

# COVID-19 VACCINES APPROVED FOR EMERGENCY USE AUTHORIZATION IN THE U.S.

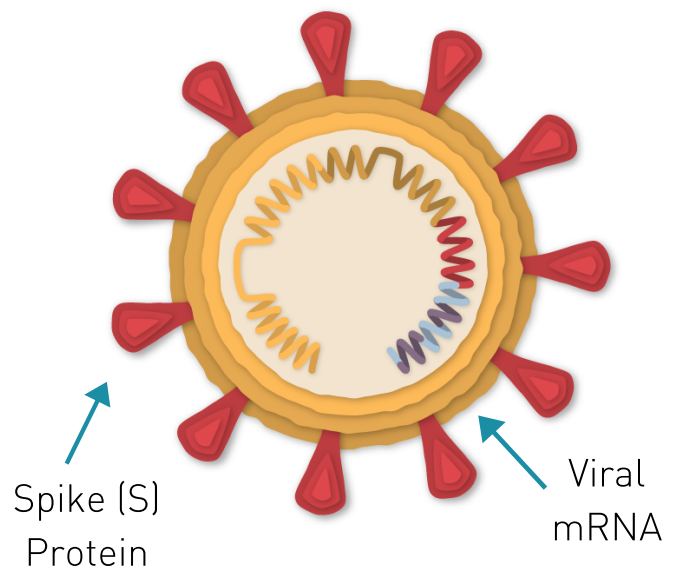


Many vaccines are currently being tested as a tool to combat the COVID-19 pandemic. Here, the vaccines that are currently approved for Emergency Use Authorization (EUA) by the FDA are explained. More information on the vaccine approval process can be found at the [CDC](#). Graphics are from the [New York Times Coronavirus Vaccine Tracker](#).

## The virus that causes COVID-19

- Coronavirus disease (COVID-19) is caused by a newly found coronavirus, SARS-CoV-2. Its structure is a membrane capsule that carries RNA. RNA are the genetic instructions used to make more copies of the virus.
- The outermost shell of the coronavirus is covered in spike (S) proteins, which are like keys that let the coronavirus into human cells to cause infection.
- Many of the vaccines being developed for COVID-19 are aimed at safely exposing the body to the S protein, a small, inactive piece of the virus, but not the virus itself. After exposure, the body can build antibodies that recognize the S protein and can fight off future SARS-CoV-2 infections.

### SARS-CoV-2



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## mRNA Vaccines

## Viral Vector Vaccines

### Efficacy

Pfizer

Moderna

Johnson & Johnson

Preventing death from COVID-19

100%

100%

100%

Preventing severe COVID-19

75%

100%

85%

Preventing all symptomatic COVID-19

95%

94.5%

66%

### Dosage



Two doses,  
3 weeks apart



Two doses,  
4 weeks apart



One dose

All three vaccines are very effective at preventing hospitalizations and deaths from COVID-19. These vaccines are our best tool for ending the pandemic. In accordance with the CDC, individuals should accept the first COVID-19 vaccine that becomes available to them.

Note: Efficacy data is from the [Public Health Collaborative](#).

# How Do mRNA Vaccines Work? (Pfizer & Moderna)

The Pfizer and Moderna vaccines that are currently being used are very similar in design. Both vaccines contain a blueprint for making the S protein in the form of messenger RNA (mRNA).

1

The mRNA vaccines contain instructions on how to build the S protein, which is only one part of the coronavirus. The SARS-CoV-2 coronavirus has about 20 proteins and the S protein is not dangerous on its own. When the body learns how to recognize the S protein, it will be able to recognize this same protein when it is attached to the outside of a real virus in the future.

2

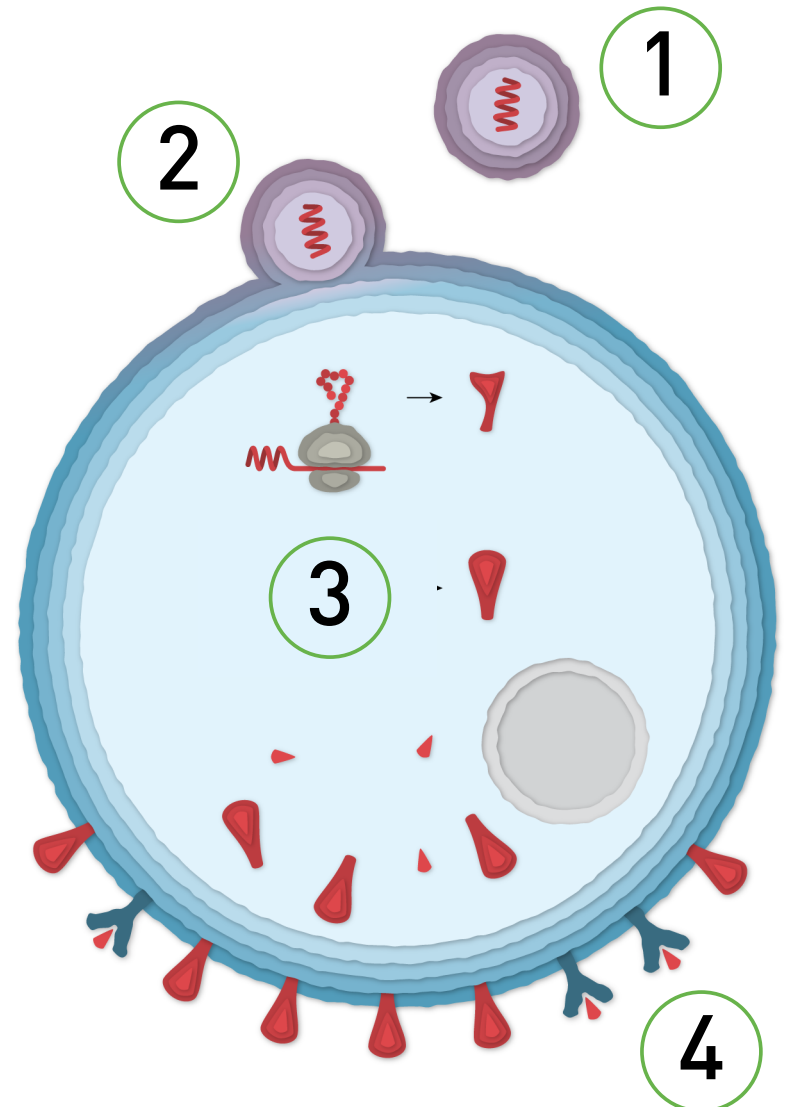
Instructions for the S protein are delivered in a protective capsule to the inside of human cells, where the S protein can be assembled.

3

Inside the cell, the mRNA instructions are read and used to build S proteins.

4

S proteins are transported to the outside of the cell, where they can be detected by the immune system ([see Part 2 below](#)). Meanwhile, the mRNA instructions for the S protein are no longer needed and destroyed by the cell.



# How Do Viral Vector Vaccines Work? (J&J)

The mRNA and viral vector vaccines have the same goal: to expose the immune system to the S protein. The key difference between the mRNA vaccines and the viral vector vaccines is how the instructions for the S protein are delivered into the cell.

1

The viral vector vaccine uses an inactivated version of a type of virus called an adenovirus as a shell to carry instructions for the S protein (much like the membrane shell the mRNA vaccines use). The adenovirus is very similar to the virus that causes the common cold, but when inactivated, it cannot replicate in the body or cause illness.

2

The inactivated adenovirus carries the instructions for the S protein into the cell in the form of DNA. Because DNA is more stable than RNA, these vaccines can be stored at warmer temperatures.

3

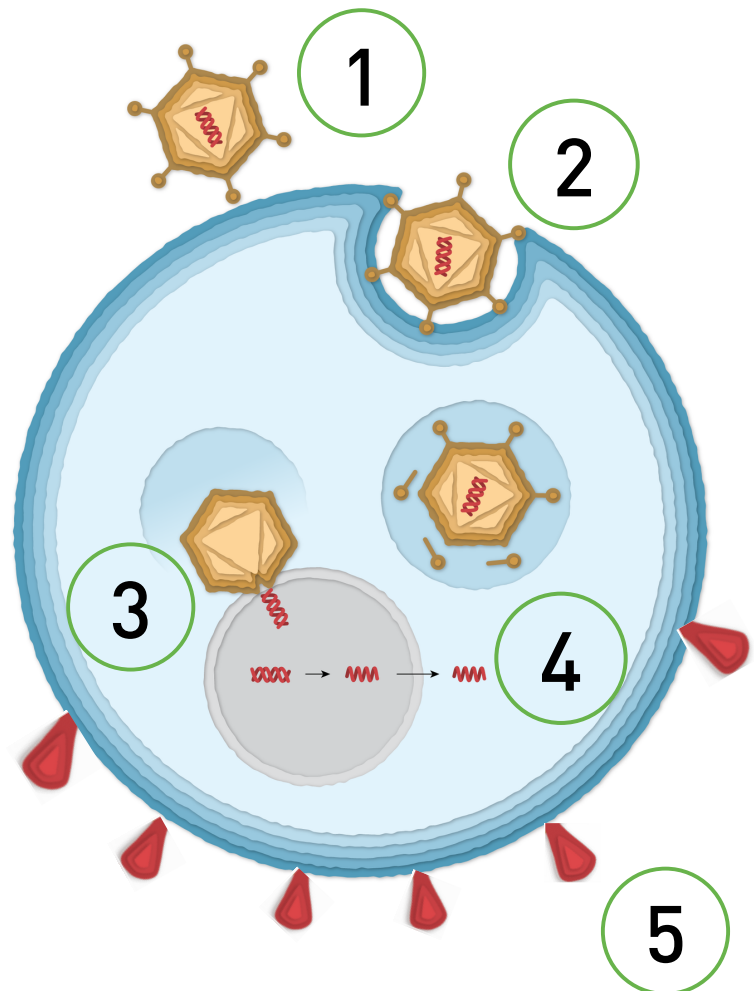
The adenovirus inserts the DNA instructions for the S protein into the nucleus of the cell, where DNA is converted into mRNA.

4

The mRNA instructions leave the nucleus, and are used to make S proteins.

5

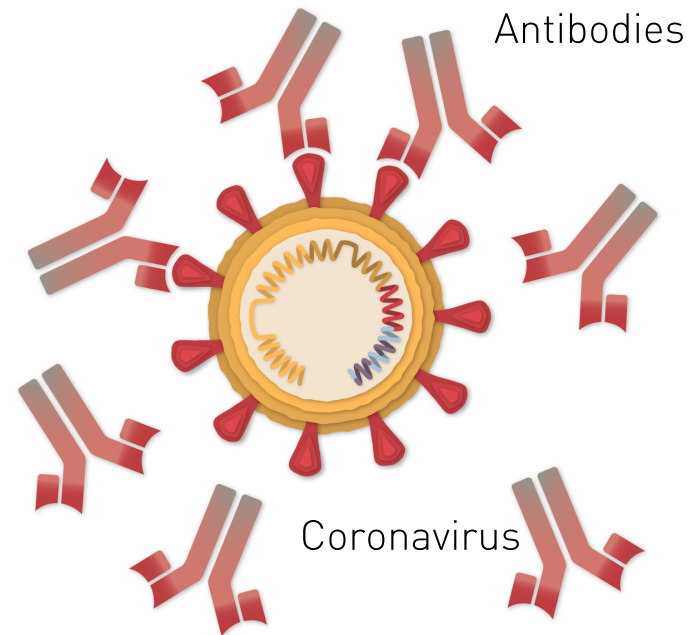
The S proteins are displayed outside the cell to be detected by the immune system (see Part 2 below).



# Part 2: The Immune Response: How Do COVID-19 Vaccines Build Antibodies Against the S Protein?

S proteins are detected by different types of cells that are part of the immune system. These immune cells recognize that the S protein is not supposed to be in the body and they respond to get rid of the protein now and to remember what it looks like for the future. Immune cells serve many functions in fighting off the virus; one of them is to form antibodies against the S protein, which work against the coronavirus.

Now, when the body comes into contact with the virus in the future, it will recognize the S protein and send antibodies and use the rest of your immune system to fight the virus off before you get sick.



## In Summary

- mRNA vaccines and viral vector vaccines are very similar: they all give the body instructions on how to make the S protein, which the body then learns how to recognize and destroy.
- The main difference between the mRNA vaccines and viral vector vaccines is how they deliver instructions for the S protein to the body.
- Vaccines are one of the most important tools for stopping the COVID-19 pandemic and everyone should get whichever vaccine is available to them first as soon as they can.