IMMUNITY

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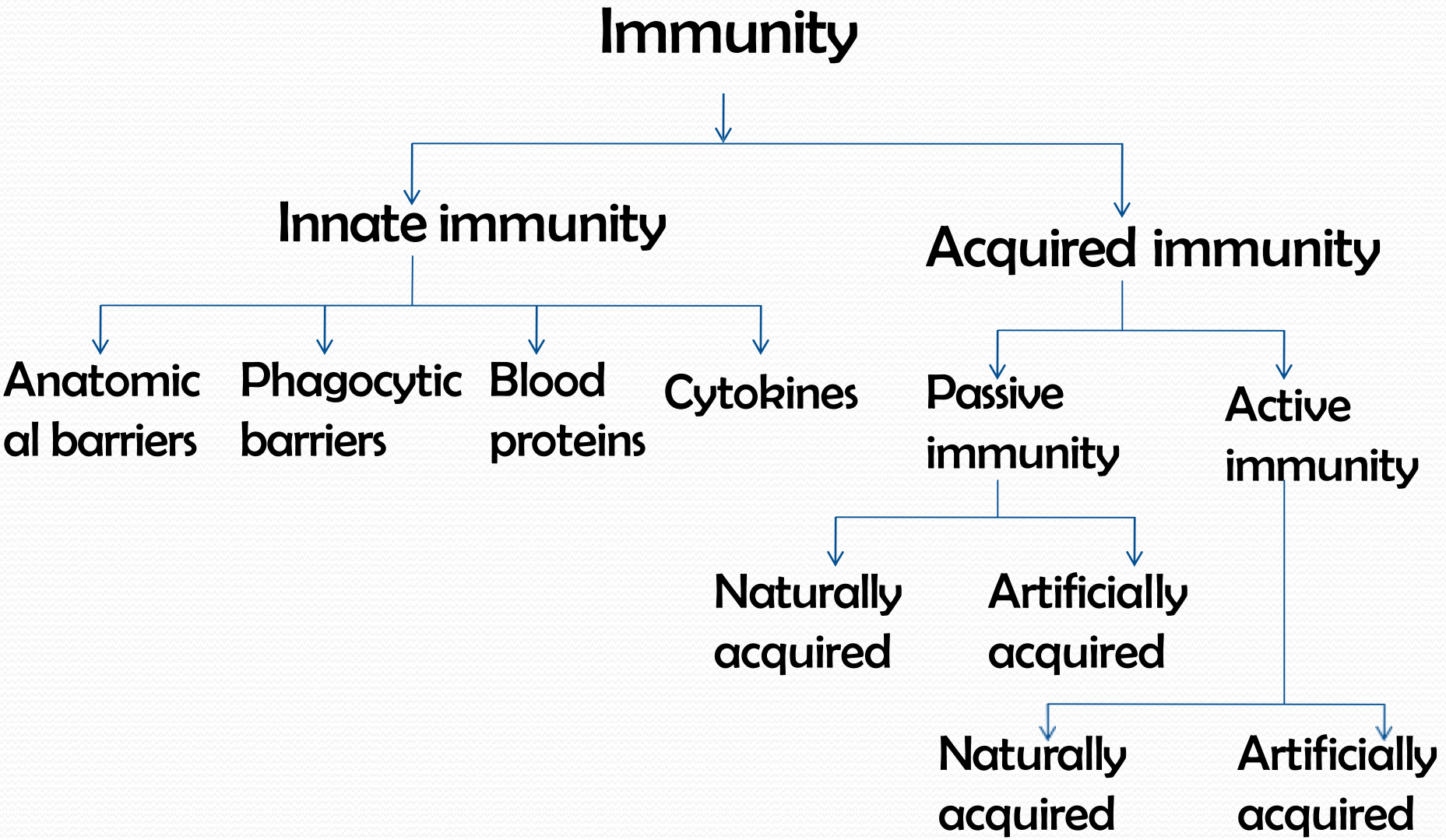
Introduction

- Immunity is a state of resistance of an organism to invading biotic or abiotic pathogens and their harmful effects that prevents the development of infection and maintains organism's integrity by counteracting, neutralizing, and clearing pathogens.

- Lack of immunity is known as susceptibility.

- Immunity is done by immune system which is a complex network of lymphoid organs such **as bone marrow, thymus, spleen etc.**

Types of immunity



Innate Immunity

- It is also called **natural** or **native** immunity, consist of mechanisms that exist before infection and are capable of rapid responses to microbes.

- It is comprises following types of defense barriers-

1) Anatomical barriers
2) Phagocytic barriers
3) Blood proteins and
4) Cytokines.

Type	Mechanism
1) Anatomical barriers	
➢ Skin ➢ Mucous membrane	Mechanical barriers retards entry of microbes. Acidic environment (pH 3-5) retards growth of microbes. Mucous entraps foreign microorganism.
2) Physiologic barriers	
➢ Temperature	Body temperature and fever response inhibits growth of some pathogens.
➢ Low pH	Acidic pH of stomach (pH 2) kills most ingested microorganism.
3) Phagocytic barriers (Neutrophils, Macrophages and NK cells)	Ingest and destroys microbes by endocytosis and phagocytosis)
4) Inflammatory barriers	Tissue damage and infection induce leakage of vascular fluid, containing serum protein with antibacterial activity.

Mechanisms of innate immunity

- Epithelial surfaces
- Antibacterial substances
- Cellular factors
- Inflammation
- Fever
- Acute phase proteins

1. Epithelial surfaces:

Skin:

- provides mechanical barrier to microorganisms
- provides bactericidal secretions
- the resident bacterial flora of skin and mucous surfaces prevent colonization by pathogen
- alteration of normal flora may lead to invasion by extraneous microbes and cause serious diseases.e.g,clostridial enterocolitis following oral antibiotics.

Respiratory tract:

- respiratory tract is lined by moist musous surfaces which act as trapping mechanism.
- inhaled particles are arrested in nasal passage on moist mucous membrane surfaces.
- the hair like cilia propels the particles towards pharynx and are swallowed or coughed out.
- some particles which manage to reach alveoli are ingested by phagocytes

Intestinal tract:

- saliva present in mouth inhibits many microorganisms.
- acidic ph of gastric juices destroys the swallowed bacteria if any.
- normal flora of intestine prevent colonization of pathogens.

Conjunctiva:

- Tears flush away bacteria and other dust particles
- lysozyme present in tears has bactericidal action.

Urinary tract:

Urine eliminate bacteria from urethra by its flushing action.

2.Antibacterial substances in blood and tissues:

There are no. of antibacterial substances present in blood and tissues

- Beta lysin: relatively thermostable substance active against anthrax and related bacilli.
- Basic Polypeptide: e.g., leukins and plakins
- Acidic substances:lactic acid present in tissue and infected area
- Interferon : protects against certain acute and viral infections.

3. Cellular factors:

- Once the infective agent cross the epithelialbarriers,tissue factors come into play for defense.
- Process:

Invasion of tissues by infective agent

Accumulation of phagocytes in site of infection

Deposition of fibrin that entangles the organisms(act as barrier to spread of infection)

Phagocytic cells ingest these organisms and destroy them.

4.Inflammation:

- An important non-specific defense mechanism
- Occurs as a result of tissue injury, initiated by entry of pathogens.
- Leads to vasodilation,increased vascular permeability and cellular infiltration
- Due to increased vascular permeability, plasma pours out and dilutes the toxic products present.
- Fibrin barrier is laid to wall off the site of infection

5.Fever:

- Rise in temperature following infection is natural defense mechanism.
- Destroys the infecting organism
- Stimulates the production of interferon, which help in recovery from viral infections

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6. Acute phase proteins: after injury ,there is sudden increase or decrease in plasma concentration of certain proteins, collectively called Acute phase proteins

- E.g. C reactive protein (CRP)
- Mannose binding proteins etc.

- They activate the alternative pathway of complement

- Prevent tissue injury and promote repair of inflammatory lesions

Types of innate immunity

It is of three types-

- **Species immunity** is the total immunity shown by all members of a species against pathogen; e.g. birds immune to **tetanus.**
- **Racial immunity** is that in which various races show marked difference in their resistance to certain infectious disease.
- **Individual immunity** is very specific for each and every individual despite having same racial background and opportunity for exposure.

B.Acquired Immunity

- The resistance acquired by an individual during life by recognizing and selectively eliminating specific foreign molecules.

- Provides second line of defense against infection.

Acquired Immunity

Acquired or **adaptive** immunity is the immunity that is developed by the host in its body after exposure to suitable antigen or after transfer of antibodies or lymphocyte from an immune donor.

Characteristics of Acquired Immunity

1. Antigenic Specificity
2. Diversity
3. Immunologic memory
4. Self/non-self recognition

Characteristics:

- **Antigen specificity:** immune system or antibodies can distinguish among antigens, even between two proteins that differ in only one amino acid.

- **Diversity:** immune system is capable of generating large antibody diversity in its recognition molecules.

- **Immunologic memory:** immune system exhibits memory on second encounter of same antigen by generating a secondary response which is more specific and quick.

- **Self/non-self recognition:** does not react with body's own molecule but effectively eliminates foreign antigens.

Types of Acquired Immunity

Acquired Immunity is of two types- active and passive immunity.

1. **Active immunity**

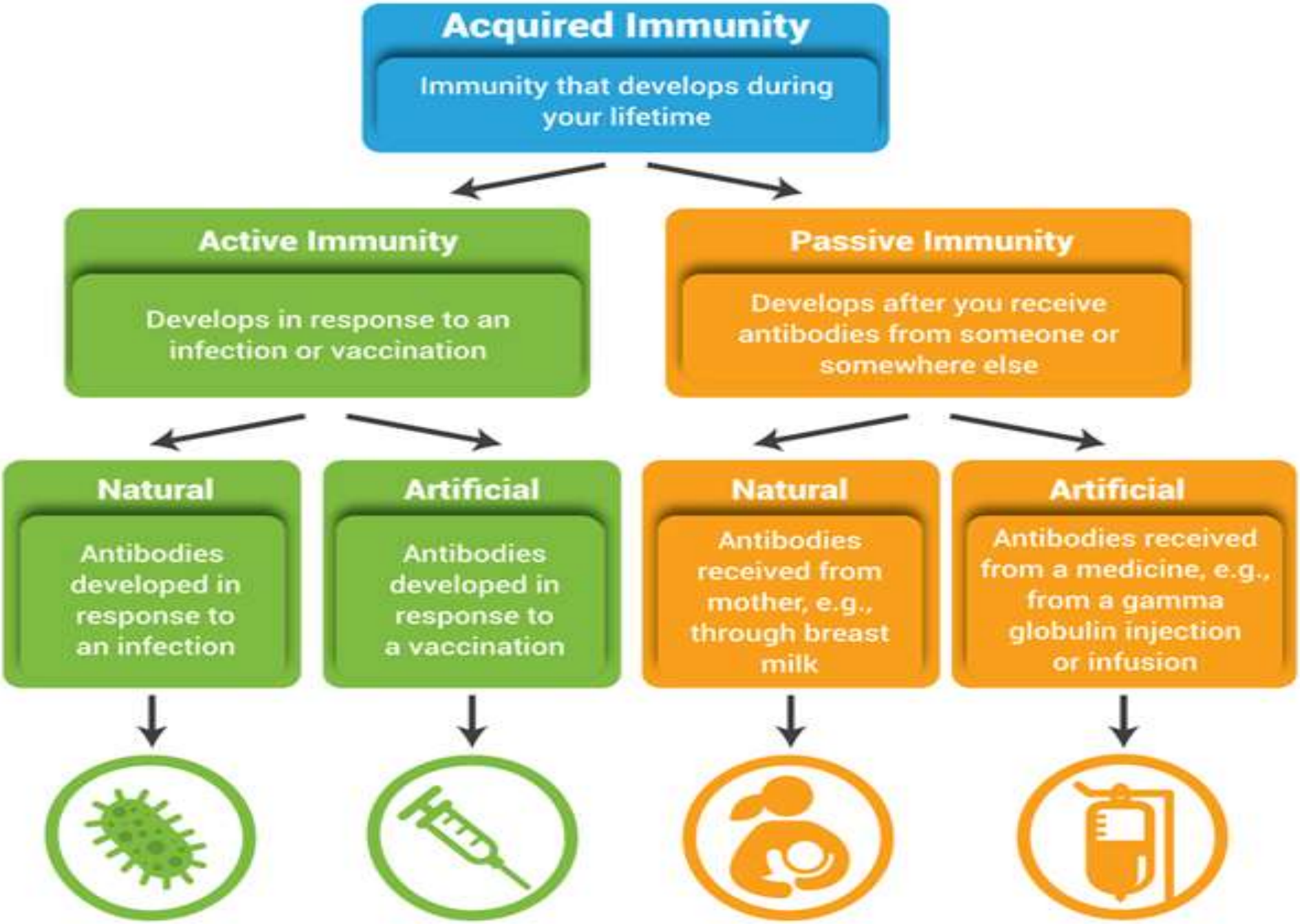
It is induced by natural exposure to a pathogen or by vaccination.

It can be categorized into two types-
Naturally acquired and Artificially acquired active immunity.

2. **Passive immunity**

Passive immunity is achieve by transfer of immune products, such as antibody or sensitized T-cells, from an immune individual to non immune one.

It is of two types- Naturally acquired and Artificially acquired passive immunity


Acquired Immunity
Immunity that develops during your lifetime
Active Immunity
Develops in response to an infection or vaccination
Passive Immunity
Develops after you receive antibodies from someone or somewhere else
Natural
Antibodies developed in response to an infection
Artificial
Antibodies developed in response to a vaccination
Natural
Antibodies received from mother, e.g., through breast milk
Artificial
Antibodies received from a medicine, e.g., from a gamma globulin injection or infusion

Mechanism of active immunity

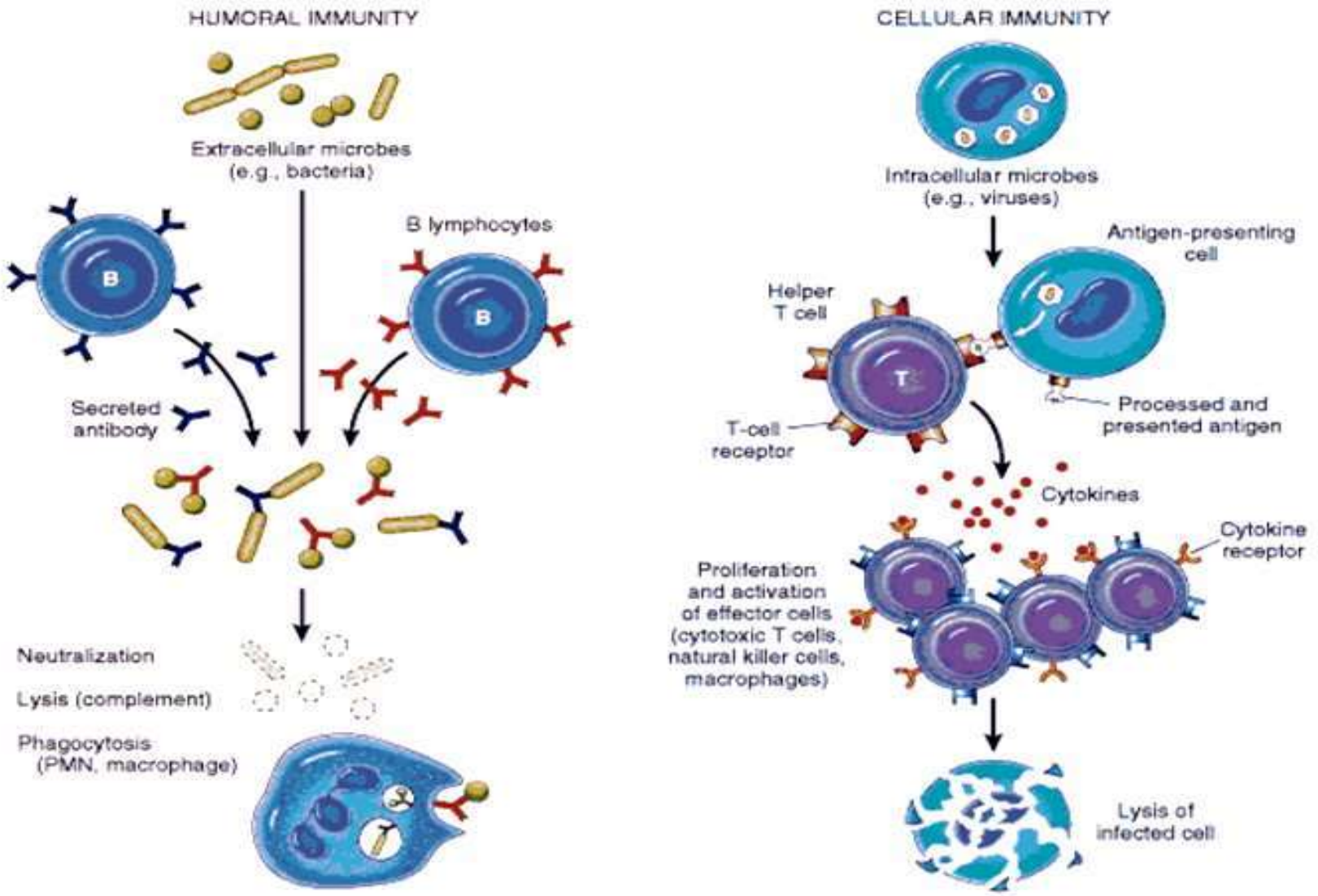
- Body's immune system provide protection by synthesizing antibodies or immunoglobulins in response to an antigen.

- **Primary immune response** takes place when the host is attacked by certain microbes for first time. The antibodies start to generate after certain period as the binding of an antigen with its particular antibody is very specific.

- **Secondary immune response** occurs when an individual is being attacked by the same antigen subsequently. It is a rapid process.

- Acquired active immune response takes two distinct forms- **humoral** and **cell mediated response.**

Humoral immunity and cell mediated immunity



Sl. No.	Cell-mediated Immunity	Humoral-Immunity
1	The cell-mediated immune response is mediated by T-cells.	The humoral immune response is mediated by antibodies (produced by B-cells).
2	Antibodies are not formed in cell-mediated immune response.	Antibodies are formed in humoral immune response.
3	Receptors are used in cell-mediated immunity to detect antigens.	Antibodies are used in humoral immunity to detect antigens.
4	T-cell receptors binds to the T-cells and then the T-cell themselves binds to the antigen.	Here the B-cells produce antibodies and the antibodies bind to the antigen.
5	It protect against fungi, virus and intracellular bacterial pathogens.	It protect against extracellular bacterial and viral pathogens.
6	Cells involved in cell-mediated immunity: Macrophage, Helper T cells, Natural killer T cells and Cytotoxic T cells.	Cells involved in humoral immunity: T-Lymphocytes, B-Lymphocytes and Macrophages.

7	Cell-mediated immunity mediates delayed hypersensitivity (type IV).	Humoral immunity mediates immediate hypersensitivity (type I, II and III)
8	Cell-mediated immune response provides the immunological surveillance.	Humoral immunity does not provide immunological surveillance.
9	It can eliminate tumor cells and thus can provide immunity against cancer	It cannot eliminate tumor cells.
10	Cell-mediated immune response also participates in the rejection of organ transplants.	Humoral immunity may be involved in the early graft rejection due to pre-formed antibodies.
11	Only the T cell dependent antigens led to cell mediated immunity.	In humoral immunity response, the B cells directly bind to soluble antigen and results in the antibody production.
12	Both CD_4+ and CD8+ T cells are involved in cell mediated immune response.	Only TH cells are involved in humoral immune response.