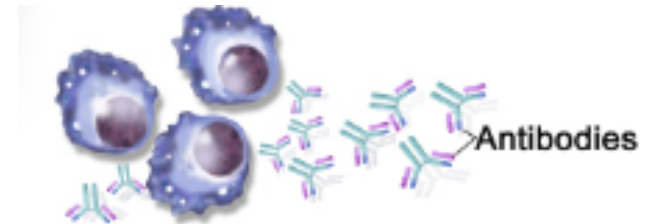


# Antibody mediated Immunity

Microbiology V

# Antibody mediated immunity (Humoral Immunity)

- The antibody mediated immune response is also known as **humoral immunity**.
- It is the host defense mechanism that are mediated by **antibody** present in plasma, lymph and tissue fluids.
- It is the type of adaptive immune system responsible for defense against **extracellular** microbes, microbial toxins and foreign macromolecules.
- The cells involved in AMI are B-lymphocytes, TH cells and phagocytic cells.



## **Antibody Mediated Immunity**

- Provides primary defense against most **extracellular** bacterial pathogens
- Helps in defense against **viruses** that infect through the respiratory or intestinal tracts
- Prevents recurrence of virus infections
- It also participates in the pathogenesis of immediate (types 1, 2 and 3) **hypersensitivity** and certain **autoimmune** diseases.

## **Antibody mediated immune response:**

- The antigens that stimulates B-cells for antibody production are classified based on their requirement of T-helper cells ( $T_H$ )
- They're classified into two types:
  1. T-dependent antigens
  2. T-independent antigens

### **T- dependent (TD) antigens:**

- Require  $T_H$  cells for the induction of antibody synthesis
- Ex. Proteins and erythrocytes

### **T-independent (TI) antigens :**

- Do not require  $T_H$  cells
- Ex. polysaccharides and other structurally simple molecules with repeating epitopes.

## Antibody mediated response:

Immune response to an antigen is brought about by three types of cells:

- Antigen processing cells (APC)
  - Macrophages and Dendritic cells
- T<sub>H</sub> cells and B cells (lymphocytes)
- The antibody mediated immune response completes in three steps:
  1. Activation and proliferation of B-cells to produce antibody
  2. Class switching of antibody
  3. Antibody mediated removal of antigen

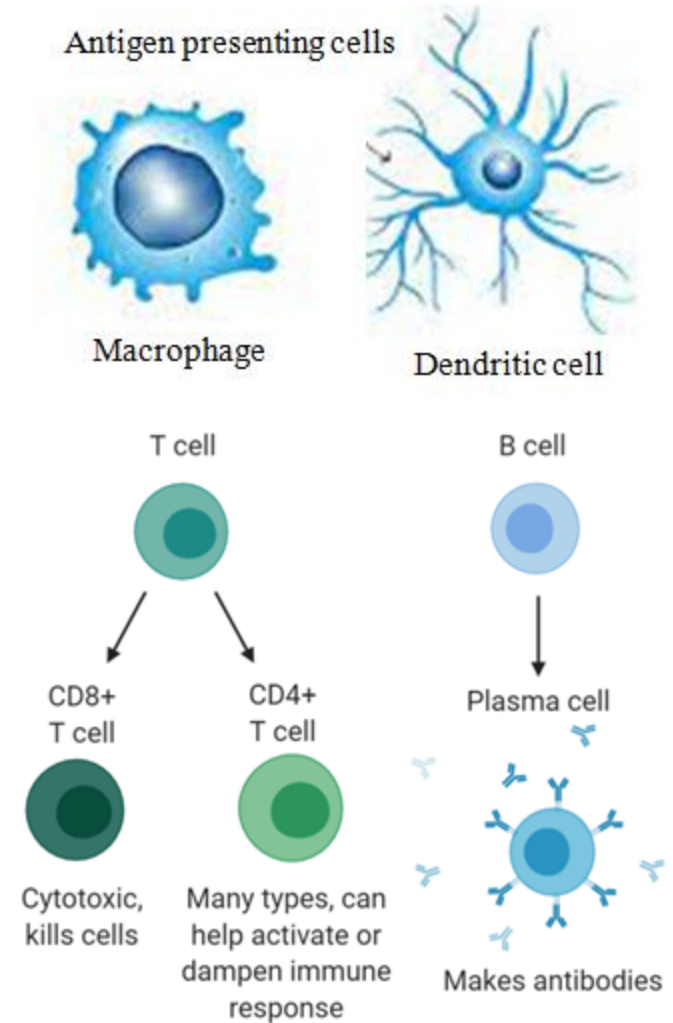
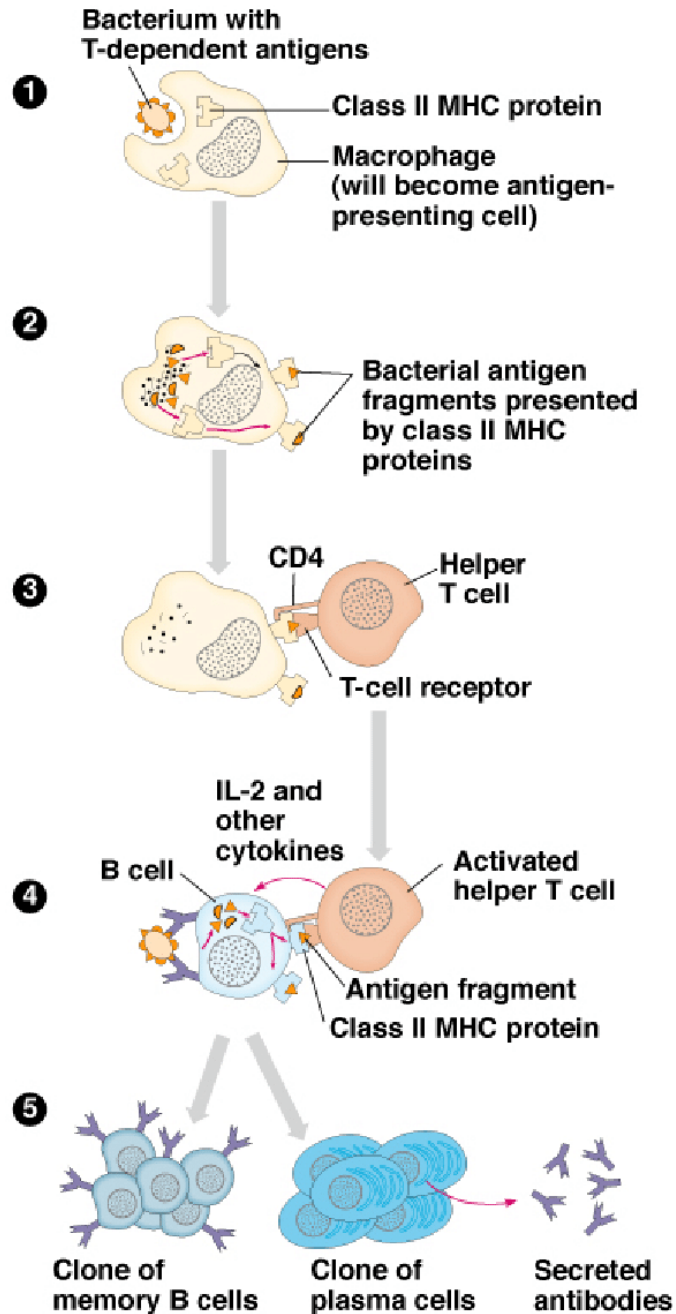


Figure 1: Types of T and B cells

## Step I: Activation and proliferation of B-cells

1. Antigen enters
2. Antigen presenting cells (APC) get activated
  - Macrophage
  - Dendritic cells
3. APC binds with **Major histocompatibility complex (MHC) II**
4. Immature  $T_H$ -cell binds with earlier formed complex with the help of **T-cell receptor (TCR)**
5. Whole complex produces signal for activation of **CD4 cells**
6. Activation of **CD4 cells** – Maturation of T helper cell ( $T_H$  cells)
7. Forms **interleukins** (IL-2, IL-4, IL-5 & IL-6):
  - B-cell maturation and subsequently release of plasma cells
  - **Plasma cells** – forms antibodies
  - Some of the plasma cells become – **memory cells**

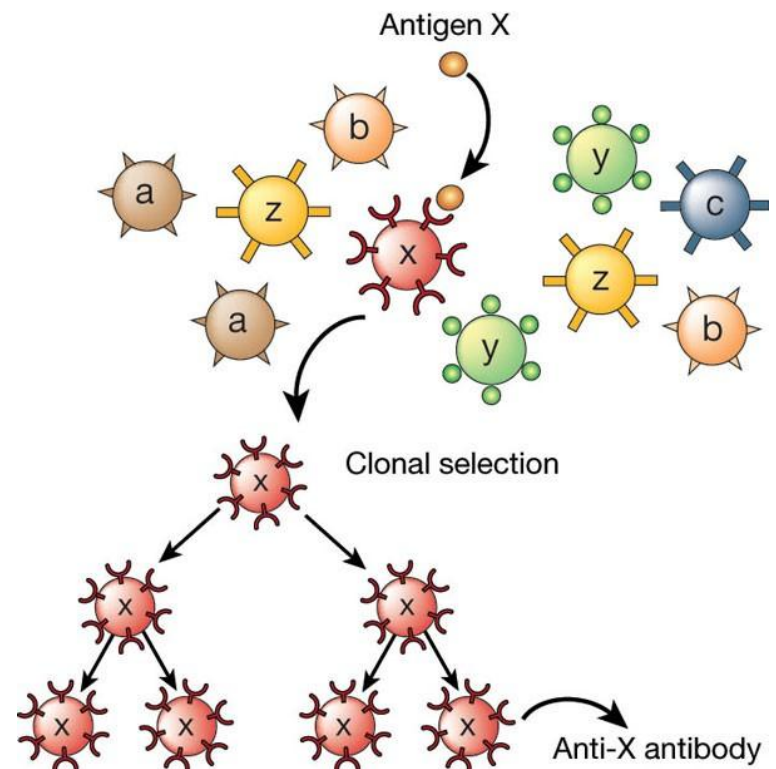


## Step II: Class switching of antibody

- In response to cytokines produced by  $T_H$  cells, the B-cells undergoes class switching (clonal selection).
- It leads to the production of antibodies with heavy chain of different classes
- It is specific to the type of antigen encountered.

## Step III: Antibody mediated removal of antigen

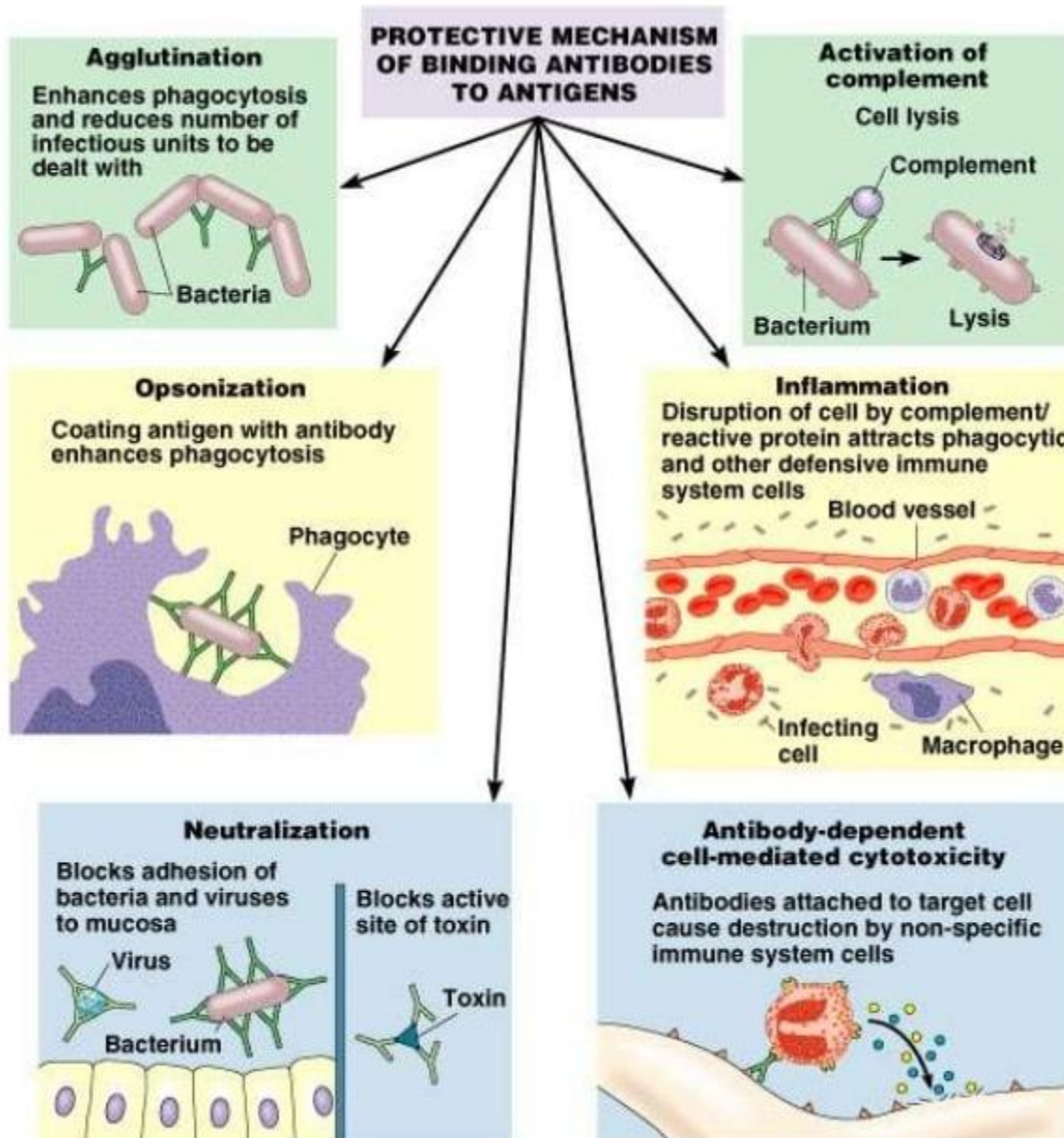
- It consists of a number of effector mechanism (antibody functions).
- It needs the participation of various cellular and humoral component of immune system involving phagocytes and complements.



Clonal selection of B-cell



# Function of Antibody – Humoral response



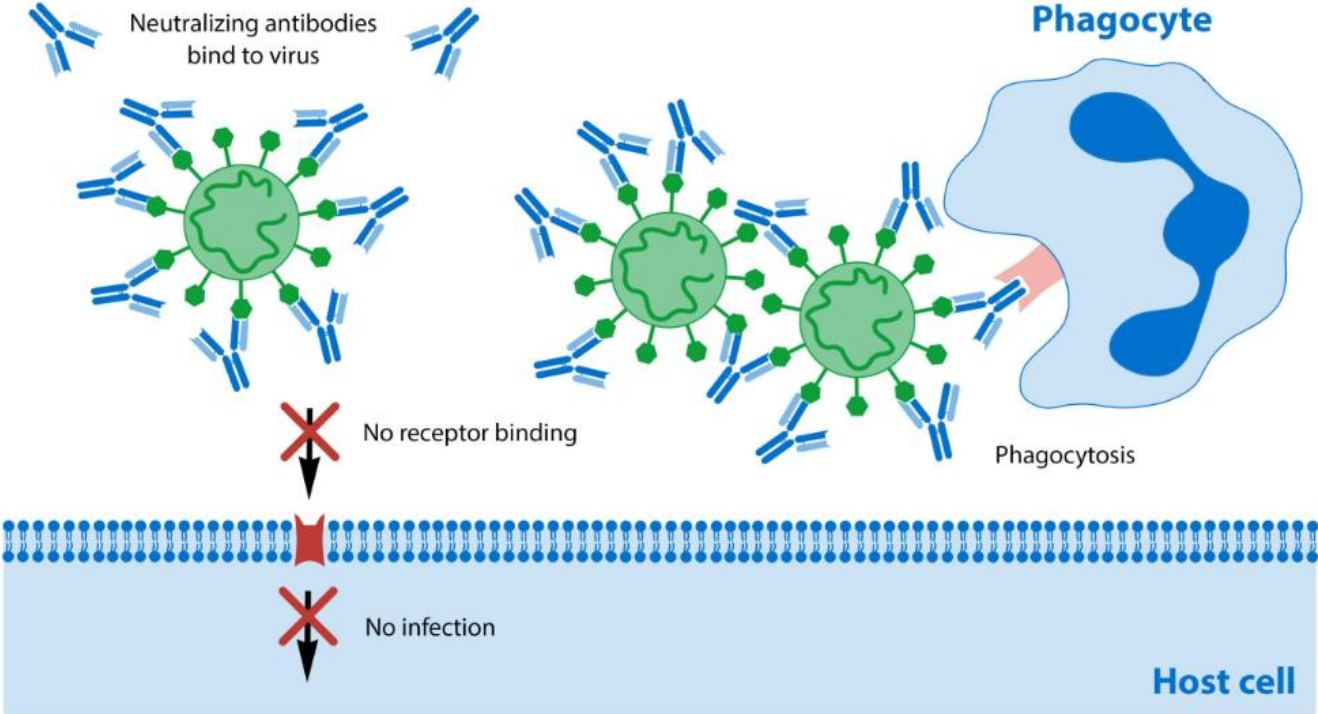
## **Neutralization of microbes and microbial toxins:**

- The first step for removal of Ag is neutralization of microbes and toxins.
- Neutralization is the process by which antibodies against microbes and microbial toxins blocks the binding of these microbes and toxins to cellular receptor, thus inhibiting the infections.

## **Antibody mediated opsonization and phagocytosis:**

- Mononuclear phagocytosis and neutrophils express a variety of surface receptors that directly bind microbes and ingest them and cause intracellular killing and degradation.
- Antibodies and complements proteins coat the surfaces of microbes (opsonization) and enhance phagocytosis.

# Neutralization by antibodies



## **Antibody dependent cell mediated cytotoxicity:**

- NK cells and other leukocytes bind to antibody coated cells by the receptor and destroy these cells.
- This process is termed as antibody dependent cell mediated cytotoxicity.
- **Activation of Complement system:**
- Activation of complement involves the sequential proteolysis of protein to generate newly assembled enzymes complex with proteolytic activity.
- The products of complement activation become covalently attached to microbial cells surface or to antibodies bound to microbes and to other antigens.

# Primary immune response – antibody production

- On exposure to antigen, antibody production follows a characteristic pattern
- It involves 4 step
  1. **Lag phase**
    - entry of pathogen, its distribution and fate in tissue
    - Contact with immuno competent cells
  2. **Log Phase**
    - Steady rise in the titre of antibody
  3. **Plateau phase**
    - Equilibrium between antibody synthesis and catabolism
  4. **Decline phase**
    - catabolism exceeds production and thus titre falls

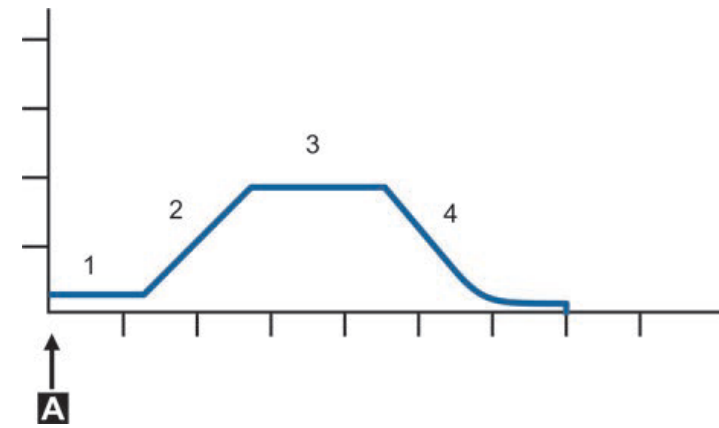


Fig: Primary immune response. An antigenic stimulus; 1. Latent period; 2. Log phase (rise in titer of serum antibody); 3. Steady state of antibody titer; 4. Decline of antibody titer

# Primary and Secondary Response

## Primary response:

- Antibody response to initial antigenic stimulus
- It differs both quantitatively and qualitatively
- Slow, sluggish and short lived
- Long lag phase and low titre of antibody
- Predominantly IgM

## Secondary response:

- Subsequent to primary response
- Prompt, powerful and prolonged
- Short or negligible lag phase
- Much higher level of antibodies for longer period
- Predominantly IgG

