Biology 1002: Final Exam Learning Objectives

Chapter 36: Defenses Against Diseases

1. **Understand the three major lines of defense against disease that vertebrates have, and be able to give examples of each.**
    - **Microbes-**
        - Include bacteria, protists, and fungi; and viruses
    - **Pathogens-**
        - A microbe that causes a disease
    - **Three Major Lines of Defense Against Diseases that Vertebrates Have:**
        - Nonspecific External barriers
            - Prevent most pathogens from entering the body
            - Includes skin and cilia, and secretions such as tears, saliva, and mucus
        - Nonspecific Internal Defenses
            - If the external barriers are breached, a variety of nonspecific internal defenses swing into action
            - Include:
                - White blood cells, which engulf foreign particles or destroy infected cells
                - Chemicals released by damaged cells and proteins released by white blood cells that trigger inflammation and fever
            - These operate regardless of the nature of the invader, neutralizing the threat
        - Specific Internal Defenses
            - The final line of defense is the **Adaptive Immune Response**, in which immune cells <u>selectively</u> destroy specific invading microbes and toxins and then remember the invader
            - This allows for a rapid response to the invader if it reappears in the future

2. **Understand Table 36-2, and be able to explain the role of each of these cell types in immunity.**
    - **Types of Cells and their Functions:**
        - **Neutrophils-**
            - White blood cells that engulf invading microbes
        - **Dendritic Cells-**
            - White blood cells that engulf invading microbes and present antigens to lymphocytes
        - **Macrophages-**
            - White blood cells that engulf invading microbes and present antigens to lymphocytes
        - **Natural Killer Cells-**
            - White blood cells that destroy infected or cancerous cells
        - **Mast Cells-**
            - Connective tissue cells that release histamine; important in the inflammatory response

- **B Cells:**
  - White blood cells that produce antibodies
  - **Memory B Cells-**
    - Offspring of B cells that provide future immunity against invasion by the same antigen
  - **Plasma Cells-**
    - Offspring of B cells that secrete antibodies into the bloodstream
- **T Cells:**
  - White blood cells that regulate the immune response or kill infected cells or cancerous cells
  - **Cytotoxic T Cells-**
    - T cells that destroy infected body cells or cancerous cells
  - **Helper T Cells-**
    - T cells that stimulate immune responses by both B cells and cytotoxic T cells
  - **Memory T Cells-**
    - Offspring of cytotoxic or helper T cells that provide future immunity against invasion by the same antigen
  - **Regulatory T Cells-**
    - T cells that suppress immune attack against the body's own cells and molecules; important in preventing autoimmune diseases

3. Understand how the mucous membranes are able to protect your body against microbes.

- **How the Mucous Membranes Protect the Body Against Microbes:**
  - Antimicrobial secretions, mucus, and ciliary action defend the mucous membranes against microbes.
    - Mucous membrane secretions trap microbes entering the nose or mouth
    - They contain antibacterial proteins, including lysozyme, which kills bacteria by digesting their cell walls, and defensin, which makes holes in bacterial plasma membranes
    - Cilia on the membranes sweep up the mucus, so it is swallowed, coughed or sneezed out of the body
    - If swallowed, microbes enter the stomach, where protein-digesting enzymes and extreme acidity is lethal to them
    - In the urinary tract, the slight acidity of urine inhibits bacterial growth. This is why urine is said to be sterile.
    - Tears, urination, diarrhea, and vomiting all help to expel invaders
    - Despite these defenses, many disease-causing microbes enter the body through mucous membranes or through cuts in the skin

4. Understand the 3 categories of the innate immune response.

- **The 3 Categories of Innate Immune Response:**
  - **White blood cells**, also called **Leukocytes or Phagocytes-**
    - Destroy invading cells or the body's own cells if they have been infected by viruses

- **The Inflammatory Response-**
  - Recruits leukocytes to the site of a wound and seals off the injured area, isolating the infected tissue from the rest of the body
- **Fever**
  - Is produces when microbes cause a major infection in the body, which both slows down microbial reproduction and enhances the body's own fighting abilities

5. Understand the role of MHC proteins in the immune response.

- **Role of MHC Proteins in the Immune Response**
  - Natural killer cells are another type of leukocyte, which strike primarily at the body's own cells that have become cancerous or have been invaded by viruses
    - The surfaces of normal body cells display proteins of the major histocompatibility complex (MHC), identifying the cells as "self"
    - Natural killer cells kill any "nonself" cells they encounter by releasing proteins that bore holes in the infected or cancerous cell's membranes and then secrete enzymes through the holes that kill the infected cells

6. Be able to explain what happens during the inflammatory response.

- **Inflammatory Response:**
  - The inflammatory response attracts phagocytes to injured or infected tissue and causes tissue to become warm, red, swollen, and painful
  - This defense mechanism has several functions:
    - It attracts phagocytes to infected or injured tissue
    - It promotes blood clotting
    - It initiates protective behavior by causing pain
- **The inflammatory response begins when damaged cells release chemicals that cause certain cells in the connective tissue, called Mast Cells, to release Histamine**
  - Histamine relaxes the smooth muscle surrounding arterioles, increasing blood flow and causing capillary walls to become leaky
  - Other chemicals released by the wounded cells, mast cells, and by the microbes themselves attract macrophages, neutrophils, and dendritic cells
    - These cells consume bacteria, dirt, and cellular debris
    - In some cases, pus, a thick, whitish mixture of dead bacteria, tissue debris, and white blood cells, may accumulate
  - Other chemicals released by injured cells initiate blood clotting to reduce blood loss and prevent more microbes from entering the blood stream

7. Understand how fever is initiated and what role it plays in the immune response.

- **Fever Combats Large-Scale Infections:**
  - The human thermostat, located in the hypothalamus of the brain is set at 97-99°F