IMMUNE SYSTEM

Biology 2201
What is a disease?

- Other than an injury, any change in the body that interferes with the normal functioning of the body.
Two Types of Diseases

- **Non-infectious**
  - often called *functional diseases*,
  - Caused when an organ does not function properly anymore
  - Examples:
    - cancer, heart disease

- **Infectious**
  - Caused by a pathogen or disease-causing agent
    - Viruses, bacteria, fungi, prions
  - Are often contagious
  - Examples:
    - Influenza, measles, AIDS, STI’s
Non-specific Defenses

- These are your first line of defense against pathogens.
- They guard against all foreign organisms and not just any one specific organism.
- Two types of non-specific defenses:
  - Chemical barriers & physical barriers
  - Inflammatory response
Physical and Chemical Barriers

- Physical Defenses
  - skin
  - membrane linings
  - Cilia

- Chemical Defenses
  - Sweat and oils
  - saliva
  - stomach acid
  - urine
  - tears
  - Mucus
  - Interferons *
Inflammatory Response

- It is a reaction that causes redness, swelling, pain, and warmth in the area of infection.
- Cells damaged by the infection release chemicals, that causes an increase in blood flow to the infected area.
- This results in white blood cells called phagocytes being transported to the site of the infection.
- The phagocytes ingest the pathogens and damaged tissue, resulting in the formation of pus.
- This usually kills the pathogen, but sometimes the infection gets to the lymphatic system and causes the lymph nodes to swell.
Inflammatory Response

- If the infection is serious, it results in the formation of more phagocytes.

- If this does not finish the infection, chemicals are released that increase the body temperature causing a fever.

- A fever serves two major purposes:
  - kills microorganisms that cannot survive the higher temperature
  - slows down microorganisms, giving the white blood cells a chance to destroy them

http://faculty.riohondo.edu/rbethel/videos/micro_inflammation.swf
Interferons

- Recall that viruses infect host cells by taking over their metabolic and reproductive functions in order to replicate virus particles.
- Interferons are substances produced by cells that have been infected by a virus.
- It causes non-infected cells to produce an enzyme that blocks reproduction of the virus.
  - This slows the replication of the virus.
Non-Specific vs. Specific Defenses

1st line: Skin, mucous membranes, chemicals

2nd line: Phagocytosis, complement, interferon, inflammation, fever

Specific defenses

3rd line: Lymphocytes, antibodies
Specific Defenses

- If the pathogen gets past the non-specific defenses, it will encounter the specific defenses.
- At this stage the immune system begins to work.
- It provides the body with the ability to fight infection through the production of antibodies or cells that inactivate foreign substances or cells.
Ready, Aim, FIRE!

- The immune system includes all parts of the body that are involved in the recognition and destruction of foreign materials.
- The basis of immunity lies in the body’s ability to distinguish between its own substances (self) and foreign substances (non-self).
- Any foreign substance that triggers a specific defense response is called an antigen.
All about antigens

- Usually protein, but can be carbohydrates, lipids or nucleic acids located on the surface of bacteria, viruses and other pathogens

- Antigens trigger a response against foreign substances identified as non-self

- The response to an antigen is called an immune response
Types of Immunity

**Active Immunity**
- The body produces its own antibodies to attack a specific antigen.
- Long lasting
- It develops in two ways:
  - when a person had the disease
  - by vaccination of a weakened or milder form of the pathogen

**Passive Immunity**
- This is “borrowed” immunity
- The person is given antibodies from another person or animal who has been infected by the antigen.
- Temporary, lasting only 30 days, but faster acting than the active immunity response
The immune response can result in problems with organ transplants. The body recognizes transplanted organs as foreign (non-self), and tries to fight them as if they were a pathogen. The result would be the destruction of the transplanted organ. This is controlled in two ways:

- Donor and recipient are closely matched
- Recipient is given drugs to suppress the immune system
Two Categories of Immune Response
T Cell Reaction vs. B Cell Reaction

1. Pathogen (Antigen) enters body

2. Macrophage ingests antigen and displays a form of antigen on its cell membrane

3. T cell recognizes antigen

4. Helper T cell recognizes antigen displayed by macrophage

5. T cell stimulated to divide by helper T cell to form killer T cells and memory T cells

6. Killer T cells bind to virus-infected cells

7. If antigen enters body again, memory T cells divide to produce new killer T cells

3. B cell recognizes antigen

5. B cell stimulated to divide by helper T cell to form plasma cells and memory B cells

6. Plasma cells produce antibodies that bind to antigen

7. If antigen enters body again, memory B cells divide to produce new plasma cells
# Types of Immune Responses

<table>
<thead>
<tr>
<th>Primary Immune Response</th>
<th>Secondary Immune Response</th>
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<tr>
<td>- This occurs when an antigen enters the body for the first time.</td>
<td>- This occurs if an antigen that has entered the body before</td>
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<td>- It takes 5 days for the body to recognize the antigen and start production of antibodies.</td>
<td>- Same pathogen enters a second time.</td>
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<td>- It takes another 10 to 15 days for the antibodies to build up.</td>
<td>- There is a shorter response time of only 1 to 2 days for antibody production</td>
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<td>- Most likely will get sick for a time</td>
<td>- May or may not get sick depending on the pathogen</td>
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AIDS – Acquired Immune Deficiency Syndrome

- The cause of AIDS is a virus called the human immunodeficiency virus – HIV
- The virus attacks the helper T cells of the immune system.
- The virus enters the T cell and remains within the cells for months or even years without producing symptoms
AIDS’ Disturbing Properties

- It is able to mutate giving it the ability to produce different strains.
  - HIV-1; 1981, HIV-2; 1985
  - Dozens of subtypes worldwide for each strain

- It causes change in the cell membrane of the T cell causing them to fuse together.
  - This allows the virus to pass from cell to cell without entering the bloodstream and becoming exposed to antibodies present in the blood
What’s more?

- When HIV becomes active, the individual develops AIDS. The virus reproduces, spreads, and destroys helper T cells. The T cells become a HIV factory.

- Some possible triggers for HIV activation are:
  - other co-infections
  - contain a gene like a ticking time bomb

- The decrease in helper T cells weakens the immune system. The body loses its ability to fight disease and becomes susceptible to opportunistic infections and malignancies
Spread of AIDS

- Sexually transmitted
- Blood-to-blood contact
- Mother to fetus during pregnancy or at the time of birth
- In rare cases through breast milk

FIGHT AIDS, NOT IRAQ
Prevention of AIDS

- Abstinence from sexual activity
- Use of a latex condom, plus spermicide nonoxynol-9
- Avoid sharing of needles during of intravenous drug use