Overview of the Immune System

https://www.youtube.com/watch?v=G7rQuFZxVQQ
Structure related to function

- White blood cells (leukocytes) are found throughout the body in the thymus, lymphoid organs, and spleen
- White blood cells are small enough to travel through the bloodstream to the site of infection
- The white blood cells are spread out all over the body to prevent foreign invaders from spreading
- Spleen is a flattened organ that allows the immune system cells to gather and complete the work necessary
- Structure is related to function - stopping foreign invaders and infection throughout the body!
Major Organs

Mucous Membrane - Shield body from pathogens
Tonsils - Activate immune system (in close contact with outside)
Lymph Nodes - Drainage system
Thymus - Helps kill pathogens
Spleen - Stores defense cells
Bowel - Contains cells that produce antibodies, cleanses body from pathogens
Bone Marrow - Produces blood cells (white blood cells fight infection)
Skin - Protective shield against pathogens (barrier)
Homeostasis

- The Immune System fights infection and disease, trying to keep the body healthy.
- Helps in the healing process by creating a fever and increasing blood flow to bring immune cells to the site of harm.
- When a person is under severe stress, the immune system is impaired
  - Decreases or stops certain hormones: the growth hormone, thyroid hormones
  - More susceptible to infections
Innate vs. Acquired

<table>
<thead>
<tr>
<th>Innate immunity</th>
<th>Adaptive immunity</th>
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<tbody>
<tr>
<td>• general protection (not antigen-specific)</td>
<td>• highly specific for a particular pathogen (antigen-specific)</td>
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<td>• early phase of host response to pathogens without requiring prior exposure</td>
<td>• late phase response of antigen-specific lymphocytes to antigens</td>
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<td>• immediate maximal response</td>
<td>• lag time between exposure and maximal response</td>
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<td>• does not alter on repeated exposure (no immunological memory)</td>
<td>• improves with each successive exposure (immunological memory)</td>
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<tr>
<td>* (rapid, non-specific, no memory)</td>
<td>* (slower, specific, diverse, memory)</td>
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- Innate immunity: General protection that all humans are born with
  - No prior exposure to the invaders is needed
- Adaptive immunity: After a pathogen is exposed to the body, the antibodies remain present so to not let the invader attack again
  - Very, very specific to the kind of pathogen
Evolution and Development

- Acquired Immunity evolves throughout a person’s lifetime by creating more and more immunities to various illnesses that the body is exposed to.
- Innate Immunity has roots in the amoeba (organism in pond water), which is seen as the earliest form of a macrophage due to the fact that it feeds on micro-organisms.
- As an embryo:
  - Stem cells of the immune system are in the spleen and liver.
- As a child:
  - Lymphocytes develop tolerance in the thymus and bone marrow, and then populate other lymphoid tissues.
  - T and B cells come in contact with their antigens and complete their development as mature immune cells.
- As an adult:
  - With old age immune system deteriorates, more susceptible to infections, cancer, and other diseases.
- The ability of our adaptive immune system to recognize foreign substances is determined by genetics.
Recognition and Response

- Animals use receptors from the innate and acquired immunity to detect foreign cells.
- The immune system tags the antigens so the body can recognize what is a foreign invader and what is not.
- As discussed in the next couple of slides, the process of the immune system relies heavily on the tagging of the invaders as to destroy later by other cells.
All of the cells involved come from the spleen, thymus, or lymphoid organs. All of the cells have a very distinct purpose in hoping to stop the attack of foreign invaders or infection.
White blood cells are the main part of the immune system:
- 5 types of white blood cells present:
  - Phagocytes: cells that destroy invading organisms
    - Neutrophil is the most common type: fights bacteria and is the first cell to arrive at the site of infection
    - Macrophages: type of neutrophil that acts as a scavenger to worn out cells
  - Basophils: defend against parasites
  - Eosinophils: defend against parasites
  - Mast cells: regulate the inflammatory response
  - Natural Killer Cells: attack and destroy tumors
- Antibodies help the adaptive immune system so to prevent the same invader from attacking again
Process of immune system

- Process by which foreign invaders are eliminated and prevents future attack
- This is why you only get sick from the same virus/bacteria once, because of the antibodies produced from the immune system
- However, there are so many bacteria viruses that are unfamiliar to your body - you can always get sick.
Interdependence between other systems

- If damage is done to another body system caused by harmful actions, the immune system is greatly affected.
  - Ex: Smoking causes damage to lungs, but also destroys the macrophages of the immune system that act as scavengers
- Immune system contains many cells that need to be transported to the site of infection rapidly through the bloodstream (circulatory system)
  - Without this ability, the immune system would be unable to stop foreign invaders from spreading
- The immune system fights infection through its own cells but it is very reliant on other body systems to properly function.
Disorders (Problems)

1. Immunodeficiency Disorder- part of the immune system does not work properly  
   a. Can be by birth (primary) or actions (acquired)
2. Autoimmune Disorder- body’s immune system attacks its own tissue or cells
3. Allergic Disorder- Overreaction to exposure to antigens in the environment
4. Cancers- cells of the immune system grow uncontrollably
Treatments

- Many specific treatments depending on the disorder or allergy
- Immunodeficiency
  - Antibiotics and Antibody replacement
- Autoimmune
  - Immunosuppressive medicines
- Allergies
  - Avoidance
  - Nasal sprays
  - Eye drops
  - EpiPen
- Cancer
  - Radiation- uses high energy waves to kill cancer cells
  - Chemotherapy- uses medications and drugs to treat
  - Surgery- removing the cancerous cells through an operation
Hepatitis

hepatitis is inflammation of the liver and is most often caused by a virus
Causes:
Hepatitis A - ingestion of fecal matter or contaminated food or drinks
Hepatitis B - Infectious blood, semen, other fluids from sex, and dirty needles
Hepatitis C - Infectious blood normally through needles used for drugs
Hepatitis D - Infectious blood similar to HBV
Hepatitis E - Ingestion of fecal matter normally through water supplies
Symptoms- Diarrhea, fatigue, loss of appetite, vomiting, weight loss
Treatment- Hepatitis b, c, d, and e can be treated by a doctor, Hepatitis A has no treatment but will normally go away fairly quickly
Syphilis

Syphilis is a bacterial infection usually spread by sexual contact.

Primary syphilis - a small sore that will heal in 6 weeks.

Secondary syphilis - After the sore some get a rash.

Latent syphilis - if not treated symptoms will go away in the latent stage leading to the tertiary stage.

Tertiary syphilis - Disease may cause damage to brain, eyes, or other organs after the years in the latent stage.
Immunity in Plants

- No circulatory system to carry cells to the site of infection
  - cells must be able to independently respond
- May respond to pathogens by cell wall thickening or host cell death
  - Many pathogens feed on living tissue
- Plants have no adaptive immunity
  - Immune System is in their genes, if the plant does not have resistance mechanisms against a pathogen, it will