The Immune System

- Immune System
  the system that fights infection by producing cells to inactivate foreign substances to avoid infection and disease.

- Immunity
  the body's ability to fight infection through the production of antibodies by inactivating foreign substances.

2 Types of Defense Mechanisms

- Nonspecific Defenses
  • 1st & 2nd line defenses
    - Can not discriminate between invaders.

- Specific Defenses
  • 3rd line defense
    - Specific defenses for specific pathogens.

Barriers to Defend Our Body From Pathogens

3 Lines of Defense

1st line defense
2nd line defense
3rd line defense

Lines of Defense

- 1st line of defense
  - Consists of barriers against invasion.
  Ex: wall around a castle

- 2nd line of defense
  - Chemicals and cells that attack pathogens that get past the first "wall".

- 3rd line of defense
  - Targets specific pathogens.
  - Responsible for identifying and remembering to attack the same pathogens in the future.
  Ex: soldiers
The 1st Line Defense

**Physical Barrier**
- Skin
- Cilia

**Chemical Barrier**
- Sweat & oil glands
- Saliva
- Tears
- Stomach acid/enzymes

2nd Line Defense: Barriers

- Pathogens invade the 2nd line of defense.

2nd Line of Defense Includes:

1. White blood cells destroy pathogens
2. Inflammatory response
3. Specialized proteins

1. WBCs (leukocytes)

WBCs Attack!!!! White blood cell destroy pathogens.
- Travel the bloodstream, lymphatic system, and interstitial fluid attacking invaders.
- Macrophages & Neutrophils are WBCs – Attack pathogens through phagocytosis.

Destroying The Pathogen

Natural Killer cells (NK cells)
- DO NOT directly kill by phagocytosis.
- NK cells RECOGNIZE & LYSE (break) infected cells or cancer cells by poking holes in the cell’s membrane.
2. Inflammatory Response

1. Injury to skin
2. **Mast cells** secrete **histamine**, which dilate blood vessels to increase blood flow to site.
3. **Plasma** leaks into the vessels & enter the infected tissue. Causes **swelling**-becomes painful
4. This body reaction is called an **Inflammatory Response**
   (swelling, redness, warmth, and pain)

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Injured Site & Inflammatory Response

- **Skin surface**
- **Bacteria**
- **Mast cell releasing histamine**
- **Blood vessel**
- **Swelling**
- **Plasma**
- **Cells**

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Inflammatory Response

>(>37.2 C or 99 F)

- A **fever** occurs when a pathogens travel the blood & the whole body responds.

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Specialized Proteins

3. Specialized Proteins: **Interferon**

- Interferons are made from infected healthy cell.
- The cell becomes an **antivirus** –(a cell against a virus) to fight the virus.
- “interfere” prevent the virus from replicating (multiplying).
- Slows down progress of infection and allows immune system to respond.

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3rd Line of Defense: Targeted Defense

- Activated when the other 2 lines of defense did not work.
- **Antibodies** produced by the immune system.
- The immune system recognizes, destroys, and “remembers” each foreign invader.
Antigens
“antibody generating molecule”
- Mostly made of proteins
- Specific proteins on pathogen’s surface that cause (trigger) an immune response.
- 3D shape of bumps and knobs → MARKERS

Antibodies (proteins that help destroy pathogens)
- Y – shaped proteins free-floating in blood to attach to antigens.
- Antigens bind at the Y tips.
- Y tips have different shapes (like keys).
- Made by B lymphocytes.

A specific antibody attaches to a specific antigen.

Antibodies have a “Y” shape.

Two Types of Lymphocytes (WBC)

B LYMPHOCYTES
(Humoral immunity)
- Made in bone marrow & matures then released.
- Attacks invading pathogens (bacteria and viruses).
- Produce memory B cells & plasma cells. Plasma cells produce antibodies for second exposure to antigen.

T LYMPHOCYTES
(Cell-mediate immunity)
- Made in bone marrow, mature in thymus gland, & released.
- Attaches cells infected with bacteria, viruses, fungi, protists, & cancerous cells.
- Helper T cells stimulate memory T cells & killer T cells. Killer T-cells destroy.

Location: center of chest, behind breastbone.
Handout: Diagram

Humoral Immunity

Lymphocyte/ Antibodies Animation

Humoral Immune Response

- Antigen molecules
- Activated B cells grow, divide, and develop into plasma cells.
- Clone of many plasma cells secretes antibodies.
- Specific antibody molecules secreted by plasma cells.

Cell Mediated Response

- Virus infects cell
- Infected cell is killed by cytoxic T cell by activation of nuclease that cleaves host and viral DNA.

2 Types of Immune Response

1. Primary Immune Response
   - First 5 days, no large amount of antibodies are present.
   - Next 10-15 days, antibodies increase.

2. Secondary Immune Response
   - A faster immune response occurs, if exposed to same antigen in the future.
   - Antibodies attack antigen within 1-2 days after infection.
Types of Immune Response

Why Could People Who Receive Organs Reject Them?

Organ Transplants

- Transplanted organs have protein markers on surface & immune system recognizes to be foreign!!!!!!
- Killer T cells want to attack!!!!!!
- So doctors look for donors that have similar cell markers to reduce chance of organ rejection.
- Patients are on drugs for life to prevent organ rejection.

As of February 2nd, 2012……..

Waiting list candidates- 112,838

As of January 11, 2011……..

Waiting list candidates- 110,179

- Donors Jan. – Oct. ’10: 12,088

http://www.organdonor.gov/