Immunology Lecture Notes: Immune responses

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Immune Responses

I- Non specific (innate).

II- Specific (Adaptive).

There are three general characteristics of the specific immune response that distinguish it from the non specific responses:

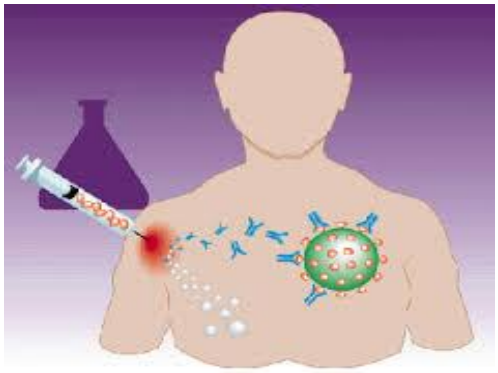
1- Specificity.

2- Heterogenicity.

3- Memory.

Specific immunity is developed as a result of **exposure** to a variety of agents capable of inducing an immune response (**immunogens**) such as:

1- Vaccines.



2- Microbes that colonize the body.

3- Macromolecules in the diet.

Specific Immune responses:

I- Antibody mediated (Humoral) immune responses:

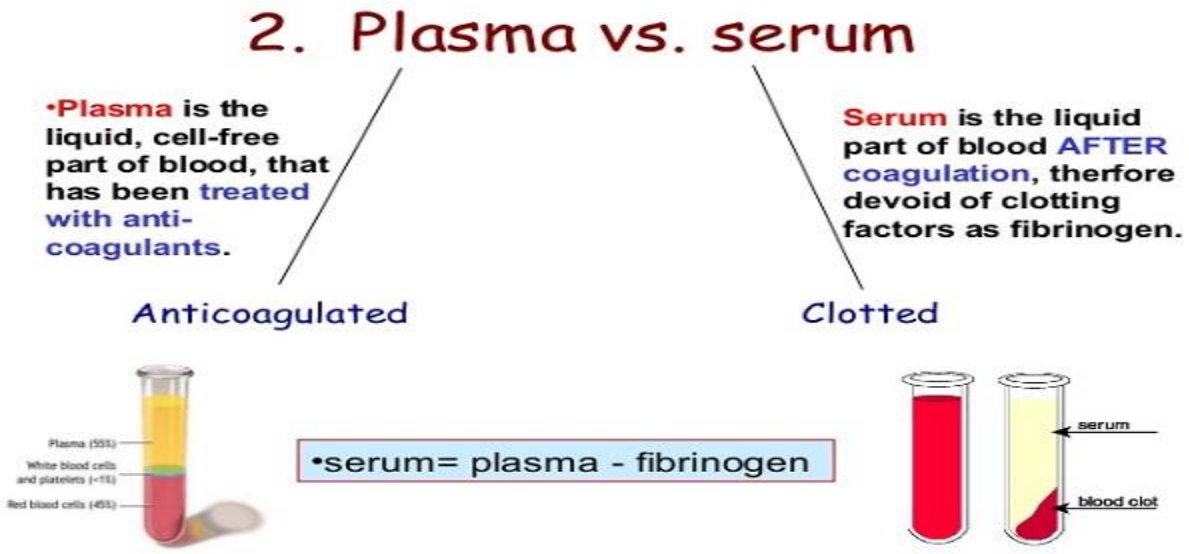
a. Primary immune response.

b. Secondary immune response.

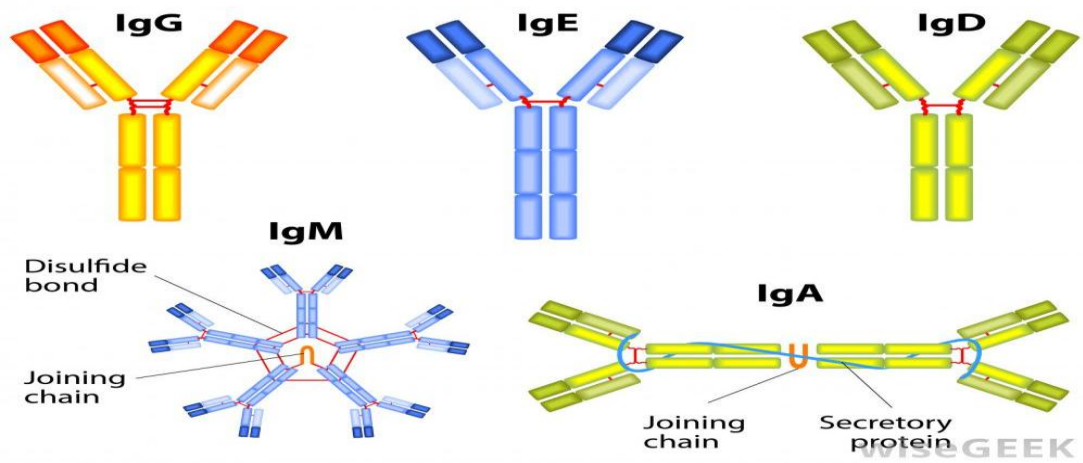
Humoral immune responses:

Louis Pasteur: Immunity can be produced against infectious agents by vaccination.

Substances (antibodies) providing this resistance could be found in **serum** and **plasma**.



The protective factors found in the serum of an immunized animal are known as **antibodies**, which are produced as a result of exposure to an antigen.



Antibodies are highly specific and can bind only to the antigen that stimulates their production.

Primary immune response:

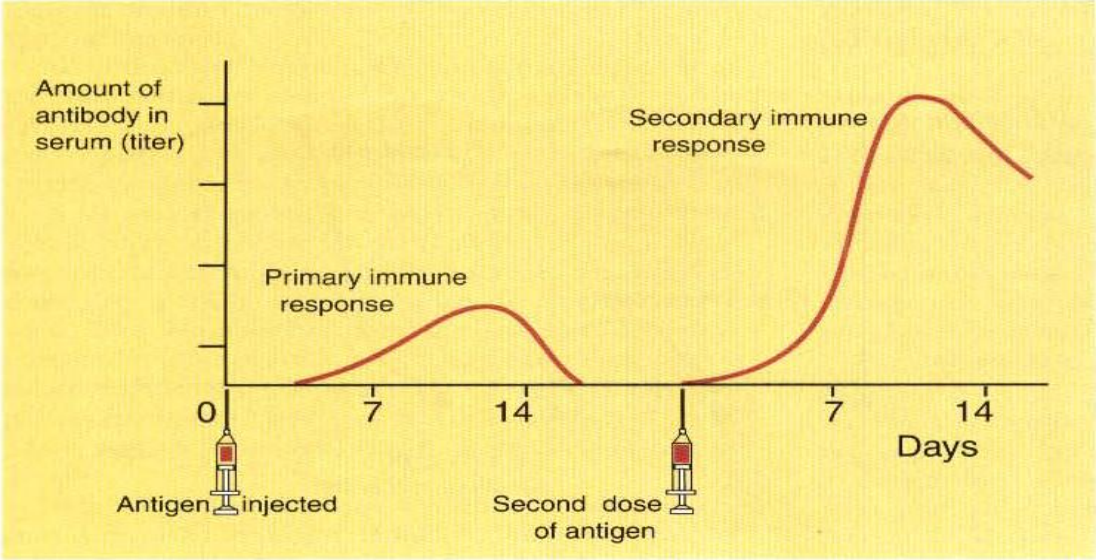
1- No detectable antibodies for several days (long lag period).

2- Antibodies become detectable after one week, they climb for 10-14 days.

3- Antibodies decline and disappear within a few weeks.

4- Amount of antibodies formed and amount of protection is relatively small.

5- Memory cells are formed.



Secondary immune response: **"Anamnestic response"**

1- The lag period is short only 2-3 days.

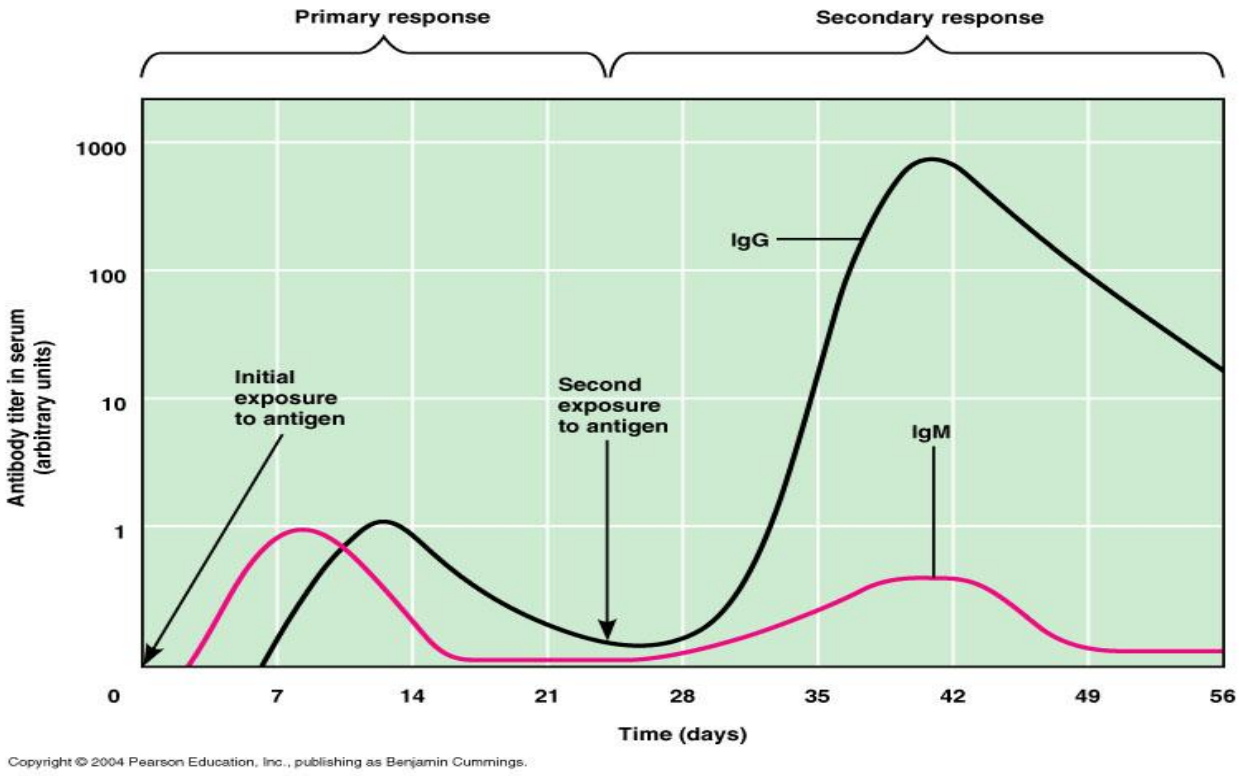
2- Amount of antibodies in the serum rises rapidly to high level before declining slowly.

3- Antibodies may be detectable for months or years after the second injection.

4- A third dose (injection) of the antigen elicits an immune response with an even shorter lag period and higher and more prolonged antibody response. This forms the basis of all current vaccination techniques. Continuous injection does not lead to indefinitely greater immune response.

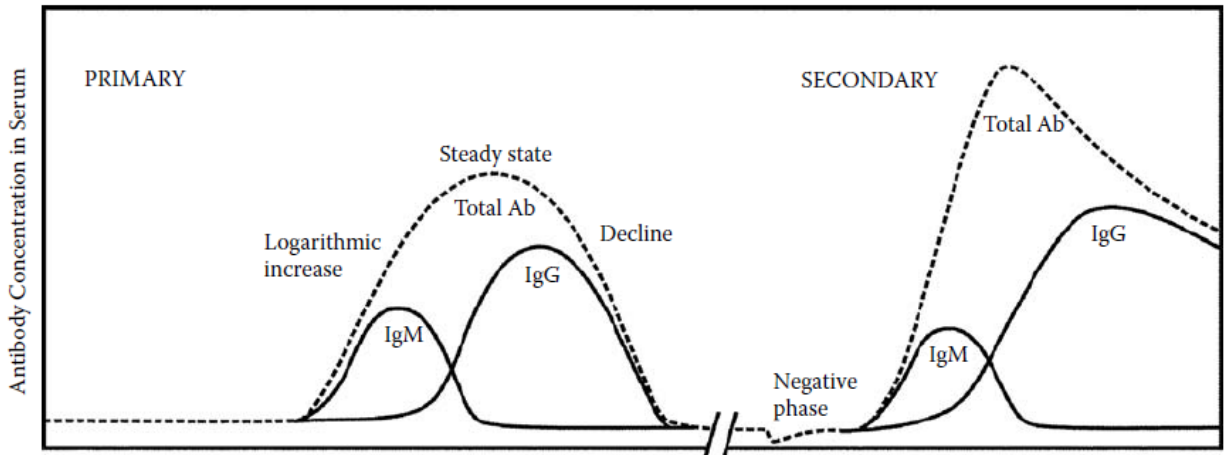
5- Secondary immune response is specific; it can be provoked only by an antigen identical to that given first.

6- Secondary immune response can be provoked many months and years after the first injection of the antigen. Antibody-forming system posses the ability to remember previous exposure to an antigen.



Negative Phase:

If second dose of antigen is given to animal that still has serum antibodies from its primary immune response, the level of these antibodies may drop for a few days before secondary immune response gets underway.



II- Cell-mediated Immune responses

Piece of living tissue (skin) grafted onto another animal from same species. It usually survives for only a few days before being destroyed by the recipient. This process is significant because it demonstrates the existence of a mechanism whereby foreign cells differing only slightly from an animal's own normal cells, are rapidly recognized and eliminated.

Cells with minor structural abnormalities may be recognized as foreign by the immune system, although they are otherwise apparently healthy.

These abnormal cells include:

1- Aged red blood cells.
2- Virus infected cells.
3- Some cancer cells.

The immune response to foreign cells shown by graft rejection demonstrates the existence of "a surveillance system" that identifies and removes abnormal cells.

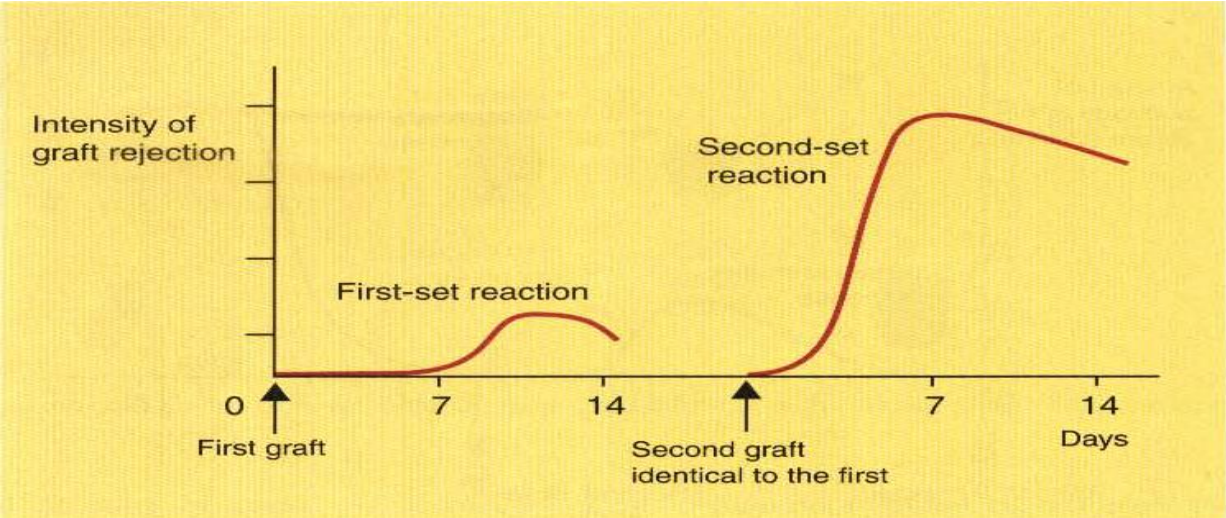
Cell-mediated Immune responses

1. First-set reaction (First graft rejection):

Transplanted skin will survive for about 10 days.

1- Grafted skin initially appears to be healthy.
2- Blood vessels develop between the grafted and the host.

By one week, these new blood vessels begin to degenerate, the blood supply to the graft is cut-off, and the graft eventually dies and is shed. This slow rejection is known as first-set reaction.



First-set reaction ------- slow and weak. Second-set reaction -------- rapid and powerful.

2. Second-set reaction (second graft rejection):

Second graft survives no longer than 1-2 days before being rejected.

This process is rapid rejection, is known as second-set reaction.

- Graft rejection is specific.
- Graft rejection possesses a memory.
- Graft rejection cannot be transferred from a sensitized to a normal animal by means of serum antibodies.
- The ability to mount a second-set reaction can be transferred between animals only by means of living cells (lymphocytes- spleen, lymph nodes- blood). Process of graft rejection is mediated primarily by lymphocytes and not by serum antibodies.

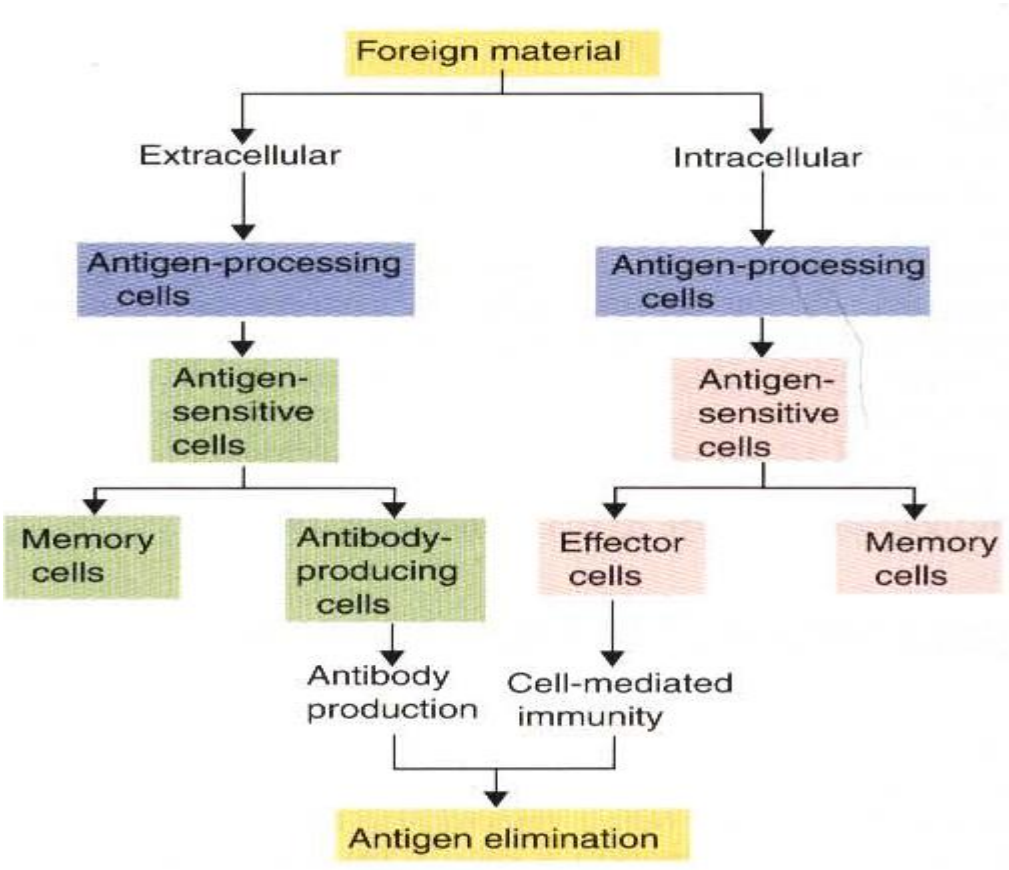


Figure 1-9. A simple flow diagram showing the essential features of the acquired immune responses.

Basic requirements of the immune system to include four components:

1. Method of trapping and processing antigen.

2. Mechanism for reacting specifically to the antigen i.e. antigen-sensitive cells.

3. Cells to provide antibodies or to participate in the cell-mediated immune responses.

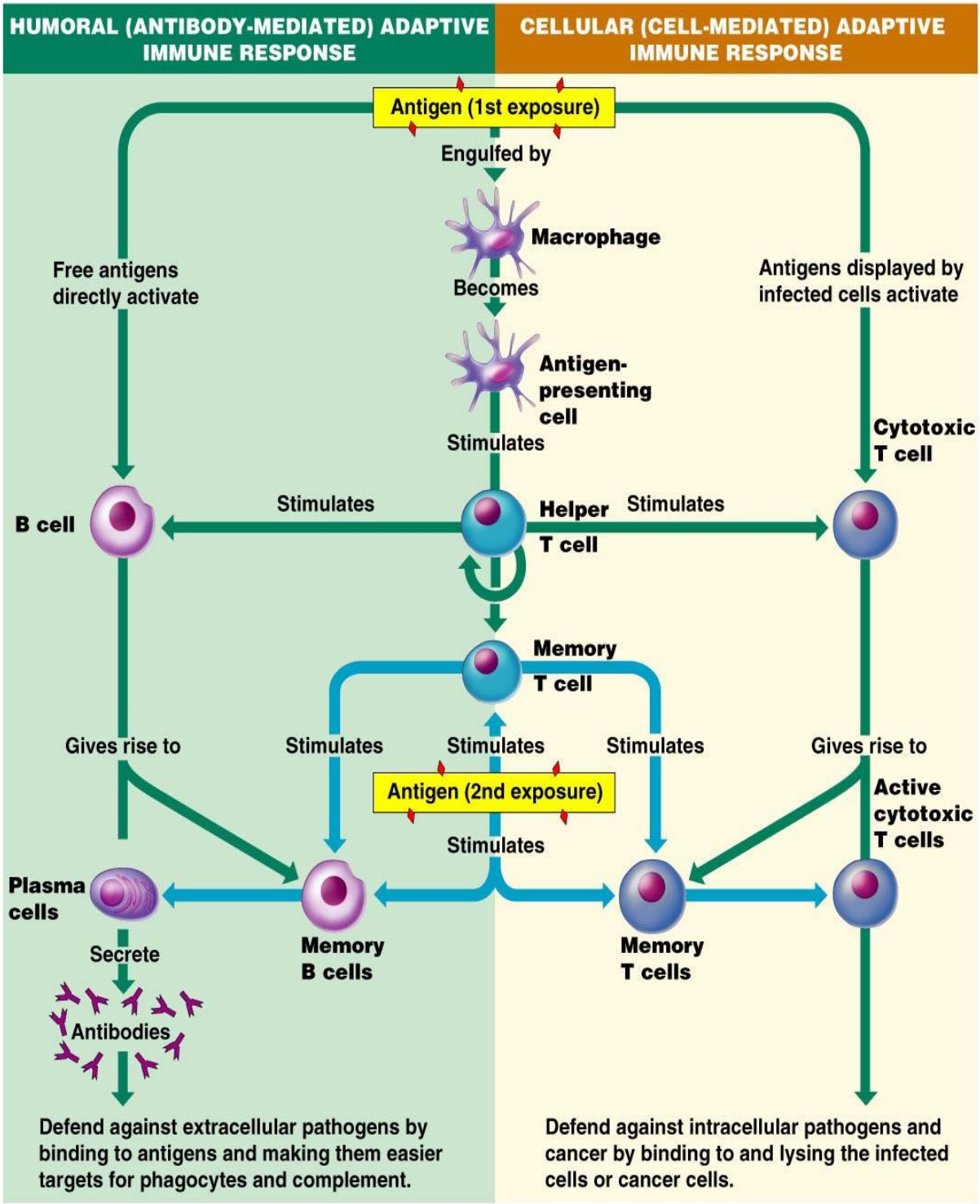
4. Cells to retain the memory of the event and to react specifically to the antigen in future.

Factors leading to variations in a host's immune response against invading microbes:

1. Virulence of invading microbe.

2. Ability of invading microbe to evade defenses.

3. Interactions of invading microbe with other microbes.



Consequences of immune responses:

1- Favorable:
   a. Protection from infectious agents.
   b. Control of pre-cancerous growths.
2- Undesirable:
   a. Allergies.
   b. Autoimmune diseases.
   c. Graft rejection.
   d. Erythroblastosis fetalis.

Tolerance:

1- State of unresponsiveness.
2- To provoke and immune response an antigen must be recognized as being foreign.
3- Immune system must be able to recognize its own cells as being not-foreign, and it must not mount an immune response against them.
4- The immune system must be tolerant to self-antigens.
5- If this tolerance breaks down, then disease occurs "Autoimmune diseases".
6- Tolerance occurs both in the cell-mediated and antibody-mediated immune systems.
7- Tolerance can be considered as another form of normal immune response.
8- Tolerance is specific for the inducing antigen.
9- Tolerance represents an essential protective mechanism that serves to prevent an animal from being damaged by an indiscriminate immune response.