

The Human Immune System

What is the immune system?

- The body's defense against disease causing organisms, malfunctioning cells, and foreign particles → Dust, pollen, pet hair

★ The First Line of Defense (non-specific) - ~Skin~

- The dead, outer layer of skin, known as the epidermis, forms a shield against invaders and secretes chemicals that kill potential invaders. You shed between 40 - 50 thousand skin cells every day! → Sweat, Acid, Normal Flora (Good bacteria)

★ The First Line of Defense ~Mucus and Cilia~

- As you breathe in, foreign particles and bacteria bump into mucus throughout your respiratory system and become stuck
- Hair-like structures called cilia sweep this mucus into the throat for coughing or swallowing.

★ The First Line of Defense ~Saliva and Stomach acid~ → Acid → Kills things

- What's the first thing you do when you cut your finger? → Saliva has proteins and enzymes that can kill bacteria/viruses. **NOT ALWAYS**
- Saliva contains many chemicals that break down bacteria
- Thousands of different types of bacteria can survive these chemicals; however, swallowed bacteria are broken down by incredibly strong acids in the stomach that break down your food
- The stomach must produce a coating of special mucus or this acid would eat through the stomach!

Escherichia coli (E.coli) is common and plentiful in all of our digestive tracts. Why are we all not sick? *Bec. its' good Bacteria*

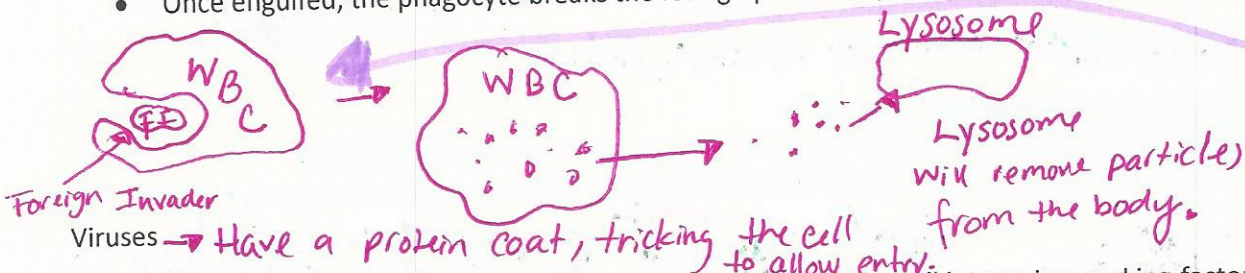
- These bacteria are technically outside the body and aid in digesting material we cannot
- Only if E.Coli are introduced in an unnatural manner can they break through the first line of defense and harm us

Makes up our Normal Flora

The Second Line of Defense (Non-specific) ~White Blood Cells~ Some are called Phagocytes → Eat foreign invaders

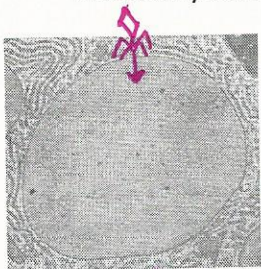
Pimples + Appendicitis

- If invaders actually get within the body, then your white blood cells (WBCs) begin their attack
- WBCs normally circulate throughout the blood, but will enter the body's tissues if invaders are detected
- Phagocytes - These white blood cells are responsible for eating foreign particles by engulfing them
- Once engulfed, the phagocyte breaks the foreign particles apart in organelles called Lysosomes.

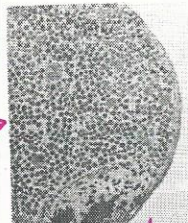


Viruses → Have a protein coat, tricking the cell to allow entry.

- Viruses enter body cells, hijack their organelles, and turn the cell into a virus making-factory. The cell will eventually burst, releasing thousands of viruses to infect new cells.



Normal unaffected cell



Infected cell w/ multiplying viruses



Releases all the viruses

Our immune system will kill the virus

- Have eradicated or severely limited several diseases from the face of the Earth, such as polio and smallpox ↓

How long does active immunity last? It depends on the antigen. Some disease-causing bacteria multiply into new forms that our body doesn't recognize, requiring annual vaccinations, like the flu shot: Booster shot - reminds the immune system of the antigen. Others last for a lifetime, such as chicken pox.

Think the flu is no big deal?? Think again...

In 1918, a particularly deadly strain of flu, called the Spanish Influenza, spread across the globe. It infected 20% of the human population and killed 5%, which came out to be about 100 million people dying from this flu.

- ★ 2. Passive Immunity - You don't produce the antibodies -Happens to babies!
 - A mother will pass immunities on to her baby during pregnancy - through the placenta
 - These antibodies will protect the baby for a short period of time, following birth while its immune system develops, this is done through the Thymus gland., and lasts until antibodies die.
 - Taken about 10 months

Immune Disorders ~Allergies~

- Immune system mistakenly recognizes harmless foreign particles as serious threats, launches immune response, which causes sneezing, runny nose, and watery eyes. Anti-histamines block effect of histamines and bring relief to allergy sufferers.
 - ↑ Allergy meds

Acquired Immune Deficiency Syndrome (AIDS) ^{2nd}

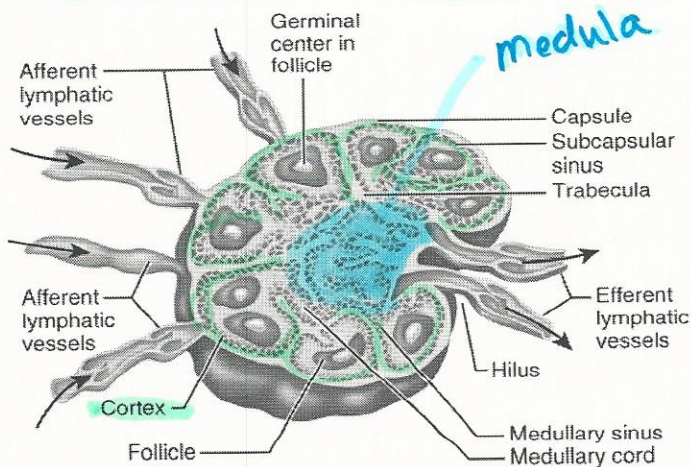
Caused by the Human Immunodeficiency Virus, Discovered in 1983, Specifically targets and kills T-cells, Because normal body cells are unaffected, immune response is not launched.

The HIV virus doesn't kill you – it cripples your immune system. With your immune system shut down, common diseases that your immune system normally could defeat become life-threatening. Can show no effects for several months all the way up to 10 years.

Transmitted by sexual contact, blood transfusions, contaminated needles. As of 2007, it affects an estimated 33.2 million people

Lymph Nodes (Lymphatic System)

- The medulla houses Macrophages that engulf and destroy foreign substances.
- The cortex nurtures lymphocytes, which provide immune response to antigens



(a)

*** The Second Line of Defense ~Interferon~**

- Virus-infected body cells release interferon when an invasion occurs
- Interferon – chemical that interferes with the ability to viruses to attack other body cells, Interferon binds to neighboring cells and stimulates these cells to produce antiviral proteins which can prevent viral replication in these cells.

White Blood Cells ~T-Cells~

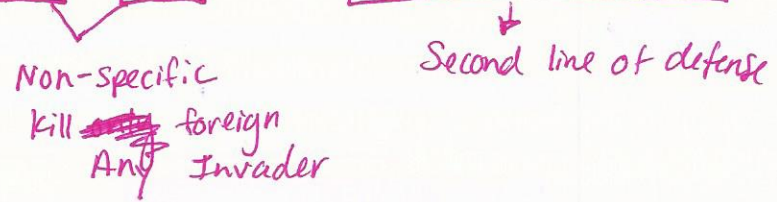
- 3rd**
- T-Cells, often called “natural killer” cells, recognize infected human cells and cancer cells
 - T-cells will attack these infected cells, quickly kill them, and then continue to search for more cells to kill

*** The Second Line of Defense ~The Inflammatory Response~**

- Injured body cells release chemicals called histamines, which begin inflammatory response
- Capillaries dilate *original size → Dilated Capillary*
- Pyrogens released, reach hypothalamus, and temperature rises
- Pain receptors activate
- WBCs flock to infected area like sharks to blood *(macrophages & phagocytes)*

Two Divisions of the Immune System

- The efforts of the WBCs known as *Eaters* phagocytes and T-cells is called the **cell-mediated immune system.**
- Protective factor = living cells
- Phagocytes – eat invaders
- T-cells – kill invaders



3rd The other half of the immune system is called antibody-mediated immunity, meaning that is controlled by antibodies. This represents the third line of defense in the immune system. *(Specific Immunity)* **Antigen**

*** The Third Line of Defense ~Antibodies~ → Looking for specific Antigen**

- WBCs gobble up invading particles and break them up
- They show the particle pieces to T-cells, who identify the pieces and find specific B-cells to help
- B-cells produce antibodies that are equipped to find that specific piece on a new particle and attach



New particles take longer to identify, and a person remains ill until a new antibody can be crafted. Old particles are quickly recognized, and a person may never become ill from that invader again. This person is now immune.

*** 1. Active Immunity - You produce the antibodies → Against a foreign Antigen**

- Resistance to a disease-causing organism or harmful substance - Two types:
- Your body has been exposed to the antigen in the past either through:
- Exposure to the actual disease causing antigen – You fought it, you won, you remember it *make Antibodies*
- Planned exposure to a form of the antigen that has been killed or weakened – You detected it, eliminated it, and remember it.
- Vaccines: Antigens are deliberately introduced into the immune system to produce immunity → you have antibodies against the specific Antigen.
- Because the bacteria/virus has been killed or weakened, minimal symptoms occur