The world finally has a defense against the SARS-CoV-2 virus, which has claimed the lives of millions and shuffled day-to-day life to the confines of homes, as a vaccine. Several SARS-CoV-2 vaccines exist and are now available to not only frontline workers, but the population at large.

**Making the Journey**

**What is in the vaccines?**

In the case of COVID-19 vaccines, the task for the vaccine developers was to arrest the replication of the SARS-CoV-2 virus without causing harm to the host. This was achieved by delivering the genetic components, which stimulate the body’s immune system to develop immunity against the virus. There are two main categories of vaccines:

- **DNA vaccines** deliver the genetic components to the cell membrane, where they are translated into proteins and processed to stimulate the immune response.
- **RNA vaccines**, such as the one developed by Moderna, deliver genetic components as messenger RNA (mRNA) to the cell to stimulate the immune response.

**What is the difference in the response to the first and second doses?**

During the first dose, the immune system is alerted to the presence of a pathogen, and the body responds with the production of antibodies and memory cells. The immune system also starts forming a cellular memory. The second dose provides a booster effect, as it is like having a memory of the first dose. This is why the second dose is often required to achieve full immunity.

**How does the immune system respond to the vaccine?**

Typically, vaccines are a proof-of-concept of a pathogen that has been killed with adjuvants or genetically modified so it cannot cause disease. The immune system responds to the vaccine in the following ways:

1. **Recognition:** The immune system recognizes the foreign molecule as a threat.
2. **Signal:** The vaccine triggers the immune system to respond.
3. **Response:** The immune system generates a response to the vaccine.
4. **Memory:** The immune system retains the memory of the response to the vaccine.

**How does the cell retrieve the genetic material and make the viral spike protein?**

Adenovirus-based vaccines encode the genetic components to be translated into proteins. Upon entering the cell, the immune system retrieves the genetic material and translates it into viral proteins.

**How does dispersing adaptive immune cells activate the innate immune system?**

Monkeys injected intradermally with vaccine distributed adaptive immune cells that stimulated the innate immune system. This led to the activation of immune cells at the site of infection, which then spread throughout the body, activating a systemic response.

**Looking Forward**

Several SARS-CoV-2 variants have emerged since the development of the initial SARS-CoV-2 and adenovirus vaccines. While a vaccine to the new variant is not needed, there is an ongoing process to develop a vaccine that is effective against all variants. This involves continuous monitoring of the virus and its variants, and adapting the vaccine to include the new genetic components.

**References**