

HUMORAL IMMUNITY

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- Humoral immunity is conferred by body (fluids) humors specifically by Igs secreted by terminally differentiated B cells (i.e plasma cells).
- If a foreign agent enters in to the body, immune system responds in different ways to get rid of it from the body.
- Response is not the same for all foreign agents. Response depends on the type of antigen or foreign substances which entered the body.
- Responses of immune system to any foreign agent are broadly classified in two main types one is humoral mediated response and the other is cell mediated.

- The destruction of antigens by producing antibodies is called antibody mediated immune response.
- Antibodies react with antigens (pathogens) present outside the cells. They cannot kill the pathogens present outside the cell.
- In humoral immunity, binding of antibodies to microorganism results in the formation of immune complex (Ag-Ab complex).

Bacteria



Extracellular Spaces of the Body



Intracellular Space



Cause Infectious Disease



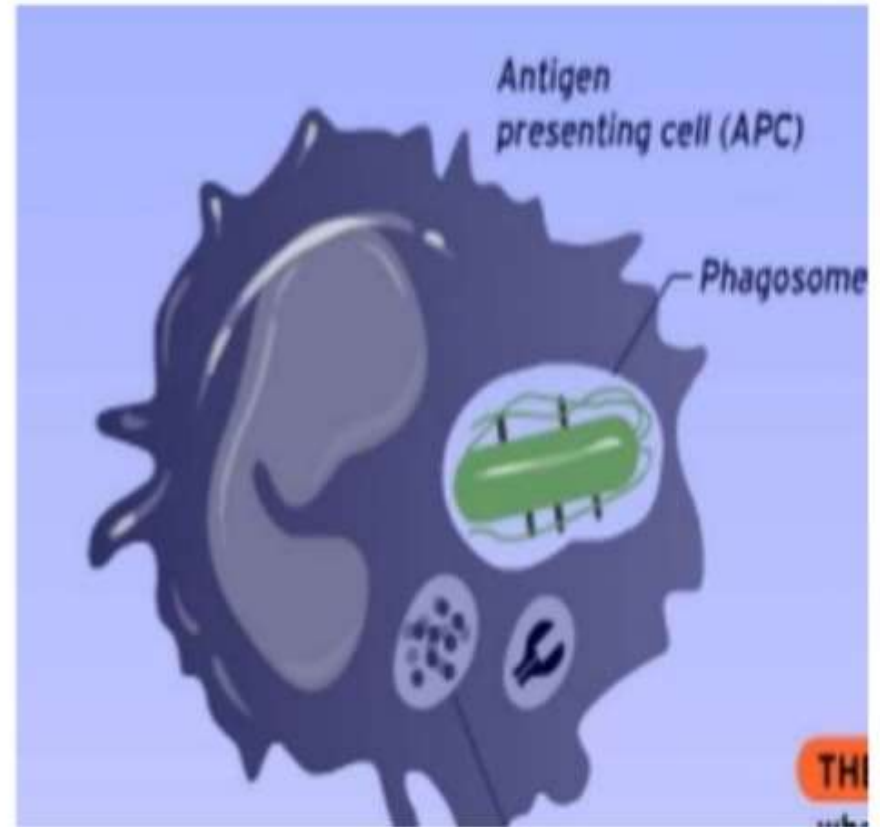
Protected



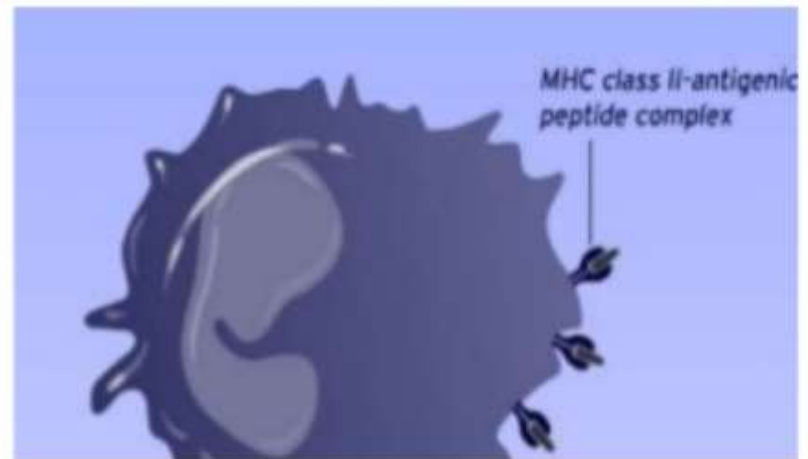
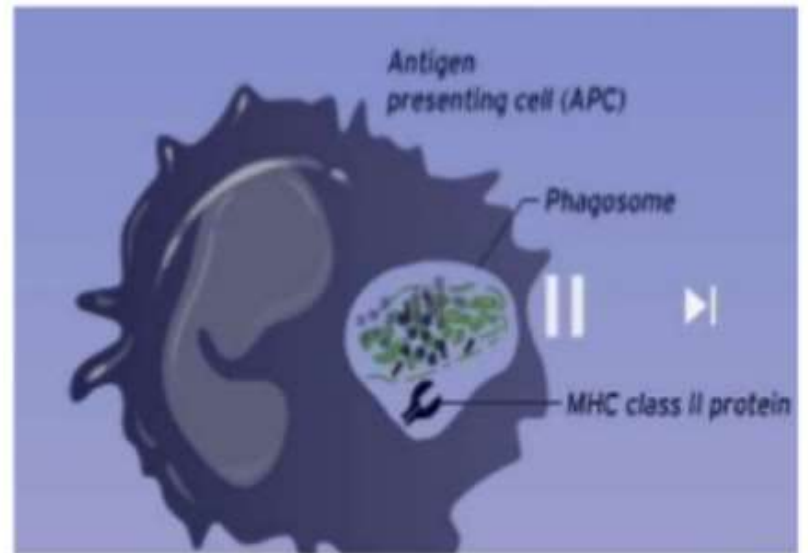
Humoral Immune Response

➤ Activation phase;

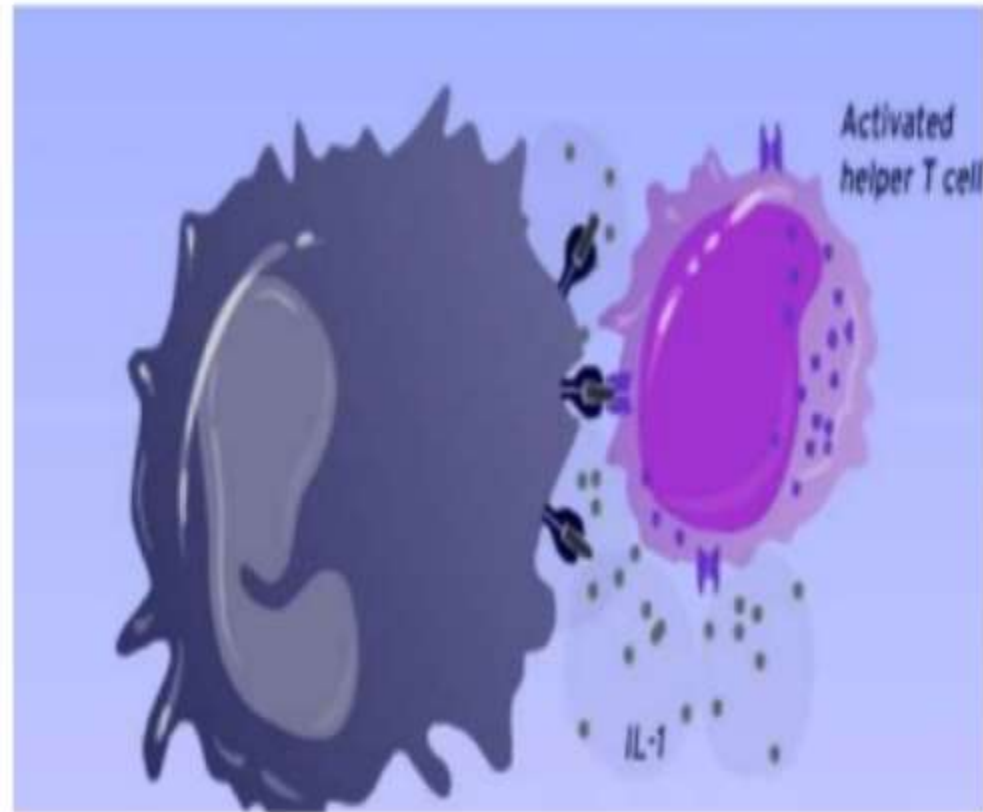
- The activation phase begins with an invading bacteria is phagocitized [engulfed] by an antigen presenting cell [APC].
- A lysosome containing digestive enzymes combines with the phagosome to process the antigen.



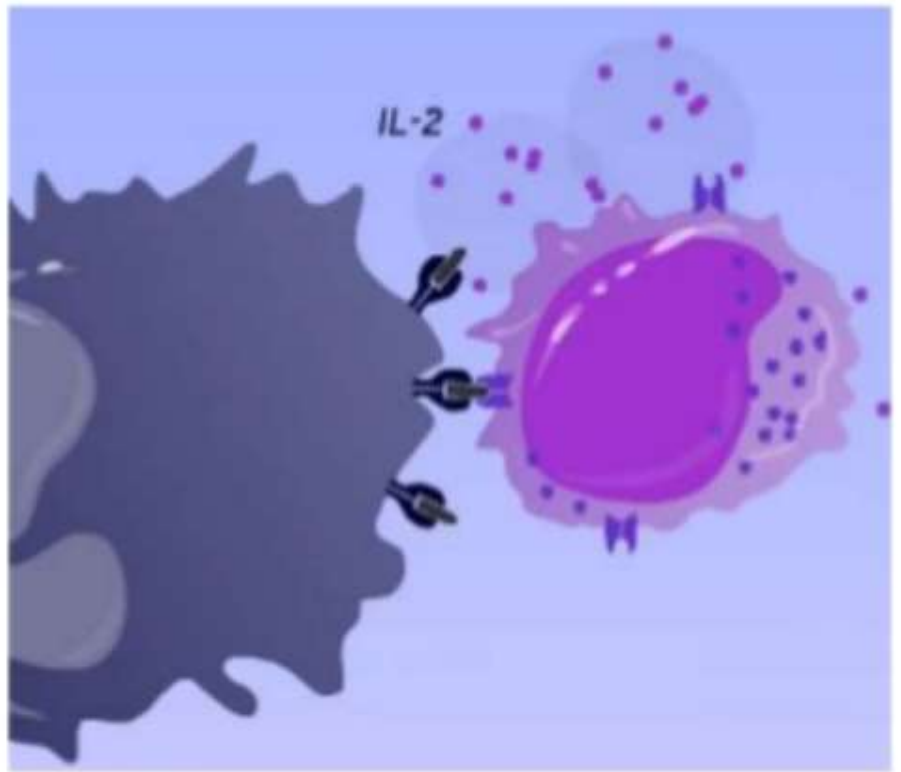
- The processed antigens combine with the MHC class II proteins and are presented on the surface of the APC.



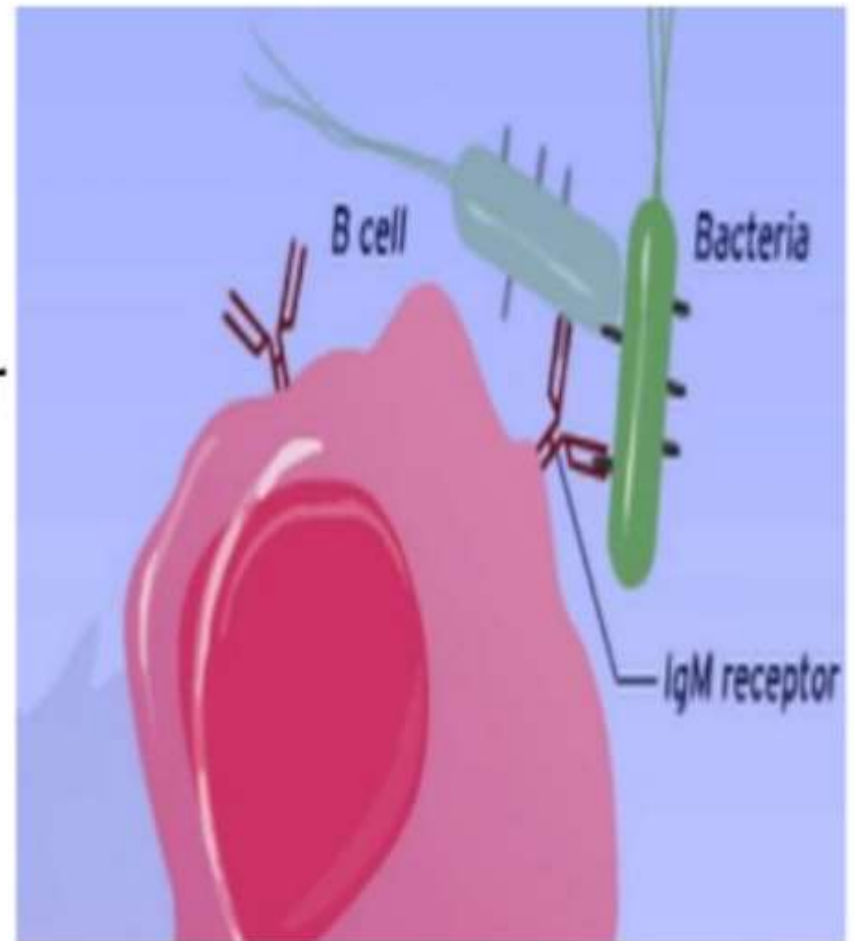
- Helper T cells [CD4+] recognize the displayed antigen on the APC and bind to the MHC class II-antigenic peptide complex.
- The binding triggers the APC to release the cytokine IL-1, which activates the Helper T cell.



- The activated Helper T cell releases the cytokine IL-2, which stimulates the helper T cell to proliferate.
- Thus, producing many Helper T cells, each with receptor specific for the original processed antigens.

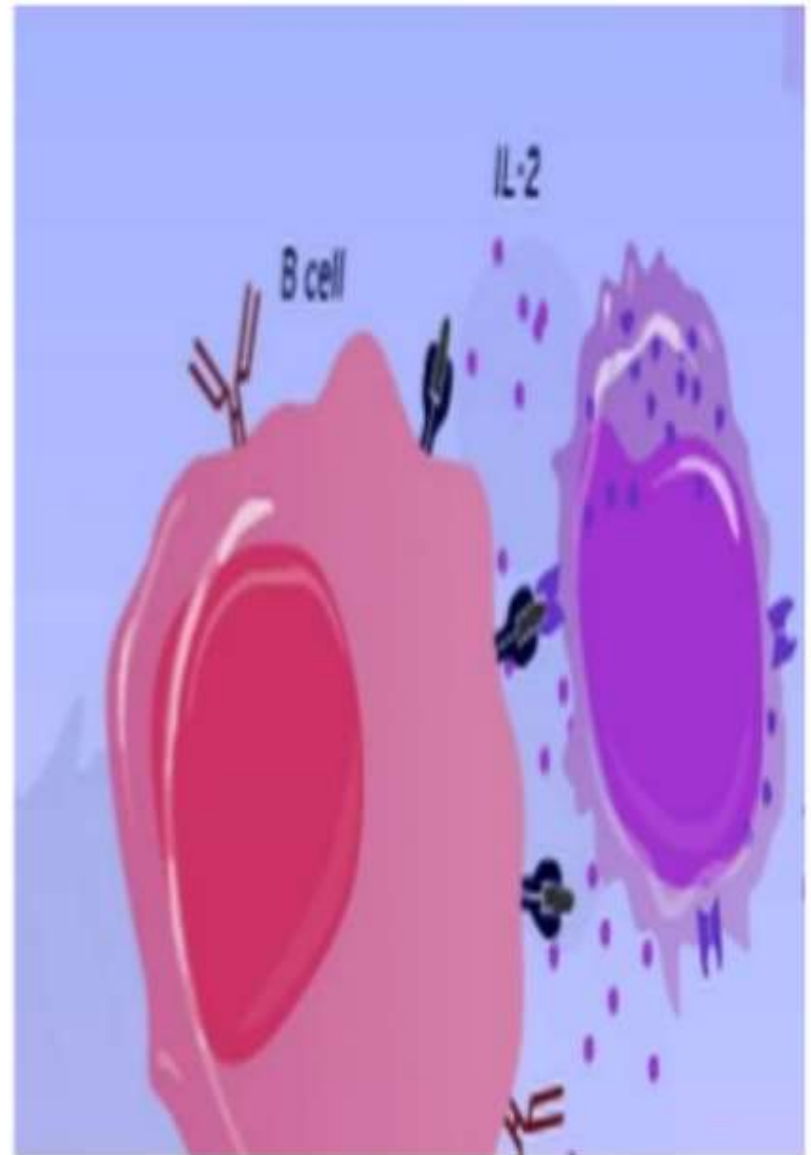


- The effector phase begins when a B cell that exhibits on its surface an IgM receptor specific for the same antigen originally engulfed by the APC encounters and binds the antigens.

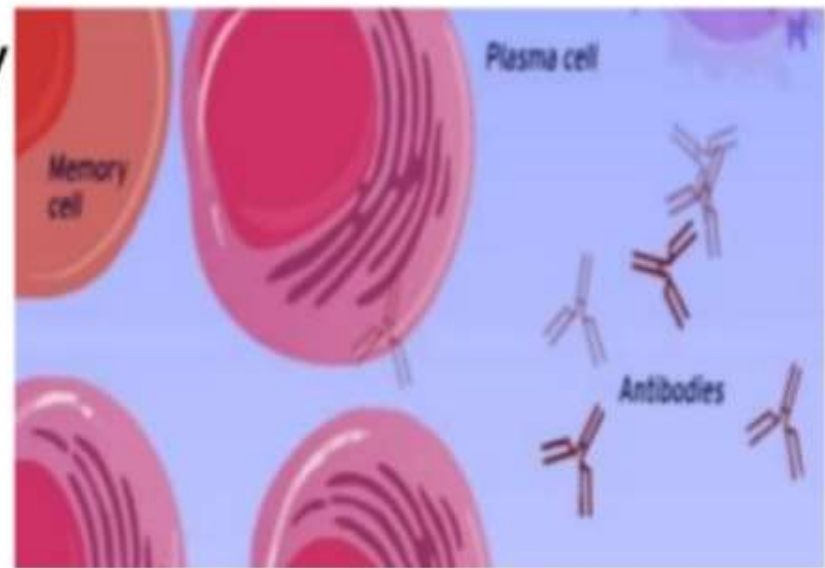


- The B cell engulfs the complex by receptor mediated endocytosis. The phagosome containing the antigens fuses with a lysosome. The antigen is processed.
- The processed antigens binds MHC class II protein and is displayed on the surface of the B Cell.

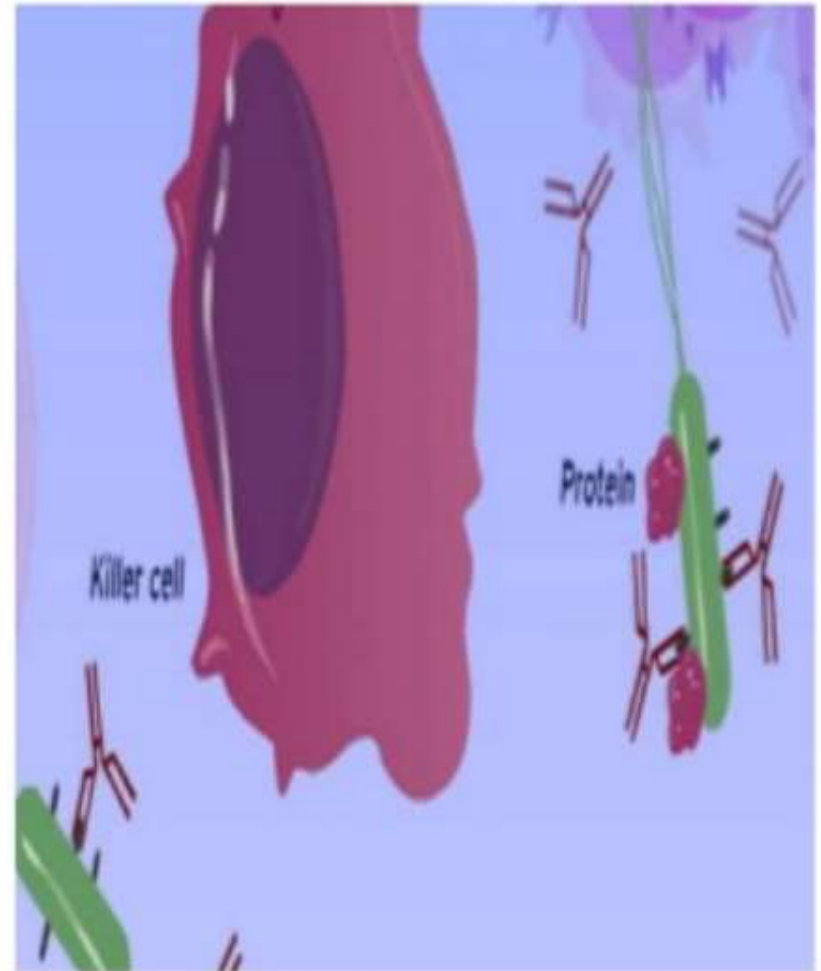
- Helper T cells now bind to the displayed antigens on the surface of the B cell causing the Helper T cell to release Cytokines.
- The cytokines stimulate the B cell to divide and proliferate into identical B cell copies.



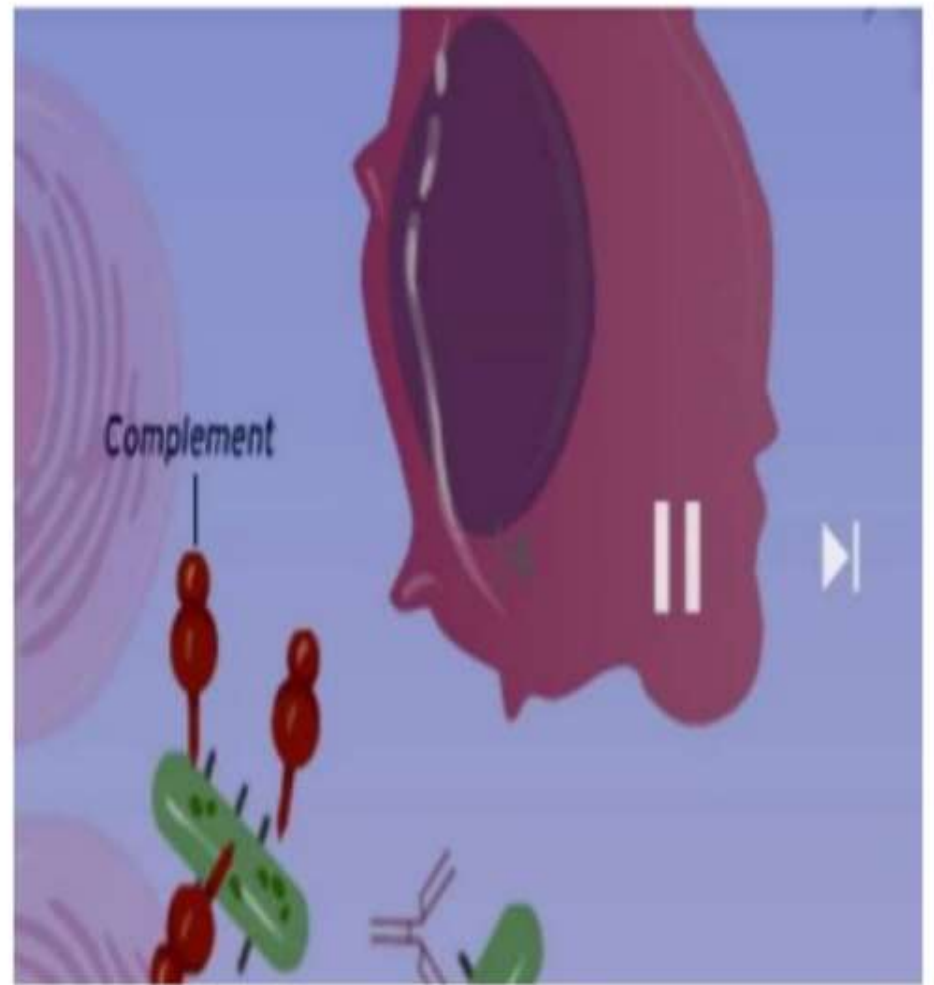
- The B cells differentiate into antibody producing plasma cells and memory cells.
- The plasma cells release antibodies with a specificity identical to that of the surface receptor on the parent B cell. These carry out the ultimate goal of fighting the foreign invaders.



- The released antibodies bind in a lock and key fashion to the antigen on the surface of the original invaders.
- These makes it easier for killer cells to attack and destroy the bacteria by phagocytosis and release of proteins causes the direct lyses of the bacteria.

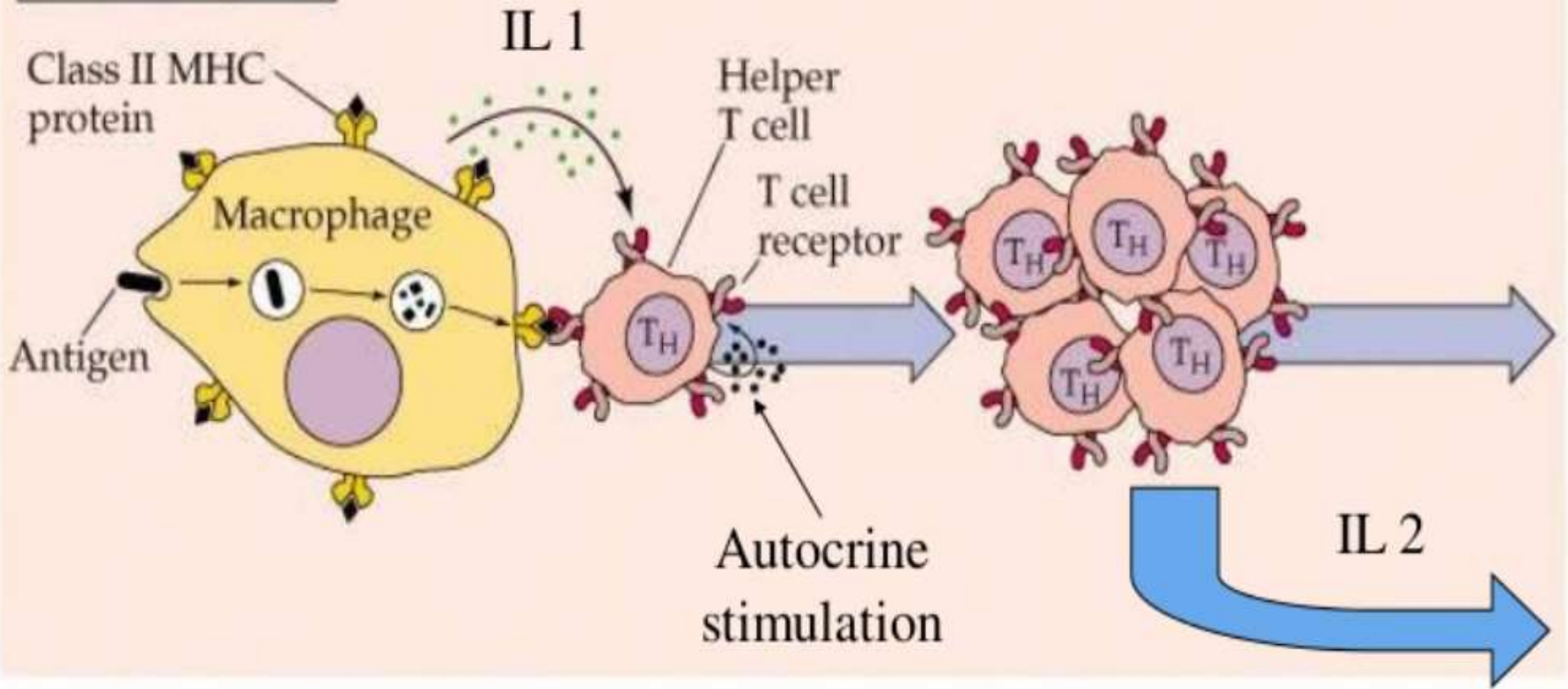


- Simultaneously a blood component known as complement is signaled to attack and puncture holes in the bacteria.

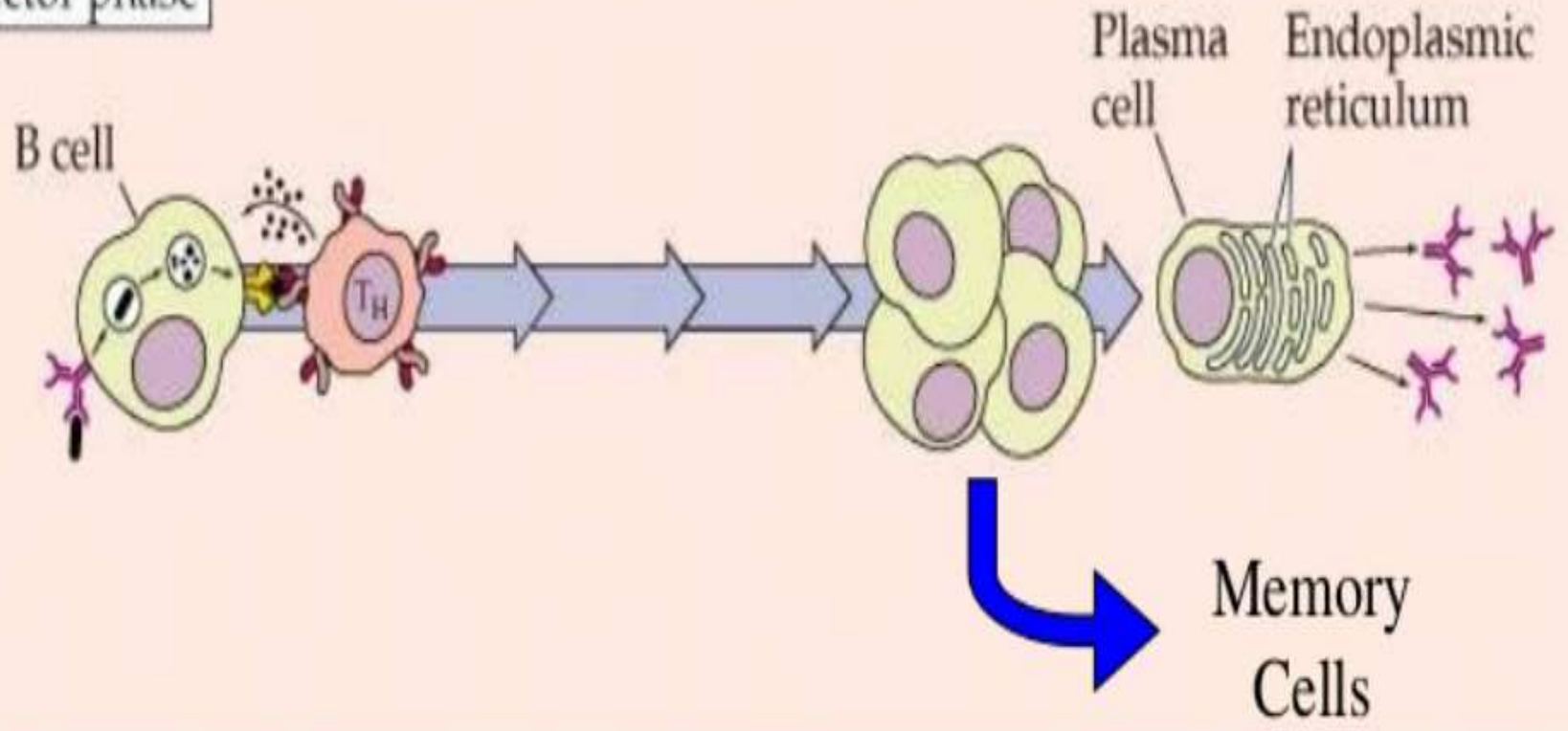


HUMORAL RESPONSE

Activation phase



Effector phase



➤ Functions and Properties of Antibody

- **Neutralization**

- Direct inactivation of pathogen or toxin thereby preventing its interaction with human cells

- **Opsonization**

- Coating of pathogens for more efficient phagocytosis

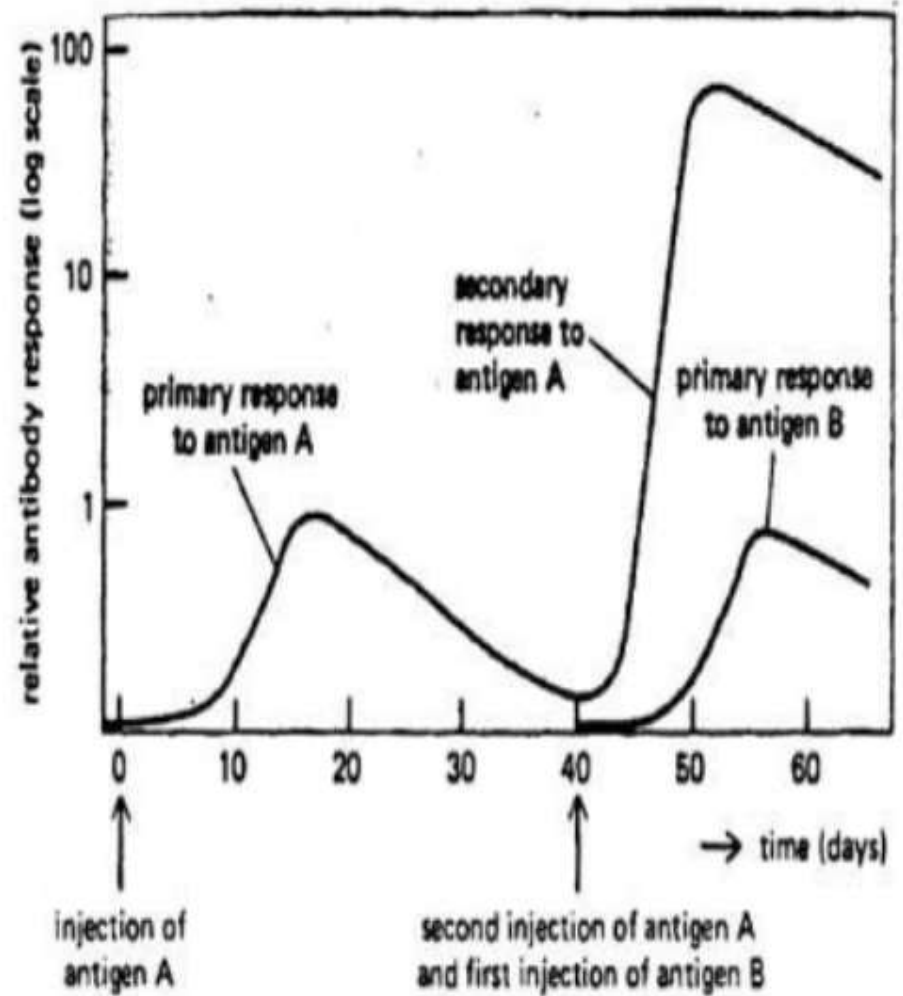
- **Activation of complement**

- More efficient phagocytosis
- Direct killing

Dynamics of Antibody Production

- **Primary immune response**

- Latent period
- Gradual rise in antibody production taking days to weeks
- Plateau reached
- Antibody level declines



- The preparation period that is the period between entry of pathogen and expression of immune response is known as “latent period”.
- Latent period in humoral immunity indicates activation and proliferation of naïve B cells to produce plasma cells and memory cells.

The immune response curve has four phases namely:

▪ Lag phase:

- Antibodies are almost absent.
- Duration of this period varies from several hours to days depending on many factors such as type and amount of antigen given, route of administration of antigen, species and health of the animal to which the antigen is injected and so on.
- For example, the lag phase is 2-3 weeks for Diphtheria toxoid and it is only a few hours with Pneumococcal antigen.

- Log phase: Antibodies gradually rise from zero stage to a maximum and this raising period is referred to as log phase.

- Stationary phase: After attaining maximum, antibody levels remain constant for some time and the period with constant antibody levels is referred as “plateau phase” .

- Decline phase:
 - indicates reduction of antibodies.

- Presence of antigens is necessary for the production of plasma cells and since the antigens are removed by the action of antibodies B cells failed to get stimulation from antigens and stops producing plasma cells.
- Drop in the formation of plasma cells producing antibodies leads to reduced antibodies level in the decline phase.

Secondary Response

- Second exposure to SAME antigen.
- Memory cells are a beautiful thing.
- Recognition of antigen is immediate.
- Results in immediate production of protective antibody, mainly IgG but may see some IgM

