

Innate and adaptive immunity (Host Defense Mechanisms)

- **Innate immunity**
 - Non-specific
 - First line of defense
 - Important and comprehensive means of defense

Innate Immunity

- **Mechanical barrier**
 - Skin: epithelial cells joined by tight junctions
 - Respiratory tract: movement of mucus by cilia
- **Chemical barrier**
 - Skin: Fatty acids
 - Tears: lysozyme, sweat: lactic acid, gut: pepsin, low pH, intestine: cryptidin, antibacteria peptide
- **Microbiological barrier**
 - Normal flora
 - Compete for nutrients and attachment to epithelium
 - Produce anti-bacterial substance

Innate Immunity

- **Complement activation (Innate humoral immunity): microbial surface**
- **Phagocytes (Innate cellular immunity):**

Innate cellular immunity

- **Macrophages in tissues**
 - Phagocytosis
 - Cytokines (inflammatory cytokines: TNF- α , IL1, IL-6, IL-8,) chemokines
 - Antigen-presenting cells (adaptive immunity)
- **PMN**
 - Phagocytosis
 - Cytokines

Innate cellular immunity

- **Natural killer cells (NK):**
 - Interferon (IFN)- α and IFN- β activate NK cells
 - Secrete interferon- γ (crucial in controlling infection before adaptive immunity)
 - Activated NK cells induce apoptosis of infected target cells (intracellular pathogens such as viruses and intracellular bacteria)

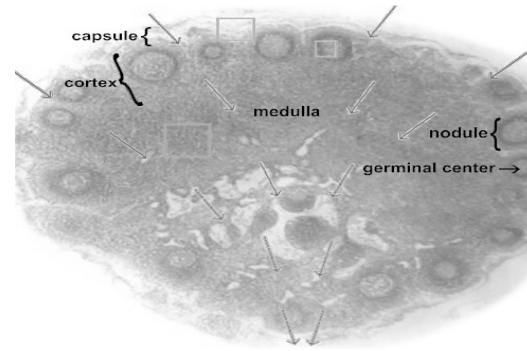
Adaptive immunity

- **Antigen specific,**
- **Mediated by lymphocytes (T and B cells)**
- **Long-lasting, memory response (the basis of vaccination)**
- **Cellular immunity:**
 - Cytotoxic T cells (CTL)
 - Macrophages
- **Humoral immunity:**
 - Antibodies (B cells)
 - Cytokines: Interferons

Adaptive immunity

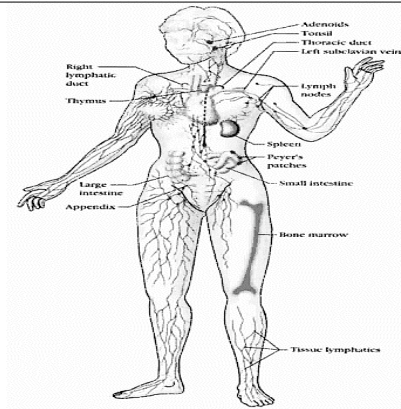
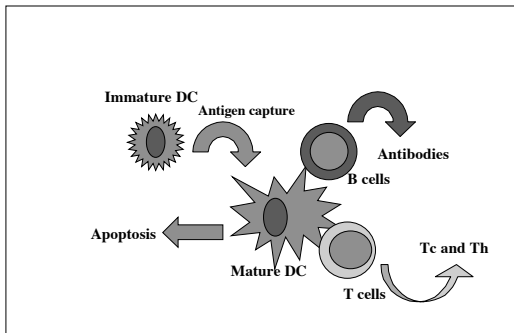
- Primary lymphoid organs
 - Sites of T and B cell maturation
 - Bone marrow (B cell development)
 - Thymus (T cell development)
- Secondary lymphoid organs
 - Antigen trapping and T, B cell activation
 - Lymph nodes
 - Spleen
 - Mucosal associated lymphatic tissue (Peyer's patch)

Structure of lymph nodes



Source: <http://science.nhmccd.edu/biol/lymphatic/lymph.htm>

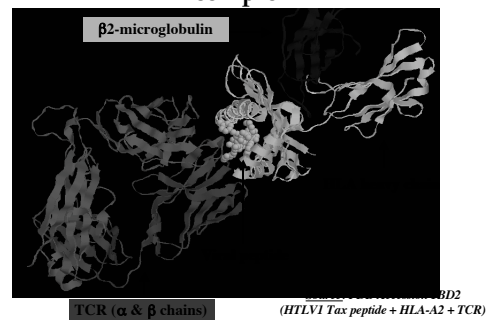
Dendritic cells as regulators of T and B cell responses



Activation of T cells

- Occurs in lymphoid organ
- Activated by binding of the T cell receptors to antigen presenting cells (macrophages, B and dendritic cells)
- Activated T cells changed their surface molecules
- Circulate through efferent lymph to the inflamed tissue

Structure of TCR::HLA/peptide complex

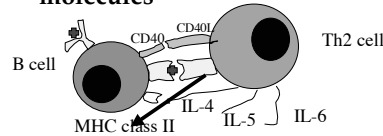


Effector mechanism of T cells

- Cytotoxic T cells (CD8 T cells)
 - Kill target cells by apoptosis (Fas ligand)
 - Kill target cells by secreting perforin (poke holes in the cell membrane) and granzymes (apoptosis)
- T helper cells (CD4 T cells)
 - Th1: activate macrophages and CTL activation
 - Th2: activation of B cells to secrete antibodies

Activation of B cells

- T cell dependent activation: depend on the activation of T helper cells (Th2)
- T cell independent activation: lipopolysaccharide (LPS)
- B cell receptor: immunoglobulin molecules



Effector functions of antibody

- Neutralization: bacteria toxin or viruses
 - IgG and IgA
- Opsonization for phagocytosis by macrophage
 - IgG
- Sensitization for killing by NK cells
 - IgG
- Activate complement
 - IgM and IgG
- Sensitization of mast cells
 - IgE

Role of adaptive immunity in defense

- Different effector mechanisms are used by different pathogens
 - Cell mediated immunity
 - CTL (activated CD8 T cells):
 - viruses
 - Early
 - Th1 activated macrophages:
 - intracellular bacteria
 - worms

Role of adaptive immunity in defense

- Humoral immunity
 - IgM:
 - Bacteria
 - Early
 - IgG:
 - viruses, bacteria, protozoa
 - Late
 - IgA:
 - Viruses
 - Mucosal surface: respiratory, GI and urogenital tract

Summary of Host Defense

- Innate immunity
 - Mechanical, chemical and microbiological barriers
 - Inflammatory response (Inflammation)
- Adaptive immunity
 - Cytotoxic T cells
 - Humoral antibodies
 - Cytokines
- Memory immunity
 - Specific
 - Fast
 - Strong