Chapter 31: Defense Against Diseases: The Immune Response

How Does a Body Defend Against Invasion?

**Barriers (1st Line of Defense):**
- Prevent microbes from entering body
  1) **Skin:**
     - In hospitable environment:
       - Dry, nutrient-free zone
       - Sweat/oil gland secretions (antibiotics)
     - Skin sloughed off
  2) **Mucous Membranes** (digestive, respiratory, urogenital tracts):
     - Secrete mucus (traps microbes):
       - Antibacterial enzymes
     - Cilia sweep up mucus (swallowed)

**Non-specific Internal Defenses (2nd Line of Defense):**
- Attack wide variety of microbes that penetrate barriers
  1) **Phagocytic Cells** (leukocytes):
     - Macrophages ("big eaters")
       - Ingest microbes via phagocytosis
     - Natural Killer Cells
       - Attack virus-infected / cancer cells
  2) **Inflammation** ("to set on fire")
     - Wounded region → red, swollen and warm:
       - Damaged cells 1) release histamine ('leaky vessels'-swelling)
       - initiate blood clotting
     - 3) attract macrophages (Clean area)
  3) **Fever** (↑ body temperature)
     - Combats large-scale infections
     - Function: 1) increases macrophage activity
               2) slows bacterial reproduction

**Specific Immune Response (3rd Line of Defense):**
- Complex attack against specific target (organism / toxin)
- **Immune System:** Cells / molecules that work together to combat the microbial invasion
- Key Players (leukocytes: lymphocytes):
  - **B cells** = Mark / inactivate foreign invaders in blood
  - **T cells** = Destroy foreign invaders in cells
- Table 31-1 (Overview of cell types...)

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Chapter 31: Immune System

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Chapter 31: Immune System

Fundamental Steps in Immune Response:
1) Immune system must recognize invader...
   - **Antigen**: Molecule located on cell surface which triggers an immune response.
   - B cells produce **antibodies** which recognize antigens
     - Antibody structure:
     - Y-shaped
     - Antigen binding site
     - High specificity

2) Immune system must launch attack...
   A) **Humoral Immunity** (B cells / circulating antibodies):
      (1) B cell antibody receptor binds antigen
      (2) Activated B cell divides rapidly (clonal selection):
          (a) Memory cells (Future immunity)
          (b) Plasma cells: \( \uparrow \) antibodies (released into blood)
      (3) Antibodies destroy invaders:
          - Inactivate invader (binding)
          - Cause invaders to clump together
          - Coat invaders with blood proteins \( \uparrow \) leukocyte activity (phagocytosis)

   B) **Cell-mediated Immunity** (T cells):
      - Attacks invaders (viruses, cancers) after they enter body cells
        (1) **Cytotoxic T cells**:
            - Release proteins \( \rightarrow \) disrupt plasma membrane
        (2) **Helper T cells**:
            - Stimulate immune cells (via chemicals)
            - Destroyed by AIDS virus
        (3) **Suppressor T cells**:
            - Activated following infection; shut down B / T cells
        (4) **Memory T cells**:
            - Protect body against future invasion

Why doesn’t our immune system destroy our own cells?
Answer: **Major Histocompatibility Complex (MHC)**:
- Unique set of proteins / polysaccharides
- Identify “self” cells
- Act as antigens in other individual’s bodies
Chapter 31: Immune System

Medical Care Augments Immune Response:
1) **Antibiotics**: Slow down microbial reproduction (not viruses)
   • Problem: Antibiotic resistant strains
2) **Vaccinations**: Injection of killed microbes to confer immunity
   • Stimulates development of memory cells

Malfunctions of Immune System:
1) **Allergies**: Adverse reaction to harmless substances
   • B cells recognize substance as antigen (histamine release)
     ➢ **Anaphylactic Shock**
2) **Autoimmune Disease**: Body mistakes own cells as invaders
   ➢ **Diabetes mellitus (Type I)**: Destruction of pancreatic cells
   ➢ **Multiple Sclerosis**: Destruction of neuron insulation (myelin)