

How Vaccines Work

By Sophia Marjanovic

Most of us build up immunity to the majority of microbes and substances through breastfeeding before our adaptive immune system is mature enough to protect us, such as before a baby is eight weeks old.

The reason that babies get vaccinations eight weeks after birth is because the human adaptive immune system is then generally mature enough to create responses to foreign substances. When one gets vaccinated, or even gets a cut or crack in their skin (which is one of the largest immune organs of our bodies), there is a type of white blood cell called dendritic cells that immediately engulfs/swallows the foreign microbe or substance.

Much like our stomachs have an acidic environment which breaks down what we eat, the dendritic cells have a digestive system that uses acid to break up whatever is foreign to our bodies. It then presents the fragments of the broken-up foreign substance on the surface of the dendritic cell. The dendritic cell then travels to the lymph nodes to present what is foreign to our bodies to another type of white blood cell, known as T cells.

T cells have extremely diverse patterns on their surfaces that can often uniquely match what the dendritic cell presents on its surface. A portion of the foreign substance is all that is needed for the extreme diversity created from our immune system genes to recognize the foreign substance. This extreme diversity is how our immune system genes keep us as safe as possible within a lifetime.

However, our immune system is not perfect in countering every foreign substance, and that is why we need help from vaccines. Getting a vaccine shot stimulates our immune systems to build up an immune response before actually getting infected by the foreign agents. This helps prevent foreign agents from overwhelming our bodies.

When there is a match between a specific dendritic cell and a specific T cell, the T cell then divides exponentially. These T cells then help to make either T cells that kill virus-infected cells or antibodies to neutralize and remove microbes from our bodies.

Once our immune system cells neutralize and/or remove the virus infected cells or microbes, the T cells die off in a type of cell suicide because the majority of the immune system cells are no longer needed. When the immune system cells do not die off after

an infection, this is what can lead to autoimmunity, i.e. the immune system attacking healthy tissues of the body.

The whole process of recognizing a foreign substance to neutralizing the foreign substance takes about two weeks. This is why a vaccine does not work immediately. In effect, it takes our immune systems at least two weeks to launch an effective response against something foreign to our bodies.

Vaccines help our immune systems generate a faster response to the real infection by making what are known as memory cells. These memory cells help recognize the foreign substance that has already had an immune response launched against it and mobilize T cells against the foreign substance faster than the usual two weeks it takes for the initial immune response.