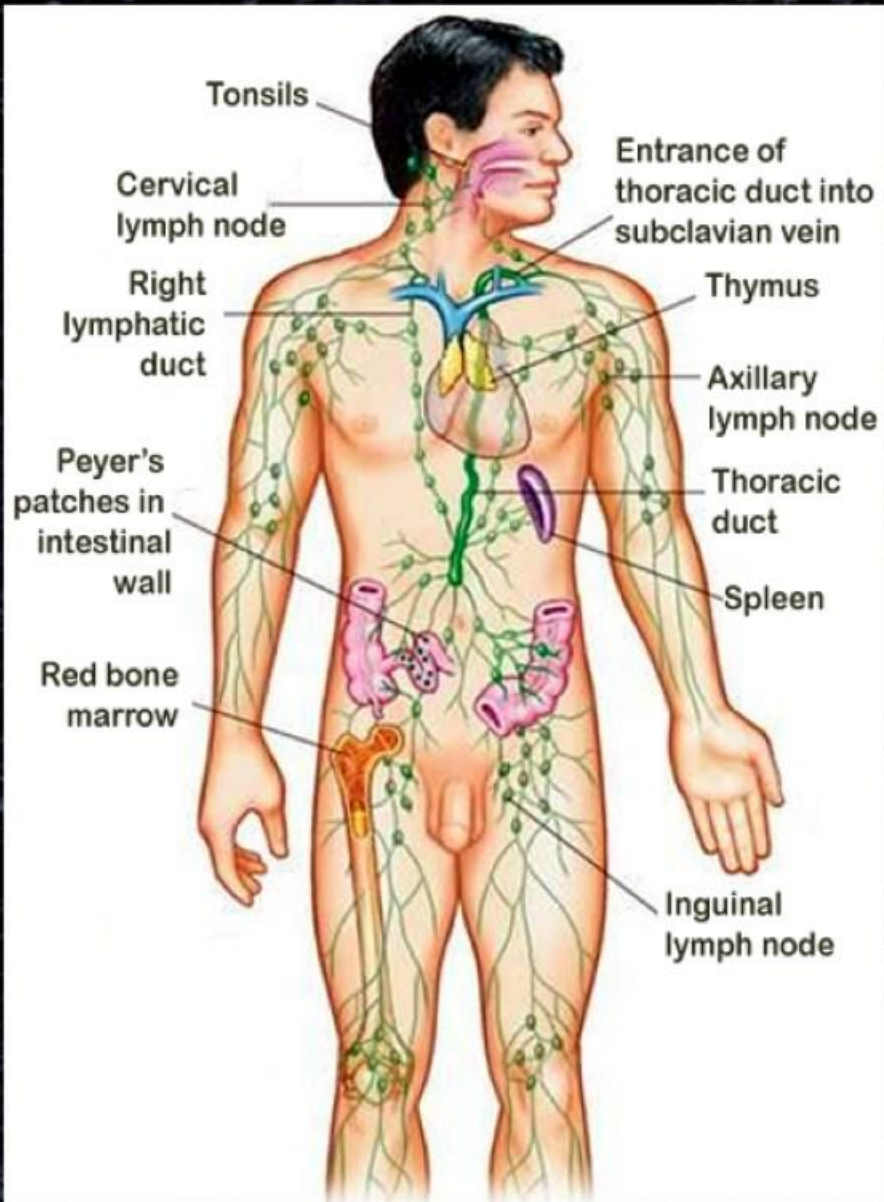


# HUMAN IMMUNE SYSTEM



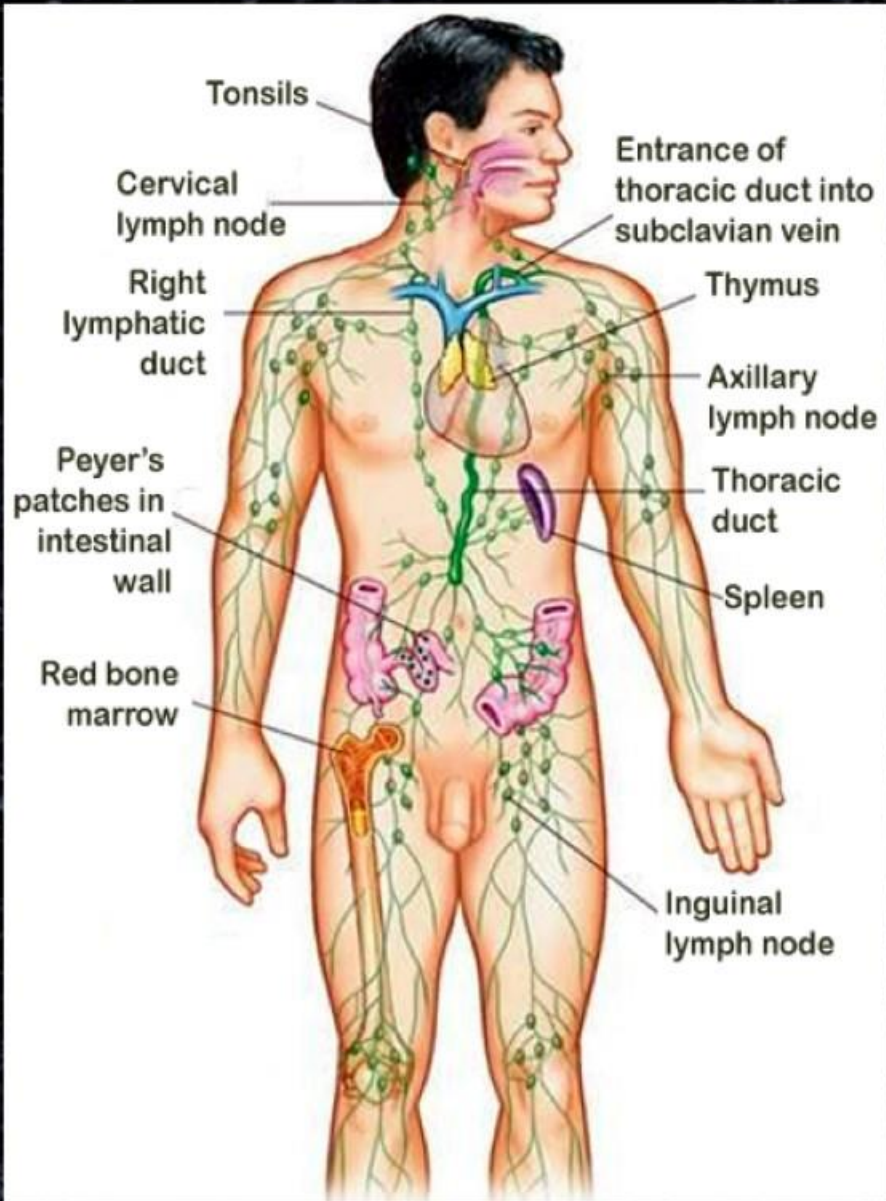
# HUMAN IMMUNE SYSTEM



- It is the system that **gives immunity to the body** by recognizing, responding and remembering foreign antigens.
- It plays role in **allergic reaction, auto-immune disease and organ transplantation.**
- It includes **lymphoid organs, tissues, cells and antibodies.**







- These are the organs where **origin, maturation and proliferation of lymphocytes** occur.

Lymphoid organs are 2 types

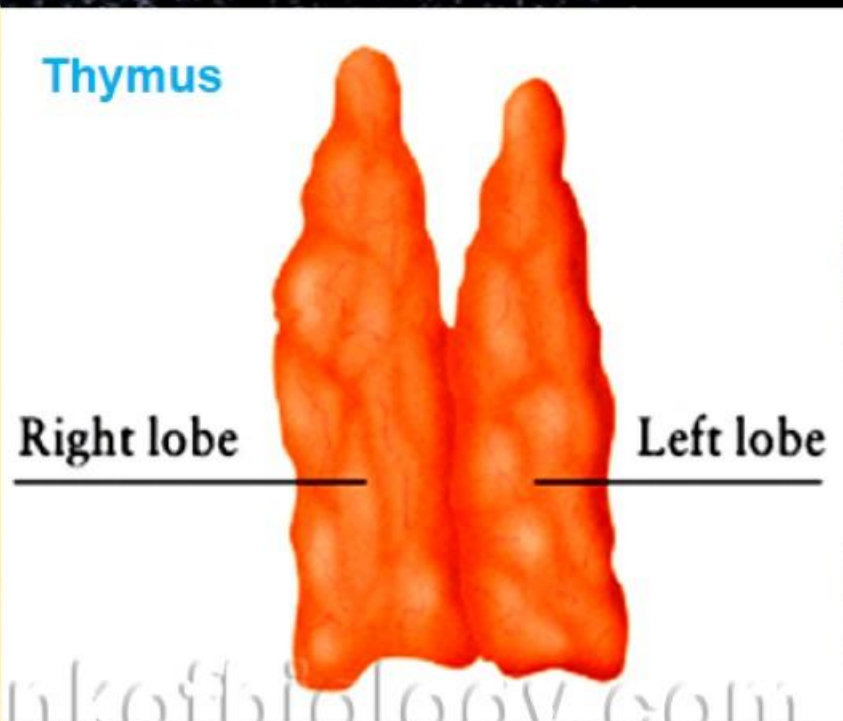
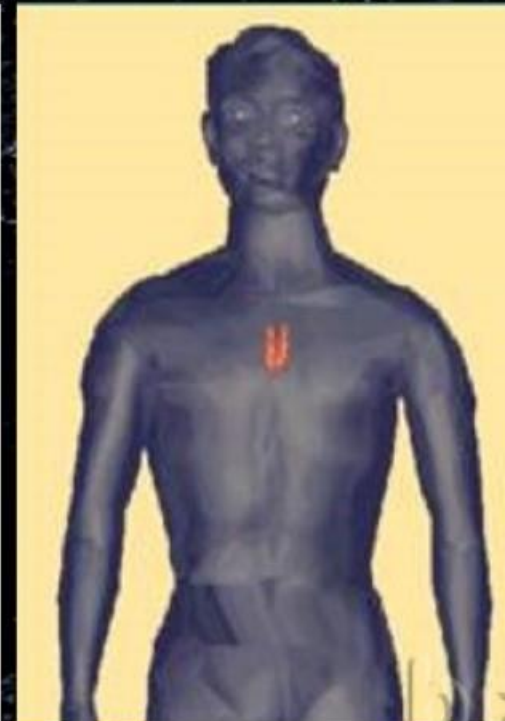
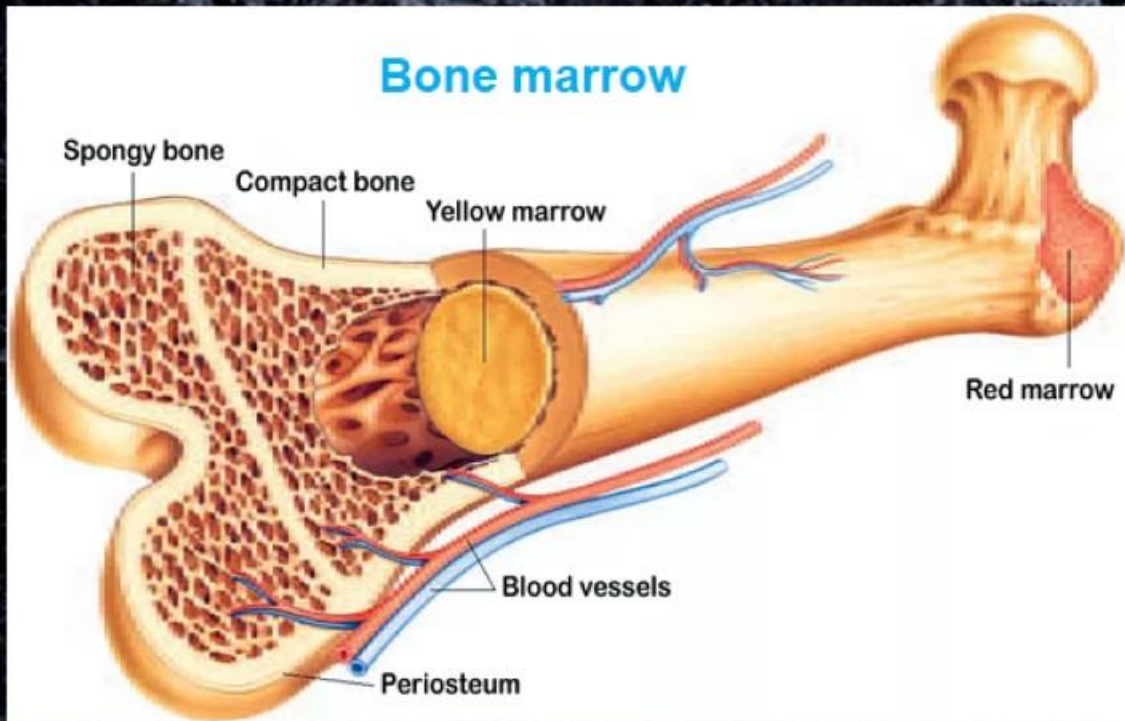
Primary lymphoid organs

Secondary lymphoid organs



## PRIMARY LYMPHOID ORGANS

- The organs where **lymphocytes are matured & differentiated** to antigen-sensitive lymphocytes.
- It is 2 types: **Bone marrow & Thymus.**



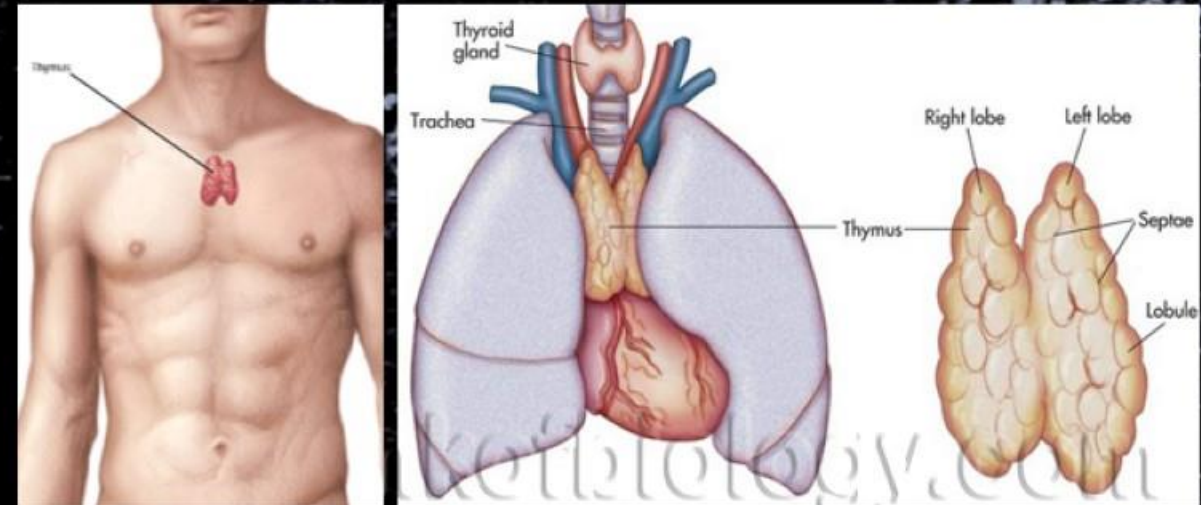
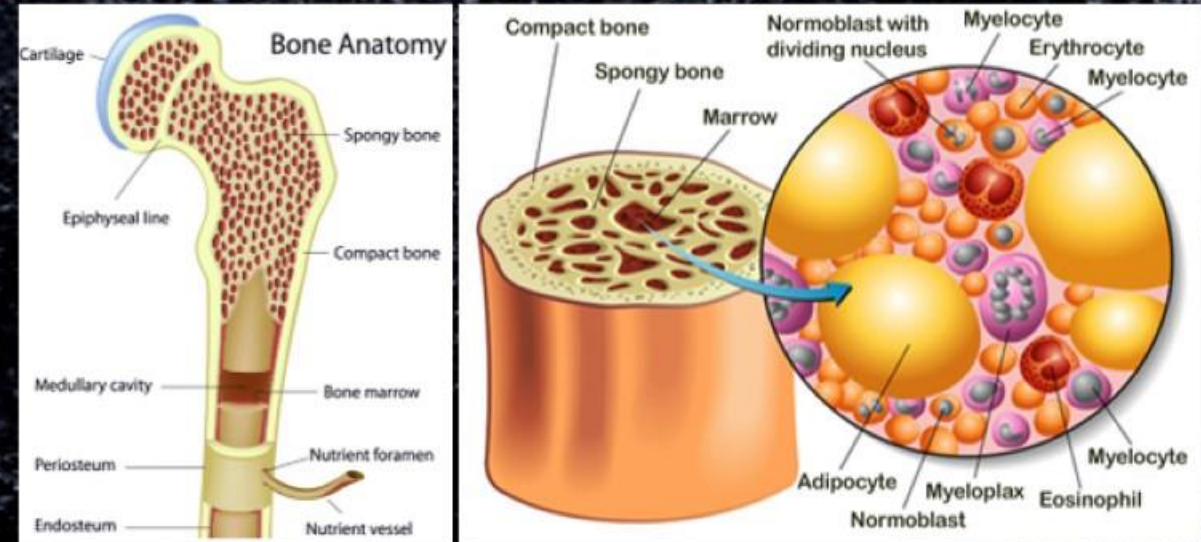


### 1. Bone marrow

- The site of formation of all blood cells including B & T-lymphocytes.

### 2. Thymus

- A bilobed organ seen near the heart and beneath the breastbone.
- It is **large during birth** but gradually reduces in size and becomes **very small size in puberty**.
- **Immature T-lymphocytes** from bone marrow is migrated to thymus and matured.



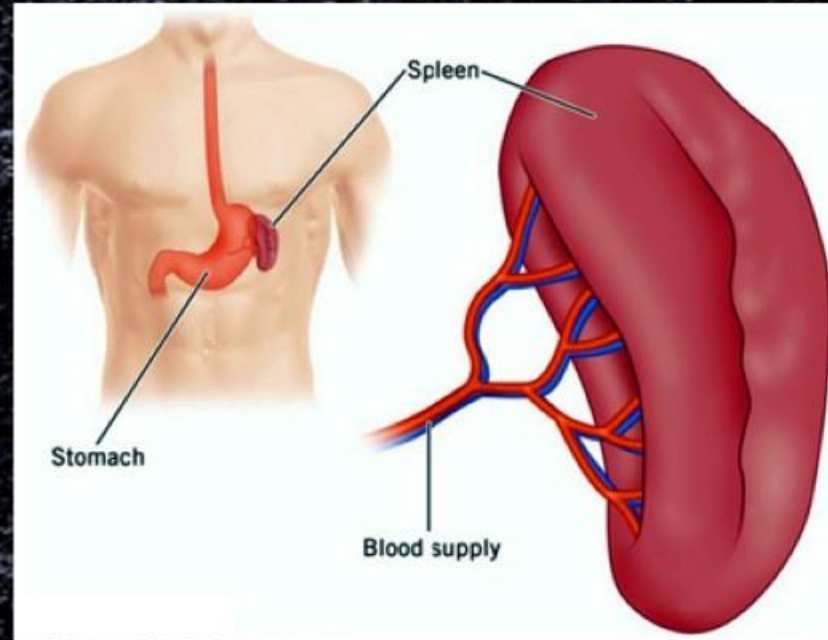


## SECONDARY LYMPHOID ORGANS

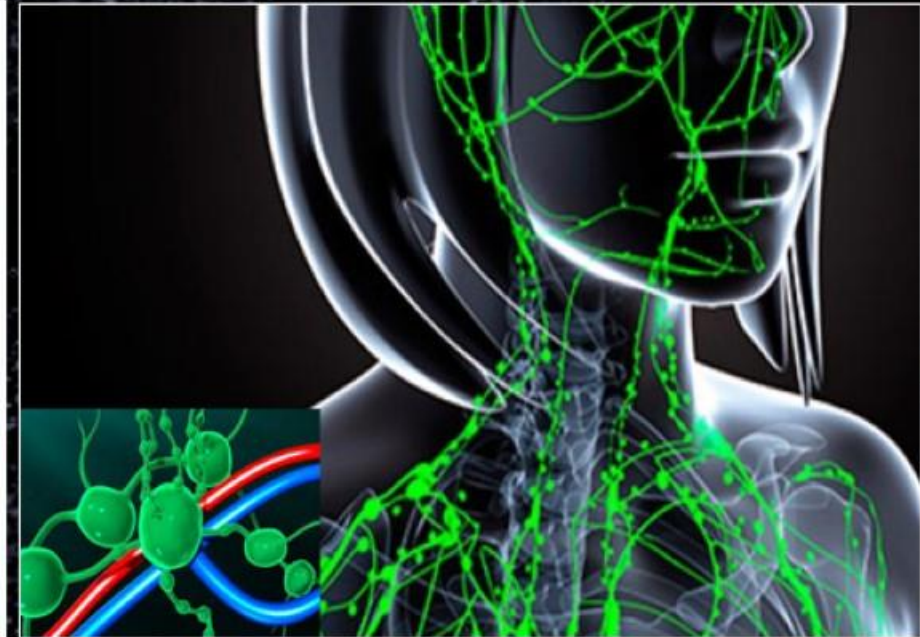
- The organs, to which matured lymphocytes migrate from primary lymphoid organs, interact with antigens and then proliferate to become **effector cells**.

- Examples:

- ❖ Spleen
- ❖ Lymph nodes



Spleen



Lymph nodes

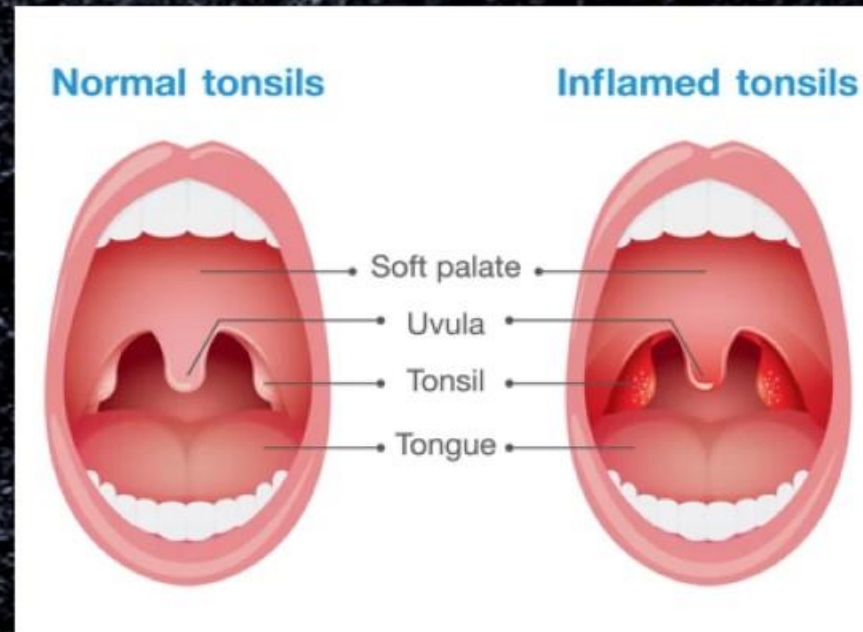


## SECONDARY LYMPHOID ORGANS

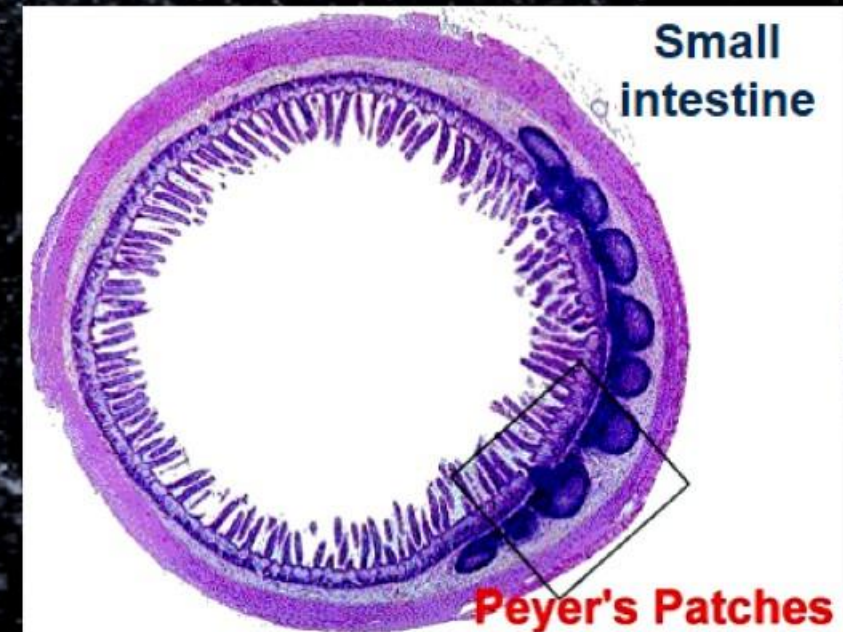
- The organs, to which matured lymphocytes migrate from primary lymphoid organs, interact with antigens and then proliferate to become **effector cells**.

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- ❖ Spleen
- ❖ Lymph nodes
- ❖ Tonsils
- ❖ Peyer's patches



Tonsils



Peyer's patches

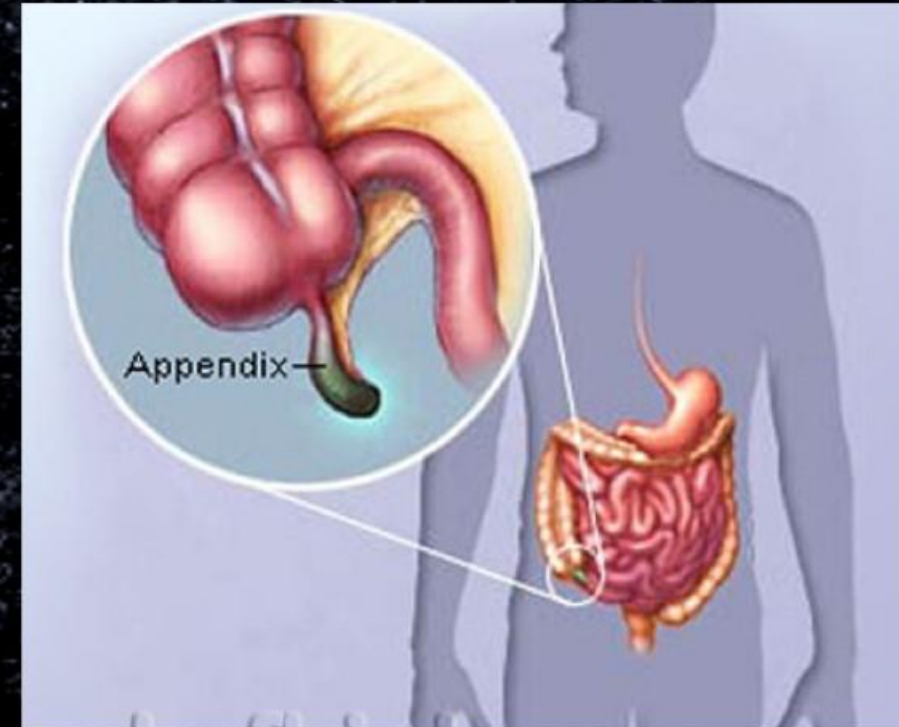
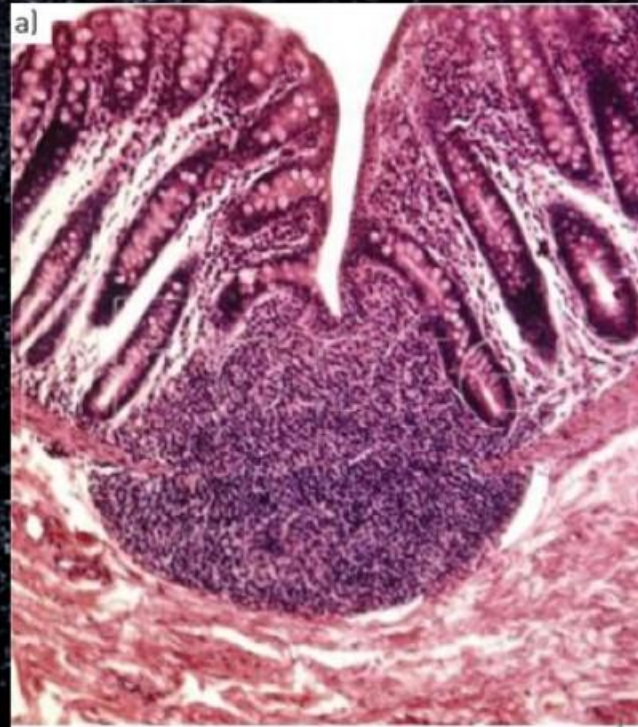


## SECONDARY LYMPHOID ORGANS

- The organs, to which matured lymphocytes migrate from primary lymphoid organs, interact with antigens and then proliferate to become **effector cells**.

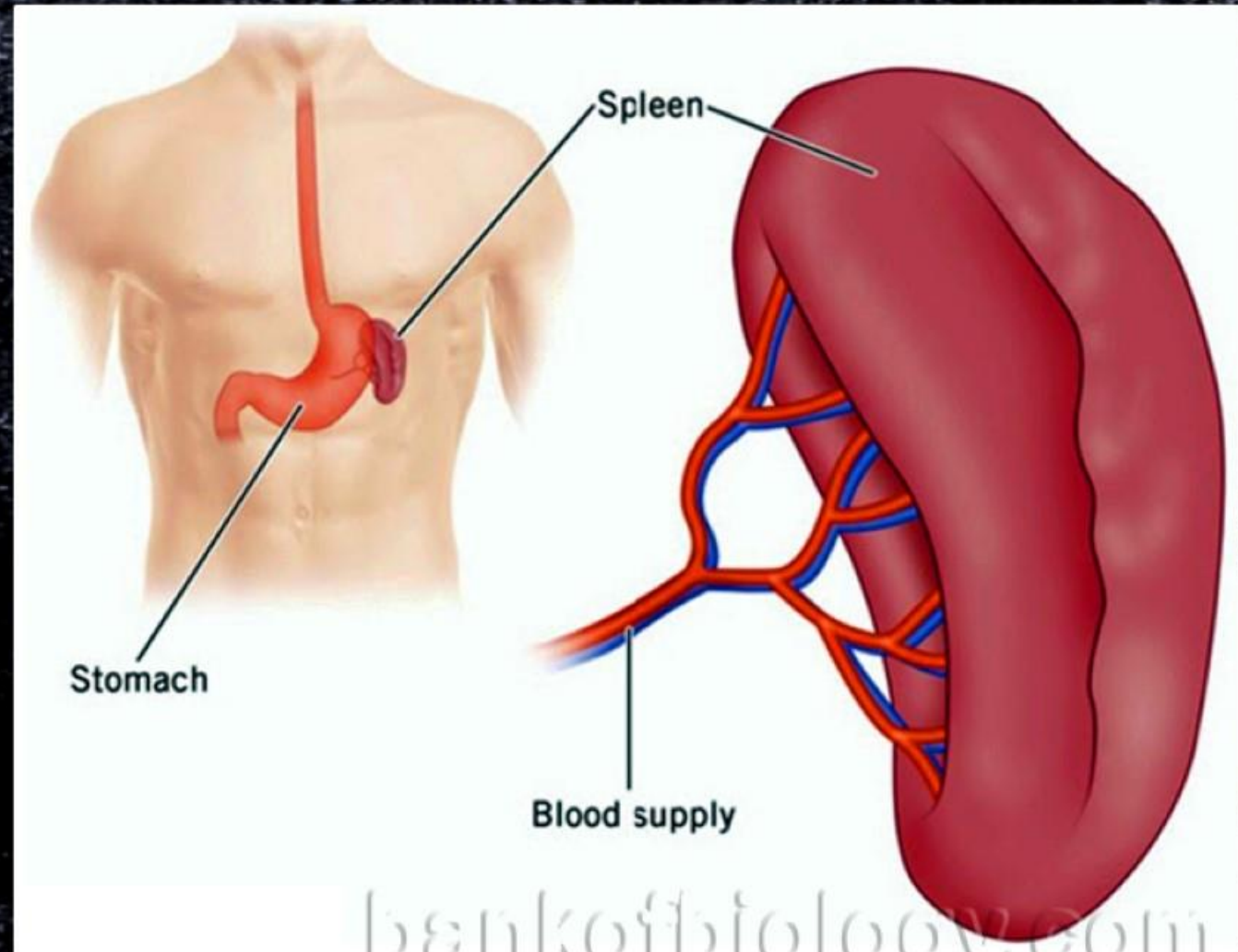
- Examples:

- ❖ Spleen
- ❖ Lymph nodes
- ❖ Tonsils
- ❖ Peyer's patches
- ❖ Mucosa- associated lymphoid tissue (MALT)
- ❖ Appendix





- Bean-shaped organ.
- Contains **lymphocytes and phagocytes**.
- Removes **worn-out RBCs and microorganisms** from blood.
- **Reservoir of erythrocytes** in foetus.





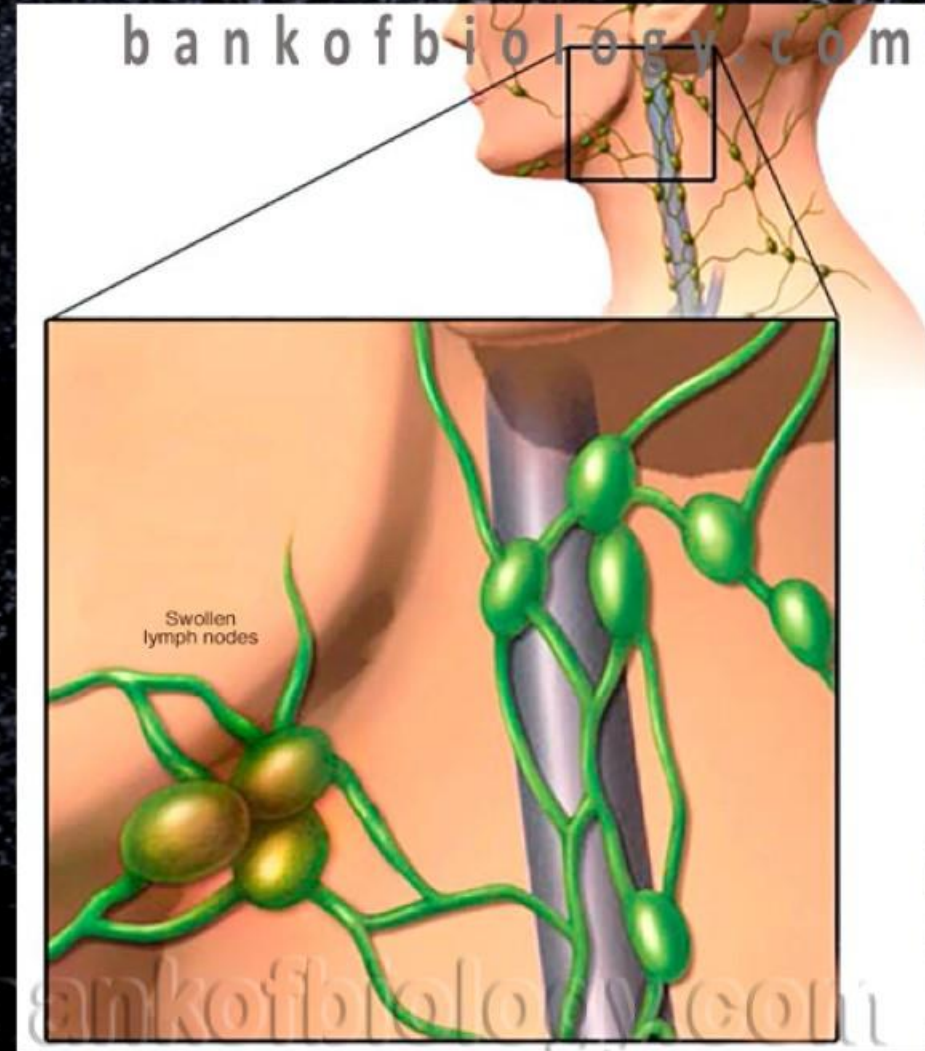
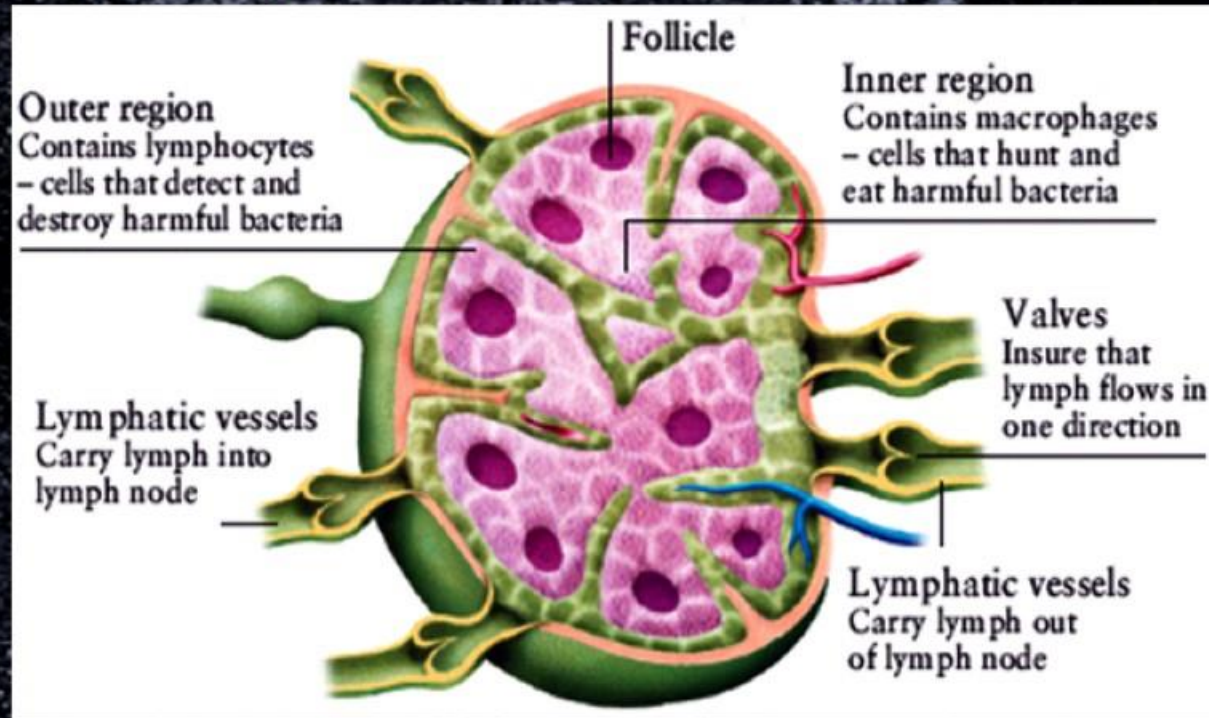
# HUMAN IMMUNE SYSTEM

# LYMPHOID ORGANS

## SECONDARY LYMPHOID ORGANS

## Lymph nodes

- Found in **lymphatic system**.
- They **trap microorganisms or other antigens**.
- Trapped antigens activate lymphocytes and cause immune response.





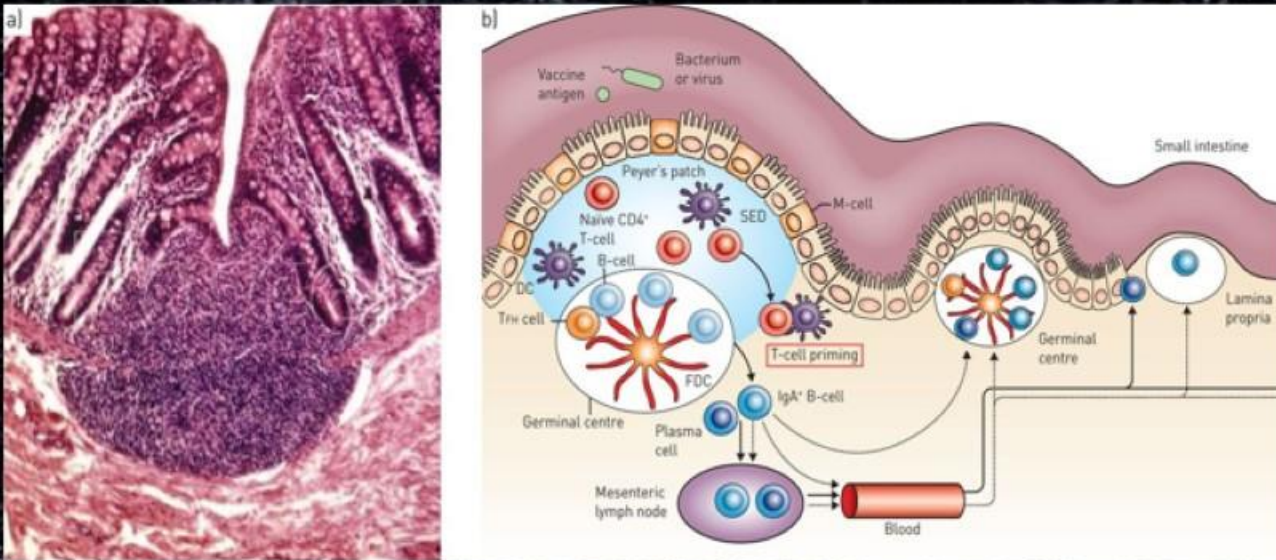
# HUMAN IMMUNE SYSTEM

# LYMPHOID ORGANS

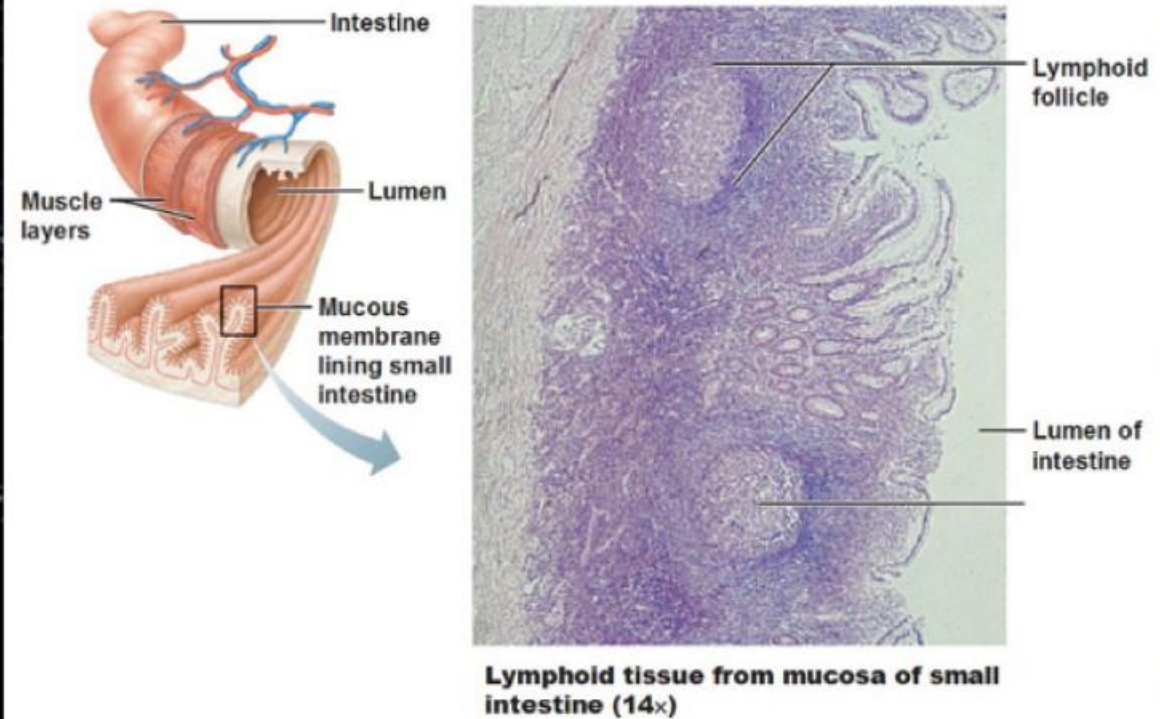
## SECONDARY LYMPHOID ORGANS

## MALT

- **MALT (Mucosa Associated lymphoid tissue)** is located within the lining of respiratory, digestive & urinogenital tracts.
- It constitutes **50%** of lymphoid tissue.



### Mucosa-Associated Lymphoid Tissue (MALT)







**IMMUNITY**



**It is the ability of the immune system to fight the disease-causing organisms.**



## Types of immunity

**Innate  
(inborn)  
immunity**



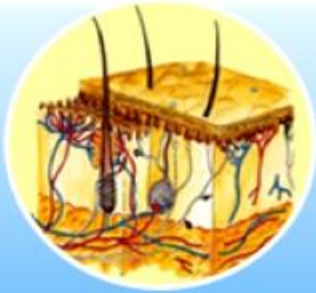
**Acquired  
(adaptive)  
immunity**



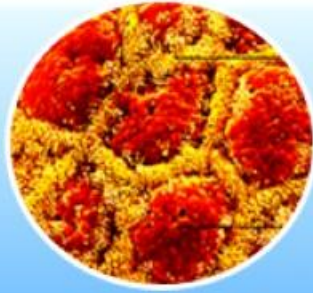


## 1. INNATE IMMUNITY

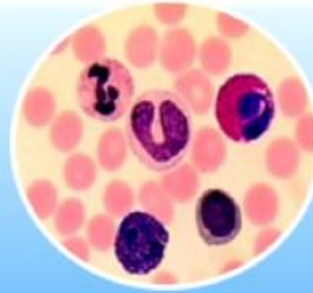
- It is the **non-specific defense** present at the time of **birth**.
- It provides **barriers** to the entry of foreign agents into our body.
- Barriers are 4 types:



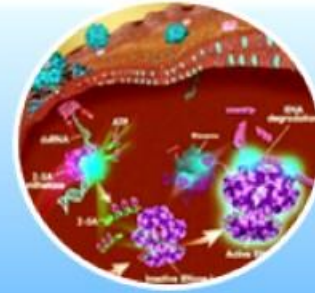
**Physical  
barriers**



**Physiological  
barriers**



**Cellular  
barriers**



**Cytokine  
barriers**



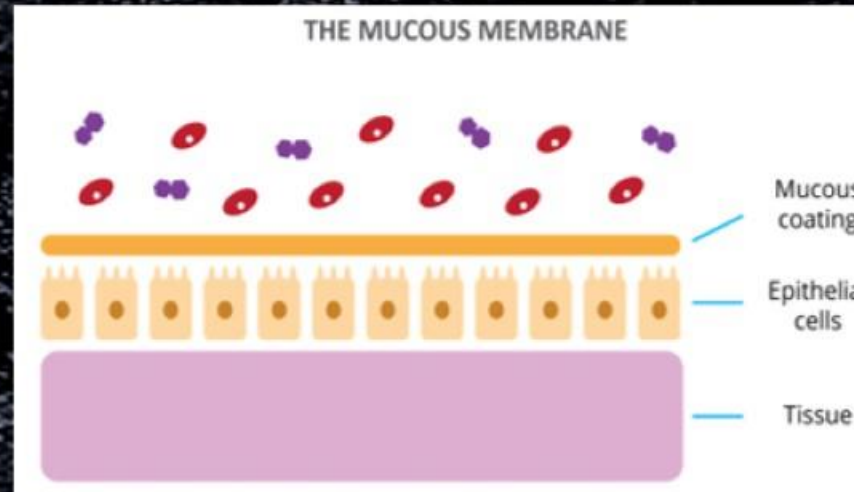
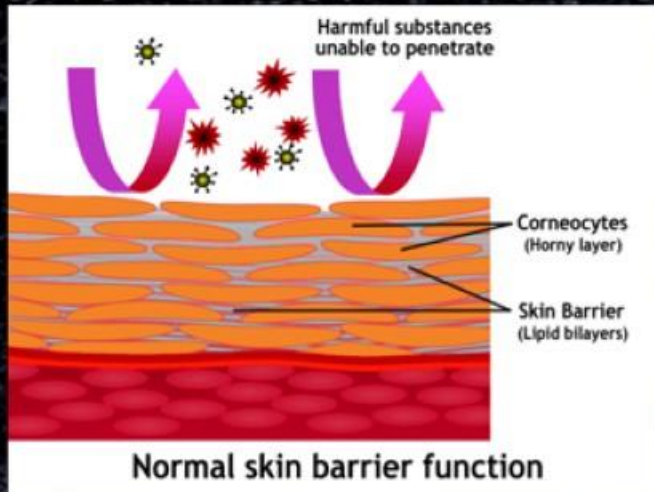
## 1. INNATE IMMUNITY

## Barriers

### 1. Physical Barriers

- » **Skin:** Prevent entry of foreign bodies.
- » **Mucous coating** of the lining the respiratory, gastro-intestinal and urino-genital tracts to trap microbes.

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### First line of defence

**Saliva:**  
Anti-bacterial enzymes

**Tears:**  
Antibacterial enzymes

**Skin:**  
prevents entry of pathogens

**Mucus lining:**  
Traps dirt and microbes

**Gastric HCl:**  
Low pH kills pathogens

**"Good" gut bacteria**  
out compete bad

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## 1. INNATE IMMUNITY

## Barriers

### 2. Physiological Barriers

- They prevent microbial growth.
- It includes
  - » *Gastric HCl*
  - » *Saliva*
  - » *Tear etc.*

### First line of defence

**Saliva:**  
Anti-bacterial  
enzymes

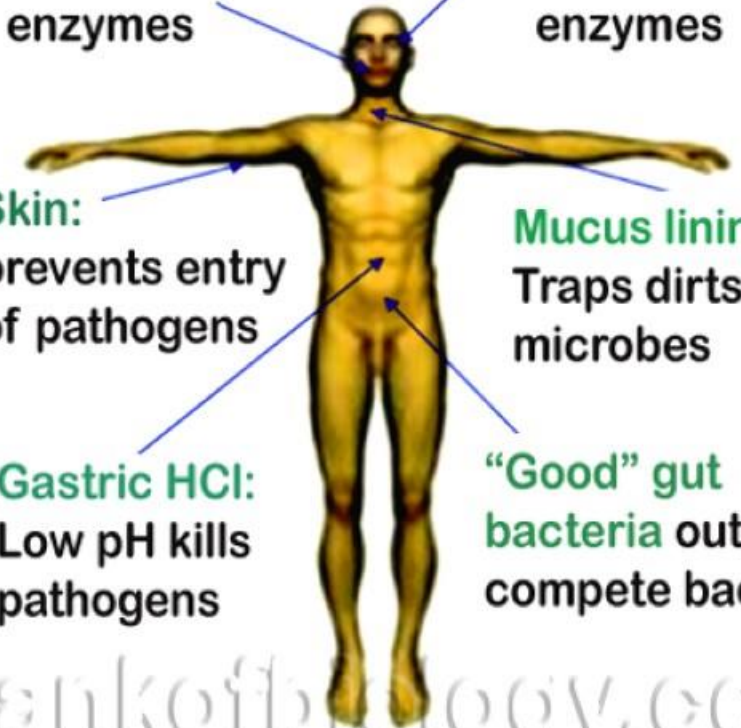
**Tears:**  
Antibacterial  
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**Skin:**  
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**Mucus lining:**  
Traps dirt and  
microbes

**Gastric HCl:**  
Low pH kills  
pathogens

**"Good" gut  
bacteria out  
compete bad**



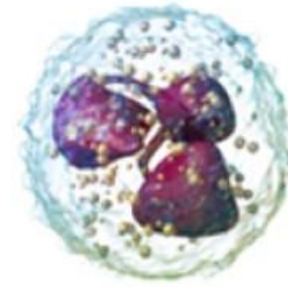
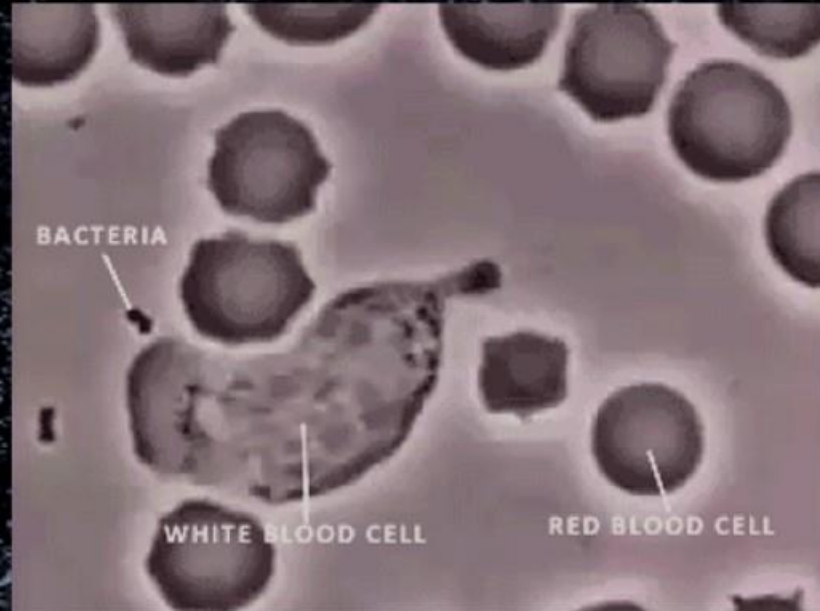
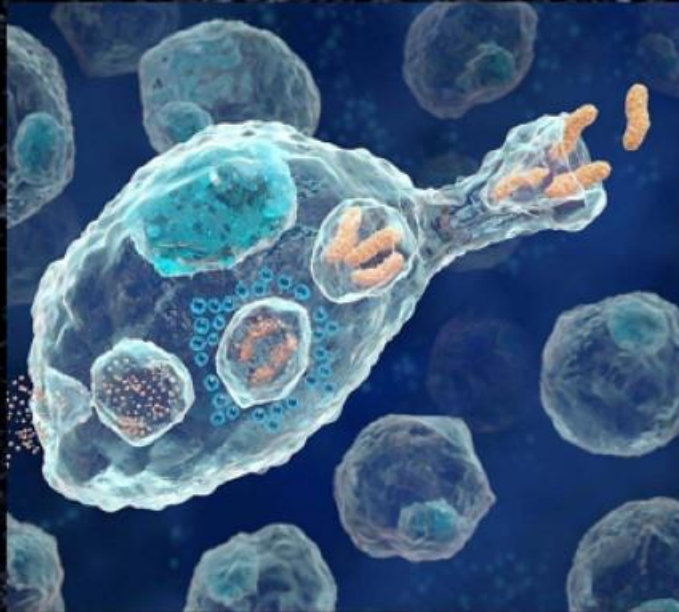


## 1. INNATE IMMUNITY

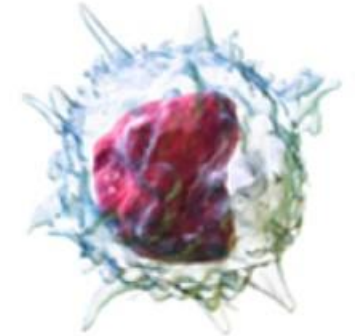
## Barriers

### 3. Cellular Barriers

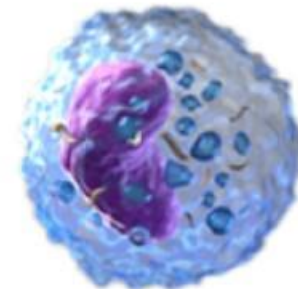
- **Phagocytes** like WBC [e.g. neutrophils or Polymorphonuclear leukocytes (PMNL), monocytes and natural killer lymphocytes], macrophages etc.



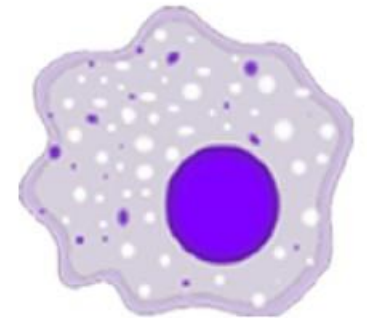
Neutrophil



Monocyte



Natural  
killer cells



Macrophage

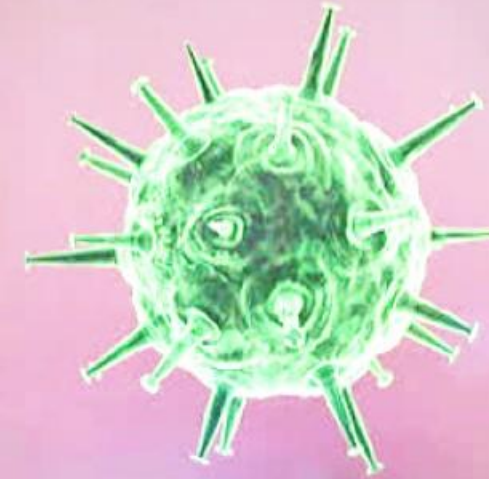
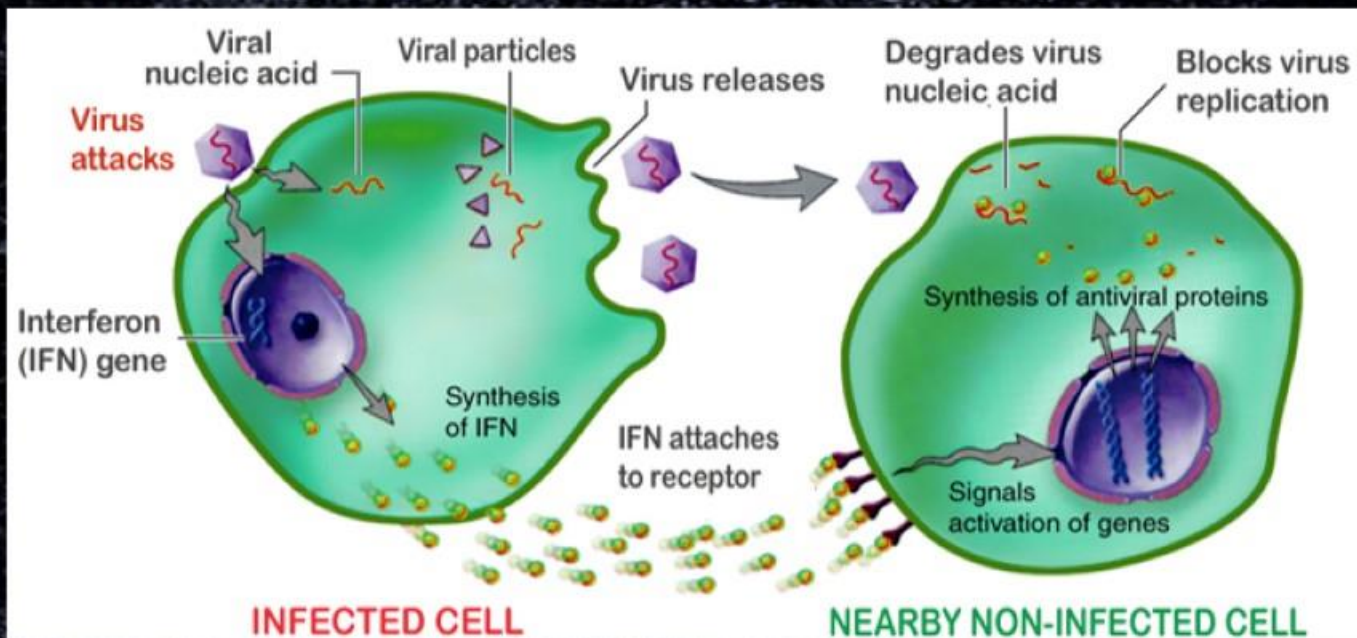


## 1. INNATE IMMUNITY

## Barriers

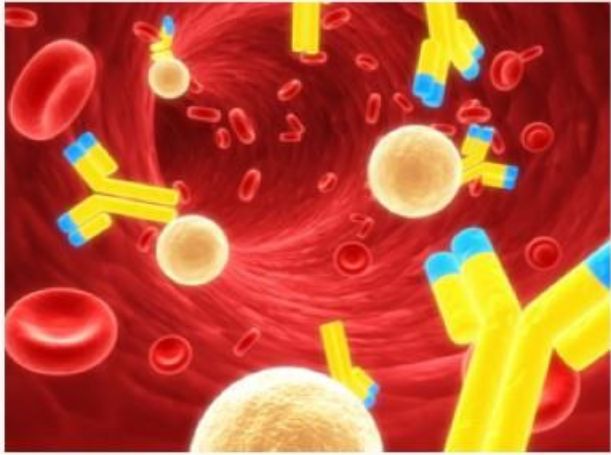
### 4. Cytokine Barriers

Virus infected cells secrete a cytokine protein called **interferon**. It protects non-infected cells from further viral infection.



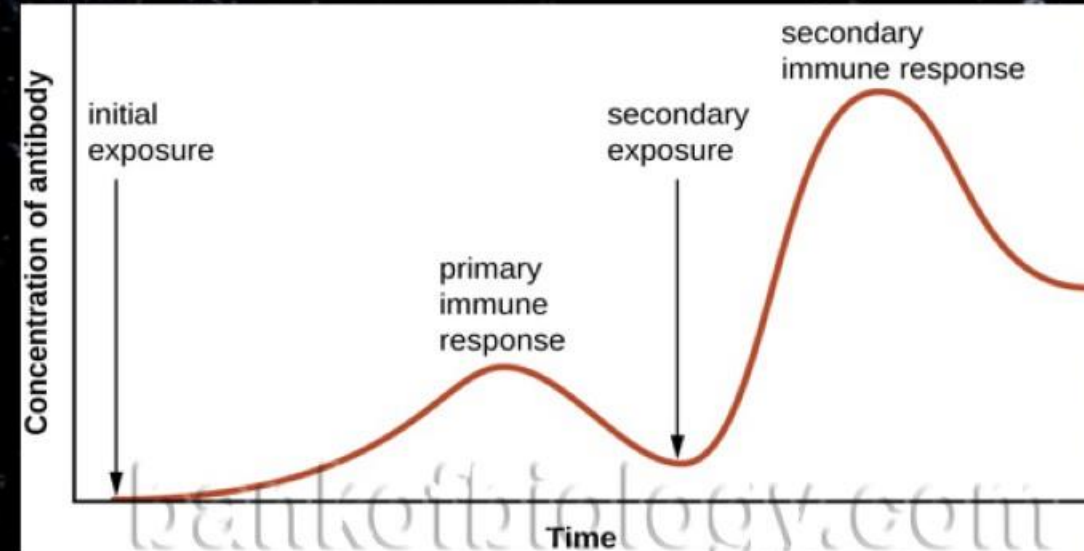
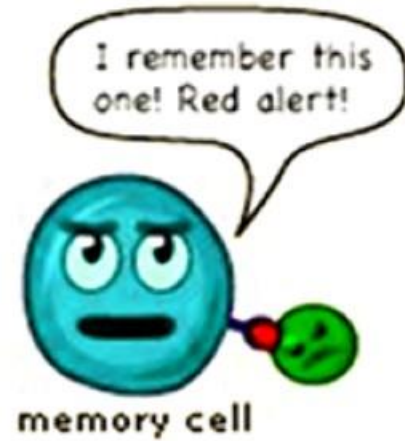
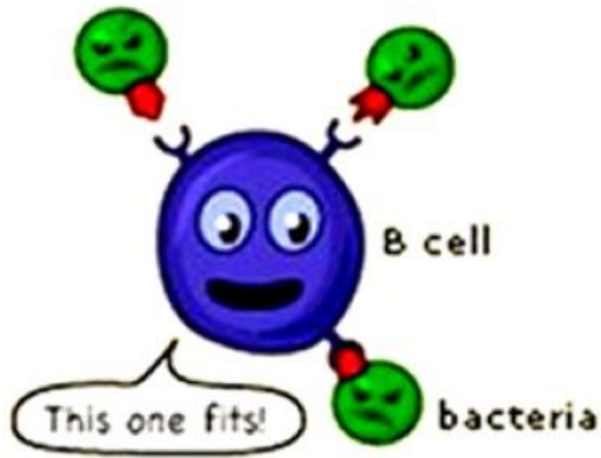


## 2. ACQUIRED IMMUNITY



- *Pathogen specific* immunity developed during life time.
- It is characterized by **memory**, i.e. during **first encounter** of a pathogen, body produces **primary response** in **low intensity**. **Second encounter** of the same pathogen causes a **secondary (anamnestic) response** in **high intensity**.

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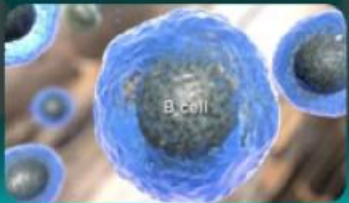
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## 2. ACQUIRED IMMUNITY

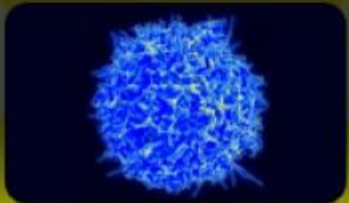
Primary & secondary immune responses are carried out with **B-lymphocytes (B-cells)** & **T-lymphocytes (T-lymphocytes)**.

### B-lymphocytes

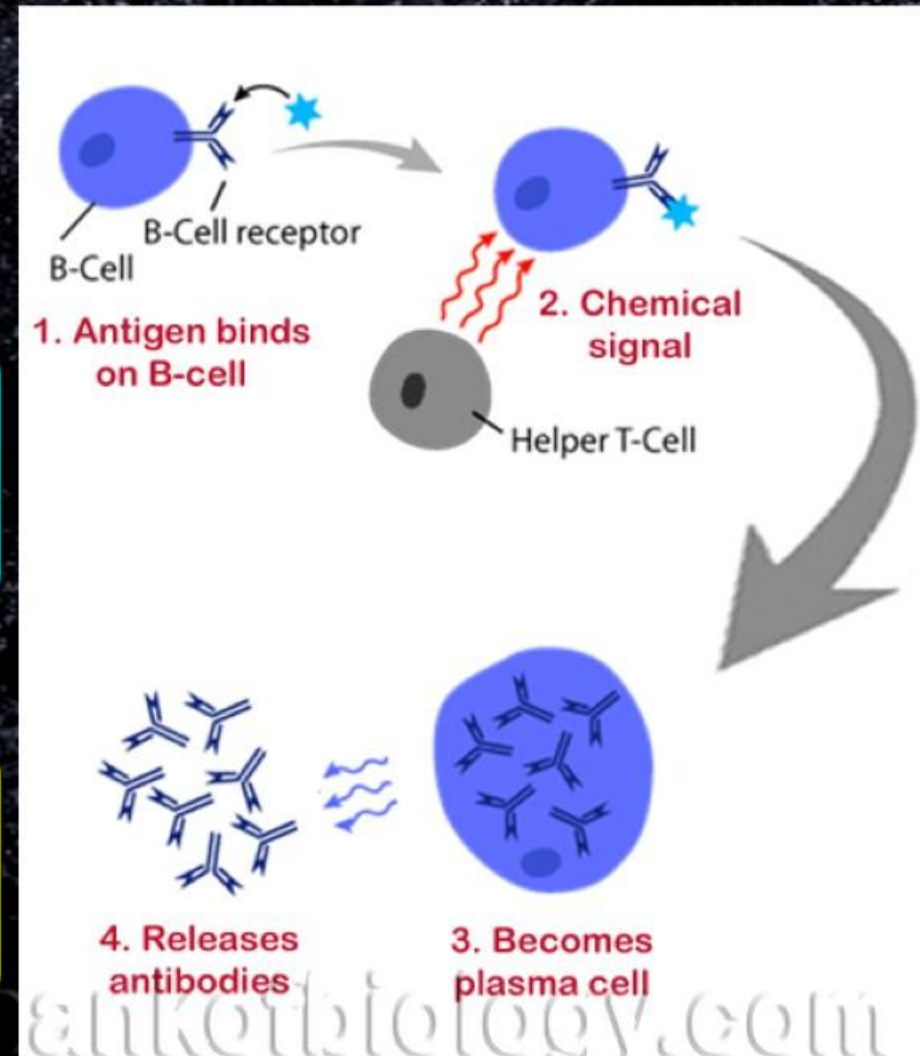


- Produce **antibodies**.
- These are the proteins to fight with pathogens.

### T-lymphocytes



- Help B-cells to produce antibodies.

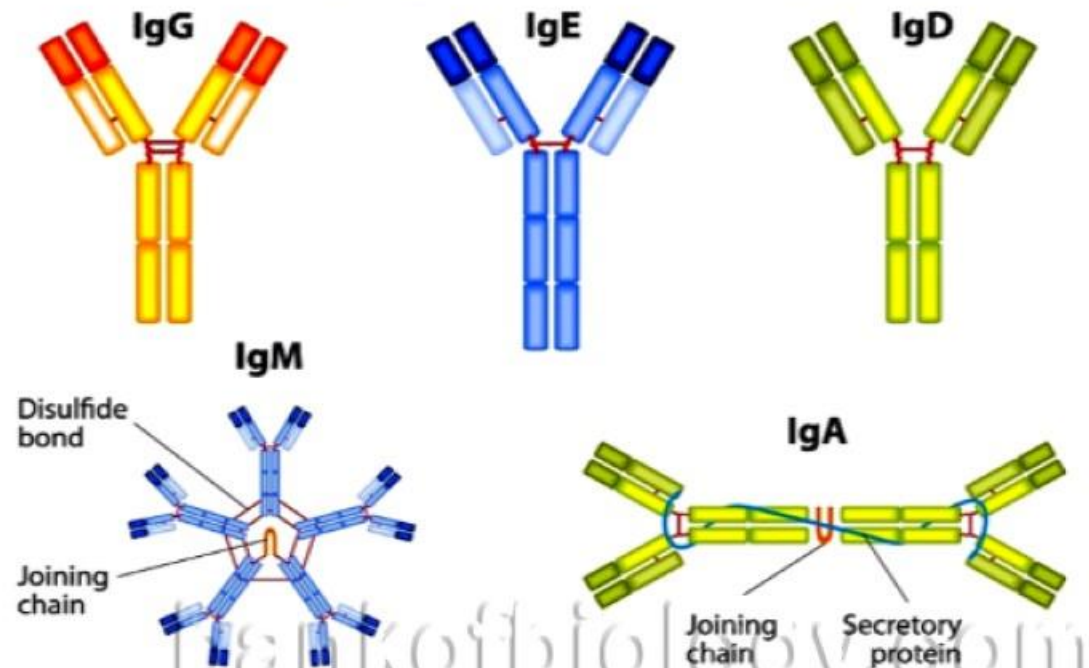
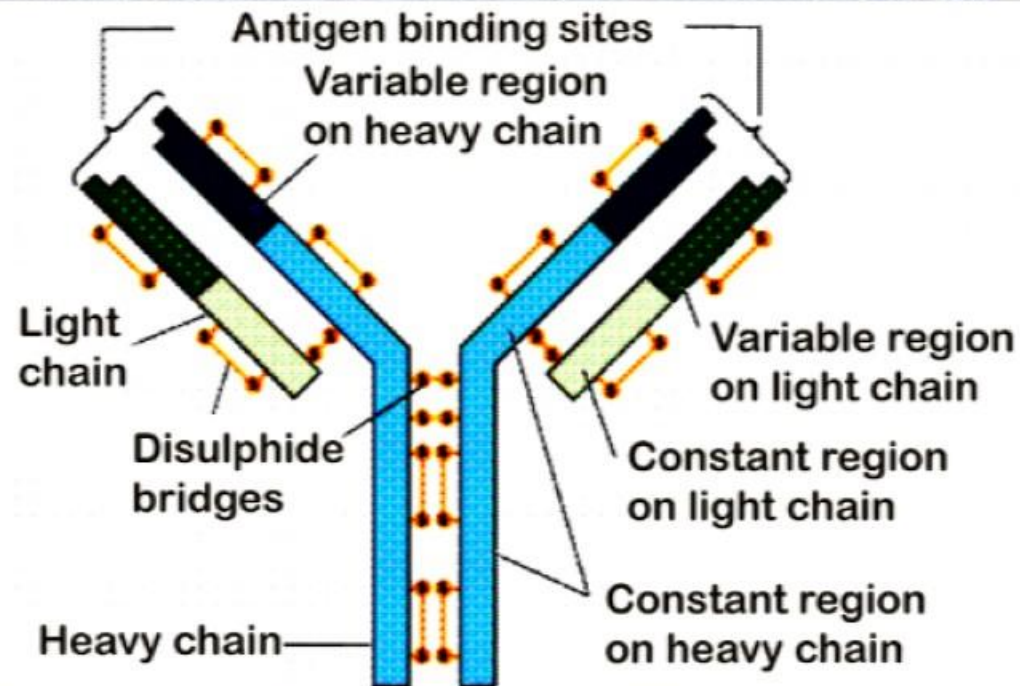




## 2. ACQUIRED IMMUNITY

### Structure of Antibody

- An antibody has 4 polypeptide chains: 2 light chains & 2 heavy chains ( $H_2L_2$ ).
- Types of antibodies: IgA, IgG, IgM, IgE & IgD.



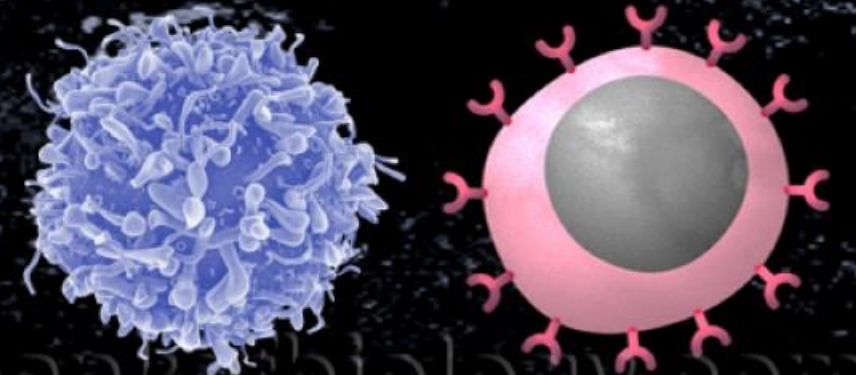


## 2. ACQUIRED IMMUNITY

### Types of Acquired immune response

1. Humoral or Antibody mediated response/ Antibody mediated immunity (AMI)

2. Cell-mediated response or cell-mediated immunity (CMI)





## 2. ACQUIRED IMMUNITY

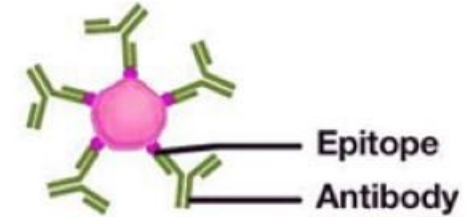
### Types of Acquired immune response

Humoral or Antibody mediated response/  
Antibody mediated immunity (AMI)

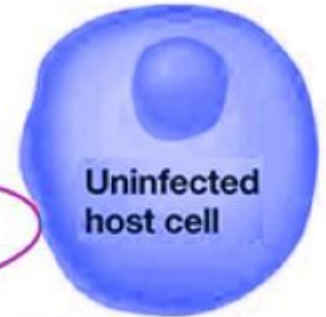
- It is the immune response mediated by *antibodies*.
- Antibodies are found in **blood plasma**. So called as Humoral immune response.

Cell-mediated response or cell-mediated immunity (CMI)

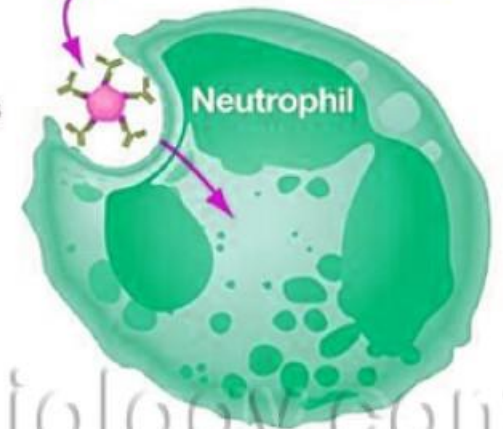
1. Antibodies coat virus.



2. Virus cannot infect cell.



3. Tagged virus is destroyed.





## 2. ACQUIRED IMMUNITY

### Types of Acquired immune response

Humoral or Antibody mediated response/  
Antibody mediated immunity (AMI)

Cell-mediated response or cell-mediated immunity (CMI)

- It is the immune response mediated by **T-lymphocytes (T-cells)**.
- The body can differentiate **'self'** and **'non-self'** and the CMI causes **Graft rejection**.

1. T cell makes contact and releases granules.

Virus-infected host cell

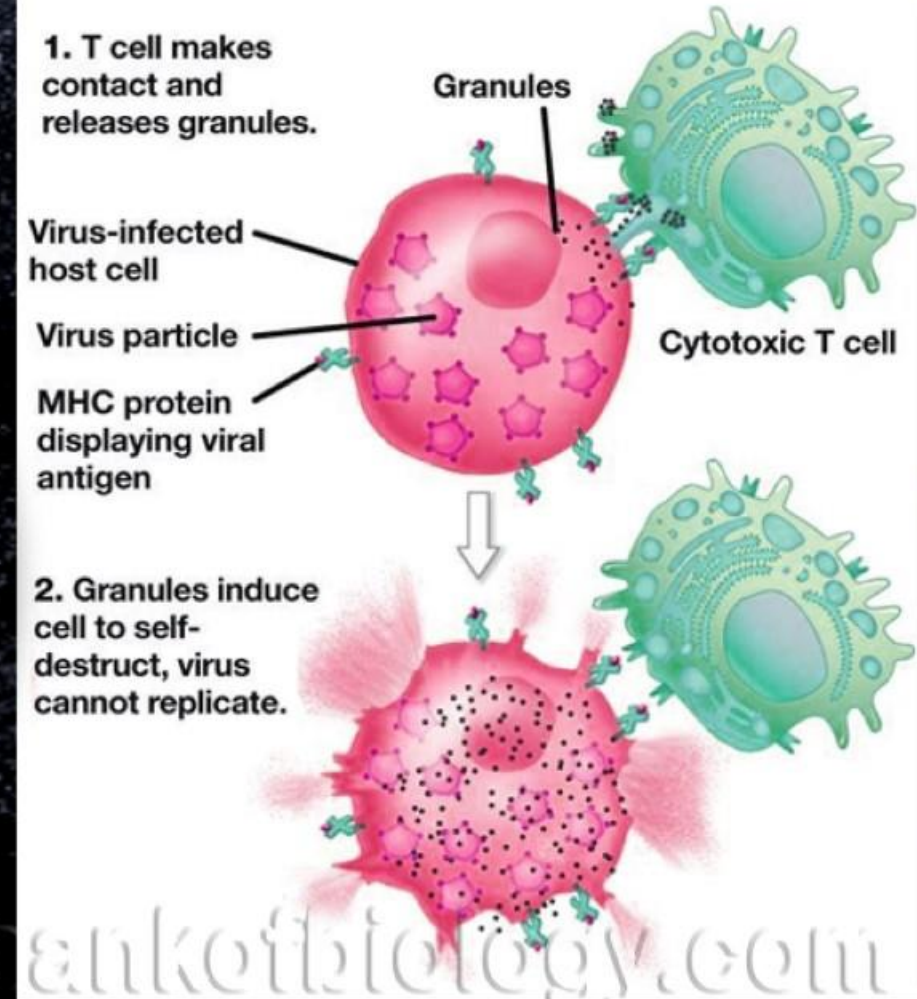
Virus particle

MHC protein displaying viral antigen

Granules

Cytotoxic T cell

2. Granules induce cell to self-destruct, virus cannot replicate.



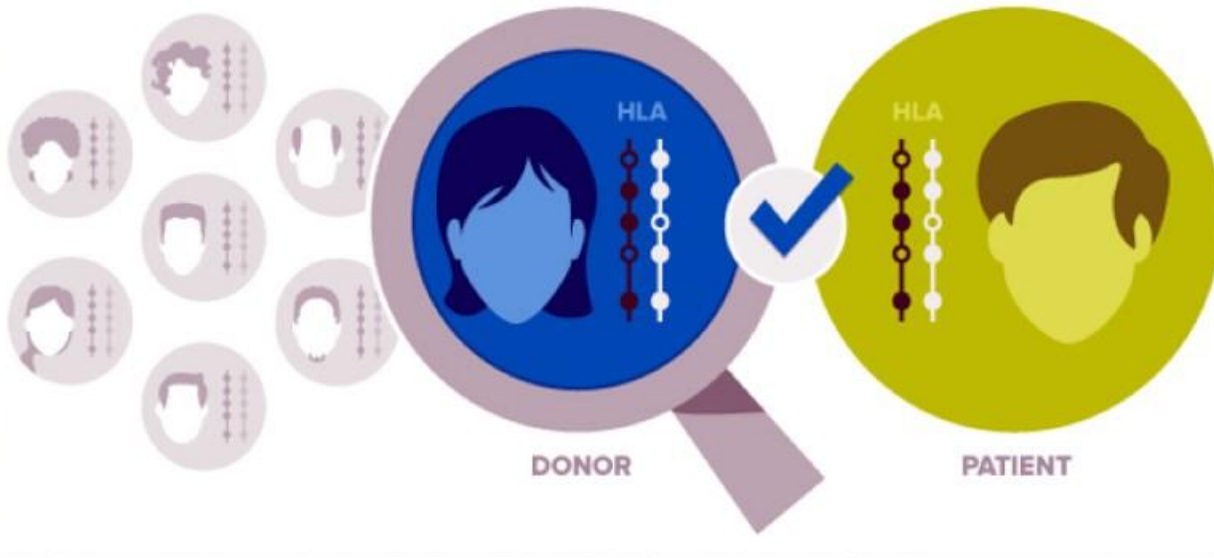


## 2. ACQUIRED IMMUNITY



**Tissue matching & blood group matching** are essential before undertaking any **graft/Transplant**. After this, the patient has to take **immuno-suppressants** all his life.

Matching **donors** with **patients**.

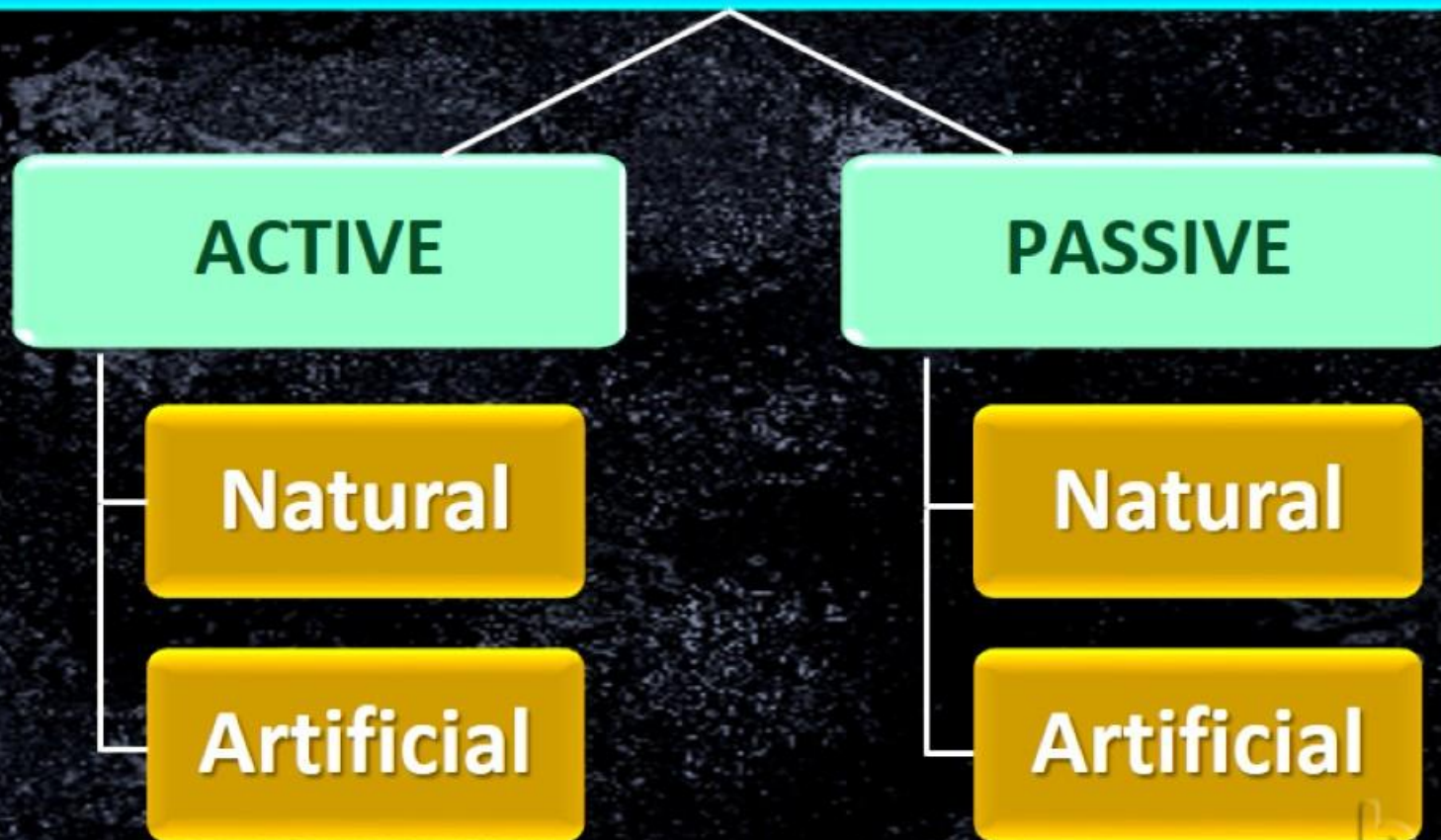


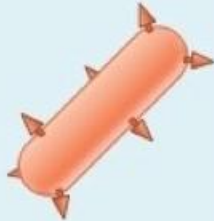

Recipient	Blood donor			
	O	A	B	AB
O	✓	✗	✗	✗
A	✓	✓	✗	✗
B	✓	✗	✓	✗
AB	✓	✓	✓	✓


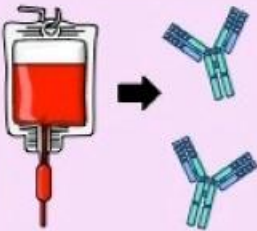


## 2. ACQUIRED IMMUNITY

### TYPES OF ACQUIRED IMMUNITY



ACTIVE IMMUNITY	
Natural	Artificial
 Infection	 Vaccination

PASSIVE IMMUNITY	
Natural	Artificial
 Maternal antibodies	 Monoclonal antibodies



## 2. ACQUIRED IMMUNITY

## ACTIVE IMMUNITY

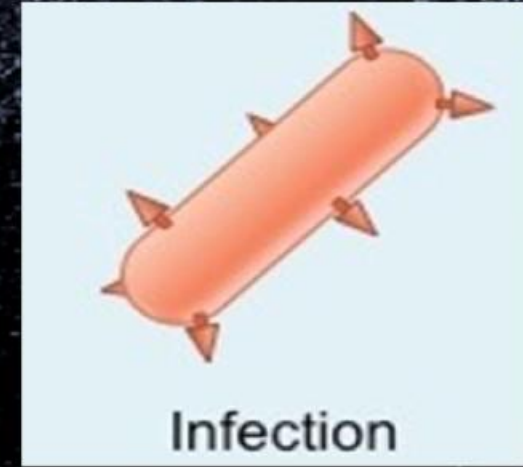
- It is the immunity in which **antibodies are produced in a host** body when the host is exposed to antigens (e.g. living or dead microbes or other proteins).
- It is a slow process.
- It is produced by 2 ways:

### 1. Natural Active Immunity

- It is developed during **natural infection** by microbes.

### 2. Artificial Active Immunity

- It is developed by **injecting microbes** deliberately during immunization.





# HUMAN IMMUNE SYSTEM

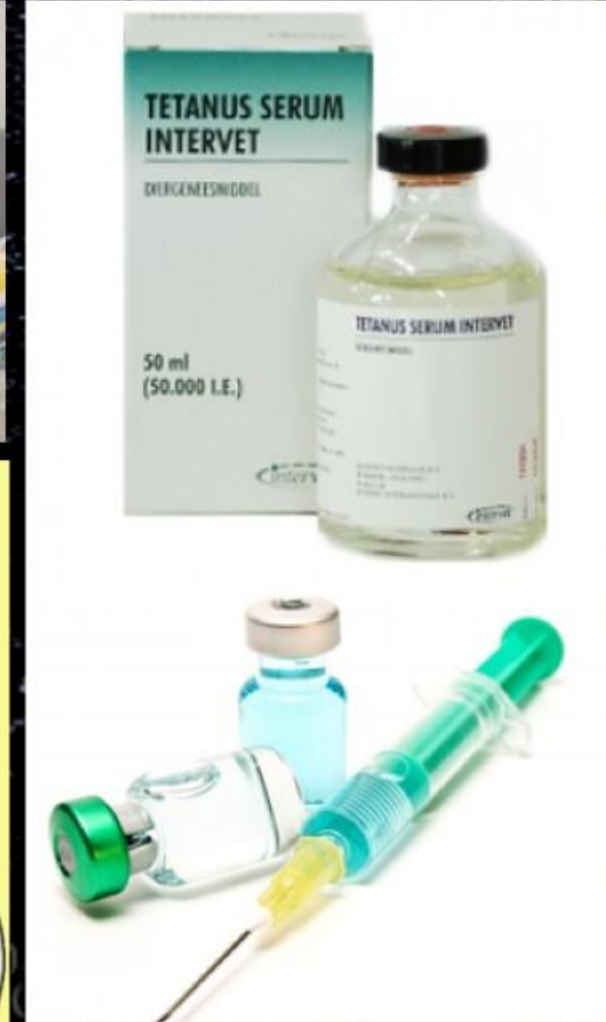
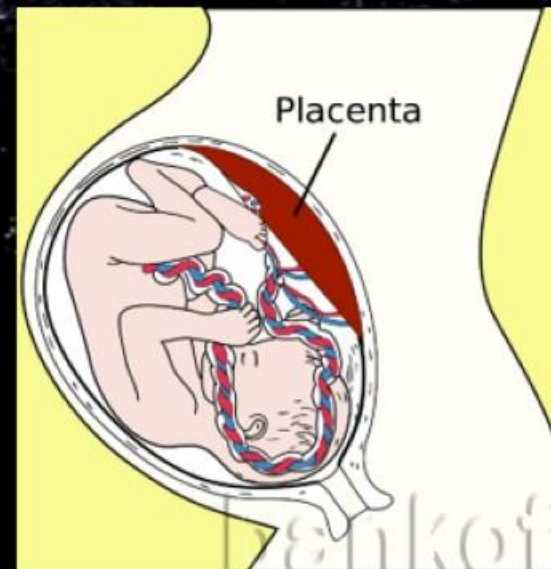
# IMMUNITY

## 2. ACQUIRED IMMUNITY

## PASSIVE IMMUNITY

- Here, **ready-made antibodies** are directly given to body.
- It is 2 types:

Types	Example
Natural Passive Immunity	<ul style="list-style-type: none"><li>✓ Antibodies (IgG) from mother → Placenta → Foetus</li><li>✓ Antibodies (IgA) in colostrum → infants</li></ul>
Artificial Passive Immunity	<ul style="list-style-type: none"><li>✓ Anti-tetanus serum (ATS)</li></ul>





## 2. ACQUIRED IMMUNITY

## IMMUNIZATION

- This is based on **'memory'** of the immune system.
- 2 types:

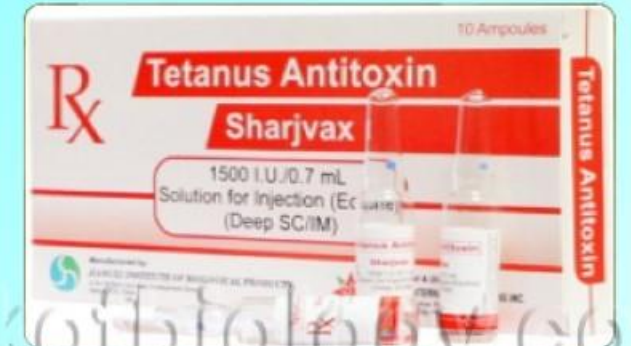
1

### Active immunization



2

### Passive immunization





## 2. ACQUIRED IMMUNITY

## IMMUNIZATION

1

### Active immunization (Vaccination)



- In this, a preparation of **vaccine** (antigenic proteins of pathogen or inactivated pathogen) is introduced into the body. It results in the development of antibodies.
- During actual infection, the antibodies neutralize antigens.





## 2. ACQUIRED IMMUNITY

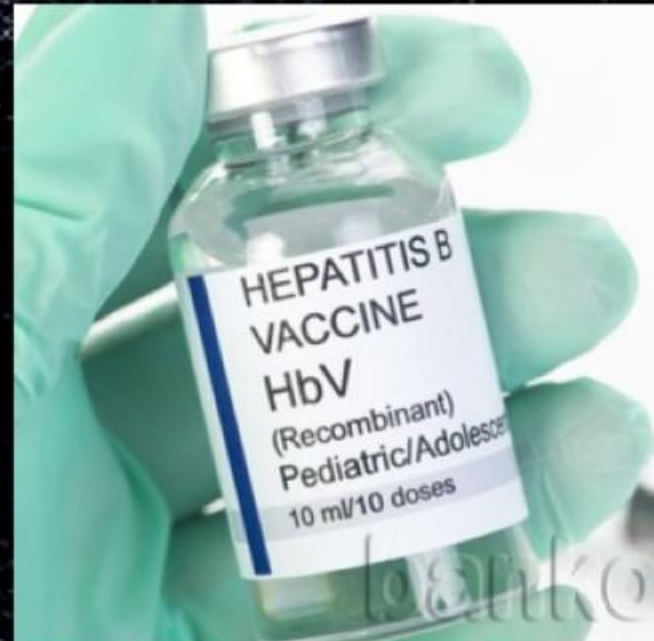
## IMMUNIZATION

1

### Active immunization (Vaccination)



- The vaccines also generate **memory B and T-cells**. They recognize the pathogen quickly.
- E.g. **Polio vaccine, Hepatitis B vaccine, DPT vaccine** etc.
- Vaccines are produced using DNA recombinant technology (E.g. Hepatitis B vaccine produced from Yeast).





## 2. ACQUIRED IMMUNITY

## IMMUNIZATION

2

- It is the direct injection of **pre-formed antibodies or antitoxin**.
- It is required for quick immune response.
- E.g. Immunization against **Tetanus, snake venom** etc.

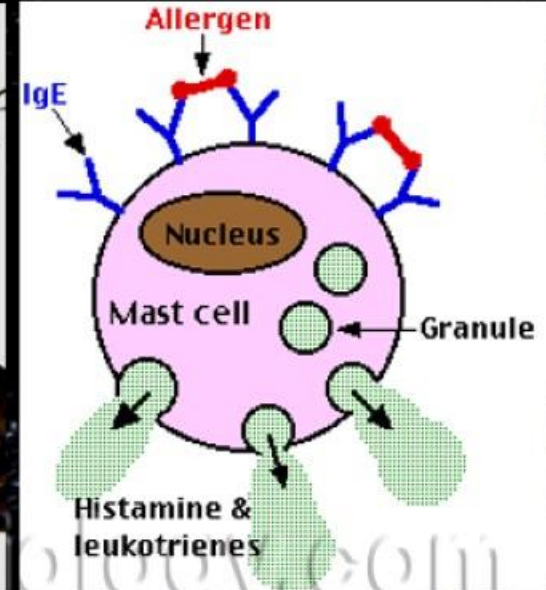
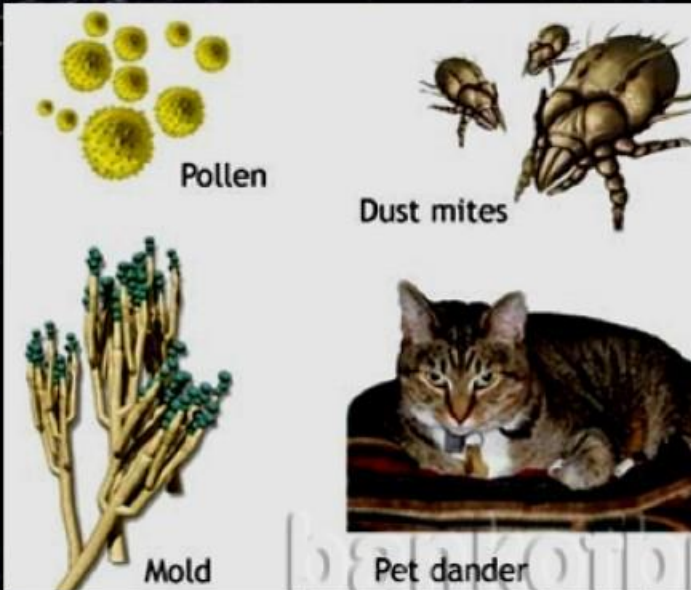
### Passive immunization





## ALLERGY

- It is the **exaggerated response of immune system to some antigens** seen in environment.
- **Allergens:** Substances causing allergy. E.g. mites in dust, pollens, animal dander, fur etc.
- Antibodies produced against the allergens are **IgE type**.
- IgE binds on **mast cells** to release chemicals like **histamine and serotonin** from them. It results in allergic reactions.





## ALLERGY

- **Symptoms:** Sneezing, watery eyes, running nose, difficulty in breathing, wheezing, skin rashes etc.
- **Determination of cause of allergy:** The patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.





## ALLERGY

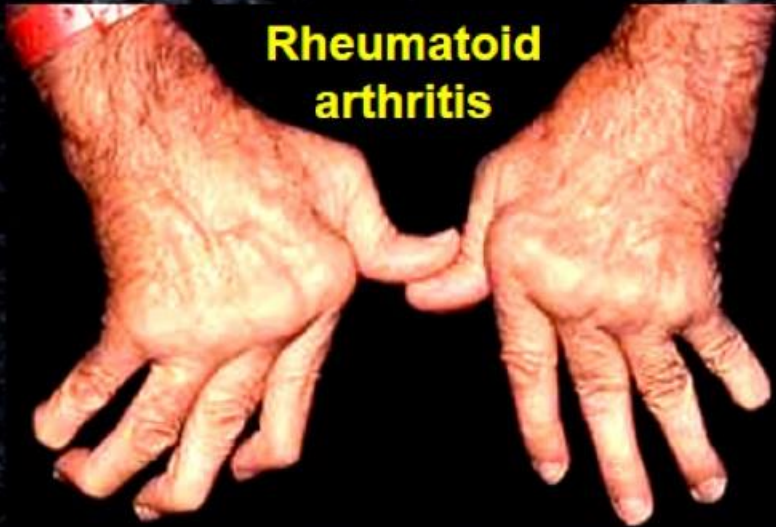
- **Treatment:** Drugs like anti-histamine, adrenaline and steroids quickly reduce the symptoms of allergy.
- **Asthma** is a respiratory disease due to allergy.
- Modern-day life style results lowering of immunity and more sensitivity to allergens. Many children in metro cities suffer from allergies and asthma due to sensitivity to the environment. This is due to the protected environment provided early in life.





## AUTOIMMUNITY

Rheumatoid arthritis



- In higher vertebrates, **memory-based acquired immunity** evolved based on the ability to differentiate foreign organisms from self-cells.
- Sometimes, due to genetic and other unknown reasons, the **body attacks self-cells** resulting in damage to the body. It is called **auto-immune disease**. E.g. **Rheumatoid arthritis**.

Normal hand



Rheumatoid arthritis

Bone erosion

Bone displacement

