

Study of COVID-19 Vaccines

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Introduction

We have experienced more than a year of COVID and every aspect of our lives has been affected. The entire world has had to adapt to a new way of life. Despite this, we realized that we don't actually know that much about the virus or the vaccines. Because of this, we wanted to focus our honors project on the creation of the vaccines and how they work.

Our research about the vaccines included:

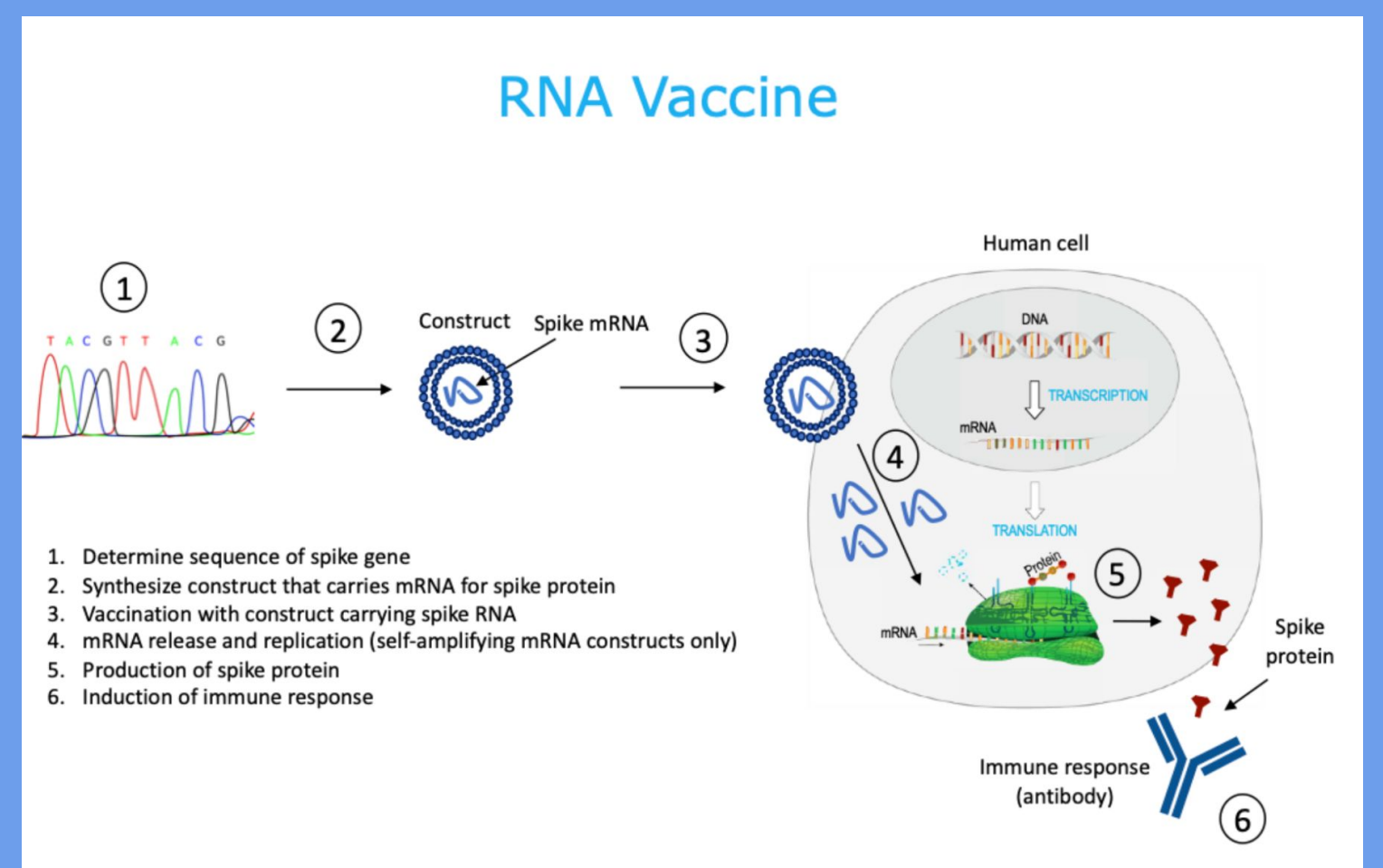
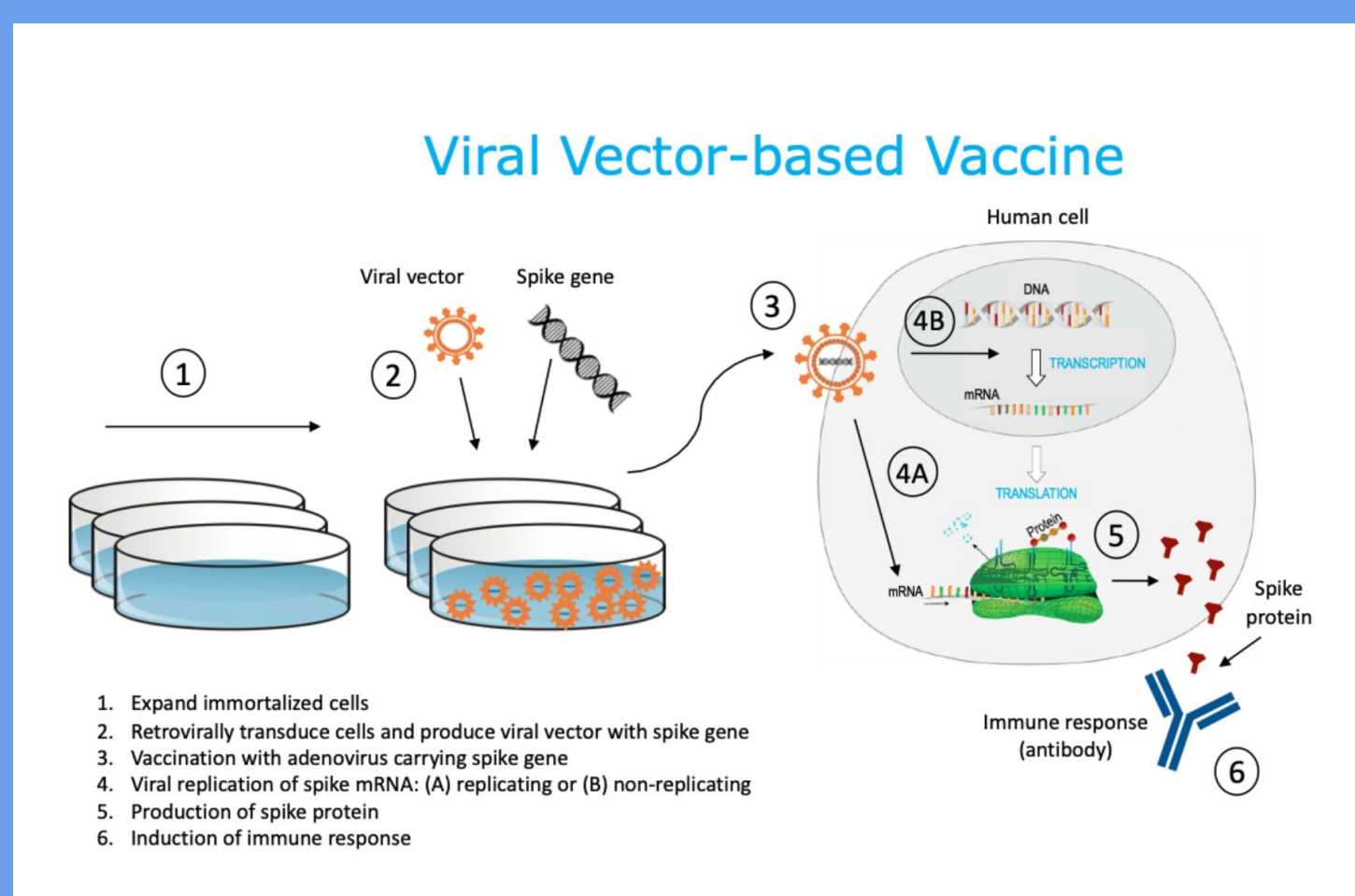
- Pfizer and Moderna (they work similarly):
 - mRNA vaccine
 - mRNA is given to the host cells to stimulate an immune response
 - The cells send the spike proteins that they learned to produce into the bloodstream
 - Body develops antibodies and memory cells
- Johnson & Johnson:
 - Viral Vector-based Vaccine
 - A harmless virus carries the genetic code from the spike proteins to the host cells
 - The cells machinery is used to produce a spike protein which our body knows isn't supposed to be there
 - This triggers an immune response
 - Creates antibodies and memory cells

Questions:

We started off with the core questions:

- How do COVID-19 vaccines work?
- What are the differences between the vaccines?
- How do our bodies respond to the vaccines?

Here are some helpful representations we found that explained the vaccines well. Throughout our process, we could resort back to these if we were confused about what we were learning:



[Link to the website with the visuals](#)

How do the immune system and Immunity work?

- It's a large safeguard to prevent infection, illness, and disease
- Big web made up of cells, tissues, and organs
 - Works together to protect our bodies from anything that could cause illness
 - Depends on defensive white blood cells called Leukocytes
 - Bone marrow → bloodstream → Lymphatic system
 - The lymphatic system is a network of vessels (Lymph Nodes) that help clear body toxins and waste
 - There are 4,000-11,000 leukocytes per microliter of blood
 - Antigens help Leukocytes go through your body and look for harmful "invaders"
 - Antigens are traces that are on the surface of pathogens and foreign substances
 - Leukocytes detect Antigens, and the "protective immune response" comes in to play
 - Leukocytes are classified in two main cellular groups that help our immune response work effectively
 - Phagocytes
 - 1st, the Phagocytes cause the immune response by sending Macrophages and Dendritic cells to the bloodstream
 - This destroys foreign cells they encounter
 - Phagocytes identify the antigen on the foreign cells and transmit this information to Lymphocytes
 - Lymphocytes
 - Causes the defense
 - Groups of Lymphocytes called T-cells search for infected body cells and kill them off
 - The other groups are B-cells which use information from the antigens to produce antibodies
 - This information comes from special "spike" proteins that are in every virus

Sources:

Microbiology Textbook:

<https://openstax.org/details/books/microbiology>

Vaccine Comparison:

<https://www.yalemedicine.org/news/covid-19-vaccine-comparison>

Information on the mRNA Vaccine:

<https://www.houstonmethodist.org/blog/articles/2020/dec/how-an-mrna-covid-19-vaccine-works/>

COVID Vaccine Development:

<https://news.uchicago.edu/story/how-were-researchers-able-develop-covid-19-vaccines-so-quickly>

General Vaccine Information

(Specifically Distribution):

<https://www.cdc.gov/coronavirus/2019-ncov/vaccines/distributing/steps-ensure-safety.html>

Vaccine Production:

<https://lozierinstitute.org/a-visual-aid-to-viral-infection-and-vaccine-production/>

How the Immune System Works:

<https://theremedypfarm.com/how-does-your-immune-system-work/>

Reflection on our learning:

Throughout this project we learned about the importance of spacing out our work and doing thorough research. We knew that in order to gain a strong understanding of the vaccines, we would need to gather a lot of information. We started off by researching the immune system in general. We read parts of the Openstax Microbiology Textbook. Then we looked for articles specific to the COVID vaccines. These included articles on how they work, how they were developed so quickly, and why they are administered into the arm. Our ability to space out this research allowed us to do thorough work and develop a clear understanding of the vaccines.

This will take you to the rest of our research:



"As soon as the genetic sequence of SARS-CoV-2 was posted online in January, three groups began independently working on adenoviral vector vaccines for COVID-19: CanSino Biologics, the University of Oxford, and Johnson & Johnson. All three teams are chock full of vaccine veterans, and their COVID-19 programs have garnered global attention for their scale and speed."

-Ryan Cross's Article, "Adenoviral vectors are the new COVID-19 vaccine front-runners. Can they overcome their checkered past?"