

Virus, Bacteria, and Pathogens

Pathogens are infectious agents that cause disease. Outbreaks of disease can cause significant declines in populations.

Disease is a **density dependent factor** because increases in population size can increase the risk of pathogen transmission. For example, measles is **virus** that was once thought to be eradicated in the United States. Measles is one of the most contagious diseases and can cause a rash, high fever, blindness, inflammation of the brain, and death.

In the 1960s and 1970s, the production and distribution of a measles **vaccination** virtually wiped out the disease. However, with an increasing number of unvaccinated individuals in the United States, measles has made a comeback, especially in young children. Measles has a 90% infectious rate, meaning that 90% of the individuals exposed to the virus, will most likely become infected.

Unfortunately, those who unable to get vaccinated due to medical concerns, such as young age, chemotherapy patients, and those allergic to albumin (use to manufacture the measles vaccination), are at risk due to individuals refusing to become vaccinated. This has led to the loss or decline of “herd immunity” which keeps diseases in check through scheduled vaccinations (see <https://www.youtube.com/watch?v=UqKP-ETVvrc>).

The human immune system works to fight off pathogens by producing antibodies in a two-step manner:

1) **T-cells**

- a. Act as the memory of the immune system
- b. Recognizes invaders
- c. Sends a signal to B-cell to “tell” them to make antibodies

2) **B-cells**

- a. Makes antibodies
- b. Antibodies attack invaders

Both T-cells and B-cells are specialized cells resulting from the **differentiation** of **stem cells** located in the bone stem cell niche.

Another type cell that is used to fight off foreign invaders and is a part of the human immune system are called **neutrophils**. Neutrophils use **pseudopods** and **phagocytosis** to surround and devour invaders (think **amoeba!**). Neutrophils are also differentiated from stem cells in the bone stem cell niche.

Long-term vaccinations, like the measles vaccination, shorten the response time of our immune system by giving our immune system a “memory” of the pathogen. These are an example of **active immunity**.

Active immunity results from the development of antibodies in response to the presence of an **antigen**, and includes long-term vaccinations or exposure to an infectious agent (pathogen).

Short-term vaccinations, like the influenza vaccine, are forms of **passive immunity**. Passive immunity is the immunity produced by the transfer of antibodies that were produced by another person. Protection from passive immunity is active over a short period of time. Another example of passive immunity is that from the mother to a baby before birth. Because antibodies are transferred directly into the individual, the body’s immune system is not activated.

Pathogens can include:

1. Viruses

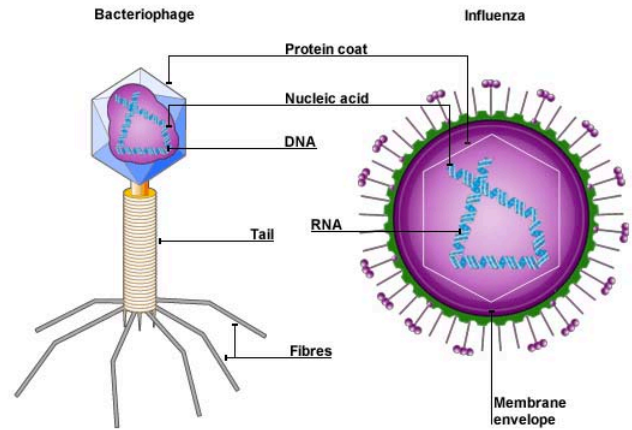
****Vaccines work by stimulating our immune system by producing antibodies (beat up foreign substances in our body) without actually infecting us with the disease. They trigger the immune system to produce its own antibodies, as though the body has been infected with the disease.**

****Types of viruses ***there are a lot more types than this!******

-**Bacteriophage**: infects bacteria

-**Retrovirus**: RNA virus uses reverse transcription (RNA → DNA → incorporated into host's DNA) to reproduce.

- a. **Influenza**. Ex. Spanish Flu—1918-1920 during WWI. 50-million to 100-million died (3-5% of human population). H1N1 in 2009—a subtype of the Spanish Flu. Vaccinations were given in large number and advances in medicine allowed the death toll to be limited to 18,000.
- b. **HIV** (Human immunodeficiency virus)—Originated in Africa most likely in the 1950s through the use of primates as bushmeat. Thought to be first transmitted to humans by a mutated version of SIV from wild chimpanzees. The United States medical community first recognized HIV in the early 1980s—safe sex was encouraged to prevent the spread of HIV which causes AIDS. However, HIV transmission in many African countries has not decreased because safe sex is not endorsed.



VIRUSES ARE MOST BENEFICIAL IF THEY ALLOW THE HOST TO SURVIVE BECAUSE IT ALLOWS THE VIRUSES TO SURVIVE.

2. Bacteria: **PROKARYOTES**—simple, yet effective! Most bacteria are GOOD or NEUTRAL, but some are pathogenic!
 - a. **Tuberculosis (TB)**
 - Infects lungs—coughing up mucus and blood, chest pain, fever
 - Also, called consumption
 - Easily transmitted in tight communities (prisons)
 - Antibiotics were successful in treating tuberculosis until recently.
 - Misuse of antibiotics allowed the strongest bacteria to SURVIVE, REPRODUCE, and PASS ON THEIR RESISTANCE to offspring. (NATURAL SELECTION!). Called ANTIBIOTIC RESISTANCE.
 - b. **MRSA**
 - Staph infection that is antibiotic resistant and most likely infects the respiratory tract or open wounds.
 - Most common in gyms, locker rooms, hospitals, and prisons.
 - NATURAL SELECTION!!!
3. **Fungus**
 - a. Athlete's foot
 - b. **Dutch Elm Disease**
 - Fungus from Asia spread by beetles
 - Causes elm trees to die from nutrient deficiency because the elm tree's own defenses blocks the spread of the disease by plugging up its own vascular tissue (xylem and phloem).
4. **Protists**
 - a. **Pfiesteria**
 - Dinoflagellate (algae) creates neurotoxin (nerve toxic)—algal blooms called RED TIDE
 - Large fish kills in coastal areas (first identified off of NC coast)
 - Red tide warnings on coast to protect swimmers
5. Prions
 - a. Infections proteins cause brain to have “holes” in it or a sponge like appearance. “Bad” or misfolded proteins influence other proteins.
 - b. Long incubation period
 - c. Neurological symptoms—shaking, headaches, loss of speech and movement, and death
 - d. Can infect humans
 - i. Mad cow disease – eating tainted beef
 - ii. Chronic wasting disease – eating or coming in contact with tainted deer or elk meat or neurological tissue
 - iii. Kuru – Papua New Guinea cannibalism of dead members of tribe (woman and children most likely affected because they are left to consume brain tissue).
 - iv. Familial insomnia disorder –genetic disorder
6. Viroids
 - a. Smallest infectious agents composed of only RNA
 - b. Infects mostly plants—especially chloroplasts and mitochondria
 - c. Does not code for a protein