Immune System

How your body goes to war to keep you well
WATCH OUT!

● Millions of bacteria and viruses are everywhere. Many aim to find a host and invade the body.

● HOW CAN WE DEFEND AGAINST IT?
The Bad Guys

- **Viruses**: Nonliving particle. Has genetic material and it literally hacks (hijacks) your cells and makes them reproduce. They cannot be killed by antibiotics.
  - Cause the common cold, the flu, HIV, and Ebola.

- **Bacteria**: Are alive and have a built in metabolism, DNA, and can reproduce themselves. They can be killed by antibiotics.
  - Cause pneumonia and food poisoning,

### Bacteria vs. Viruses

**Bacteria**
- Prokaryotic cell
- Most are free-living (some parasitic)
- Relatively large size
- **Antibiotics** used to kill bacteria

**Virus**
- Not a living cell (genes packaged in protein shell)
- Intracellular parasite
- 1/1000 size of bacteria
- **Vaccines** used to prevent viral infection
- Antiviral treatment
3 Stages of DEFENSE!!

1. Nonspecific External Barriers
   - Skin and mucous membranes

2. Innate Immune Response
   - Phagocytic cells, killer cells, fever, inflammation.

3. Adaptive Immune Response
   - Cell-mediated Immunity, Humoral Immunity
1. Skin and Mucus

SKIN: Acts as a great wall. Bacteria and viruses cannot pass through it. Also contains sweat and oil which carry built-in antibiotics.

MUCUS: Contains lysosomes (enzymes that destroy cell walls of bacteria).

- The flow of mucus washes away many harmful pathogens or captures them and dumps them in the stomach
2. Innate Immune Response

Phagocytes: A term that describes several kinds of white blood cells that literally hunt down and destroy invaders.

- **Neutrophil**: The most abundant phagocyte. They eat and they explode. Pus is dead neutrophils.
- **Macrophages**: Less common. HUGE. Roam around (free) or stay in one place (fixed) and eat bad guys.
2. Inflammation (SOUND THE ALARM)

- Mast cells trigger the release of HISTAMINE when an injury occurs.
- Fluid collects around an injury (swelling) and it traps and dilutes the toxins coming in.
- Temperatures could rise and this may cause the microbes that are sensitive to higher temperatures to die off.
- Phagocytes are drawn to histamine and flood in to kill...
1. Tissue damage carries bacteria into wound.
2. Wounded cells release chemicals that stimulate mast cells.
3. Mast cells release histamine.
4. Histamine increases capillary blood flow and permeability.
5. Phagocytes leave capillaries and ingest bacteria and dead cells.
FEVER

- Works in the same way inflammation works
- Increases temperature across the entire body and destroys temperature sensitives pathogens
- It is one of the ways your body can kill some kinds of viruses
3. Specific Defense (the rest of the slides)

- Specific defenses give immunity to specific disease
- Makes a chemical “memory” of the virus or bacteria by marking it. When it is encountered again, the body reacts incredibly fast to instantly kill it.
- This is how vaccines work (e.g. chicken pox).
1. **Antibody**: A signaling (marker) protein that immune cells produce. They tag on to foreign invaders and mark them for destruction, block them, and cause their destruction to occur rapidly.

2. **Antigen**: On almost everything. Antibodies recognize antigens as either good or bad. If it is bad, an immune response is initiated.
Antibodies and Antigens

Antibodies are like a key that only binds to one kind of antigen. Antibodies either float around the blood as free antibodies or are attached to B or T cells.

One B or T cell could have numerous antibodies attached to it.

When a bad antigen binds to an antibody (either on a B cell or floating free), the key “turns” and unlocks a full scale immune response.
B Cells

- B cells start out with few antibodies but add numerous ones to their collection as they get older.

- B cells produce antibodies. If one B cell antibody collides with a foreign antigen, they rapidly clone themselves and make MANY other B cells specific for that one bad antigen.
Memory and Effector B Cells

After B cell division these B cells can become one of two things...

1. **Memory B Cells**: Stay alive for a very long time and reproduce themselves. They are designed to recognize the same bad antigen in the future if it invades again.

2. **Effector B Cells**: Produce millions upon millions of free antibodies for that specific pathogen. Those free antibodies block the binding sites to prevent the pathogen from causing problems and also mark it for death.
T CELLS

1. **Helper T Cells**: Also have special receptors for recognizing antigens. If they find a antigen, they release *cytokines* which trigger B cell replication. They are the main “ALARM” for the specific defense system.

2. **Killer T cells**: Roam around like assassins looking for antigens that were marked by a free roaming antibody. When it finds it, it stabs the pathogen and injects it with an enzyme that destroys it from the inside out.
   - Also can kill cells infected with viruses and cancer! All healthy cells have a protein on its surface called MHC1. Cancer cells and infected cells loose this. No MHC1 = death by killer T cell.

- People with AIDS cannot produce T cells!