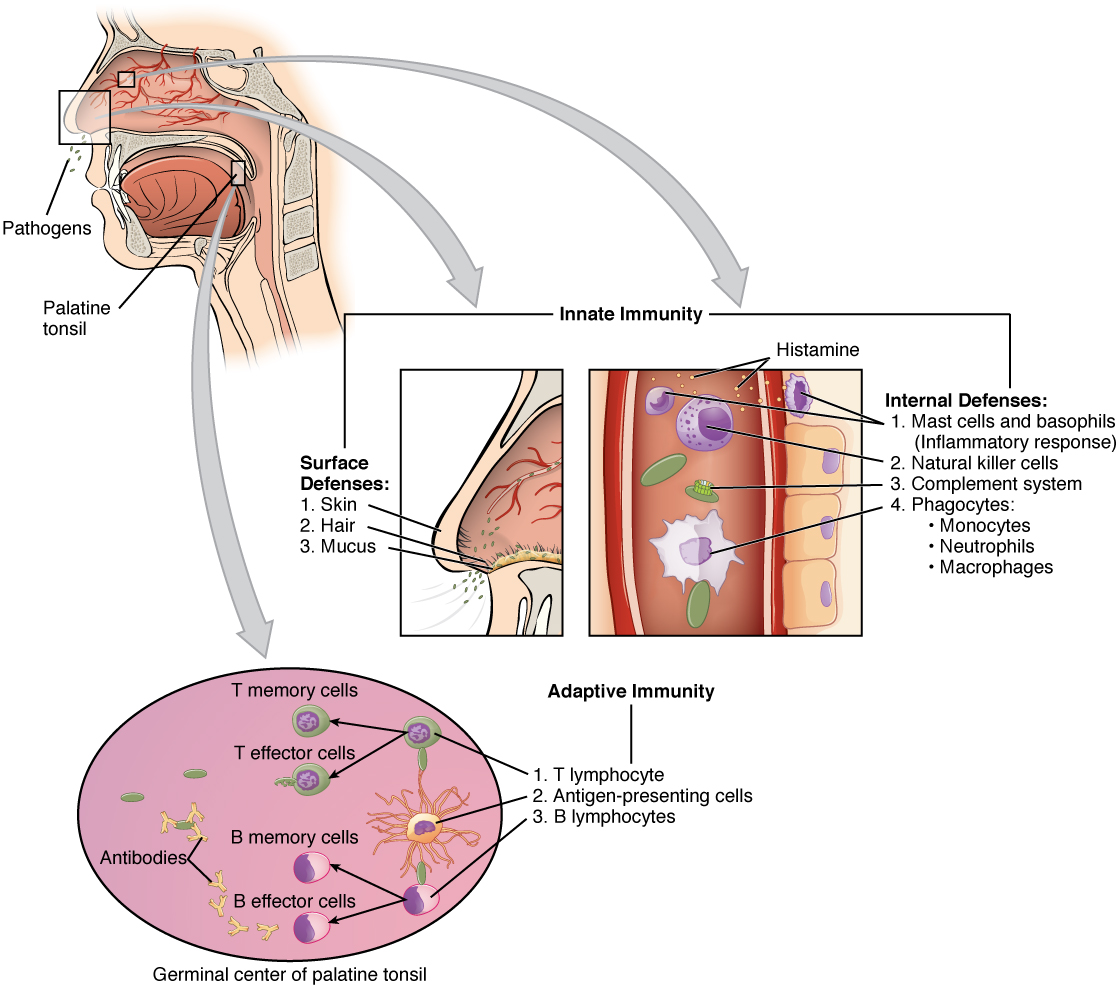
Which of the following structures functions to filter lymph of possible pathogens and diseased cells?

1. spleen
2. liver
3. tonsils
4. lymph nodes
5. Peyer’s patches

Immune System

Innate Defenses

Figure 1. Cooperation between Innate and Adaptive Immune Responses. The innate immune system enhances adaptive immune responses so they can be more effective

Barriers

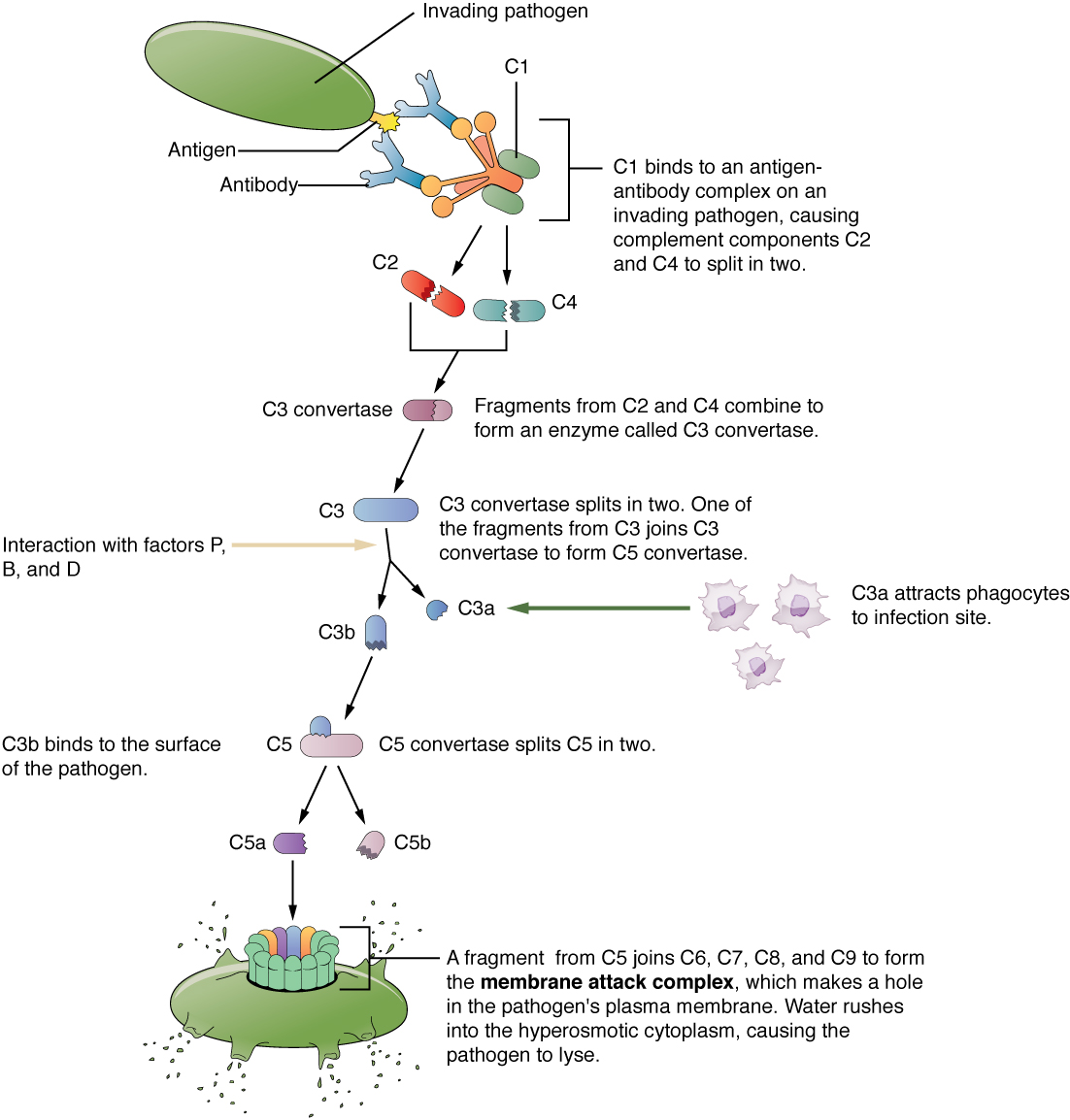
| **Barrier Defenses (Table 2)** | | |
| --- | --- | --- |
| **Site** | **Specific defense** | **Protective aspect** |
| Skin | Epidermal surface | Keratinized cells of surface, Langerhans cells |
| Skin (sweat/secretions) | Sweat glands, sebaceous glands | Low pH, washing action |
| Oral cavity | Salivary glands | Lysozyme |
| Stomach | Gastrointestinal tract | Low pH |
| Mucosal surfaces | Mucosal epithelium | Nonkeratinized epithelial cells |
| Normal flora (nonpathogenic bacteria) | Mucosal tissues | Prevent pathogens from growing on mucosal surfaces |

Phagocytes

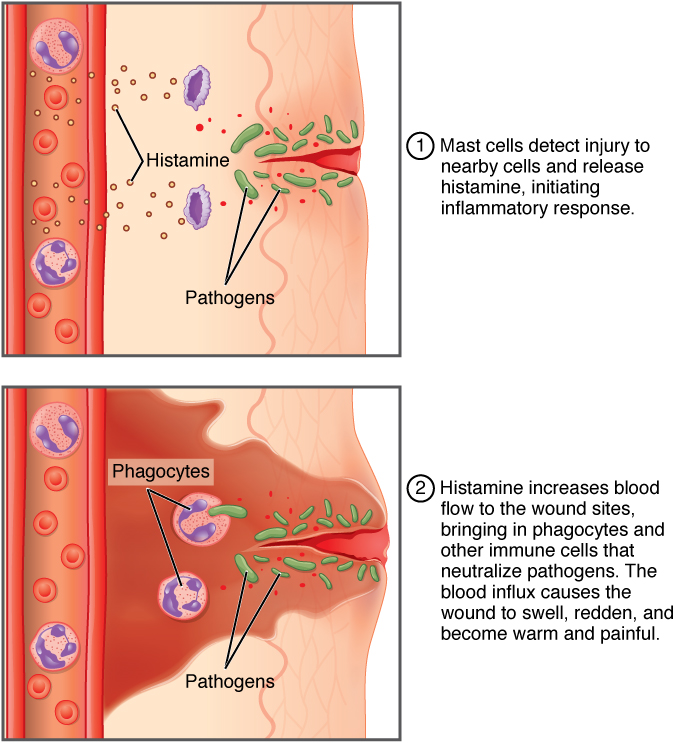
| **Phagocytic Cells of the Innate Immune System (Table 3)** | | | |
| --- | --- | --- | --- |
| **Cell** | **Cell type** | **Primary location** | **Function in the innate immune response** |
| Macrophage | Agranulocyte | Body cavities/organs | Phagocytosis |
| Neutrophil | Granulocyte | Blood | Phagocytosis |
| Monocyte | Agranulocyte | Blood | Precursor of macrophage/dendritic cell |

Natural Killer Cells

Chemical Signals

Figure 2. Complement Cascade and Function. The classical pathway, used during adaptive immune responses, occurs when C1 reacts with antibodies that have bound an antigen.

Inflammation



Fever

Adaptive Defenses

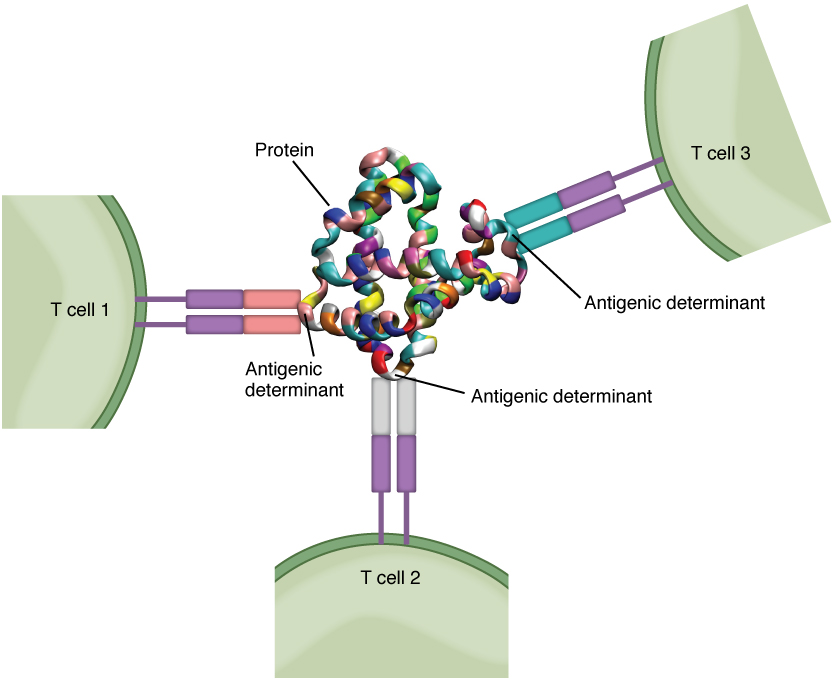


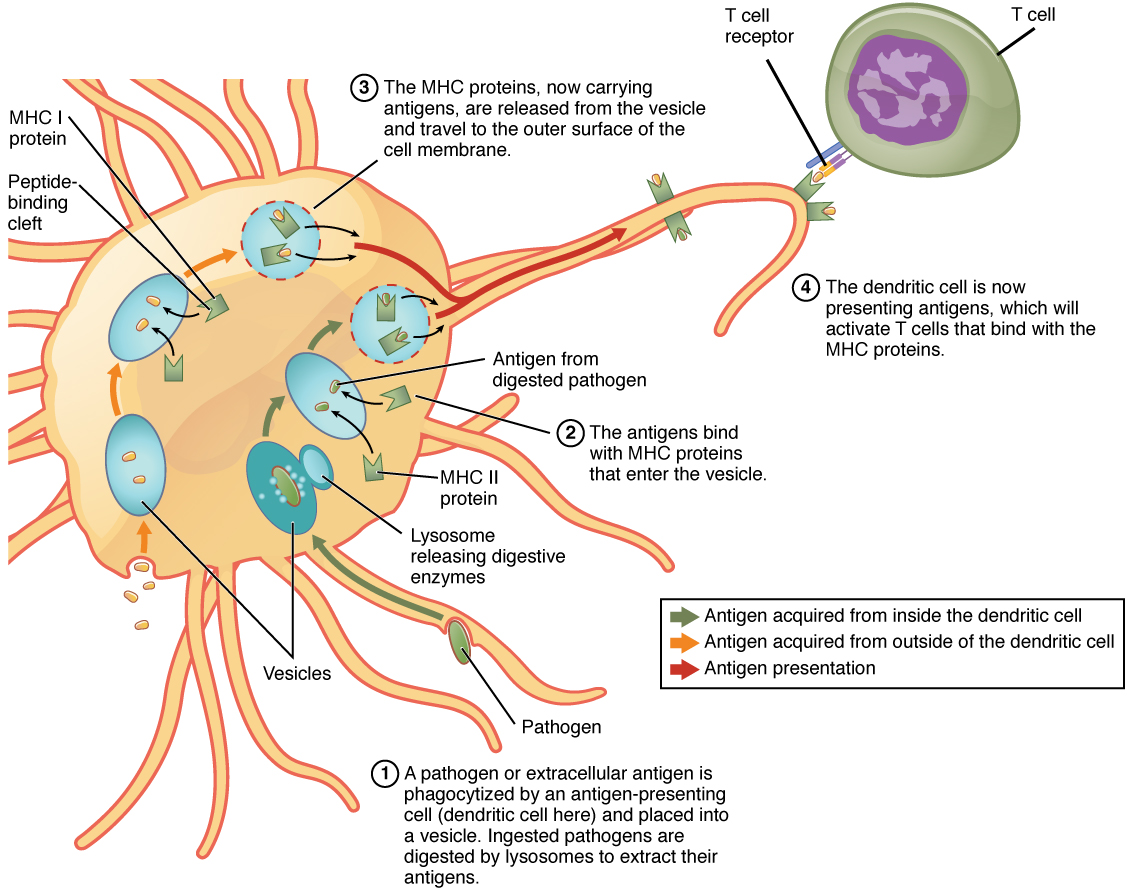
Figure 2. Antigenic Determinants. A typical protein antigen has multiple antigenic determinants, shown by the ability of T cells with three different specificities to bind to different parts of the same antigen.

T-Cells

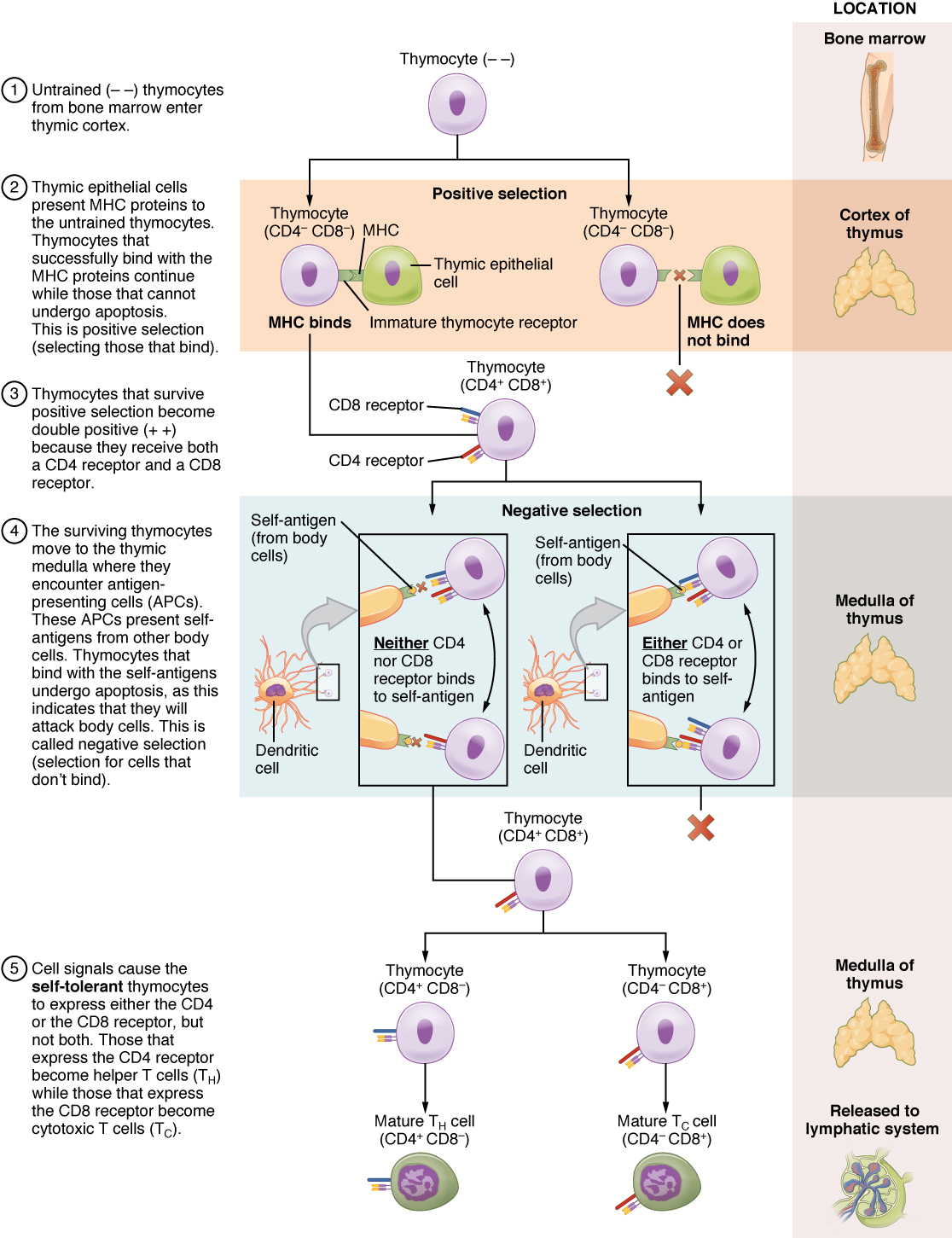
MHC Proteins

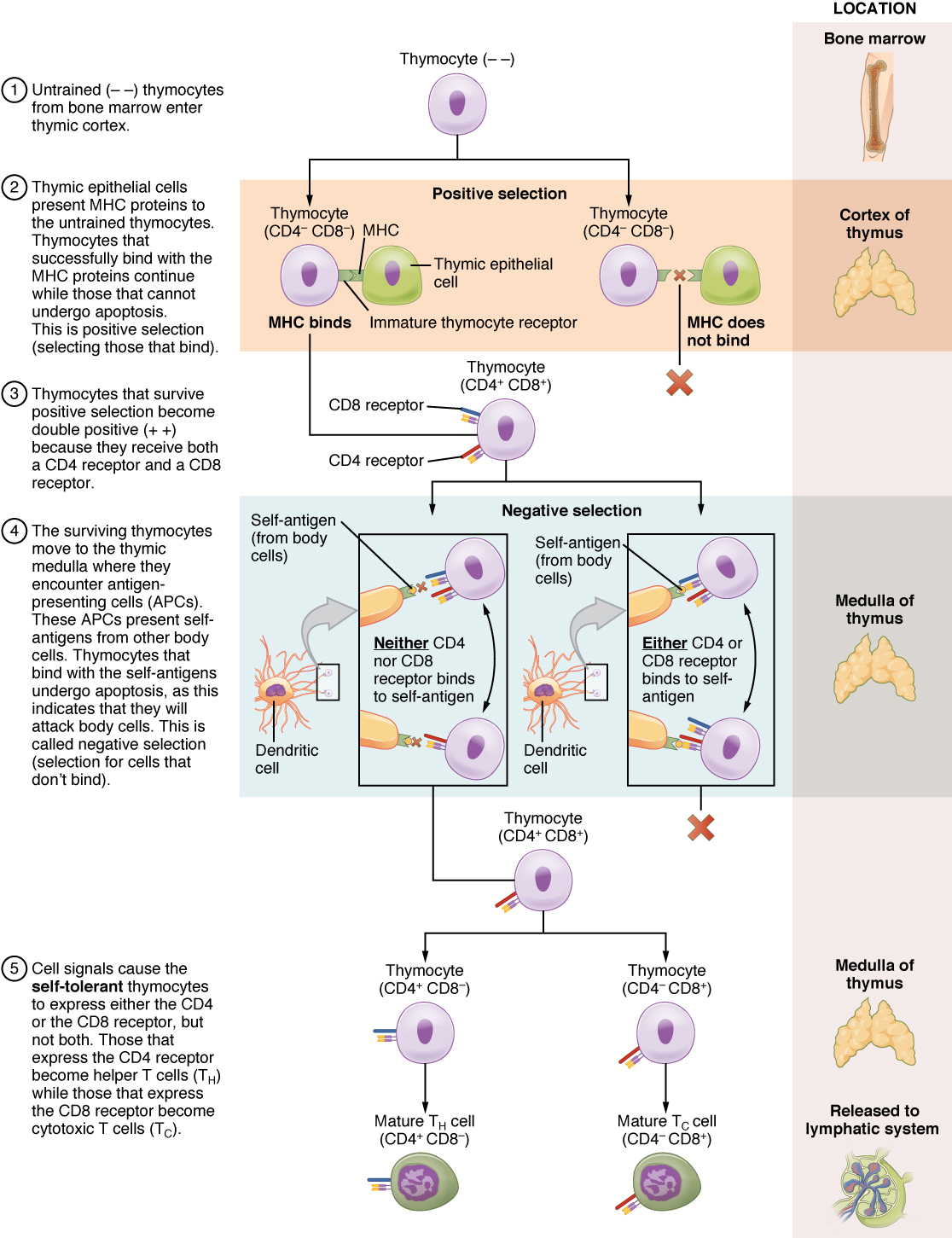
| **Classes of Antigen-presenting Cells (Table 4)** | | | |
| --- | --- | --- | --- |
| **MHC** | **Cell type** | **Phagocytic?** | **Function** |
| Class I | Many | No | Stimulates cytotoxic T cell immune response |
| Class II | Macrophage | Yes | Stimulates phagocytosis and presentation at primary infection site |
| Class II | Dendritic | Yes, in tissues | Brings antigens to regional lymph nodes |
| Class II | B cell | Yes, internalizes surface Ig and antigen | Stimulates antibody secretion by B cells |

Antigen Presentation

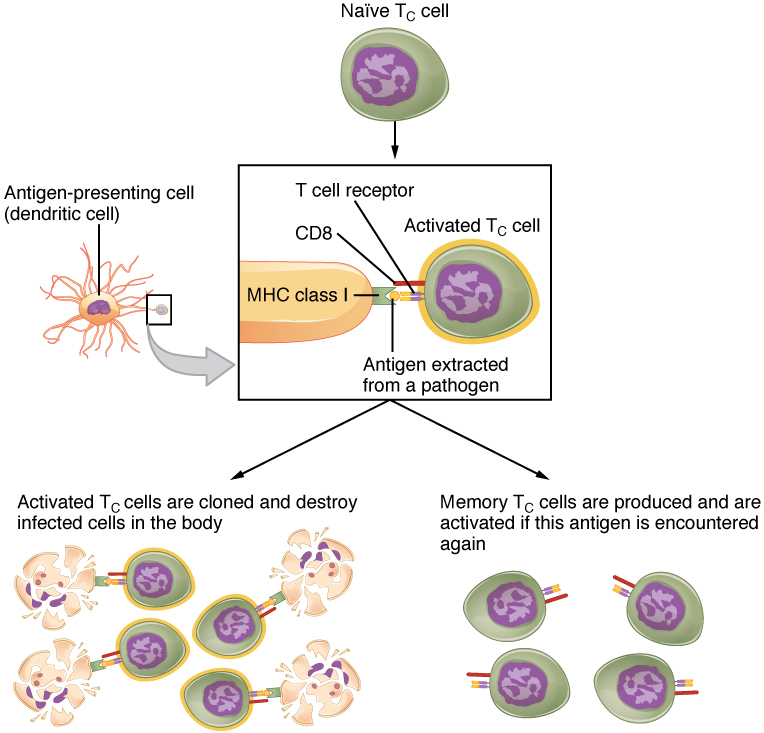


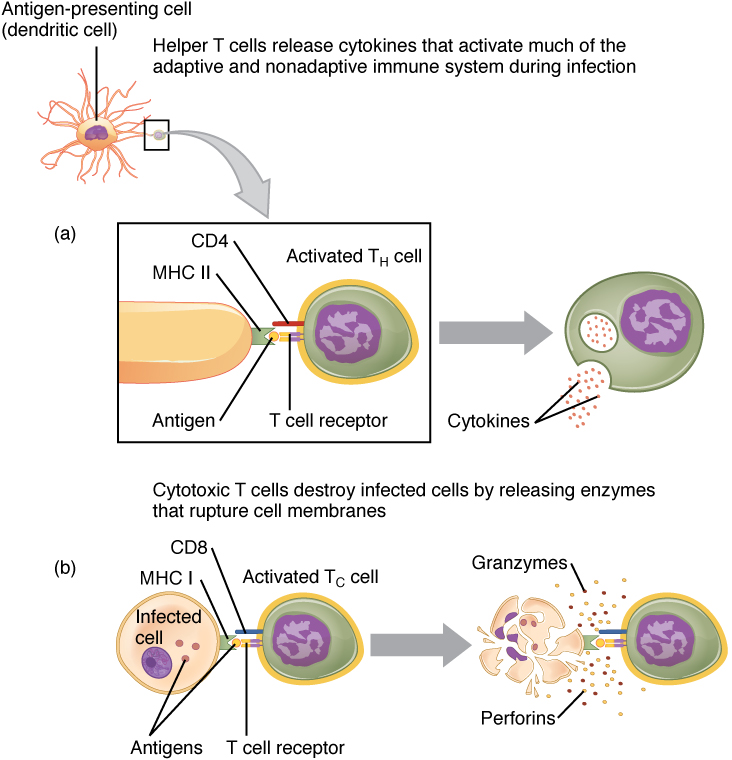
T-Cell Differentiation

Figure 4. Differentiation of T Cells within the Thymus. Thymocytes enter the thymus and go through a series of developmental stages that ensures both function and tolerance before they leave and become functional components of the adaptive immune response.

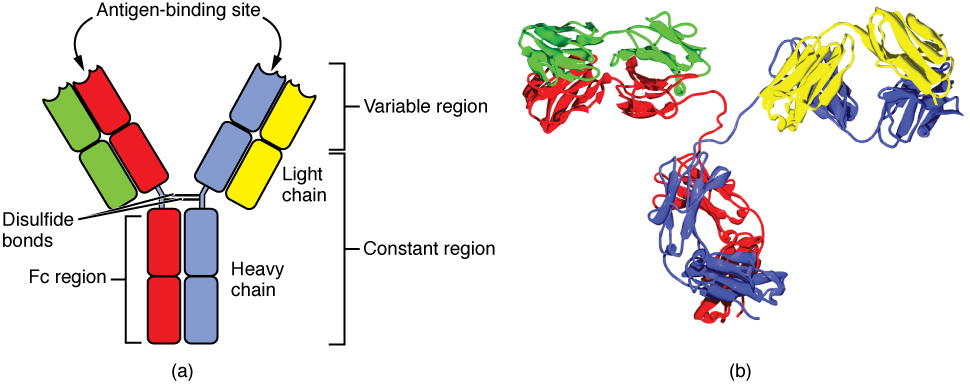


T-Cell Mediated Responses

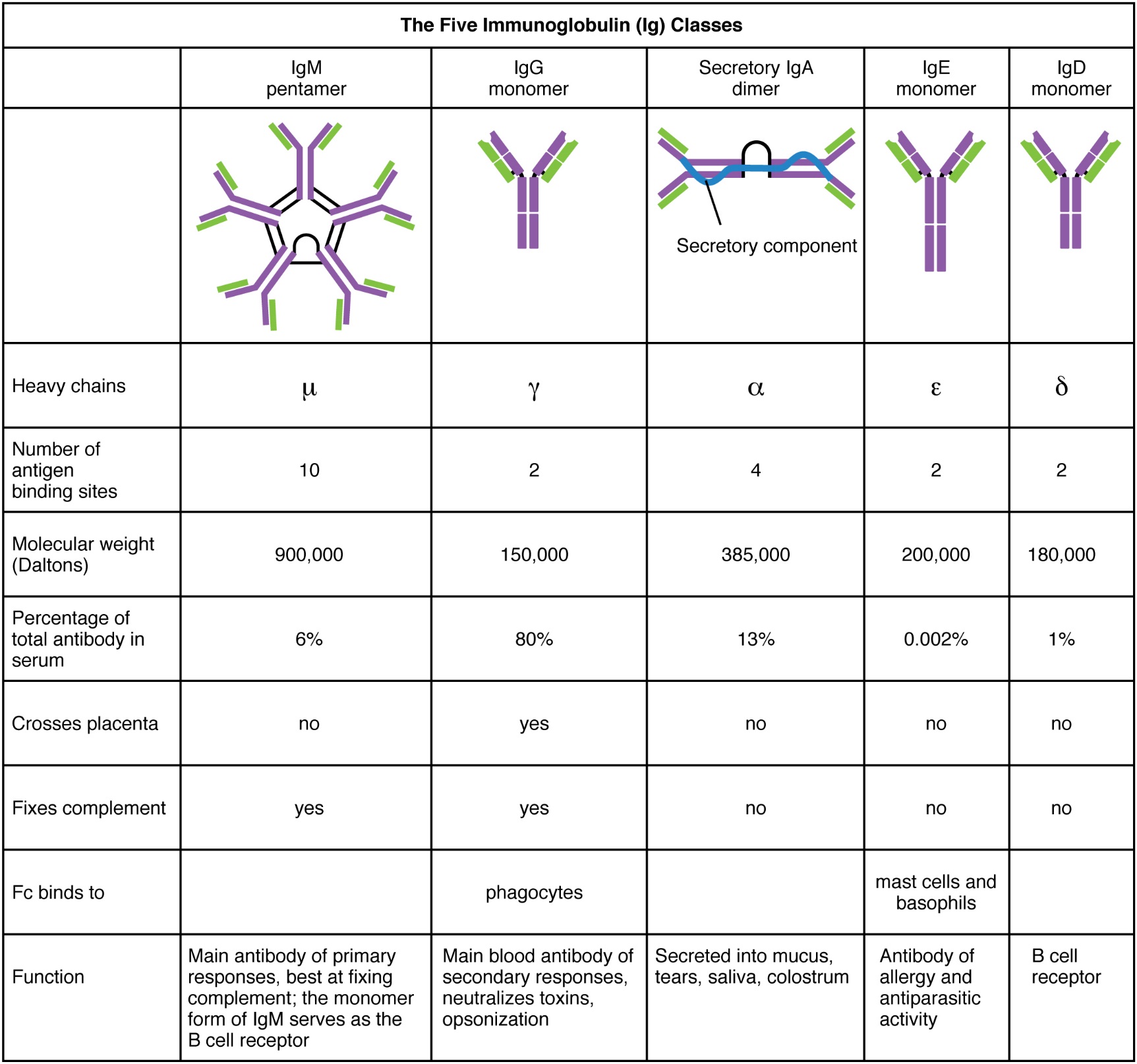
Figure 5. Clonal Selection and Expansion of T Lymphocytes. Stem cells differentiate into T cells with specific receptors, called clones. The clones with receptors specific for antigens on the pathogen are selected for and expanded.

Figure 6. Pathogen Presentation. (a) CD4 is associated with helper and regulatory T cells. An extracellular pathogen is processed and presented in the binding cleft of a class II MHC molecule, and this interaction is strengthened by the CD4 molecule. (b) CD8 is associated with cytotoxic T cells. An intracellular pathogen is presented by a class I MHC molecule, and CD8 interacts with it.

B-Cells and Antibodies

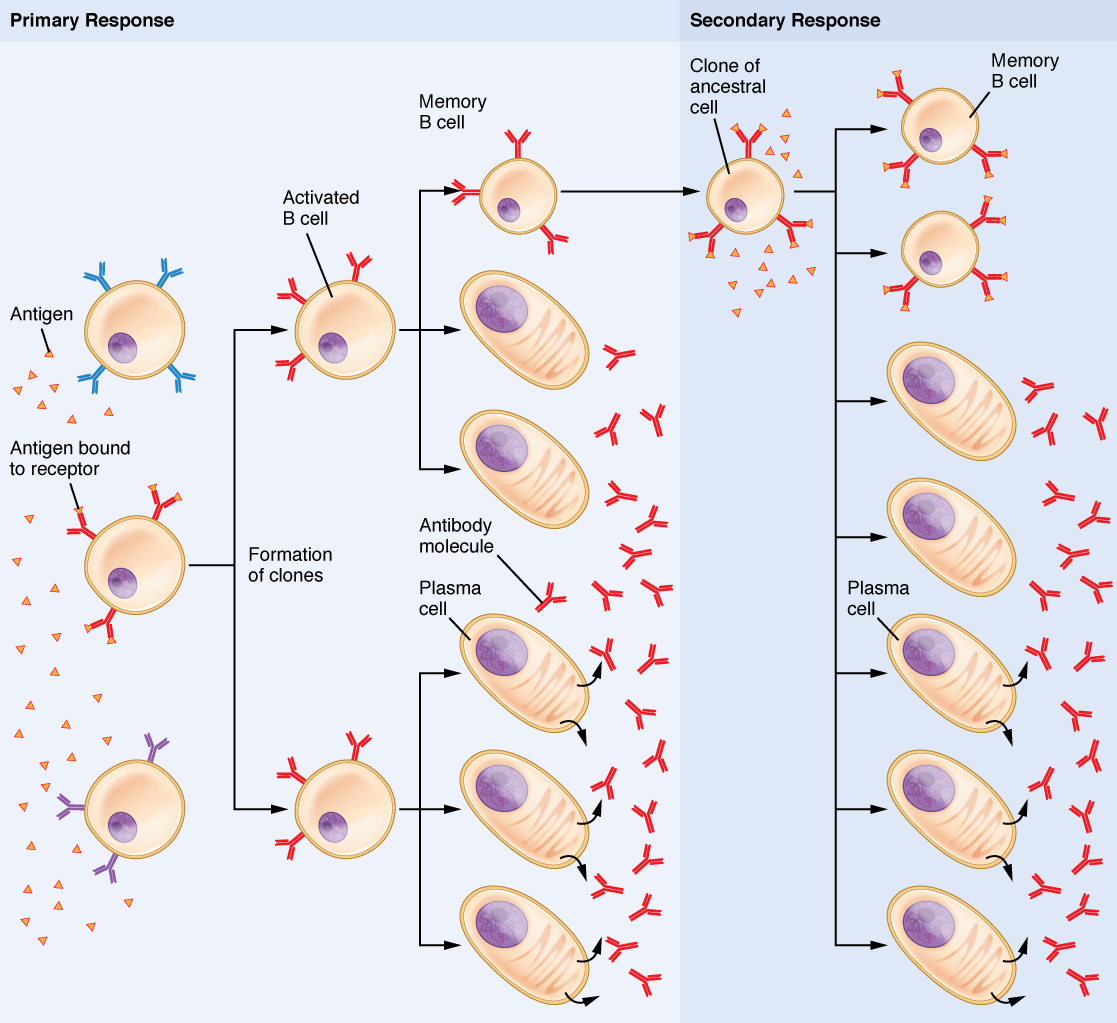
Figure 1. Antibody and IgG2 Structures. The typical four chain structure of a generic antibody (a) and the corresponding three-dimensional structure of the antibody IgG2 (b). (credit b: modification of work by Tim Vickers)

Classes of Antibodies



Mechanism of Antibody Action

Clonal Selection

Figure 3. Clonal Selection of B Cells. During a primary B cell immune response, both antibody-secreting plasma cells and memory B cells are produced. These memory cells lead to the differentiation of more plasma cells and memory B cells during secondary responses.

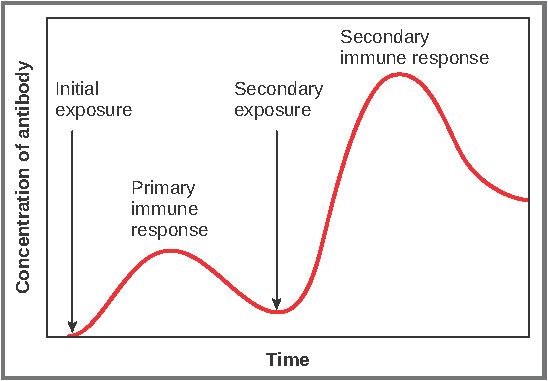


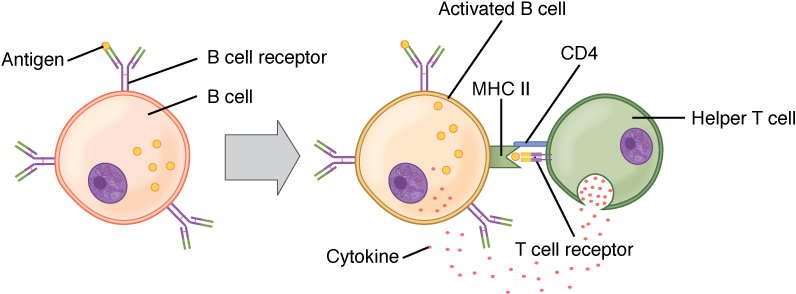
Figure 4. Primary and Secondary Antibody Responses. Antigen A is given once to generate a primary response and later to generate a secondary response. When a different antigen is given for the first time, a new primary response is made.

Vaccinations

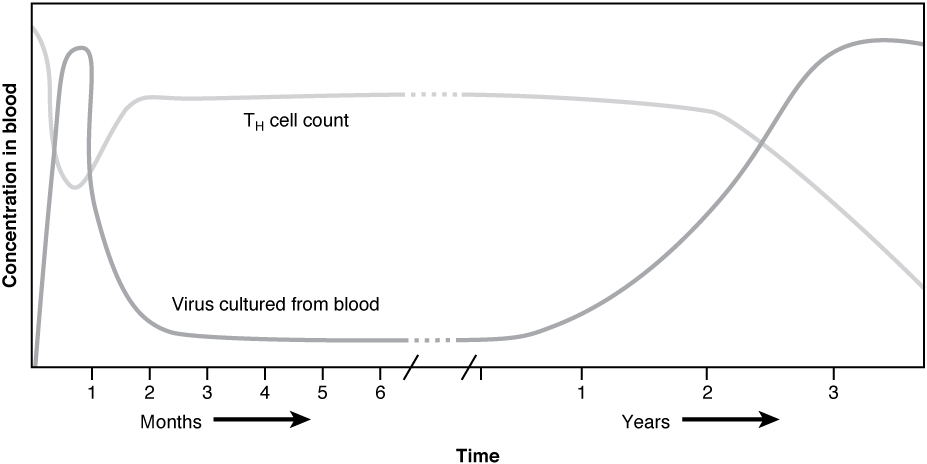
Evolution of Virulence

Active vs. Passive Immunity

Interaction between B-Cells and T-Cells

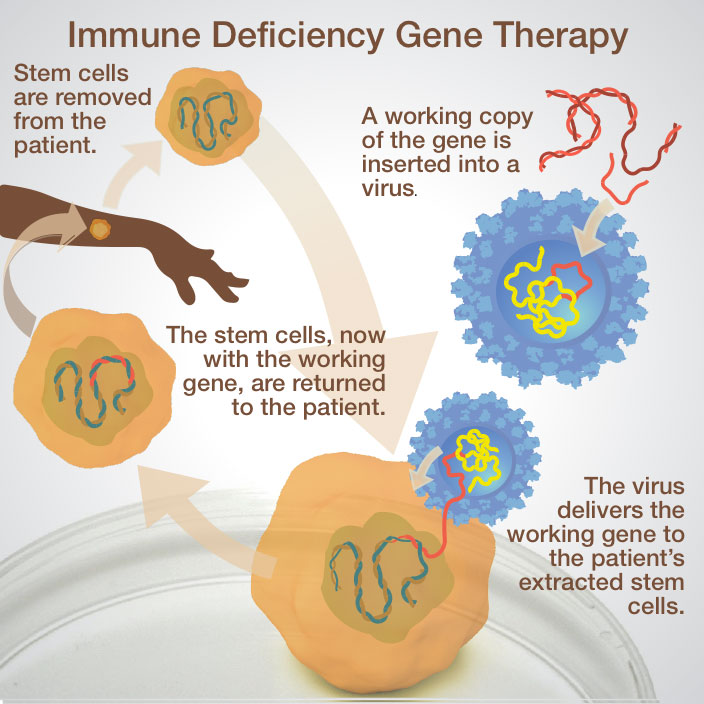
Figure 5. T and B Cell Binding. To elicit a response to a T cell-dependent antigen, the B and T cells must come close together. To become fully activated, the B cell must receive two signals from the native antigen and the T cell’s cytokines.

AIDS

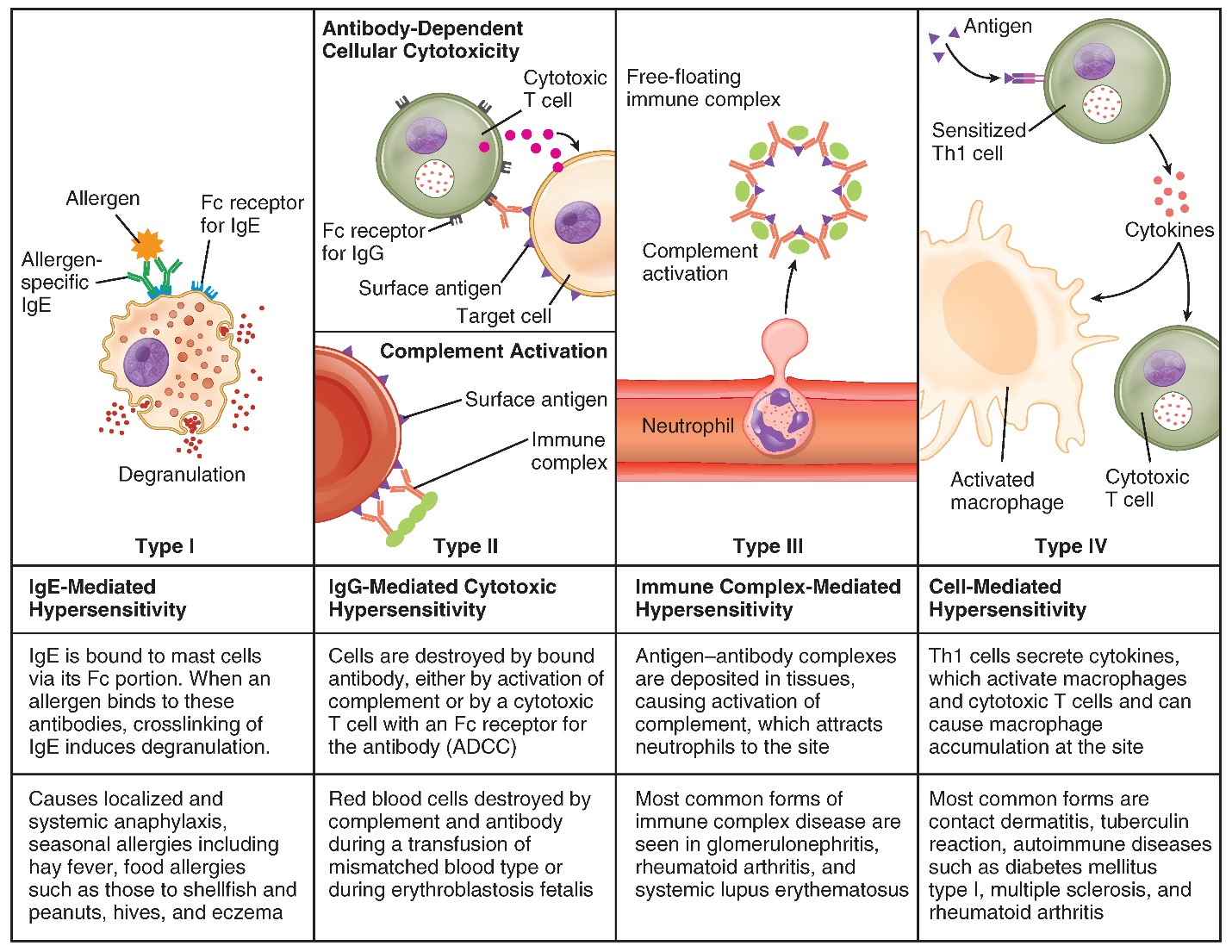


Other Immunodeficiencies

SCID



Hypersensitivities



Autoimmunity

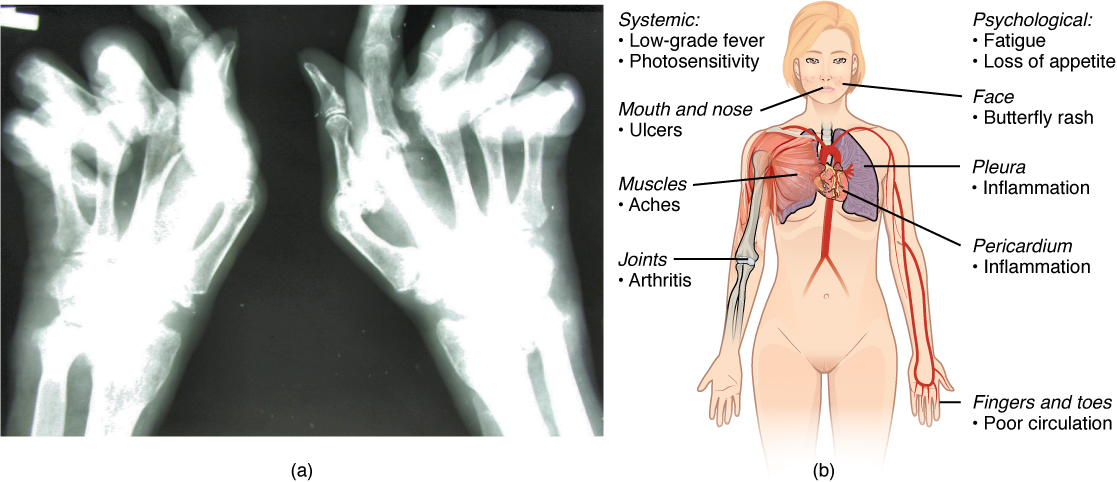


Figure 2. Autoimmune Disorders: Rheumatoid Arthritis and Lupus. (a) Extensive damage to the right hand of a rheumatoid arthritis sufferer is shown in the x-ray. (b) The diagram shows a variety of possible symptoms of systemic lupus erythematosus.

| **Autoimmune Diseases (Table 7)** | | |
| --- | --- | --- |
| **Disease** | **Autoantigen** | **Symptoms** |
| Celiac disease | Tissue transglutaminase | Damage to small intestine |
| Diabetes mellitus type I | Beta cells of pancreas | Low insulin production; inability to regulate serum glucose |
| Graves’ disease | Thyroid-stimulating hormone receptor (antibody blocks receptor) | Hyperthyroidism |
| Hashimoto’s thyroiditis | Thyroid-stimulating hormone receptor (antibody mimics hormone and stimulates receptor) | Hypothyroidism |
| Lupus erythematosus | Nuclear DNA and proteins | Damage of many body systems |
| Myasthenia gravis | Acetylcholine receptor in neuromuscular junctions | Debilitating muscle weakness |
| Rheumatoid arthritis | Joint capsule antigens | Chronic inflammation of joints |