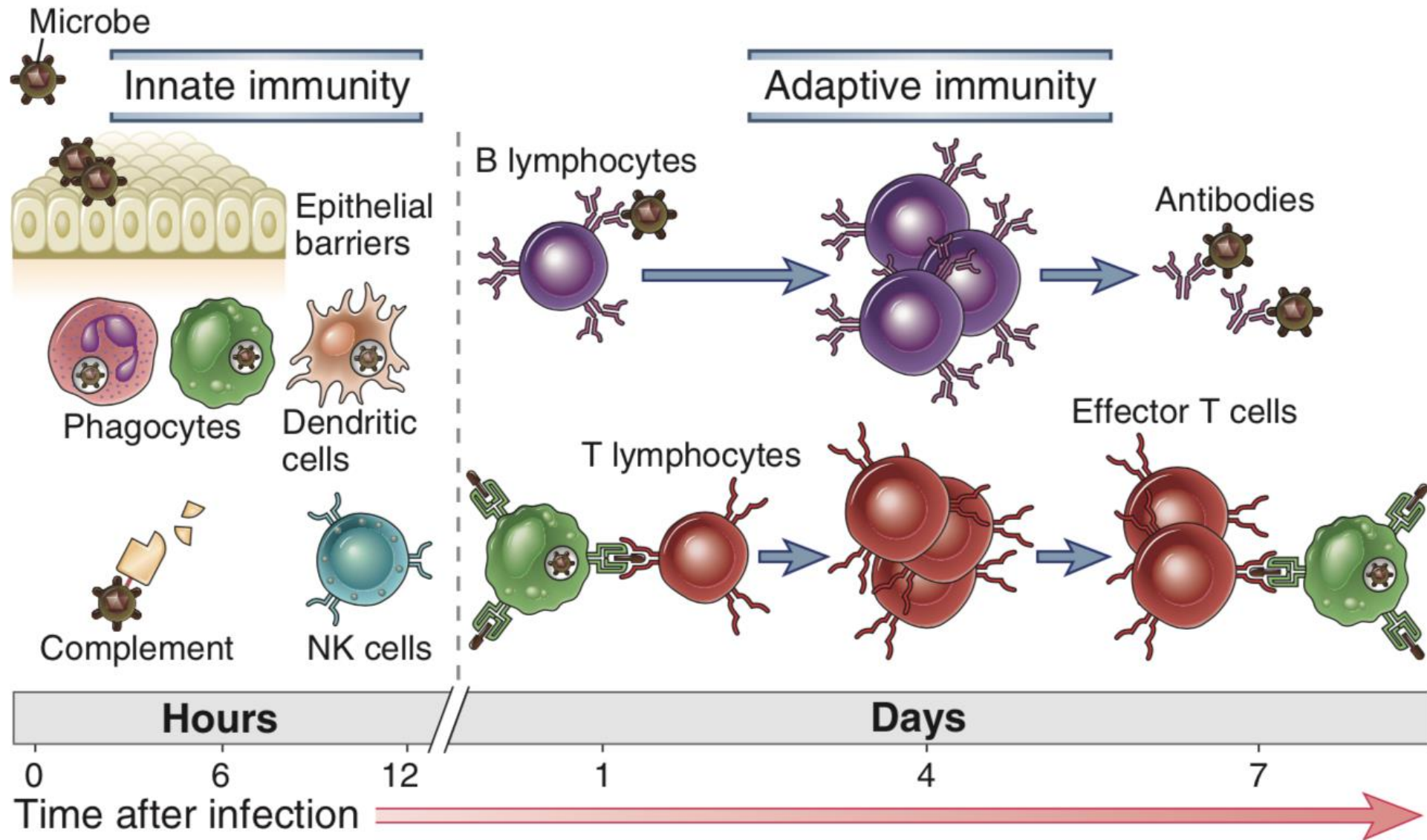
- Anatomic barriers (Skin, ,mucous membranes.....)
- Physiological barriers (temperature, pH.....)
- Phagocytic Barriers (cells that eat invaders)
- Inflammatory barriers (redness, swelling, heat and pain)



### Adaptive (specific) immunity

- Antigen specificity
- Diversity
- Immunological memory
- Self/non-self recognition



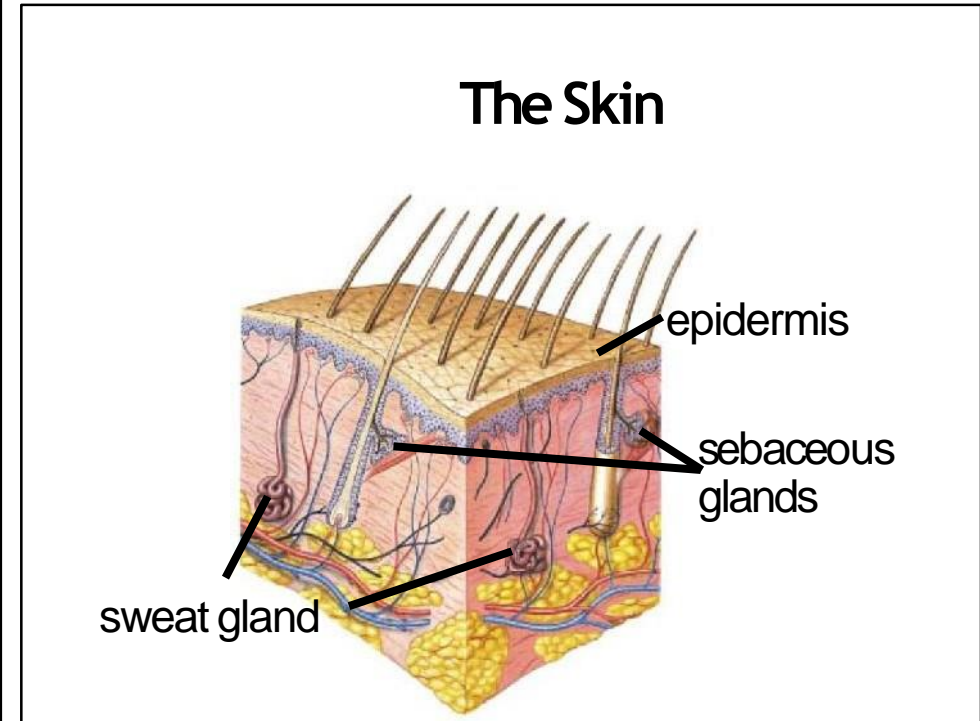


# Defense Mechanism

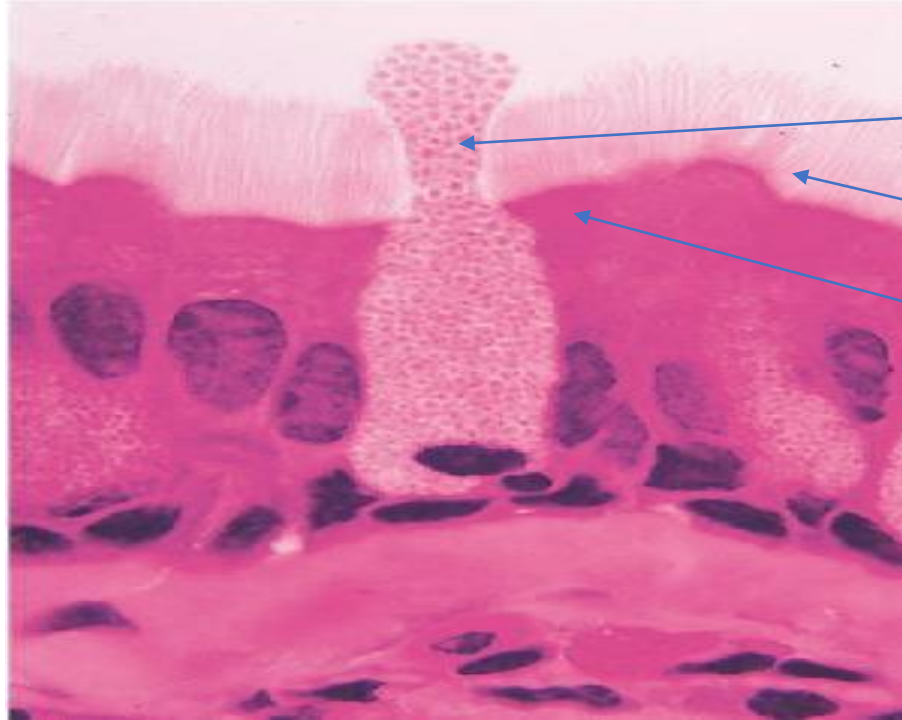
<b>Nonspecific defense mechanisms</b>		<b>Specific defense mechanisms (immune system)</b>
<b>First line of defense</b>	<b>Second line of defense</b>	<b>Third line of defense</b>
<ul style="list-style-type: none"><li>• Skin</li><li>• Mucous membranes</li><li>• Secretions of skin and mucous membranes</li></ul>	<ul style="list-style-type: none"><li>• Phagocytic white blood cells</li><li>• Antimicrobial proteins</li><li>• The inflammatory response</li></ul>	<ul style="list-style-type: none"><li>• Lymphocytes</li><li>• Antibodies</li></ul>

## A. First Line of Defense

- **Skin** acts as barrier to microbes and viruses
  - sweat has a low pH acts as an inhibitor.
- **Mucus** can traps foreign particles.
- Tears contains lysozyme which can act as an antimicrobial agent.
- **Gastric and stomach acid.** Which is very strong and destroy the vast majority of pathogens



# Mucous Membranes



mucus

cilia

columnar epithelium

## **B. Second Line of Defense**

- Phagocytic cells
  - ✓ WBCs
  - ✓ Natural Killer (NK) Cells: attack virus infected cells
- Inflammatory Response
- Antimicrobial proteins like:
  - Lysozyme
  - Interferon
  - Antibodies

## **C. Third Line of Defense includes:**

- Lymphocytes
- Antibodies

# **Biological (Physical and Chemical) Barriers**

**1. Anatomical barriers:** barriers that prevent the entry and colonization of many microbes. Examples skin, mucous membranes, and bony encasements.

**a. Skin**

- The skin is dry, acidic, and has a temperature lower than 37 degrees Celsius. These conditions are not favorable to bacterial growth.
- Resident normal flora of the skin also inhibit potentially harmful microbes.
- The dead, keratinized cells that make up the surface of the skin are continuously being sloughed off so that microbes that do colonize these cells are constantly being removed.
- Hair follicles and sweat glands produce lysozyme and toxic lipids that can kill bacteria.
- Epithelial cells also produce defensins to kill microbes.
- Beneath the epidermis of the skin are Langerhans' cells - immature dendritic cells- that phagocytose and kill microbes,

## **b. Mucous membranes**

- Line body cavities that open to the exterior, such as respiratory, gastrointestinal, and genitourinary tract.
- Composed of an epithelial layer that secretes mucus, which is a physical barrier that traps microbes and contains
  - lysozyme to degrade bacterial peptidoglycan,
  - An antibody called secretory IgA that prevents microbes from attaching to mucosal cells and traps them in the mucus,
  - Lactoferrin, bind iron and keep it from being used by microbes.
- Resident normal flora of the mucosa also inhibit potentially harmful microbes.
- Beneath the mucosal membrane is mucosa-associated lymphoid tissue (MALT) that contains Langerhans' cells - immature dendritic cells-that phagocytose and kill microbes

## **c. Bony encasements**

- Bony encasements, such as the skull and the thoracic cage, protect vital organs from injury and entry of microbes.



**2.Mechanical removal:** is the process of physically flushing microbes from the body.  
include:

**a.Mucus and cilia**

- Mucus traps microorganisms and prevents them from reaching and colonizing the mucosal epithelium. (Previously mentioned)
- **Cilia** on the surface of the epithelial cells **propels mucus and trapped microbes upwards towards the throat where it is swallowed and the microbes are killed in the stomach.**

**b. The cough and sneeze reflex**

- Coughing and sneezing removes mucus and trapped microbes.

**c. Vomiting and diarrhea**

- These processes remove pathogens and toxins in the gastrointestinal tract.

**d. The physical flushing action of body fluids**

- Fluids such as urine, tears, saliva, perspiration, and blood from injured blood vessels also flush microbes from the body.

### **3. Bacterial Antagonism by Normal Flora**

- These normal body flora keep potentially harmful opportunistic pathogens in check and also inhibit the colonization of pathogens by:
  - a. Producing metabolic products (fatty acids, bacteriocins, etc.) that inhibit the growth of many pathogens;
  - b. Adhering to target host cells so as to cover them and preventing pathogens from colonizing;
  - c. Depleting nutrients essential for the growth of pathogens; and
  - d. Non-specifically stimulating the immune system.