

Adaptive Immune Response Overview

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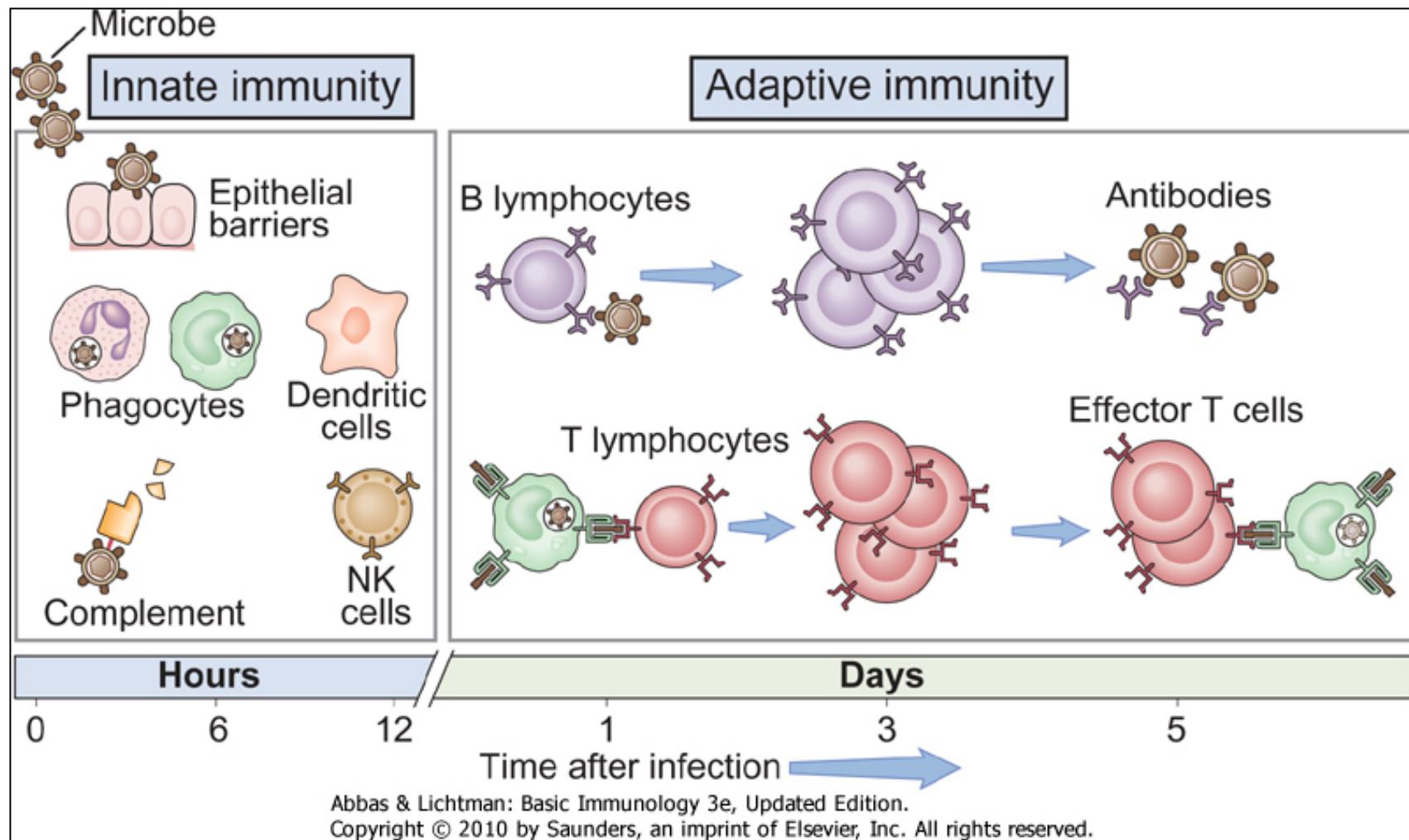
Lecture outline

- The nomenclature of Immunology
- Outline of the adaptive immune system

Functional importance of the immune system

Role of the immune system	Implications
Defense against infections	Deficient immunity results in increased susceptibility to infections; exemplified by AIDS Vaccination boosts immune defenses and protects against infections
Defense against tumors	Potential for immunotherapy of cancer
Clearance of dead cells and tissue repair	Deficient immunity can lead to secondary infections after injury, and excessive immune responses can lead to fibrosis and organ dysfunction
The immune system can injure cells and induce pathologic inflammation	Immune responses are the cause of allergic, autoimmune, and other inflammatory diseases
The immune system recognizes and responds to tissue grafts and newly introduced proteins	Immune responses are barriers to transplantation and gene therapy

Innate and Adaptive Immunity



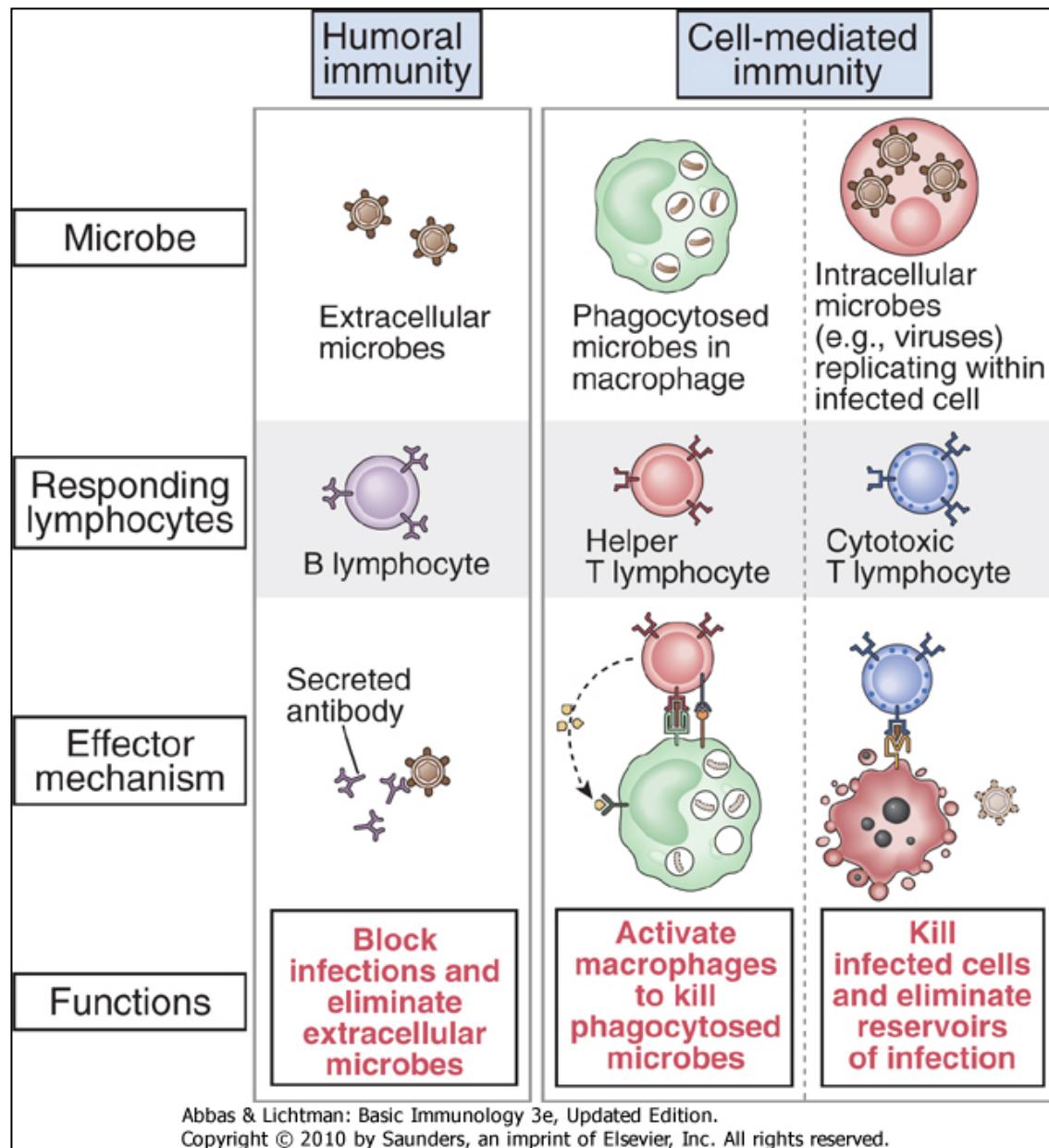
Innate immunity: always present (ready to attack)

Adaptive immunity: stimulated by exposure to microbe and more potent

Adaptive Immunity

- Third Line of Defense
- Develops after exposure to pathogens
- Involves very specific response to pathogens
- Much slower than innate immunity
- Requires support of innate immunity to function
- Two parts:
 - Humoral immunity
Eliminates extracellular pathogen
 - Cell mediated immunity
Eliminates intracellular pathogens

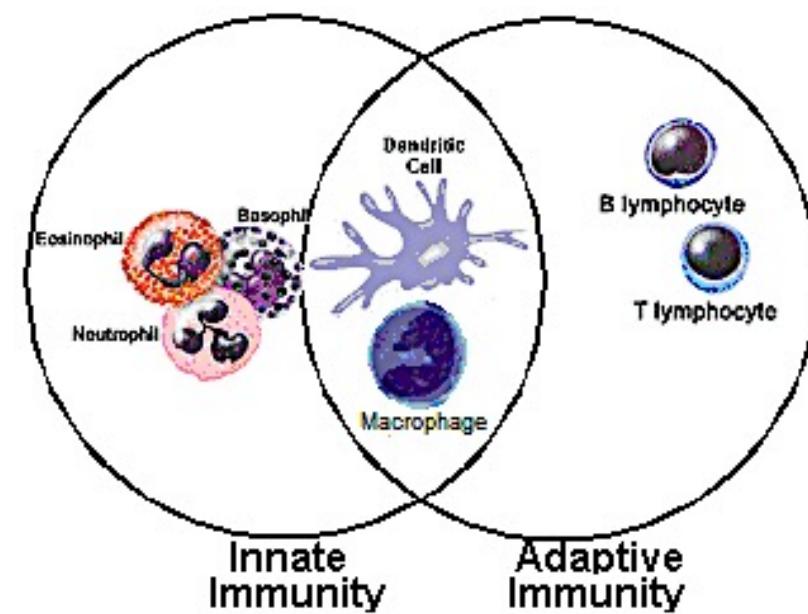
Types of Adaptive Immunity



Different types of immune responses are mediated by different classes of lymphocytes and defend against different types of microbes

Needs the Support of Innate immunity

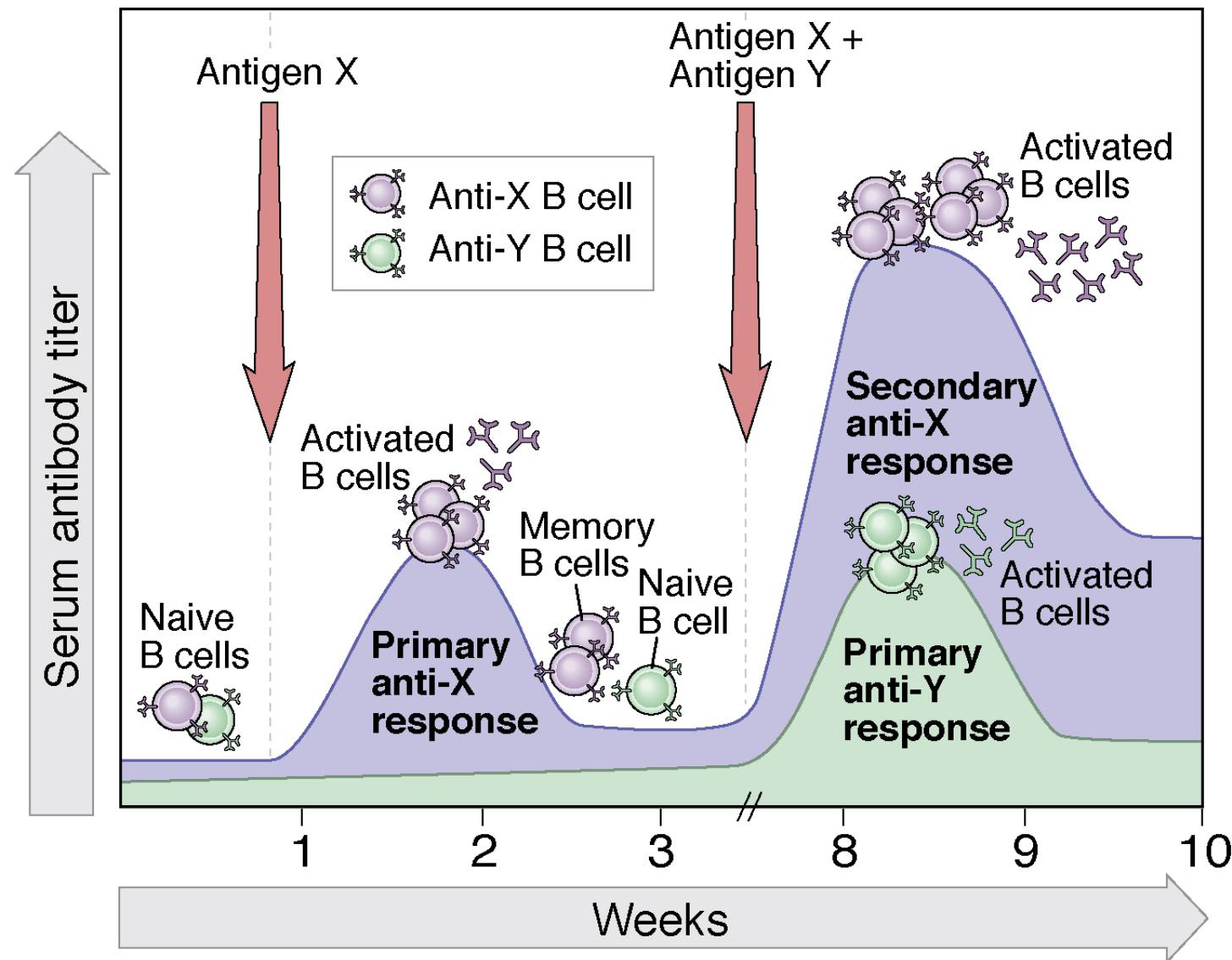
The cell mediated immunity needs support of cells in innate immunity



Properties of Adaptive Immune Responses

Feature	Functional significance
Specificity	Ensures that distinct antigens elicit specific responses
Diversity	Enables immune system to respond to a large variety of antigens
Memory	Leads to enhanced responses to repeated exposures to the same antigens
Clonal expansion	Increases number of antigen-specific lymphocytes to keep pace with microbes
Specialization	Generates responses that are optimal for defense against different types of microbes
Contraction and homeostasis	Allows immune system to respond to newly encountered antigens
Nonreactivity to self	Prevents injury to the host during responses to foreign antigens

Primary and Secondary Immune Responses Illustrate Specificity and Memory in Adaptive Immunity



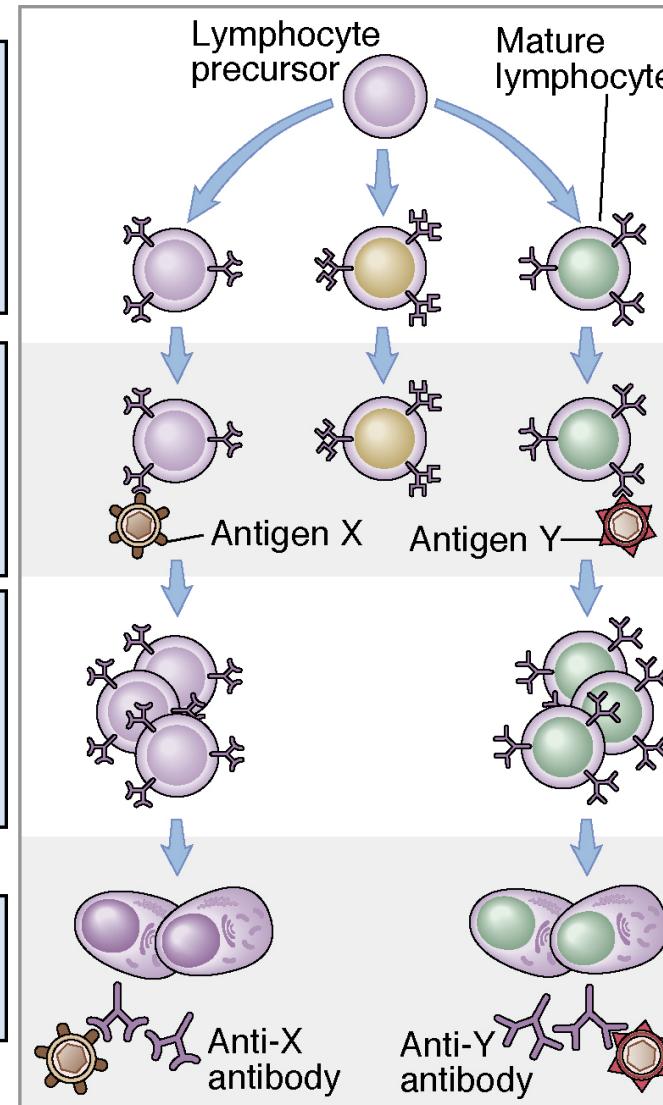
The Concept of Clonal Selection

Lymphocyte clones mature in generative lymphoid organs, in the absence of antigens

Clones of mature lymphocytes specific for diverse antigens enter lymphoid tissues

Antigen-specific clones are activated ("selected") by antigens

Antigen-specific immune responses occur

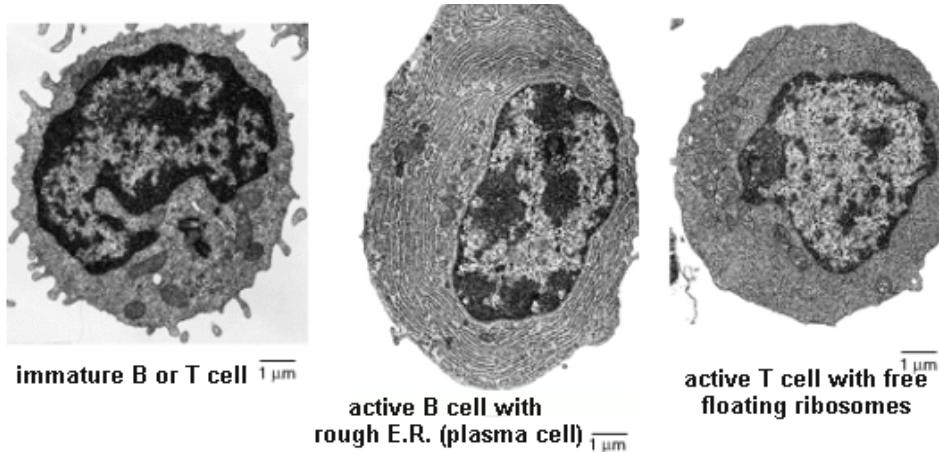


Development of specificity and diversity precedes exposure to antigens

Abbas, Lichtman and Pillai. Cellular and Molecular Immunology, 7th edition, 2011

Specialized Cells Involve

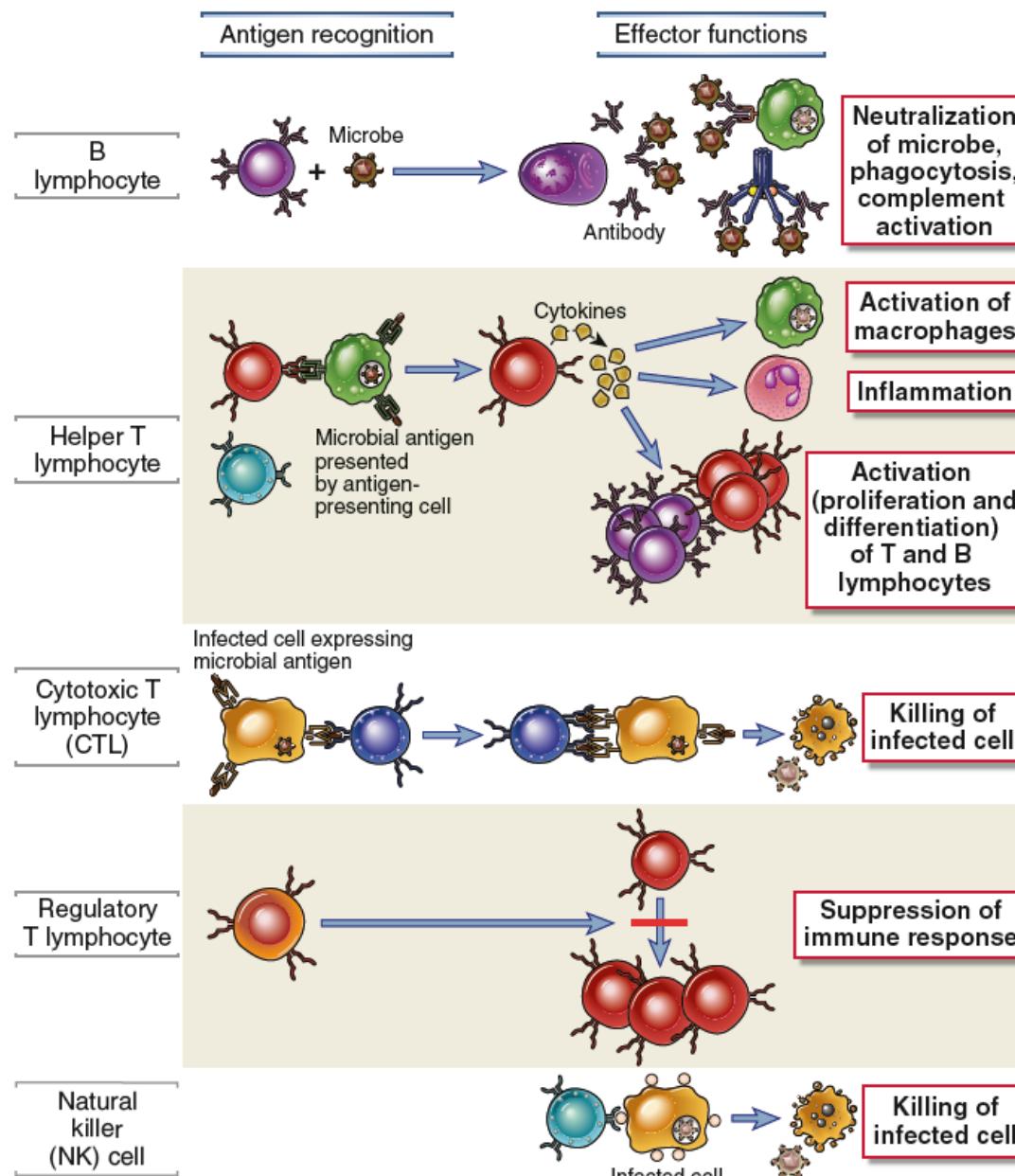
- **B cells**- synthesized and mature in the red bone marrow
- **T cells**- synthesize in bone marrow but mature in the thymus



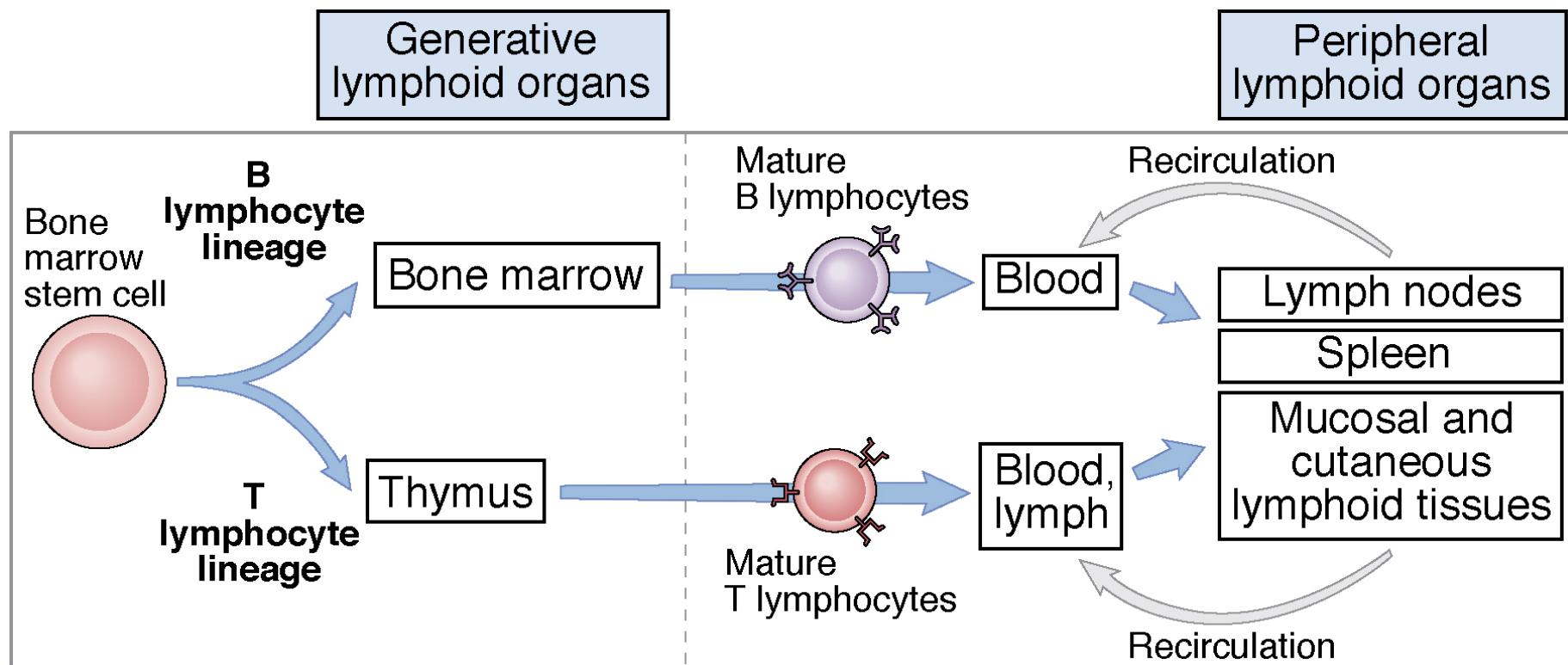
Cells Involve

- Lymphocytes
 - Mediators of adaptive immune responses
 - *only cells with specific receptors for antigens*
- Antigen-presenting cells (APCs)
 - Specialized to capture, concentrate, and display antigens for recognition by lymphocytes
 - *Dendritic cells; macrophages, B cells; follicular dendritic cells*
- Effector cells
 - Function to eliminate microbes
 - *lymphocytes, granulocytes (neutrophils, eosinophils), macrophages*

Classes of lymphocytes



Development of B and T lymphocytes



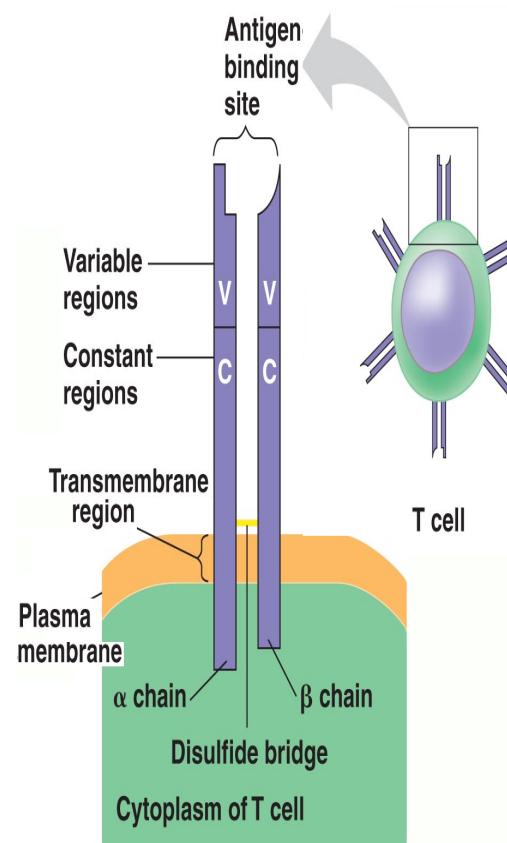
Abbas, Lichtman and Pillai. Cellular and Molecular Immunology

The CD Nomenclature

- Cluster of differentiation (CD)
- CD molecules (CD antigens, CD markers)
 - Used to classify leukocytes into functionally distinct subpopulations
e.g. helper T cells are CD4+CD8-, CTLs are CD8+CD4-

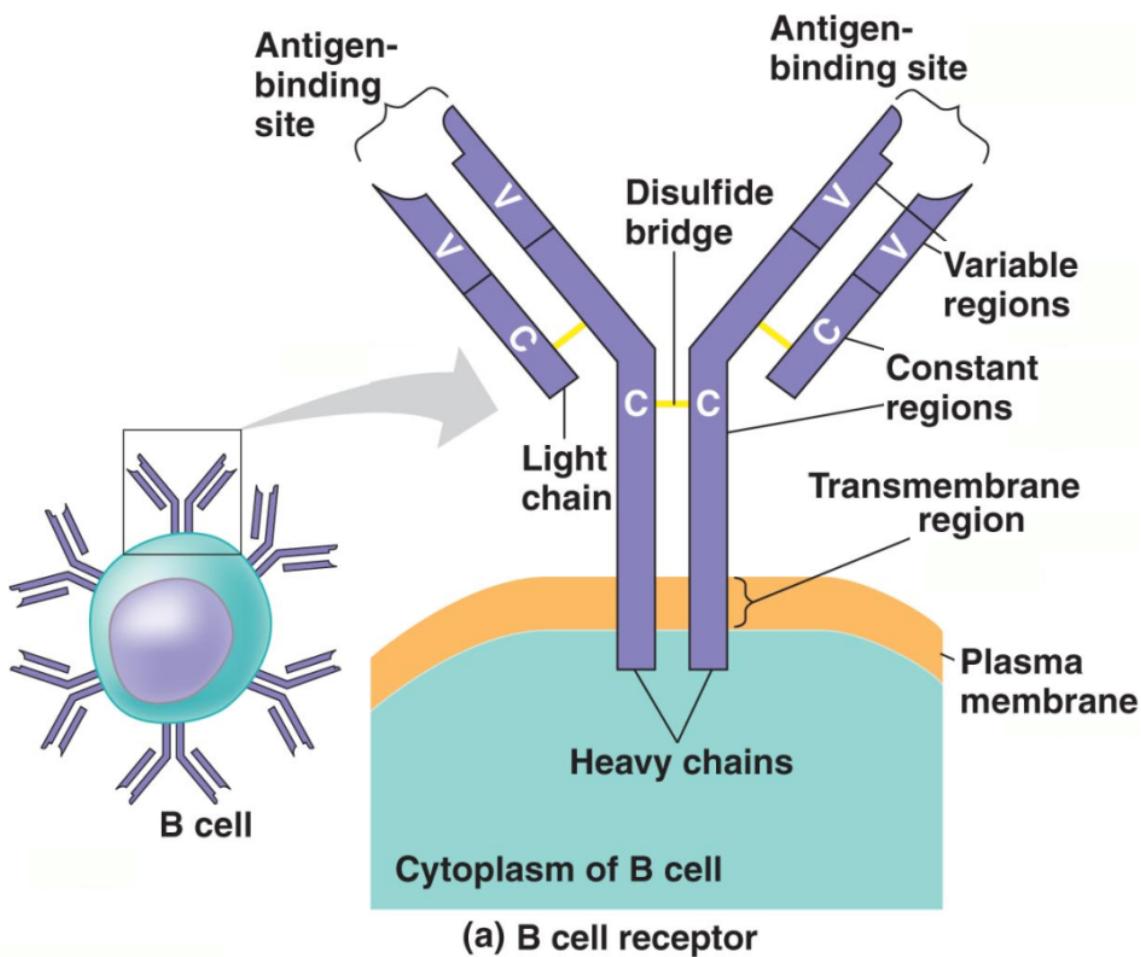
T Cell Receptors

T cell receptor (TCR) Attach
to an antigen that is
presented macrophage or
dendritic cell



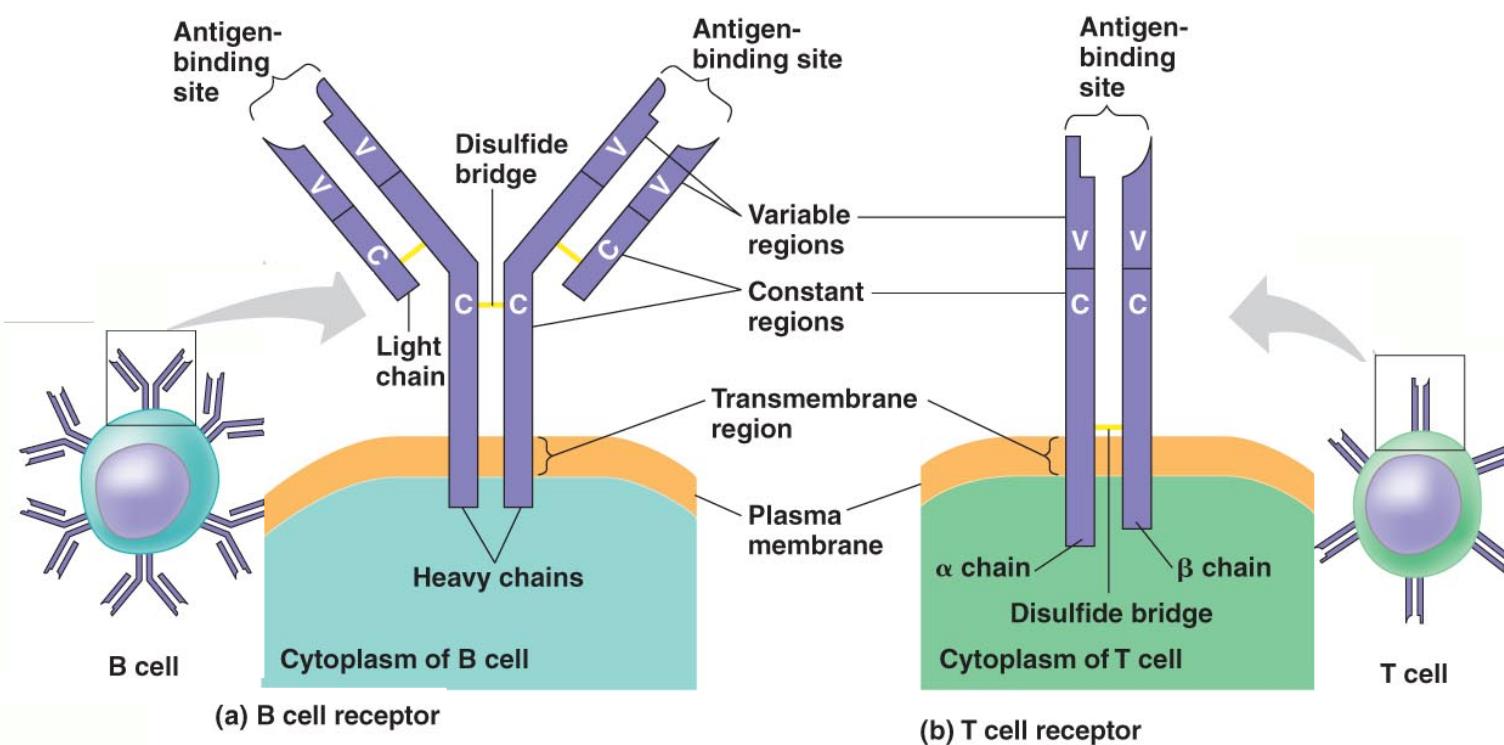
(b) T cell receptor

B Cell Receptor Sites

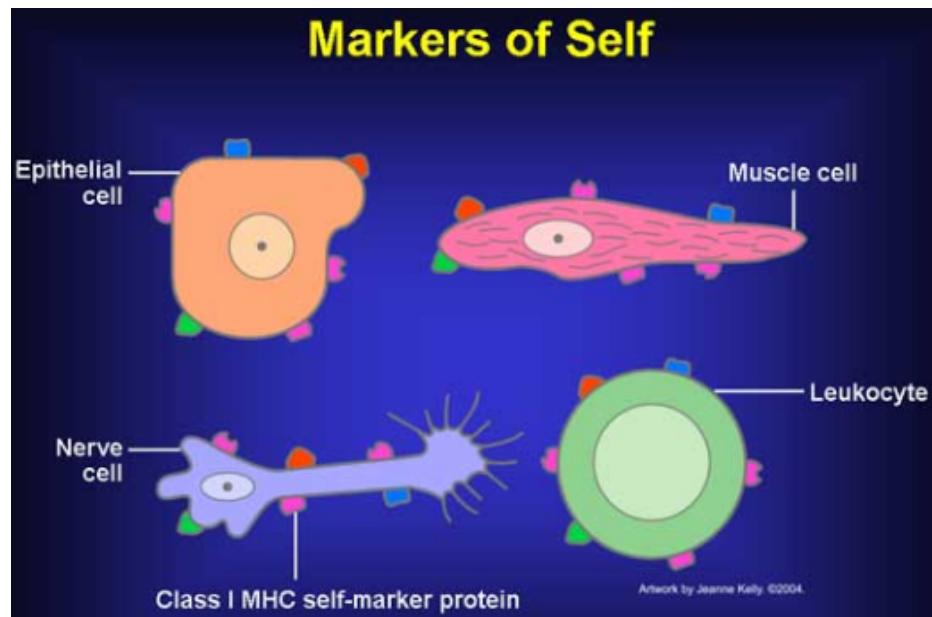


The specificity and diversity of adaptive immunity

- Lies in the receptor



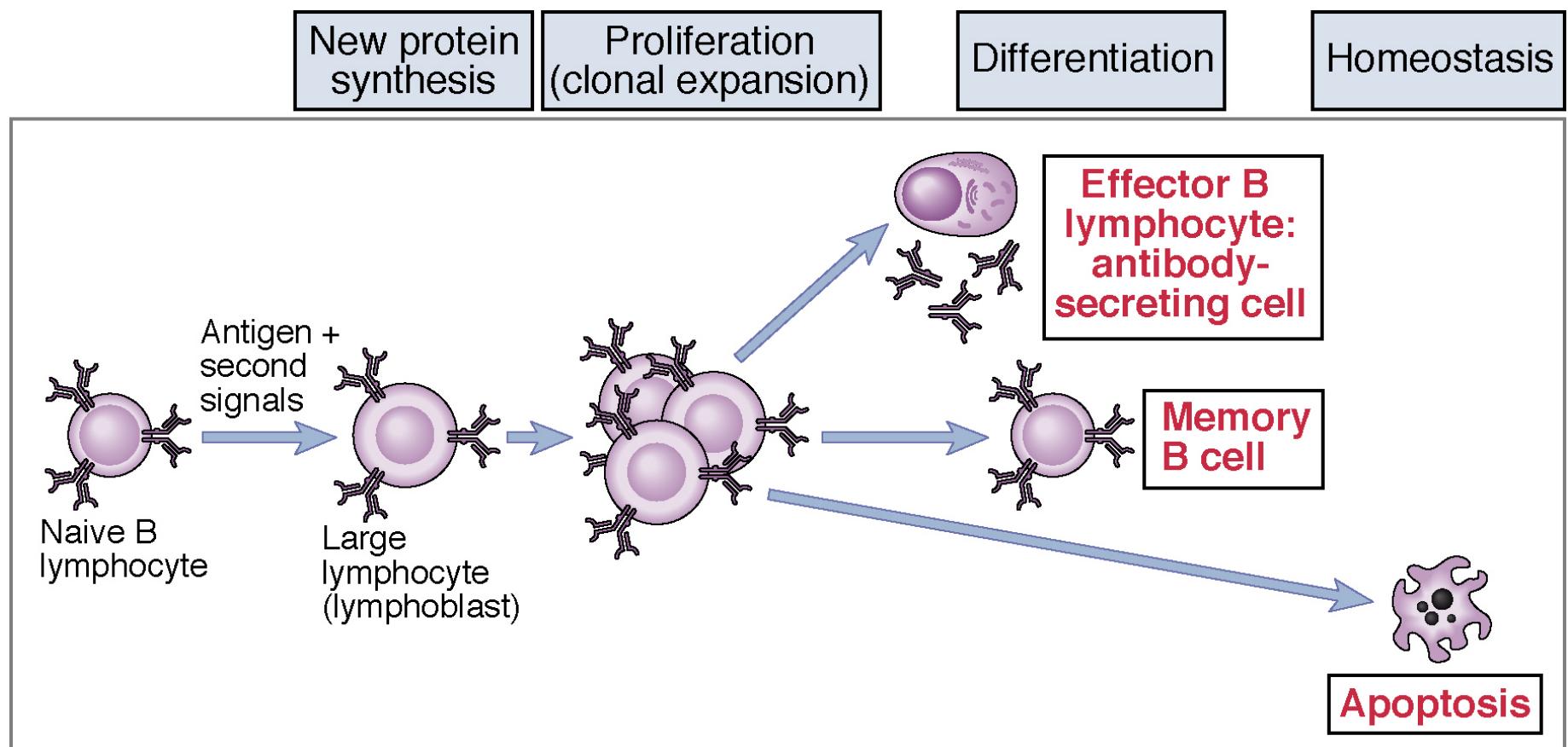
Major Histocompatibility Complex (MHC) Proteins



surface proteins unique
for each individual
(except for identical twins)

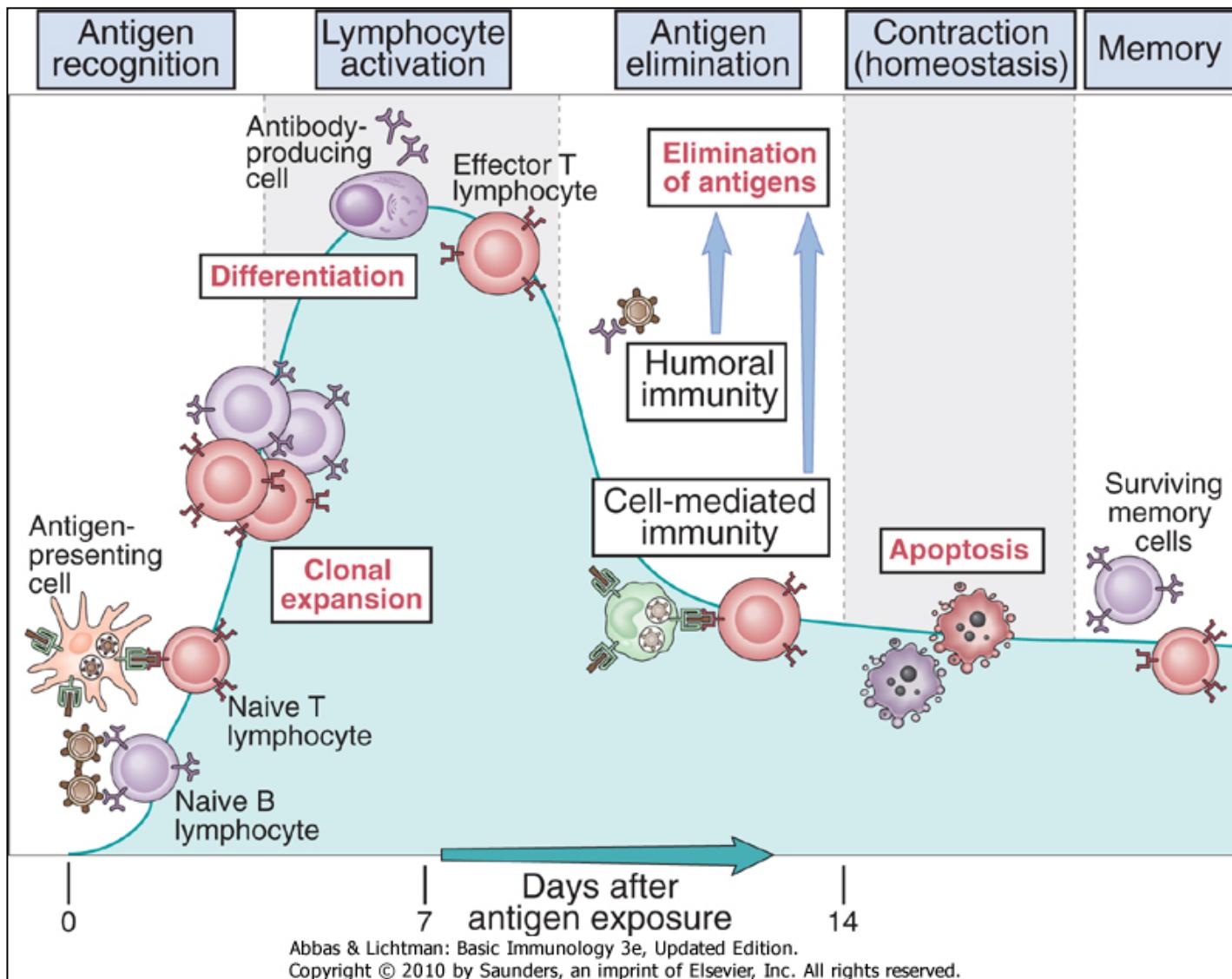
- Three classes of MHC proteins - MHC I, II, and III
- MHC I proteins are on ALL cells
- MHC II proteins are on antigen presenting cells (B cells, macrophages, dendritic cells)

Lymphocyte Activation



Abbas, Lichtman and Pillai. Cellular and Molecular Immunology

Adaptive Immune Responses



Summery

- Third line of defense
- Vertebrates
- Requires support of innate immunity to function
- Develops after exposure to pathogens
- Involves very specific response to pathogens
- Much slower than innate immunity
- Much Potent than innate immunity
- Develops long standing memory

THANKS