

# MBT-301

# Cellular and Molecular Immunology

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Source -: Internet

**Unit I:** Immunology- Fundamental concepts and anatomy of the immune system; Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Haematopoiesis; Organs and cells of the immune system- primary and secondary lymphoid organs-Bone marrow, thymus, lymph nodes, spleen; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue (MALT and CALT); Mucosal Immunity. Toll-like receptors, inflammation. Antigens - haptens, antigenicity and immunogenicity.

**Unit II:** Humoral and Cell-Mediated Immune responses, primary and secondary immune modulation, Immunoglobulins: Basic structure, Classes and Subclasses of immunoglobulins, ADCC; antigenic determinants; B and T cell epitopes; B and T cell receptors; Immune responses generated by B and T lymphocytes; activation and differentiation of B and T cells, Memory B cell maturation, activation and differentiation; Cell-mediated effector functions; Functional T Cell Subsets; Cell-mediated immune responses, Cytokines-properties, receptors and therapeutic uses. Structure and function of antibody molecules; Multigene organization of immunoglobulin genes; Immunoglobulin superfamily; Generation of antibody diversity.

**Unit III:** Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing; MHC molecules, antigen processing and presentation, endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens.

**Unit IV:** Antigen-antibody interactions- Kinetics of immune response; Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques; RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasmon resonance, Biosenor assays for assessing ligand-receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis, Microarrays.

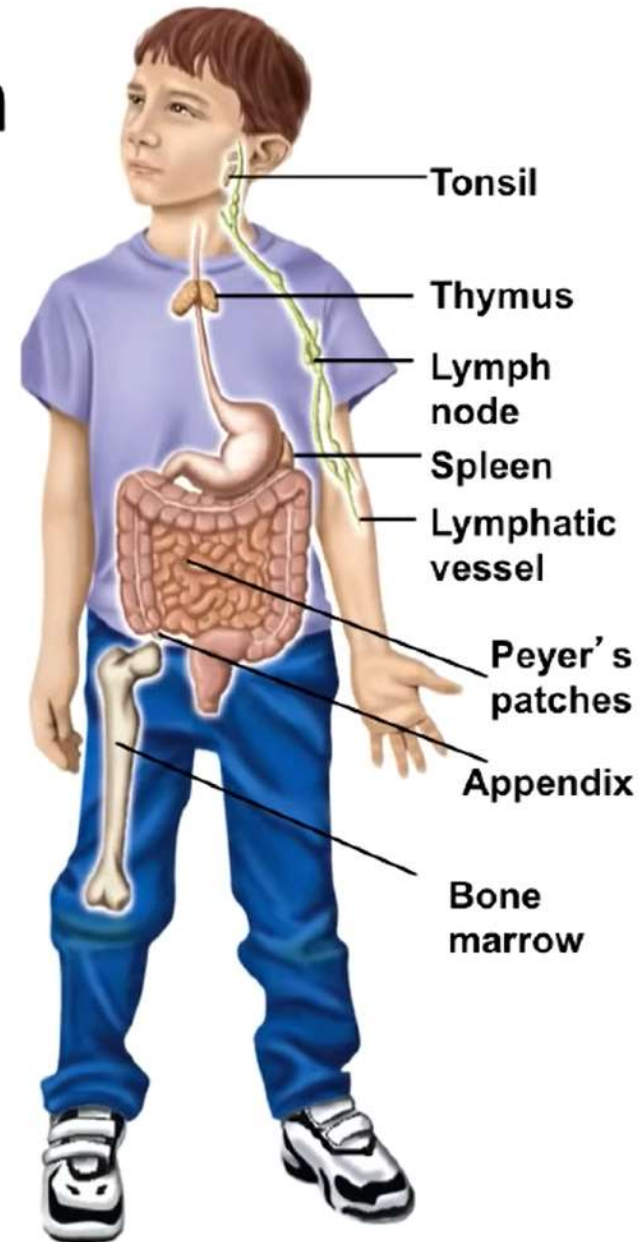
**Unit V:** Clinical Immunology: Immunity to Infection Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation immunology– Immunological basis of graft rejection; congenital and acquired immunodeficiencies. Cancer: Tumor immunology; Oncogenes, Tumor Suppressor Genes; Immune response to tumors and tumor evasion of the immune system.

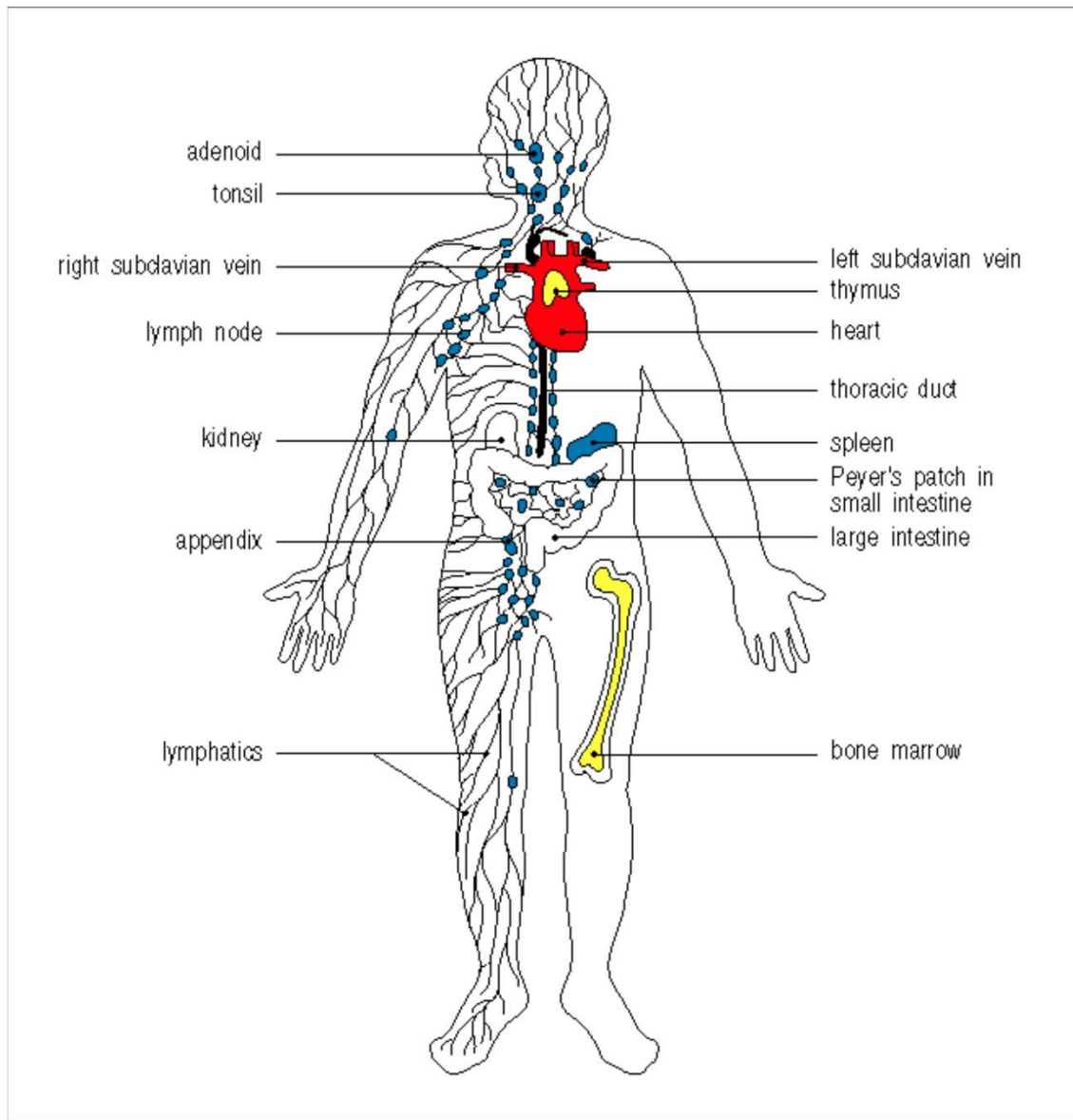
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# The Immune System

- **The Immune System** helps to guard against disease and tissue damage
- Immune cells are distributed throughout the body, but are highly concentrated in blood and lymphatic tissue.
- **Functions:**
  - **Defense:** against invading microorganisms
  - **Clean up:** and removes damaged tissue
  - **Surveillance:** identifies and destroys abnormal body cells.





# Immunity

- Immunity is body's ability to resist or eliminate potentially harmful foreign materials or abnormal cells





# Immunity

- Immunity (immunis- Latin-exempt, state of protection from infectious diseases)
- Immunity is body's ability to resist or eliminate potentially harmful foreign materials or abnormal cells
- consists of following activities:
  - Defense against invading pathogens (viruses & bacteria)
  - Removal of 'worn-out' cells (e.g., old RBCs) & tissue debris (e.g., from injury or disease)
  - Identification & destruction of abnormal or mutant cells (primary defense against cancer)
  - Rejection of 'foreign' cells (e.g., organ transplant)
  - Inappropriate responses:
    - Allergies - response to normally harmless substances
    - Autoimmune diseases

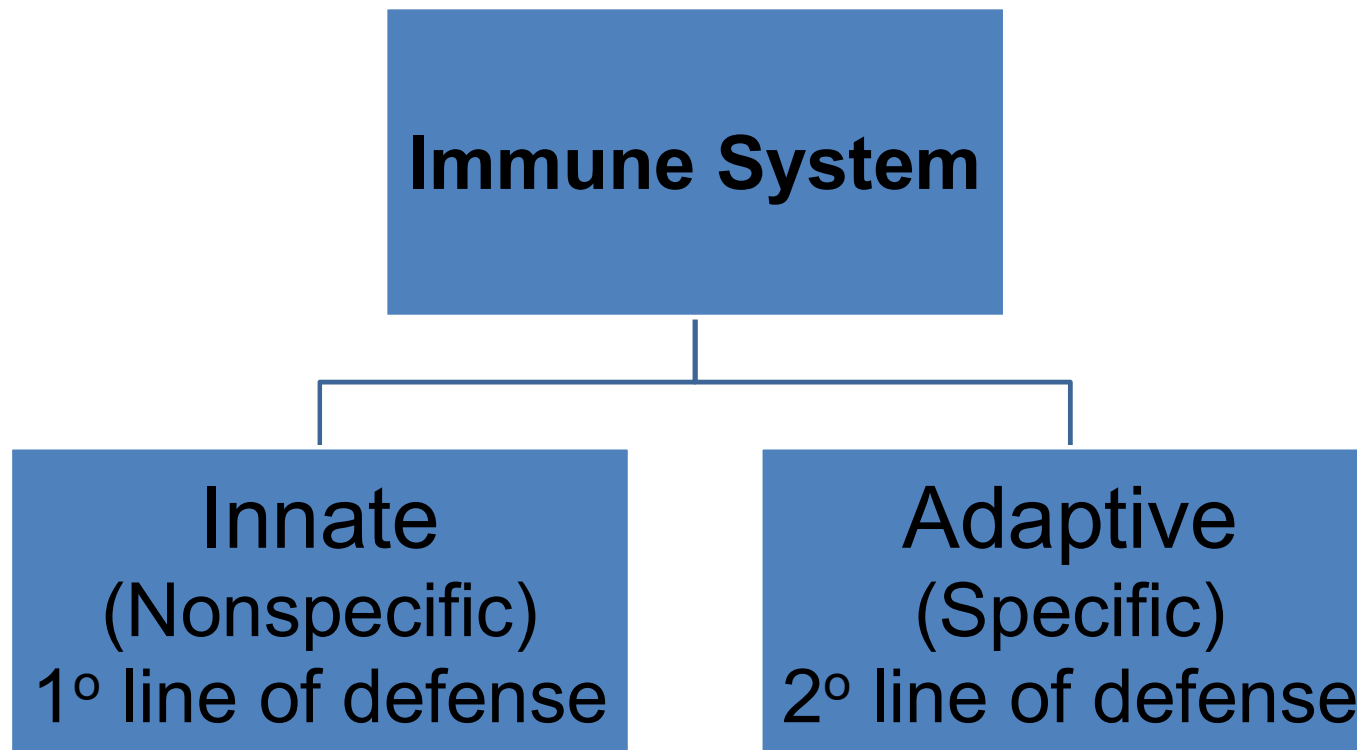
# IMMUNOLOGY

The science which studies all the aspects of the immune system

- Its structure and function
- Immune responses to infections or diseases
- Disorders of immune system

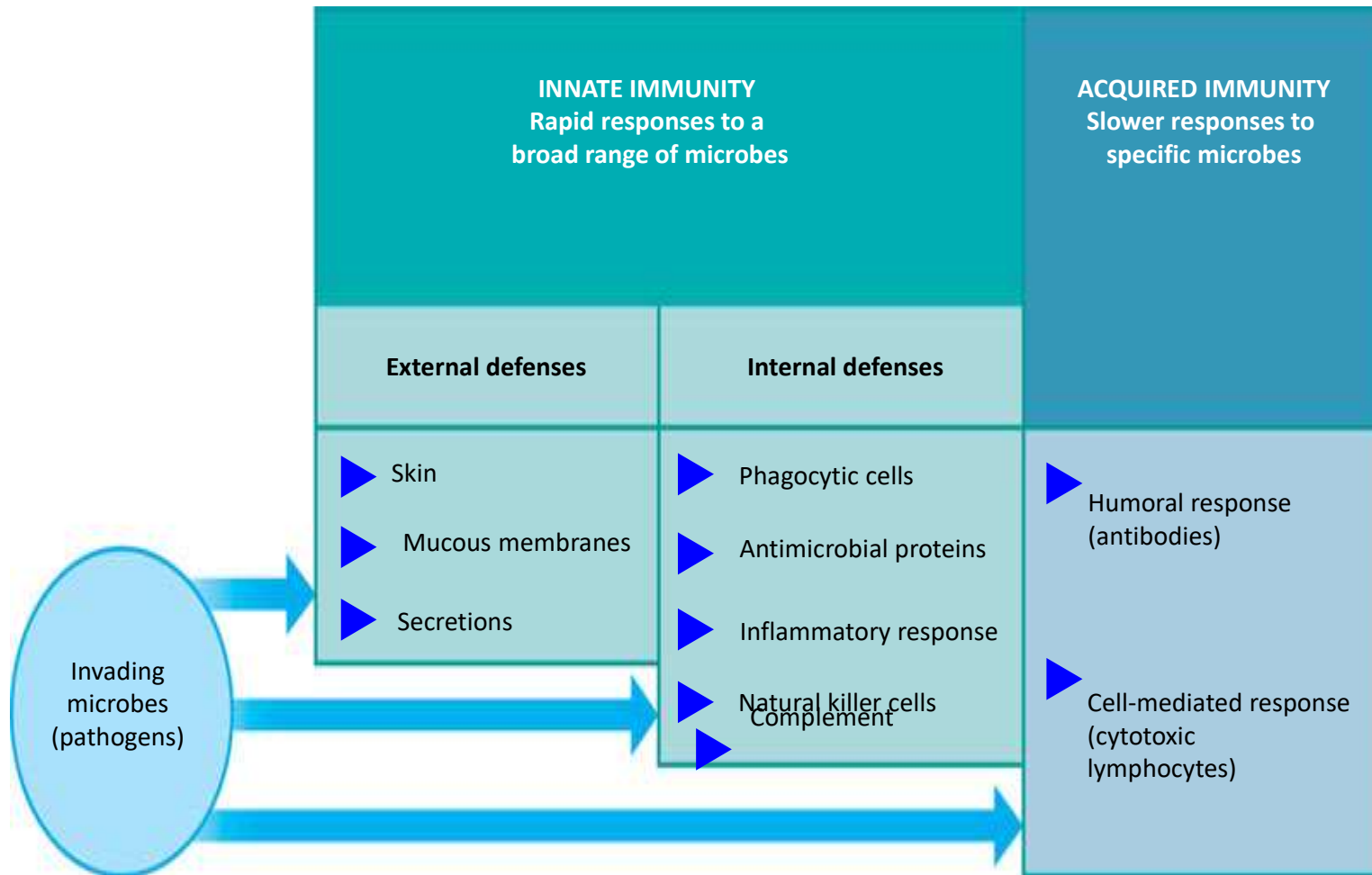


# Overview of the Immune System



Interactions between the two systems

# A typical immune response



# **INNATE IMMUNITY**

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graph TD; A[INNATE IMMUNITY] --- B[Natural/Native immunity]; A --- C[Non-Specific Immunity]; A --- D[Immunological Memory is Absent]; A --- E[Respond quickly i.e. within minutes or hours]; A --- F[Major Components are: 1. Skin and Mucous membrane 2. Phagocytes, Antimicrobial substances, Natural Killer cells, Inflammation,];
```

**Natural/Native  
immunity**

**Non-Specific  
Immunity**

**Immunological  
Memory is Absent**

**Respond quickly i.e. within  
minutes or hours**

**Major Components are:**

- 1. Skin and Mucous membrane**
- 2. Phagocytes, Antimicrobial substances, Natural Killer cells, Inflammation,**

# **AQUIRED IMMUNITY**

```
graph TD; A[AQUIRED IMMUNITY] --- B[Adaptive Immunity]; A --- C[Specific Immunity]; A --- D[Immunological Memory is Present]; A --- E[Slower but long-lasting immune response]; A --- F[Major Components are: Antigen Presenting Cells (APCs), B- Cells, T- Cells];
```

**Adaptive Immunity**

**Specific Immunity**

**Immunological Memory is Present**

**Slower but long-lasting immune response**

**Major Components are:**

- **Antigen Presenting Cells (APCs)**
- **B- Cells**
- **T- Cells**



## FIRST LINE OF DEFENSE

(Skin and mucous membranes)

## SECOND LINE OF DEFENSE

(Defensive cells, Antimicrobial substances, Inflammation, Fever)

## THIRD LINE OF DEFENSE

(T cells, B cells and Antigen Presenting Cells)

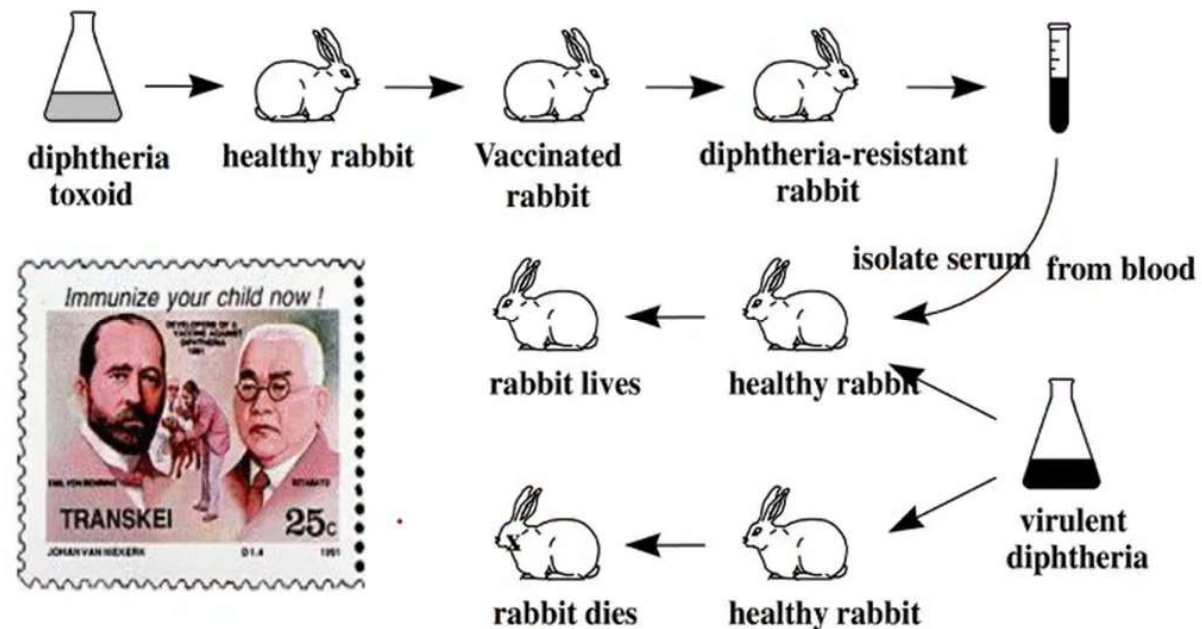




# Early Studies Revealed Humoral and Cellular Components of the Immune System

- The experimental work of Emil von Behring and Shibasaburo Kitasato in 1890 gave the **first insights into the mechanism of immunity**, earning **Von Behring the Nobel prize in medicine in 1901**.
- Von Behring and Kitasato demonstrated that **serum (the liquid, noncellular component of coagulated blood) from animals previously immunized to diphtheria could transfer the immune state to unimmunized animals**.

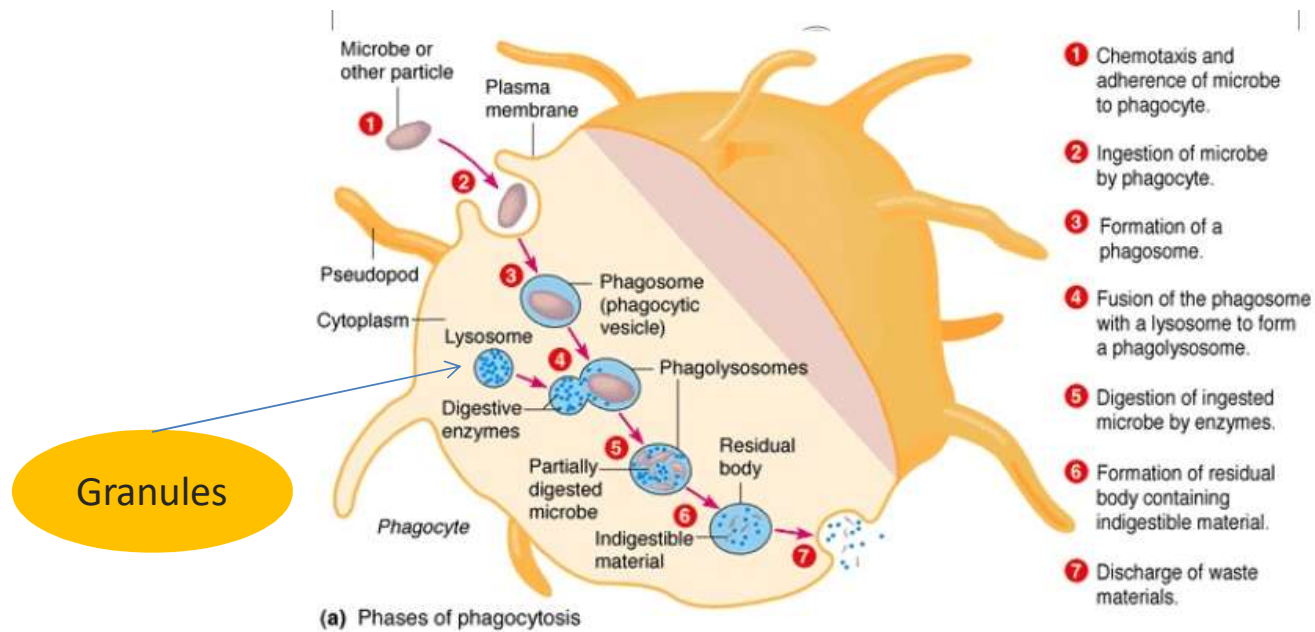
## von Behring and Kitasato experiment (1892)



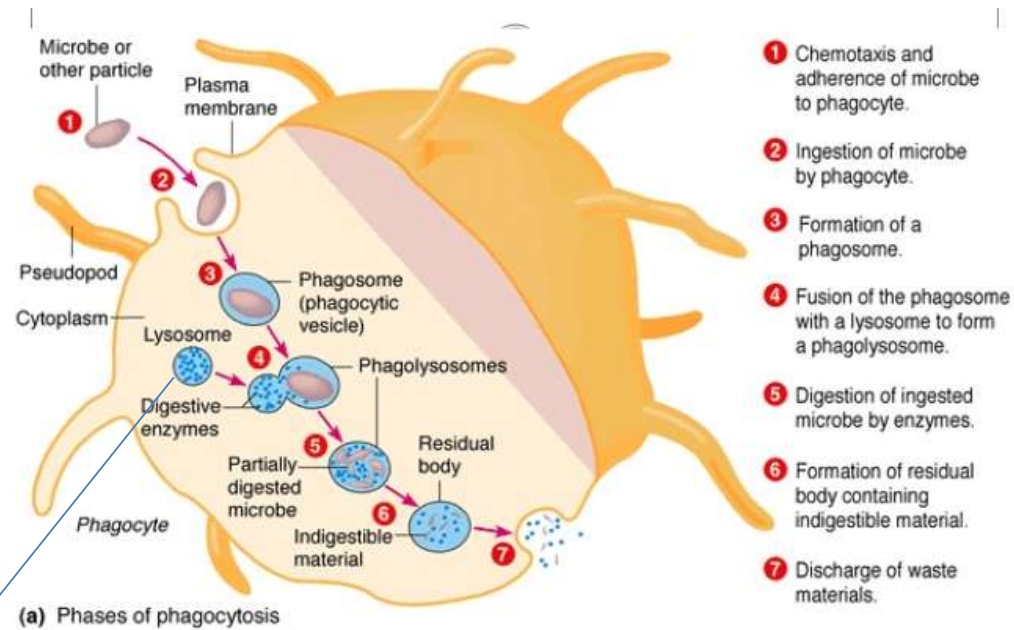
- > protective substances appeared in **serum**
- > Immunity could be passively acquired.



# How do neutrophils eat and digest microbes ?

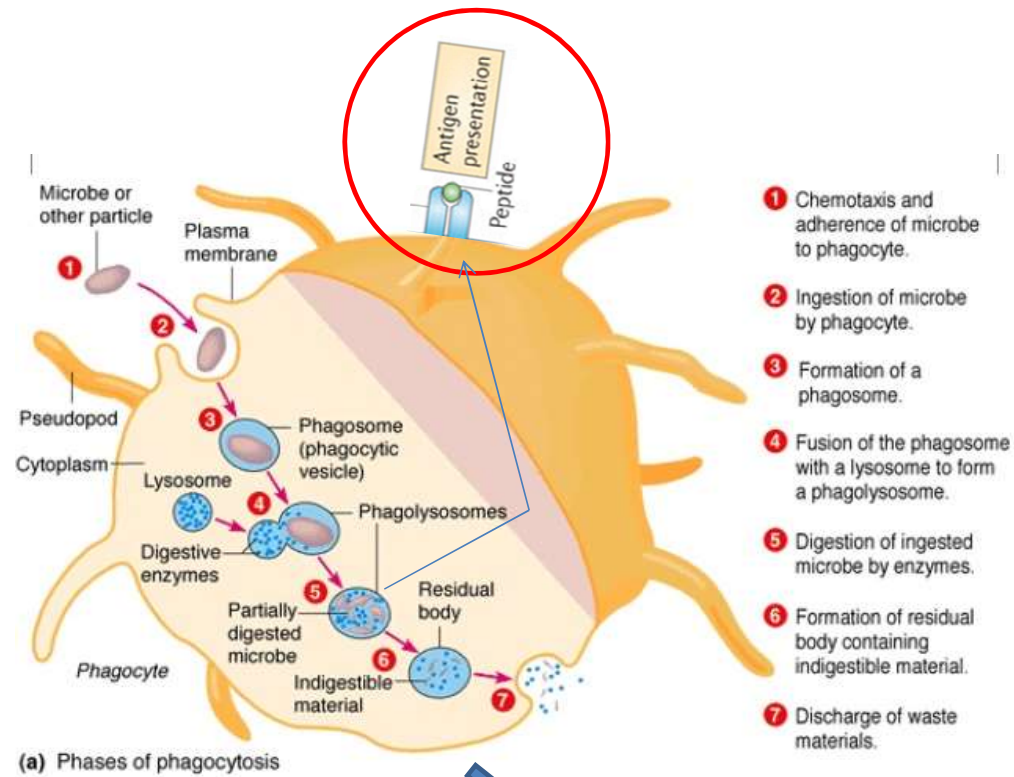


# What's in the granules ?



**Lysozyme – digests bacterial cell wall;  
other antimicrobial proteins**

# Additional role of neutrophils



Triggers inflammatory response