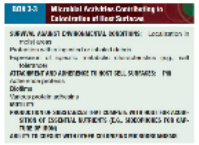

Microbial Colonization:

colonization may be **the first step in the process of developing infection and disease.**

successful initial colonization depends on the microorganism's ability to survive the conditions first encountered on the host surface (Box 3-3).

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BOX 3-3 Microbial Activities Contributing to Colonization of Host Surfaces

SURVIVAL AGAINST ENVIRONMENTAL CONDITIONS: Localization in moist areas
Protection within ingested or inhaled debris
Expression of specific metabolic characteristics (e.g., salt tolerance)
ATTACHMENT AND ADHERENCE TO HOST CELL SURFACES: Pili
Adherence proteins
Biofilms
Various protein adhesins
MOTILITY
PRODUCTION OF SUBSTANCES THAT COMPETE WITH HOST FOR ACQUISITION OF ESSENTIAL NUTRIENTS (E.G., SIDEOPHORES FOR CAPTURE OF IRON)
ABILITY TO COEXIST WITH OTHER COLONIZING MICROORGANISMS

SPECIFIC RESPONSES—THE IMMUNE SYSTEM(the third line of defense)

The immune system provides the human host with the ability to mount a specific protective response to the presence of a microorganism, **a customized defense against the invading microorganism.**

The immune system has a "memory" so that if a microorganism is encountered a second or third time, an immune-mediated defensive response is immediately available.

It is important to remember that nonspecific (i.e., phagocytes, inflammation) and specific (i.e., the immune system) host defensive systems are interdependent in their efforts to limit the spread of infection.

Components of the Immune System:

The central molecule of the immune response is the **antibody**.
Antibodies, also referred to as immunoglobulins, **are specific proteins produced by certain cells in response to the presence of foreign molecules known as antigens**

In the case of infectious diseases, the antigens are components of the invading microorganism's structure that are usually composed of proteins or polysaccharides.

Antibodies circulate in the serum portion of the host's blood and are present in secretions such as saliva. These molecules have two active areas: the antigen binding site and the phagocyte binding site (Figure 3-8).

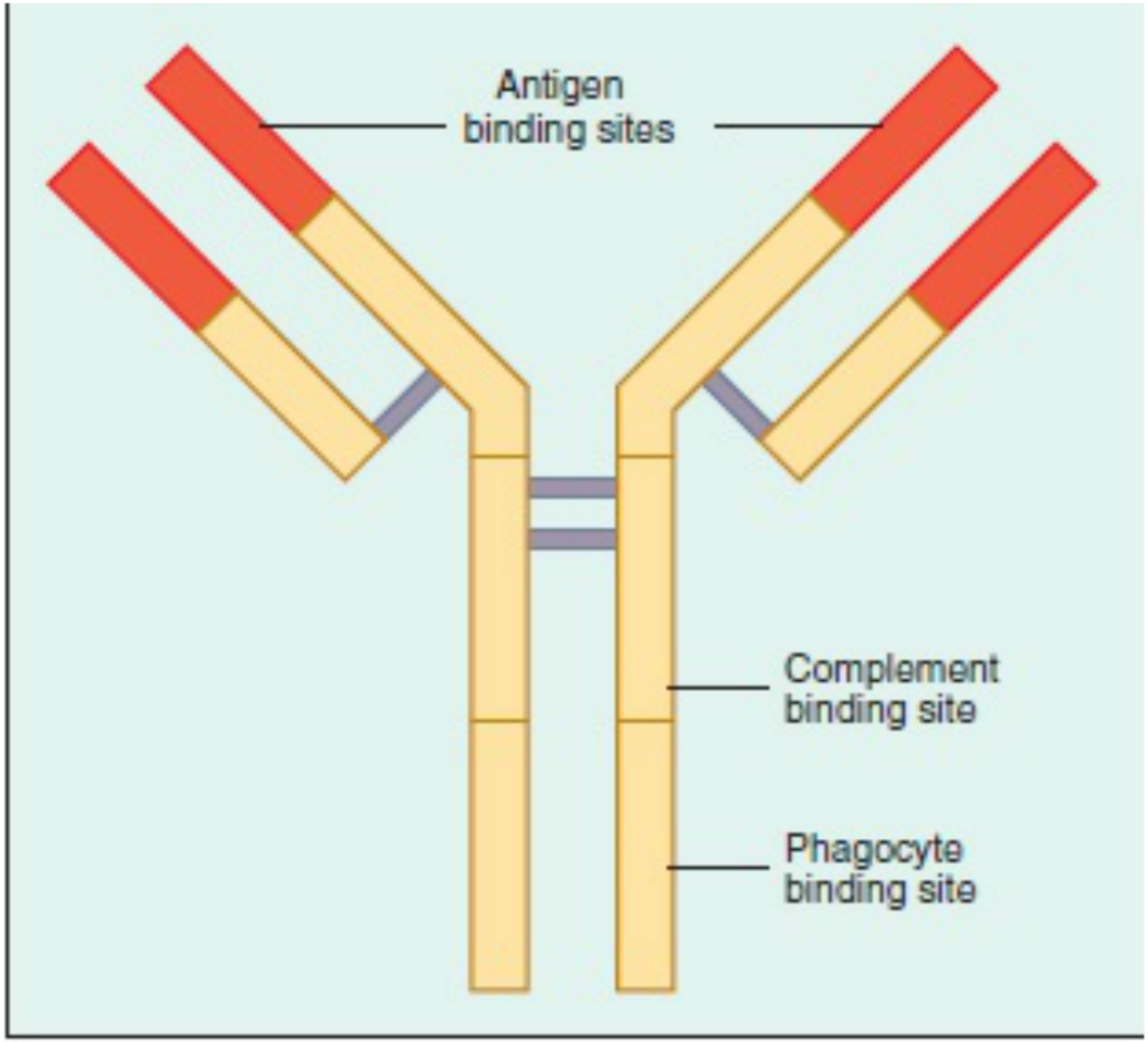

Figure 3-8 General structure of the IgG class antibody molecule.

There are five different classes of antibody: IgG, IgA, IgM, IgD, and IgE. Each class has distinctive molecular configurations

-IgG, IgM, IgA, and IgE are most involved in combating infections.

-IgM is the first antibody produced when an invading microorganism is initially encountered; production of the most abundant antibody, IgG, follows.

-IgA is secreted in various body fluids and primarily protects those body surfaces lined with mucous membranes.

-Increased IgE is associated with various parasitic infections.

our ability to measure specific antibody production is a valuable tool for the laboratory diagnosis of infectious diseases.

Regarding the cellular components of the immune response, there are three major types of cells:

B lymphocytes, T lymphocytes, and natural killer cells.

The functions of these cells are summarized in Box 3-6.

B lymphocytes originate from stem cells and develop into B cells in the bone marrow before being widely distributed to lymphoid tissues throughout the body.
These cells primarily function as antibody producers.

T lymphocytes also originate from bone marrow stem cells, but they mature in the thymus and either directly destroy infected cells or work with B cells to regulate antibody production.

The development of natural killer cells, which destroy infected or malignant host cells, is uncertain.

Each of the three cell types is strategically located within lymphoid tissue throughout the body to maximize the chances of encountering invading microorganisms that the lymphatic system drains from the infection site

BOX 3-6 Cells of the Immune System

B LYMPHOCYTES (B CELLS)

Residence: Lymphoid tissues (lymph nodes, spleen, gut-associated lymphoid tissue, tonsils)

Function: Antibody-producing cells

Subtypes:

- B lymphocytes; cells waiting to be stimulated by an antigen
- Plasma cells; activated B lymphocytes that are actively secreting antibody in response to an antigen
- B-memory cells; long-lived cells programmed to remember antigens

T LYMPHOCYTES (T CELLS)

Residence: Circulate and reside in lymphoid tissues (lymph nodes, spleen, gut-associated lymphoid tissue, tonsils)

Functions: Multiple, see different subtypes

Subtypes:

- Helper T cells (TH); interact with B cells to facilitate antibody production
- Cytotoxic T cells (TC); recognize and destroy host cells that have been invaded by microorganisms
- Suppressor T cells (TS); shut down immune response when no longer needed

NATURAL KILLER CELLS (NK CELLS): Function similar to cytotoxic T cells but do not require stimulation by presence of antigen to function

the two arms of the Immune System:

The immune system provides immunity that generally can be divided into two arms:

- Antibody-mediated immunity (or humoral immunity)
- Cell-mediated immunity (or cellular immunity)

-Antibody-mediated immunity is centered on the activities of B cells and the production of antibodies.

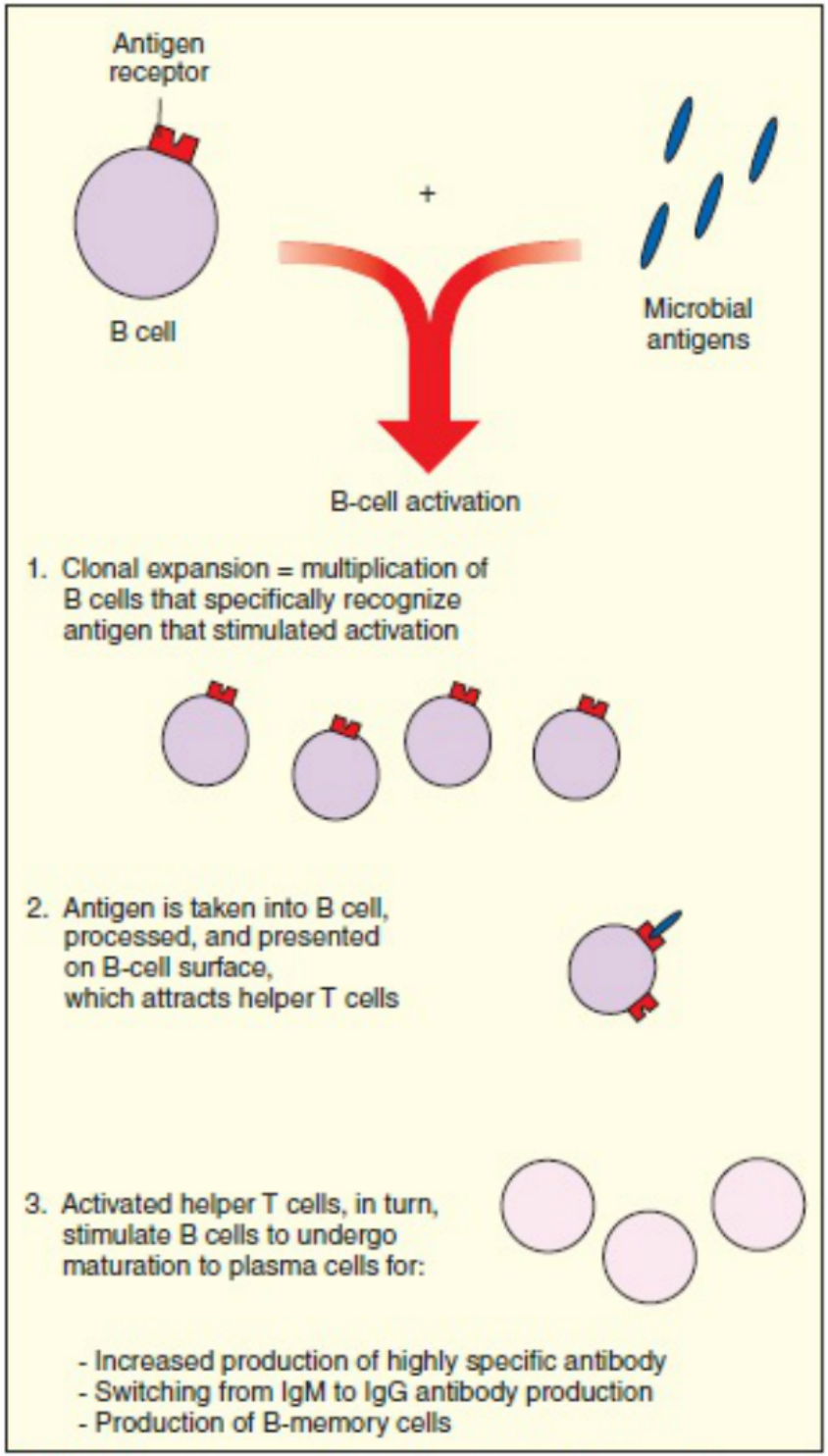

Figure 3-9 Overview of B-cell activation that is central to antibody-mediated immunity.

Antibodies protect the host in a number of ways:

- Helping phagocytes ingest and kill microorganisms
- Neutralizing microbial toxins detrimental to host cells and tissues
- Promoting bacterial clumping (agglutination) that facilitates clearing from infection site
- Inhibiting bacterial motility
- Combining with microorganisms to activate the complement system and inflammatory response

Some antigens, such as bacterial capsules and outer membranes, activate B cells to produce antibodies without the intervention of helper T cells. However, this activation does not result in production of B-memory cells so that on reexposure to the same bacterial antigens, there will be no rapid memory response on the part of the host.

The primary cells that mediate cell-mediated immunity are T lymphocytes that recognize and destroy human host cells infected with microorganisms.

This function is extremely important for the destruction and elimination of infecting microorganisms (e.g., viruses,
tuberculosis, some parasites, and fungi) that are able to survive within host cells where they are "hidden" from antibody action. Therefore, antibody-mediated immunity targets microorganisms outside of human cells
while cell-mediated immunity targets microorganisms inside human cells. **However, in many instances these two arms of the immune system overlap and work together.**

Like B cells, T cells must be activated. Activation is accomplished by T-cell interactions with other cells that process microbial antigens and present them on their surface (**e.g., macrophages and B cells)**. The responses of activated T cells are very different and depend on the subtype of T cell (Figure 3-10). Activated helper T cells work with B cells for antibody production (see Figure 3-9) and facilitate inflammation by releasing cytokines. Cytotoxic T cells directly interact with and destroy host cells that contain microorganisms.

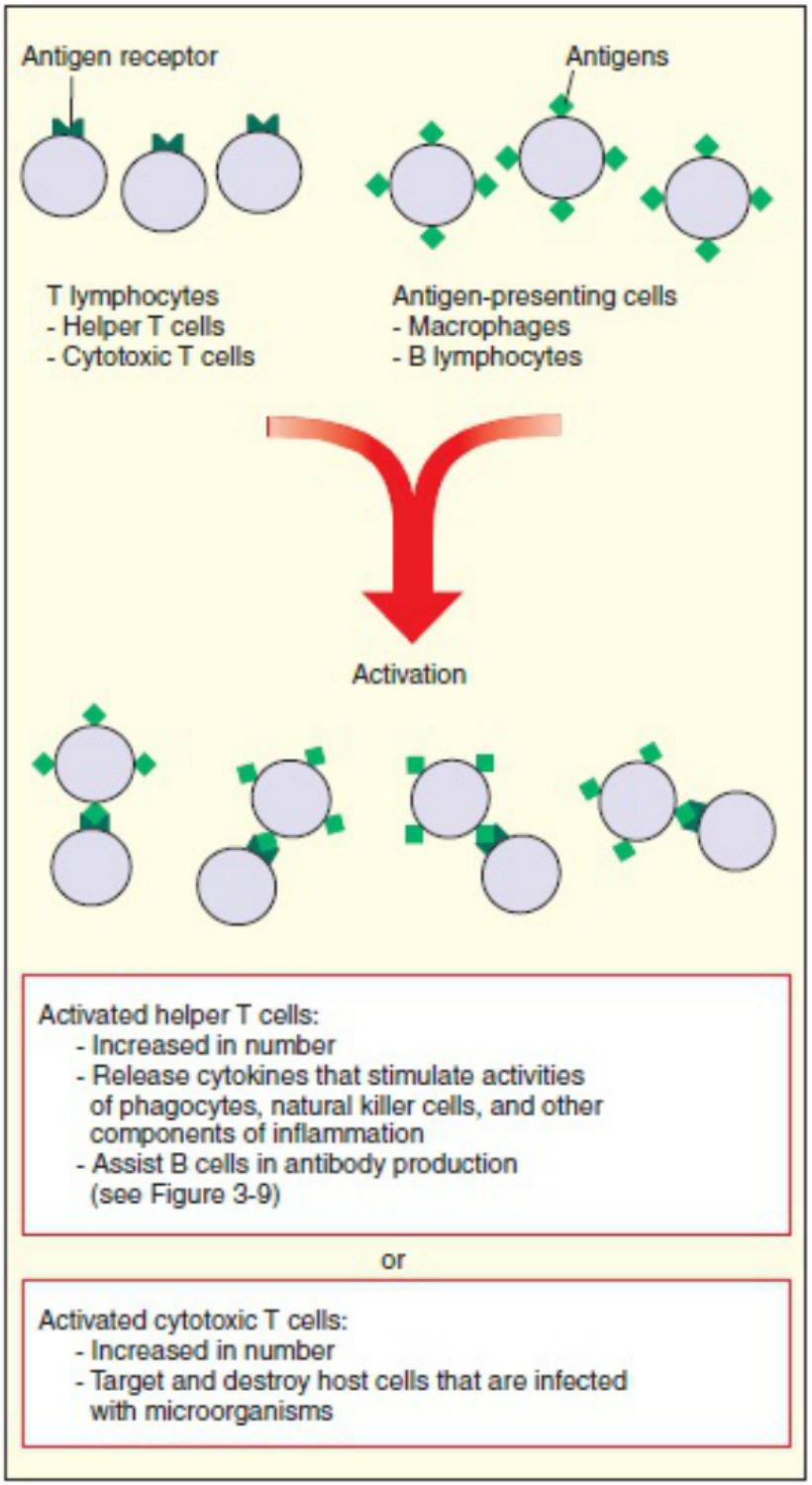

Figure 3-10 Overview of T-cell activation that is central to cell-mediated immunity.