Defense &The Immune System

Overview

Immune System Agenda

- The bigger picture
- Non specific defenses
- Specific defenses (Immunity)

Defense & the Immune System

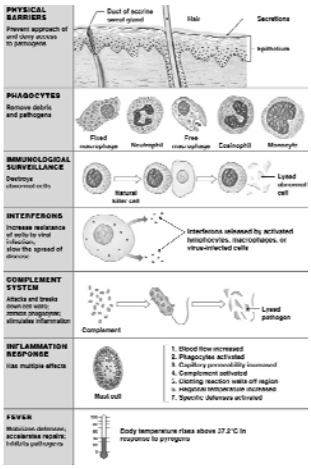
Big Picture

- Defense
  - Any means of preventing or destroying disease causing agents
  - May be non-specific or specific defenses (immunity)
- Immune system provides
  - Specific Protection against foreign material (bacteria, viruses, toxins, cells…)
  - How?
    - By constantly surveying tissues for things that don't belong
      - Foreign cells, dead cells, viruses, bacteria, toxins
    - How do the surveyors know?
      - By constantly comparing a known pattern of surface markers to newly encountered items.
      - When surface markers don't match… immune system is activated

Non-Specific Defense

- Goal is to
  - prevent the entrance of disease causing agents and destroy those that may have entered the body tissues
- Accomplished by
  - Physical barriers
    - Skin, mucous membranes, ciliated epithelium, tears, gastric juices
  - Non-specific defenses in blood
    - Interferons
      - intercellular chemical signals from infected cells
    - Complement
      - Proteins which cause destruction of bacteria
    - Natural Killer cells
      - destroy abnormal or foreign cells
    - Phagocytes
      - ingest and digest foreign material
    - Mast cells
      - release histamine
    - Fever
      - Decreases hospitality of the host for the invader

Non-Specific Defenses



Specific Defenses (Immunity)

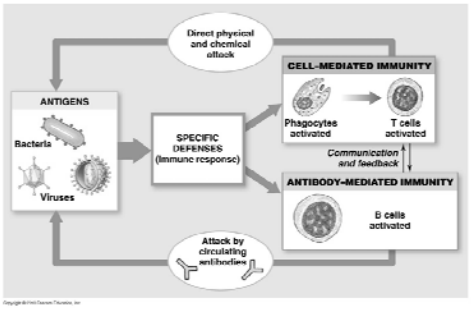
- What makes this defense specific?
  - the production or use of antibodies or T cells that are "grown" specifically for an antigen
    - Defense cells involved in immunity are
      - B cells (antibody mediated), when activated produce
        - » plasma cells
          - produce antibodies
        - » memory cells
          - create long term immunity
      - T cells (cell mediated), when activated produce
        - » produce T killer (cytotoxic) cells – to destroy
        - » Produce T helper cells – to help out in the activation process
        - » produce memory T cells long term immunity

Specific Defenses (Immunity)

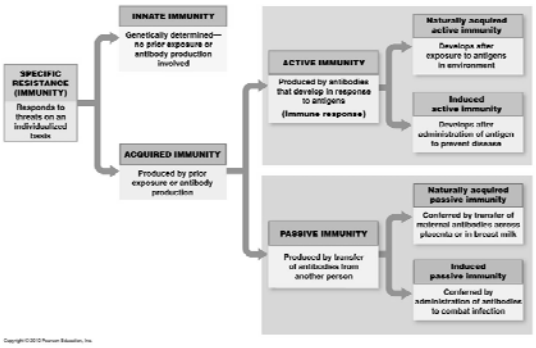
- Immunity may be
  1. Innate – genetic basis
  2. Acquired - may be
     a. Actively
        - Naturally
          - » Obtained the disease on your own from your environment
          - » Made your own antibodies or T cells for that disease agent
        - Induced
          - » Where given an injection of dead agents
          - » Made your own antibodies or T cells for that disease agent
     b. Passively – Transfer of antibodies from another individual
        - Naturally
          - » From mother through placenta or breast milk
        - Induced
          - » Given an injection of antibodies

Specific Defenses (Immunity)

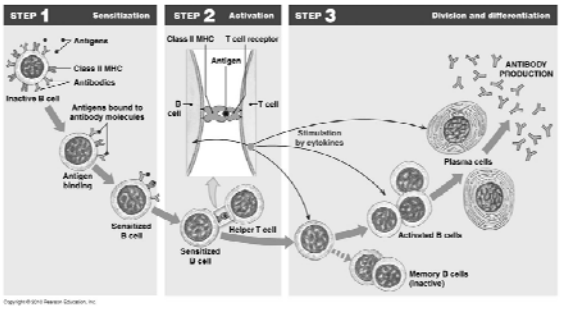
- The differences between B and T cells



Specific Defenses (Immunity)

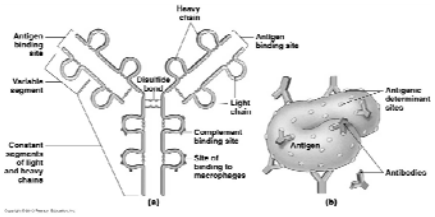


B Cell (Antibody Mediated) Defense



B Cell (Antibody Mediated) Defense

- What are antibodies?
  - Antibodies (Ab's) are proteins (immunoglobulins)
    - Have variable regions which can be made to fit nearly an endless variety of shapes



B Cell (Antibody Mediated) Defense

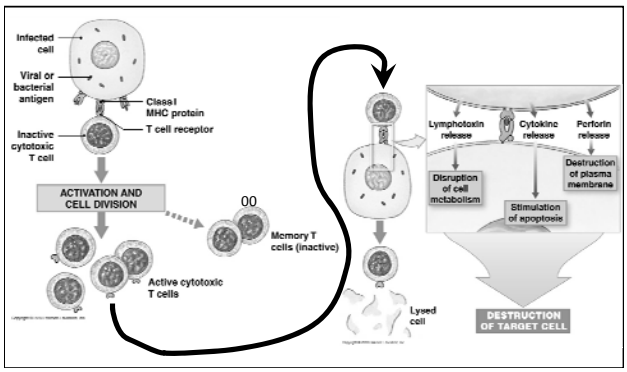
- Classes & Forms of Antibodies

IgA	Found in mucosal areas, such as the gut, respiratory tract and urogenital tract, and prevents colonization by pathogens. Also found in saliva, tears, and breast milk.
IgD	Functions mainly as an antigen receptor on B cells that have not been exposed to antigens. It has been shown to activate basophils and mast cells to produce antimicrobial factors.
IgE	Binds to allergens and triggers histamine release from mast cells, eosinophils and basophils, and is involved in allergy. Also protects against parasitic worms.
IgG	In its four forms, provides the majority of antibody-based immunity against invading pathogens. The only antibody capable of crossing the placenta to give passive immunity to fetus.
IgM	Expressed on the surface of B cells and in a secreted form with very high avidity. Eliminates pathogens in the early stages of B cell mediated (humoral) immunity before there is sufficient IgG.

B Cell (Antibody Mediated) Defense

- What do Antibodies (Ab's) do?
  - Enhance phagocytosis by:
    1. Opsonizing
       - Attaching to antigen to make it easier for phagocytes to engulf
    2. Neutralizing
       - Bind to the antigen and render it non-toxic
    3. Chelating
       - Coating smaller antigens, making them insoluble
    4. Agglutinating
       - Clumping together to ease phagocytosis
  - Play a role in the non-specific complement pathway

T Cell (cell mediated) Defense

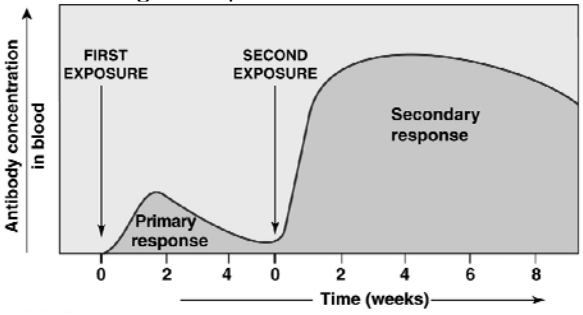


T Cell (cell mediated) Defense

- Type of lymphocyte
- Once activated create cytotoxic T cells or T killer cells that
  - Lyse the cell using perforins
  - Chemically induce cell death
  - Interfere with cellular metabolic pathways

What is the benefit of antibody or cell mediated immunity?

- It's all about the next time the antigen show's its' foreign little parts!



Cytokines

all purpose chemical messengers

TABLE 14-2 Examples of Cytokines of the Immune Response

COMPOUND	FUNCTIONS
INTERLEUKINS	
IL-1	Stimulates T cells to produce IL-2, promotes inflammation, causes fever; stimulates the secreting cell in a positive feedback loop that recruits more immune cells
IL-2, -12	Stimulate T cells and NK cells; stimulate the secreting cell in a positive feedback loop that recruits more immune cells
IL-3	Stimulates production of mast cells and other blood cells
IL-4, -5, -6, -7, -10, -11	Promote differentiation and growth of B cells, and stimulate plasma cell formation and antibody production
IL-8	Stimulates blood vessel formation
IL-15	Suppresses production of several cytokines (IL-1, IL-8, TNF)
INTERFERONS	Activate other cells to prevent viral entry and replication, stimulate NK cells and macrophages
TUMOR NECROSIS FACTORS (TNFs)	Kill tumor cells, slow tumor growth, stimulate activities of T cells and eosinophils, inhibit parasites and viruses
PHAGOCYTIC REGULATORS	
Monocyte-chemotactic factor (MCF)	Attracts monocytes, transforms them into macrophages
Migration-inhibitory factor (MIF)	Prevents macrophage migration from the area
COLONY-STIMULATING FACTORS (CSFs)	Stimulate RBC and WBC production
M-CSF	Stimulates production of monocytes
GM-CSF	Stimulates production of both granulocytes (neutrophils, eosinophils, and basophils) and monocytes
Multi-CSF	Stimulates production of granulocytes, monocytes, and RBCs