

CHAPTER 16
THE ADAPTIVE IMMUNE
RESPONSE

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THE ADAPTIVE IMMUNE
RESPONSE

- ◆ The adaptive immune response is specific and involves both a cellular and a humoral (antibody) component
- ◆ Antigens are substances that can elicit an adaptive immune response

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LYMPHOID STRUCTURES

- ◆ There are lymphoid structures such as GALT, MALT, and BALT that are strategically located in major portals of entry used by pathogens

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ANTIGEN-PRESENTING CELLS

- ◆ The adaptive immune response is interrelated with the innate immune response through antigen presentation by cells called antigen-presenting cells (APCs). APCs from innate immunity include dendritic cells and macrophages

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B CELLS AND T CELLS

- ◆ Cells involved in adaptive immunity arise from stem cells in the bone marrow
- ◆ The two lymphocyte types involved in the adaptive response are T cells and B cells

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B CELLS AND T CELLS

- ◆ Activated B cells differentiate into plasma cells, which produce antibody
- ◆ Activated T cells differentiate into cytotoxic T cells, helper T cells, and regulatory T cells, which have a variety of functions
- ◆ Both T cells and B cells have specific receptors for antigen
- ◆ Both T cells and B cells will produce memory cells

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B CELLS AND T CELLS

- ◆ T cells mature in the thymus; B cells mature in the bone marrow
- ◆ Clonal selection is the process by which some lymphocytes are allowed to mature and become specific for an antigen. Clonal deletion occurs when lymphocytes that react to self antigens are eliminated

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B CELLS AND T CELLS

- ◆ Lymphocytes continue to circulate through lymphoid tissue by way of the blood or lymph until they either encounter their specific antigens or die
- ◆ B cells are continually produced and if not activated by antigen will die. Naive T cells live longer but once activated have a limited life span

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MHC MOELCULES

- ◆ T cells can only recognize antigen if it is bound to MHC molecules and presented on the surface of other cells
- ◆ There are two types of MHC molecule, class I and class II
- ◆ MHC class I molecules are expressed on all nucleated cells, MHC class II molecules are only expressed on cells of the immune system, primarily APCs

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T CELL RESPONSE

- ◆ Cytotoxic T cells bind to class I MHC-antigen via their CD8 receptor, which stimulates the T cell to destroy the antigen presenting cell
- ◆ Helper T cells bind to class II MHC-antigen via their CD4 receptor, which stimulates the T cell to multiply and activate other immune cells, especially B cells
- ◆ T cells that bind to superantigens produce an immune reaction that damages the host

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T CELL RESPONSE

- ◆ The cellular portion of the adaptive immune response is performed by T cells
- ◆ Helper T cells are activated through class II MHC bound to antigen displayed by dendritic cells, macrophages and B cells

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T CELL RESPONSE

- ◆ Cytotoxic T cells (CD8) are activated by antigen in association with MHC I molecules
- ◆ Cytotoxic T cells kill infected host cells through perforin, granzyme and granulysin

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T CELL RESPONSE

- ◆ CD4 helper T cells can be divided into several subpopulations
- ◆ T_H1 CD4 helper T cells are involved with pathogens that accumulate inside vesicles in macrophages and dendritic cells
- ◆ T_H2 and T_H17 CD4 helper T cells deal with extracellular bacteria and fungi by activating B cells, eosinophils, mast cells and neutrophils

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T CELL RESPONSE

- ◆ T_{FH} cells provide signals to B cells required for antibody production
- ◆ Regulatory T cells suppress other T cells and prevent excessive reactions after the antigen is gone

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B CELL RESPONSE

- ◆ Activation of B cells by antigen or helper T cells causes them to proliferate and differentiate into plasma cells, which produce antibody
- ◆ Antibody protects the host through neutralization, opsonization, and complement activation

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IMMUNOGLOBULINS

- ◆ The immunoglobulin molecule is Y shaped and composed of two heavy and two light chains
- ◆ Antibody specificity is determined by its variable region, antibody function is determined by its constant region
- ◆ There are five isotypes of immunoglobulin molecules (IgG, IgA, IgE, IgD, and IgM), and each of these has different functions in protecting the host

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ADAPTIVE RESPONSE

- ◆ The adaptive response can be divided into a primary phase and a secondary phase
- ◆ The primary response is slower, predominantly produces IgM and is not very powerful.
- ◆ The secondary response is faster and much more powerful than the primary, with IgG being the predominant class of antibody formed

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B CELL RESPONSE

- ◆ B cells must interact with helper T cells to be activated and differentiate
- ◆ T cell and B cell cooperation is carried out using MHC II molecules

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IMMUNOLOGICAL MEMORY

- ◆ One of the most important properties of the adaptive immune response is the development of memory
- ◆ The adaptive response causes memory to occur for both T and B cells
- ◆ Memory causes a quicker and more powerful response to antigens that have been seen before

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