**Why It Matters**

* Our bodily defense mechanisms fall into two categories
  + Keeping germs out of the body (the skin’s job)
  + Fight the germs once they get inside the body (job of the immune system)
* Two deadly diseases that have been entirely or almost entirely eradicated from the world due to vaccinations are:
  + Smallpox
  + Polio

**What We Know**

* Structure and Function of the Skin
  + Skin is the first line of defense for the body and is part of the integumentary system.
  + Name four properties of skin:
    - Creates mechanical barrier
    - Has several layers of cells, packed together
    - Has an outer layer of dead and dying cells
    - Has an inner layer of regenerating cells
    - Contains nerve endings and modified neuronal cells that register pain, cold, heat, and pressure
    - Contains blood vessels, especially in the innermost parts
* Immune and Lymphatic Systems
  + When a foreign invader is detected in the body, the immune and lymphatic systems are activated.
  + The defense cells that are mobilized in the blood and lymph vessels are called white blood cells and include cells called lymphocytes.
  + Lymphocytes are developed in the lymph nodes which are connected together by lymph vessels that together make up the lymphatic system.
* White Blood Cells
  + The most abundant white blood cell is the neutrophil which is active during bacterial infections. They “eat” bacteria and other foreign invaders through a process called phagocytosis.
  + Lymphocytes are another type of white blood cell that comes in a B-type and T-type
    - Killer T-cells or cytotoxic T-cells kill/destroy cells infected with viruses or cancer by releasing cytotoxins to prevent the infection of healthy cells.
    - T-cells are made in the thymus.
  + B-cells make circulating antibodies. The B-type lymphocytes are made in the bone marrow and mature in the lymph nodes.
    - A B-cell is activated by an antigen binding to the antibody receptor or by receiving signals from other immune cells.
    - After being activated, B-cells turn into memory B-cells, which stay in the body to respond to repeat infections, and plasma cells which secrete antibodies into the blood to inactivate antigens.
* What is an Antibody?
  + Antibodies are Y-shaped proteins that are specific to a multitude of potential antigens.
  + When antibodies bind to their antigen, like proteins or other substances from bacteria, fungi, or viruses, they inactivate them.
* Invaders!
  + Substances that cause an immune response are called antigens.
  + The body recognizes proteins on its own cells but if something is recognized as foreign, then the immune system makes antibodies to attach to and inactivate the foreign bodies.
  + Antibodies can circulate in the blood or found anchored to other cells.
* Fighting the Invaders!
  + Two approaches the immune system has to attacking an invader are
    - Ingestion or phagocytosis by migrating cells like macrophages and neutrophils
    - Binding and inactivation by antibodies
* There are two Types of Immunity
  + An organism is born with innate immunity.
    - Name three components of the innate immune system
      * Skin
      * Mucous membranes
      * neutrophils/macrophages/eosinophils, basophils/monocytes/natural killer cells
    - The innate immune system responds quickly and non-specifically
  + Acquired/adaptive immunity is developed after exposure to an antigen.
    - The cells and proteins it produces can change and adapt to fight a given invader more effectively.
    - Acquired immunity is slower to act than innate immunity, but is much more efficient.
    - There are two types of acquired immunity:
      * Active immunity - develops after exposure to an antigen such as following infection or vaccination, and can last for years.
      * Passive immunity - develops after receiving antibodies or other immune system components from another organism that has active immunity such as through mother’s milk or an injection/infusion. This immunity does not last very long.

**How We Know**

* The First Line of Defense: Skin
  + To examine skin under a microscope, certain steps must be completed:
    - The sample must be sliced very thin so that it is translucent.
    - The sample must be placed on a microscope slide.
    - The skin must be stained with a dye to make the cell parts visible.
  + What kind of substances are absorbed into the skin?
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The Second Line of Defense: The Immune System
  + In the past some diseases have affected/killed some but not others.
* Oh no, Zits!
  + What makes some zits white?
    - White blood cells that are attracted to wounds and foreign invaders.
* Studying White Blood Cells
  + The components of blood are separated for studying by an instrument called a centrifuge.
* Vaccines
  + The goal in vaccine manufacturing is to make the infectious organism weak enough so that it won’t cause the disease but strong enough that it will activate the body’s immune system.
  + Once the immune system is activated by a disease agent, antibodies are produced to fight the disease and are specific to that particular infectious agent.
  + While the original antibodies eventually go away, the adaptive immune system has a memory to fight off the same disease later on.

**Common Hazards**

* Sunburn
  + The sun radiates ultraviolet light.
  + The skin has a protective pigment called melanin that turns brown when struck by the sun’s rays.
  + If the sun gives off more rays than the body can handle, then this will cause a sunburn.
  + The redness of a sunburn is caused by increased blood flow.
    - Damage to cell membranes causes histamine and bradykinin to be released which causes blood vessels to dilate.
  + The pain and soreness or a sunburn is due to inflammatory processes to try to heal the body.
  + Being in the sun too much can cause DNA mutations and eventually skin cancer.
    - Skin cancer is the most common cancer in the U.S. and worldwide
  + SPF or sun protection factor tells how long you will be protected for based on how long you can normally stay in the sun before burning.
    - If you can normally stay in the sun for 10 minutes how long would SPF 15 sunscreen protect you?
      * 150 minutes or 2.5 hours
  + Skin tone corresponds to the amount of melanin in the skin. Light-skinned people have less melanin and are (more/less) likely to develop melanoma than dark-skinned people.
* HIV/AIDS
  + HIV stands for human immunodeficiency virus
    - There is currently no vaccine for HIV
  + AIDS stands for acquired immunodeficiency syndrome
    - There is currently no cure for AIDS
  + AIDS is a syndrome/disease caused by HIV.
  + HIV attacks T-cells which causes their numbers to drop and weakens the immune system. If this goes untreated, it can lead to AIDS.
  + What are the three routes HIV can be spread by:
    - Sexual intercourse or other sexual activities
    - Contact with blood
    - Mother-to-child
  + It can take 3 months for HIV to be detectable by blood test.
  + AIDS doesn’t directly cause death, but opportunistic diseases like cancer and pneumonia that wouldn’t affect someone with a functioning immune system do.
  + While there is no cure or vaccine for HIV/AIDS at this time, it can be managed with antiretroviral therapy (ART). This helps prevent the virus from spreading between and destroying T-cells.