The Evolution Of Diseases: Viruses, Bacteria, And Immunity

The immune system is a military, waiting for the perfect time to strike and win their fight against their sworn enemies, viruses and bacteria. This isn't just a metaphor, this actually happens in real life. Our immune system fights viruses and bacteria in order to keep us healthy and safe. This essay will look into how the immune system functions, about viruses and bacteria, and why the immune system sometimes fails to protect us.

The immune system is "a collection of structures and processes within the body" (Zimmermann) that help protect us from bacteria, viruses, fungi, and toxins. The immune system is split into two types, the innate immune system and adaptive immune system. The innate immune system is the immune system that we are born with. It serves as the first line of defense against pathogens that attack the body. The parts that make up the innate immune system are the skin, stomach acid, enzymes found in tears and skin oils, mucus and the cough reflex. It also consists of a few chemicals which are called interferon and interleukin-1. When the system identifies an invader, it immediately goes into action. The cells that are a part of this immune system surround the invader and engulf it, causing it to die inside the cells. However, if the innate immune system fails to eliminate the invader, the adaptive immune system steps in. The adaptive system is the second line of defence. A main component of the adaptive immune system are lymphocytes. Lymphocytes start off their life in the bone marrow. As they mature, they either stay in the bone marrow and become B cells, or they go in the thymus and become T cells. T cells are split into two groups, Helper T cells and Killer T cells. Helper T cells help destroy infected cells and determine what type of immune response the body should make to a specific pathogen. Killer T cells kill cells that are infected or damaged. B cells create antibodies that help to get rid of the invader that has entered the body. Antibodies are Y-shaped proteins produced by the immune system which stop invaders from harming the body. After getting rid of the invader, the body remembers these antibodies. Remembering antibodies helps the body get rid of the same invader more efficiently. As we grow and experience many different invaders, our body creates a library full of antibodies and different types of pathogens. This is called immunity.

Our immune system protects us from invaders such as bacteria and viruses. But what are bacteria and viruses? Bacteria are single-celled organisms that can be found all around us. Us humans have trillions of bacteria in our bodies. These are friendly bacteria that help with some bodily functions like digestion. Bacteria are living things. They are made up of porous cell walls and a plasma membrane. Inside the cell, we can find many different materials like proteins, fats, carbohydrates, DNA, and water. There are also many biochemical processes that go on in the bacteria at all times which happen under the control of the cell's DNA. All of these cause the bacteria to be alive. So, since bacteria are alive, that means that they are able to eat, reproduce, and be killed. These are some of the reasons why bacteria are classified as living organisms. On the other hand, viruses are non-living. Viruses are fractions of DNA or RNA wrapped in a protective coat. Thay are much smaller and much more simple than bacteria. Until a virus bumps into a host cell, they remain non-living. Without a host cell, viruses have no protoplasm and no plasma membrane. They don't have ongoing metabolic processes, they don't eat food, they don't starve, they don't expel waste, and they don't reproduce on their own.

But, once a virus finds a host cell, it takes it over and it starts to reproduce. After taking over the host cell, the virus is able to reproduce, eat, and get killed. This means that viruses are living, but only if they take over a host cell. Otherwise, they are non-living.

So, since we have this complex immune system protecting us from bacteria and viruses, why do we still get sick? Well, the answer is simple. Bacteria and viruses have the ability to mutate over time. Bacteria evolve by becoming resistant to antibiotics. Using antibiotics helps the immune system fight off the bacteria that have entered the body. However, if the antibiotics are misused, this can cause trouble. If antibiotics are misused bacteria may evolve and become resistant. First, bacteria can evolve by changing their cell wall, not letting the antibiotics penetrate it. Second, bacteria can make enzymes that destroy the antibiotics before they can work. Finally, bacteria can eject the antibiotics before they are able to exert any effect. This is called antibiotic resistance. Like bacteria, viruses can also mutate. There are two ways that viruses can evolve, through antigenic drift or antigenic shift. Antigenic drift is a small change that happens in the genes of the virus. This type of mutation causes small changes in the surface proteins of the virus called hemagglutinin and neuraminidase. Hemagglutinin and neuraminidase are antigens which when recognised by the immune system trigger an immune response. When an antigenic drift occurs the immune system cannot recognise these new antigens, an immune response is not triggered and the immune system is not able to protect us. That’s why flu vaccines have to be reviewed and updated every year in order to keep up with the virus’s constant change. Antigenic shift is a lot more different and a lot more serious than antigenic drift. Antigenic shift causes a major change in the virus, creating new hemagglutinin and neuraminidase proteins. This mutation happens when a virus that affects animals becomes able to affect humans too. This may cause the animal virus to combine with the human virus to create a totally new virus with new antigens. If this happens, the immune system may not be able to fight off this new virus. Antigenic shift can also cause pandemics, while antigenic drifts can’t. These pandemics are very similar to the one that we are in now.

When one considers the complex structure of the immune system and the amazing ability of viruses and bacteria to evolve, we can see why sometimes the immune system fails to protect us. At the moment, we all live in the time of a global pandemic where over 400,000 people have died from coronavirus. Scientists are assuming that the coronavirus is a result of an antigenic shift, or more precisely a combination of an animal and a human virus. After researching about the immune system and the evolution of viruses and bacteria, I better understand the challenges that the scientists are going through trying to create a vaccine. I deeply respect their effort and I believe that they should be getting more recognition. They really are our heroes!