HUMANS ARE REPEATEDLY EXPOSED to various disease-causing organisms known as pathogens, including viruses and bacteria, which pose a threat to their health. The body defends itself against these foreign invaders using an incredibly complex network of cells, molecules, tissues, and organs, which together make up the immune system.

The two key categories of defenses the immune system uses to combat pathogens include innate and adaptive. The innate immune responses are the first responders against an invading virus, acting within hours. These responses are not specific, as neither the pathogen is a cell itself or the response will be broad enough to stop the infection. Innate immune responses don’t always clear an infection, instead they help control the virus and then the adaptive immune responses take days to weeks to actually get rid of the pathogen, especially if the innate immune response is not sufficient. The adaptive immune responses are orchestrated by two main classes of cells: B cells, which produce antibodies, and T cells, which coordinate cellular immune responses.

B cells and T cells recognize the same pathogens, but they respond differently. Whereas B cells produce antibodies that neutralize the pathogen, T cells recruit and activate other immune cells and help direct their activity.

HOW HIV INTERACTS WITH THE IMMUNE SYSTEM

1. To establish an infection, HIV first encounters the mucosal barrier, the body’s first line of defense. Once across, the virus infects T cells. This is particularly detrimental because T cells orchestrate the adaptive immune responses, helping to activate B cells that produce antibodies, and CD4+ T cells that produce cytokines.

2. The adaptive immune responses are orchestrated by two main classes of cells: B cells, which produce antibodies, and T cells, which coordinate cellular immune responses.

3. B cells recognize the HIV antigen on the surface of infected cells and produce antibodies that neutralize the virus. If these antibodies are ineffective, the virus may enter the lymph nodes. This triggers cellular immune responses.

4. CD4+ T cells recognize the same virus antigens, but they respond by producing cytokines that activate other immune cells, such as macrophages and dendritic cells.

5. Macrophages and dendritic cells then present the virus antigens to CD4+ T cells, which then produce cytokines that activate other immune cells, such as B cells and natural killer cells.

6. Natural killer cells recognize and destroy HIV-infected cells.

CURRENT STRATEGIES IN AIDS VACCINE RESEARCH

Vaccines are a highly effective way to train the immune system to combat pathogens. Scientists have been working on creating vaccines for the novel coronavirus since the concept of vaccination was discovered. Researchers are currently exploring multiple strategies to develop an effective AIDS vaccine.

1. To generate an immune response against HIV, a vaccine must contain a component of HIV that is able to stimulate the immune system. This component is called an immunogen.

2. One strategy is to use a viral or bacterial vector to deliver the HIV antigen to the immune system. This approach is called a prime-boost strategy.

3. Another approach is to use an HIV protein as an immunogen. Viral and bacterial carriers are known as vectors.

4. Researchers have also studied different ways of introducing harmless pieces of the virus known as immunogens. For example, researchers have used DNA vaccines, which are made up of genes from the virus that are able to stimulate the immune system to produce antibodies against HIV.

5. In addition, researchers have also explored the use of artificial immune cells, such as dendritic cells, to deliver the HIV antigen to the immune system.

6. The goal of these strategies is to induce a strong immune response against HIV, which will help prevent the virus from infecting more cells and spreading in the body.