SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(Affiliated to Bharathidasan University)
(Accredited with 'A' Grade {3.45/4.00} By NAAC)
(An ISO 9001: 2015 Certified Institution)
Sundarakkottai, Mannargudi-614 016.
Thiruvarur (Dt.), Tamil Nadu, India.

III B.SC BIOCHEMISTRY
CC-VIII- IMMUNOLOGY (16SCCBC8)
SEMESTER: VI

PREPARED BY
Dr. R. NALINI
ASSISTANT PROFESSOR
PG & RESEARCH DEPARTMENT OF BIOCHEMISTRY

THE IMMUNE SYSTEM REVIEW

KEY TERMS

Term	Meaning
Pathogen	A disease-causing organism, including bacteria,
Antigen	Molecule that stimulates an immune response
Innate immune system	Non-specific immune system
Adaptive immune system	Antigen-specific immune system
Antibody	Specialized Y-shaped protein that tags antigens for destruction
B cells	White blood cells that produce antibodies and aid in immunological memory
T cells	White blood cells specialized to assist B cells (helper T) and others directly kills infected cells (killer T)

Term	Meaning
Humoral immunity	Adaptive immune defense depending on the action of antibodies
Cell-mediated Immunity	Adaptive immune defense in which foreign cells are destroyed by T cells
Virus	Nonliving particle containing protein and DNA/RNA that can infect a living cell
Vaccine	A killed or weakened form of a pathogen that produces immunity when injected into the body

Infectious disease

- Infectious diseases are caused by viruses, bacteria, fungi, protists, and other **pathogens**.
- Pathogens are often spread through coughing, sneezing, and physical contact between people.
- They can also be spread through contamination of water supply, or through the exchange of body fluids, including sexual intercourse or blood trasfusion

Nonspecific defense: the innate immune system

- The human body has a series of nonspecific defenses that make up the **innate immune system**.
- These defenses are not directed against any one pathogen but instead; provide a guard against all infection.

First line of defense

- The body's most important nonspecific defense is the *skin*, which acts as a physical barrier to keep pathogens out.

- Even openings in the skin (such as the mouth and eyes) are protected by saliva, mucus, and tears, which contain an enzyme that breaks down bacterial cell walls.

Second line of defense

If a pathogen does make it into the body, there are secondary nonspecific defenses that take place.

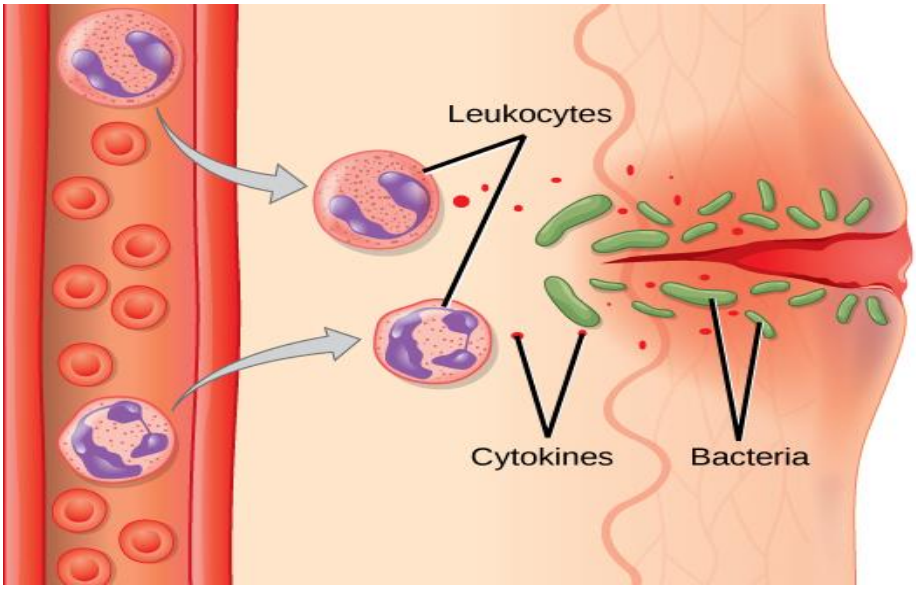


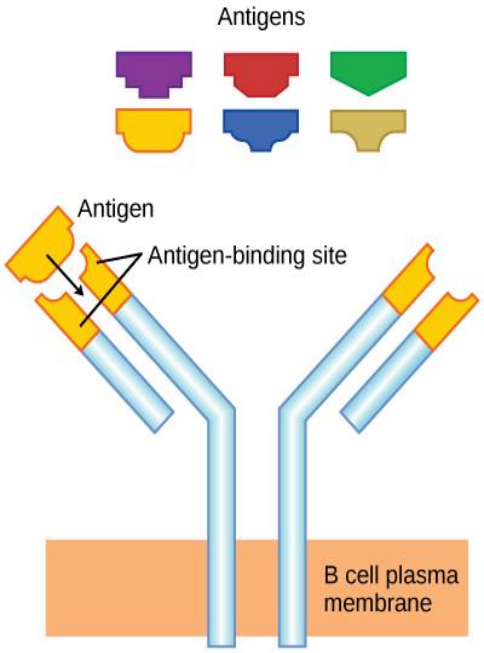
Image showing white blood cells releasing chemicals to induce inflammatory response

- An *inflammatory response* begins when a pathogen stimulates an increase in blood flow to the infected area.
- Blood vessels in that area expand, and white blood cells leak from the vessels to invade the infected tissue.
- These white blood cells, called *phagocytes* engulf and destroy bacteria.
- The area often becomes red, swollen, and painful during an inflammatory response.
- When a pathogen has invaded, the immune system may also release chemicals that increase body temperature, producing a *fever*.

- Increased body temperature may slow or stop pathogens from growing and helps speed up the immune response.

Specific defense: the adaptive immune system

- When pathogens are able to bypass innate immune defenses, the **adaptive immune system** is activated.
- Cells that belong in the body carry specific markers that identify them as "self" and tell the immune system not to attack them.
- Once the immune system recognizes a pathogen as "non-self," it uses cellular and chemical defenses to attack it.
- After an encounter with a new pathogen, the adaptive immune system often "remembers" the pathogen, allowing for a faster response if the pathogen ever attacks again.

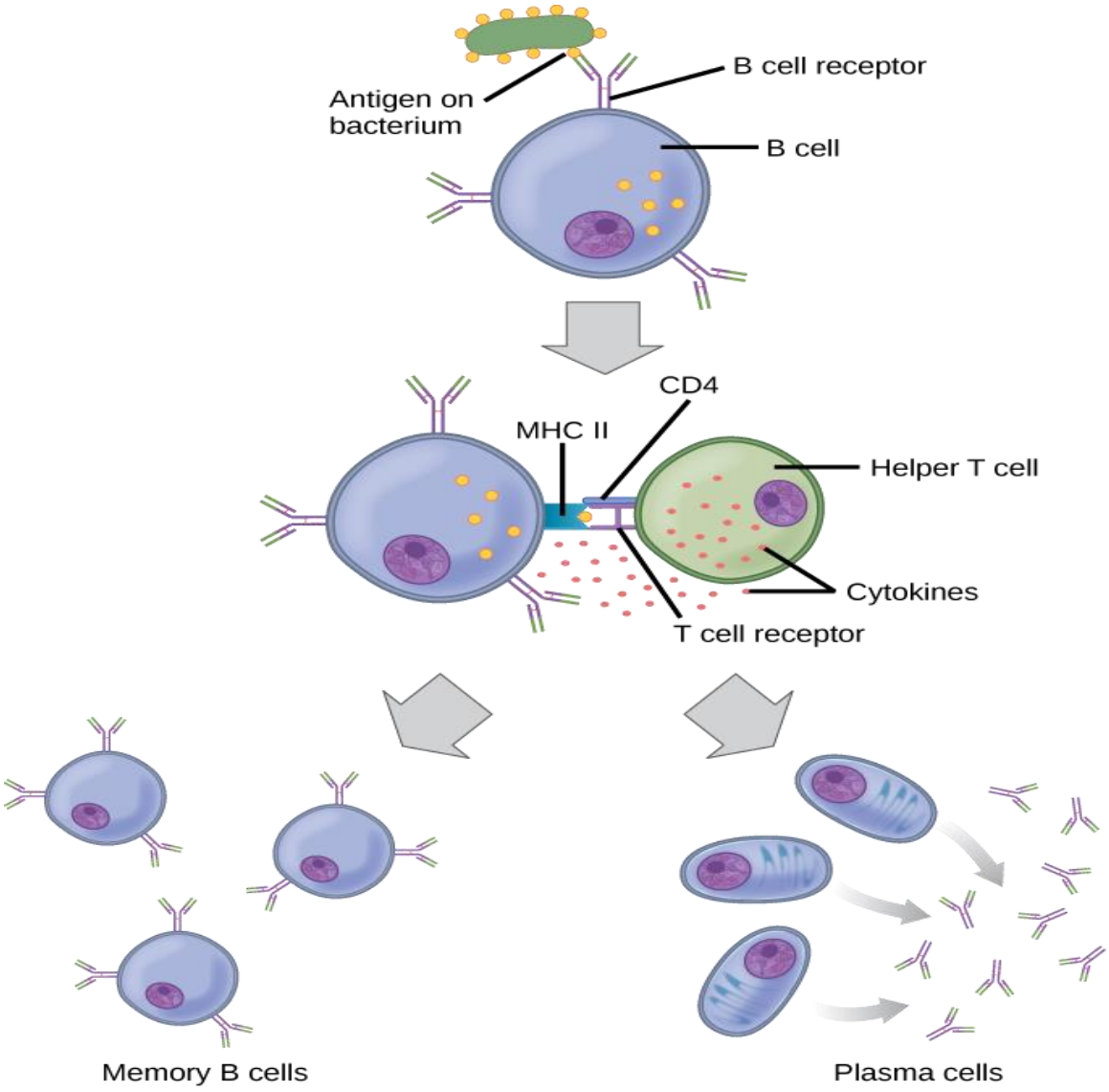


- Specific immune responses are triggered by **antigens**.
- Antigens are usually found on the surface of pathogens and are unique to that particular pathogen.
- The immune system responds to antigens by producing cells that directly attack the pathogen, or by producing special proteins called **antibodies**.

- Antibodies attach to an antigen and attract cells that will engulf and destroy the pathogen.
- The main cells of the immune system are lymphocytes known as **B cells** and **T cells**.
- B cells are produced and mature in bone marrow.
- T cells are also produced in bone marrow, but they mature in the thymus.

Humoral immunity

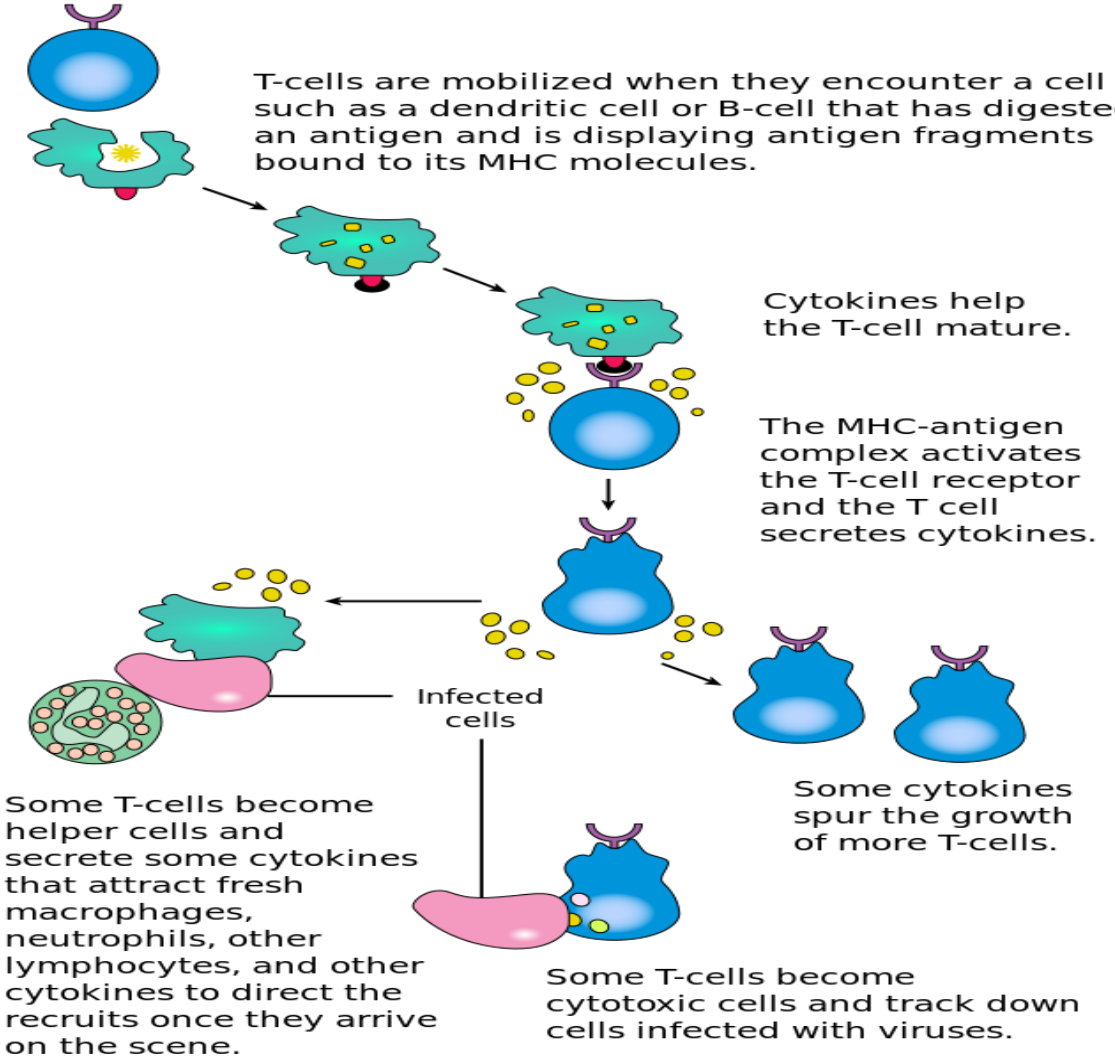
Humoral immunity relies on the actions of antibodies circulating through the body.



- Humoral immunity begins when an antibody on a B cell binds to an antigen.
- The B cell then internalizes the antigen and presents it to a specialized helper T cell, which in turn activates the B cell.
- Activated B cells grow rapidly, producing *plasma cells*, which release antibodies into the bloodstream, and *memory B cells*, which store information about the pathogen in order to provide future immunity.

Cell-mediated immunity

Antibodies alone are often not enough to protect the body against pathogens. In these instances, the immune system uses **cell-mediated immunity** to destroy infected body cells.



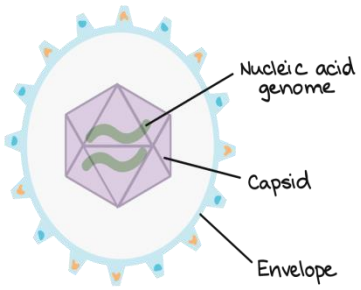
T cells are responsible for cell-mediated immunity. *Killer T cells (cytotoxic T cells)* assist with the elimination of infected body cells by releasing toxins into them and promoting apoptosis. *Helper T cells* act to activate other immune cells.

Vaccines

- **Vaccines** work by taking advantage of antigen recognition and the antibody response.
- A vaccine contains the antigens of a pathogen that causes disease. For example, the smallpox vaccine contains the antigens specific to smallpox.
- When a person is vaccinated against smallpox, the immune system responds by stimulating antibody-producing cells that are capable of making smallpox antibodies.
- As a result, if the body comes into contact with smallpox in the future, the body is prepared to fight it.

Viral structure

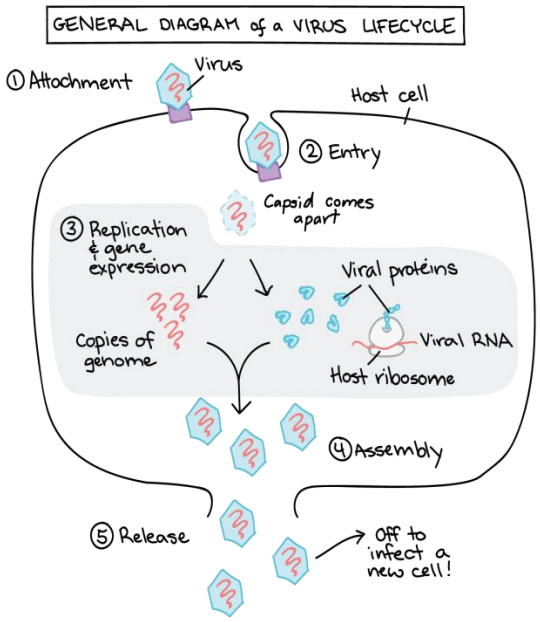
Viruses are infectious particles that reproduce by hijacking a host cell and using its machinery to make more viruses.



- There are many kinds of viruses, differing in structure, genome, and host specificity. However, viruses tend to have several features in common.
- All viruses contain a protective protein shell, or *capsid*, that houses their nucleic acid *genome* (either DNA or RNA).
- Some viruses also have a membrane layer called an *envelope* that surrounds the capsid.

Steps of viral infection

Viruses reproduce by infecting their host cells, providing instructions in the form of viral DNA or RNA, and then using the host cell's resources to make more viruses.



Steps of a viral infection, illustrated generically for a virus with a + sense RNA genome

1. Attachment. Virus binds to receptor on cell surface.
2. Entry. Virus enters cell by endocytosis. In the cytoplasm, the capsid comes apart, releasing the RNA genome.
3. Replication and gene expression. The RNA genome is copied (this would be done by a viral enzyme, not shown) and translated into viral proteins using a host ribosome. The viral proteins produced include capsid proteins.
4. Assembly. Capsid proteins and RNA genomes come together to make new viral particles.
5. Release. The cell lyses (bursts), releasing the viral particles, which can then infect other host cells.