

**COVID-19**  
Prevention Network

# Vaccine Product Pipeline

**COVID-19 Prevention Network**  
**Operation Warp Speed**

# What could a SARS-CoV-2 vaccine do?

## Benefit the individual

- ➔ Reduce the severity of illness
- ➔ Prevent infection

## Benefit the community

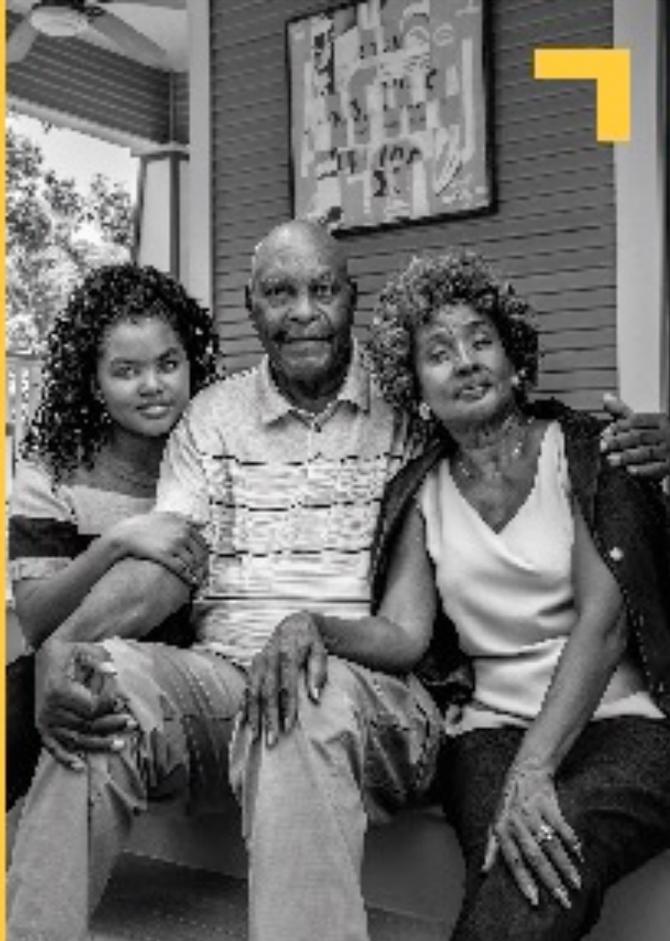
- ➔ Reduce transmission
- ➔ Healthier communities
- ➔ Less stress on health systems



# Who are we enrolling?

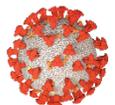
HELP FIND  
A **VACCINE**  
FOR COVID-19!

PreventCOVID.org

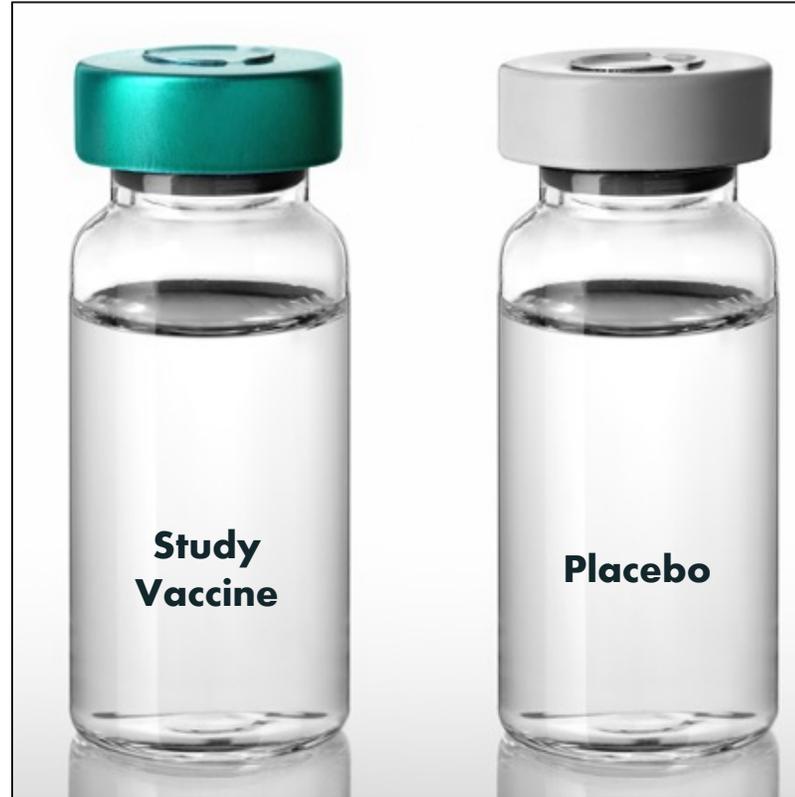


We're looking for:

- ❖ Adults aged 18 and older
- ❖ People who are more likely to be exposed to COVID-19, including:
  - People with underlying medical conditions
  - People with greater chances of exposure at their job
  - People who live or work in elder-care facilities
  - People who work in jails or prisons
  - People from racial and ethnic groups that have been impacted in greater numbers by the pandemic, such as Black/African American, Latinx, American Indian/ Alaska Native/Native Hawaiian



# Not Everyone Gets the Study Vaccine



- Some people will get a **placebo**, which is sterile salt water that does not contain the vaccine ingredients.
- The number of people in each group can vary between studies. It might be half and half, or 2/3 getting the study vaccine and 1/3 getting the placebo.

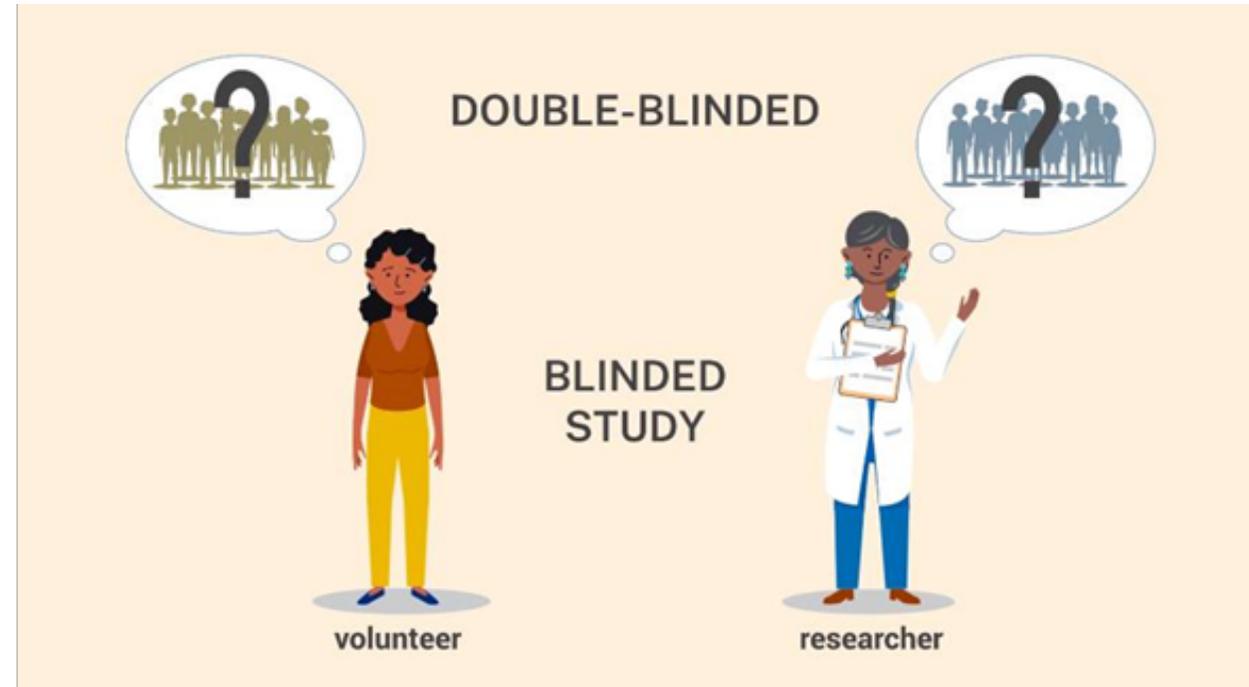
# Who chooses which group you are in?



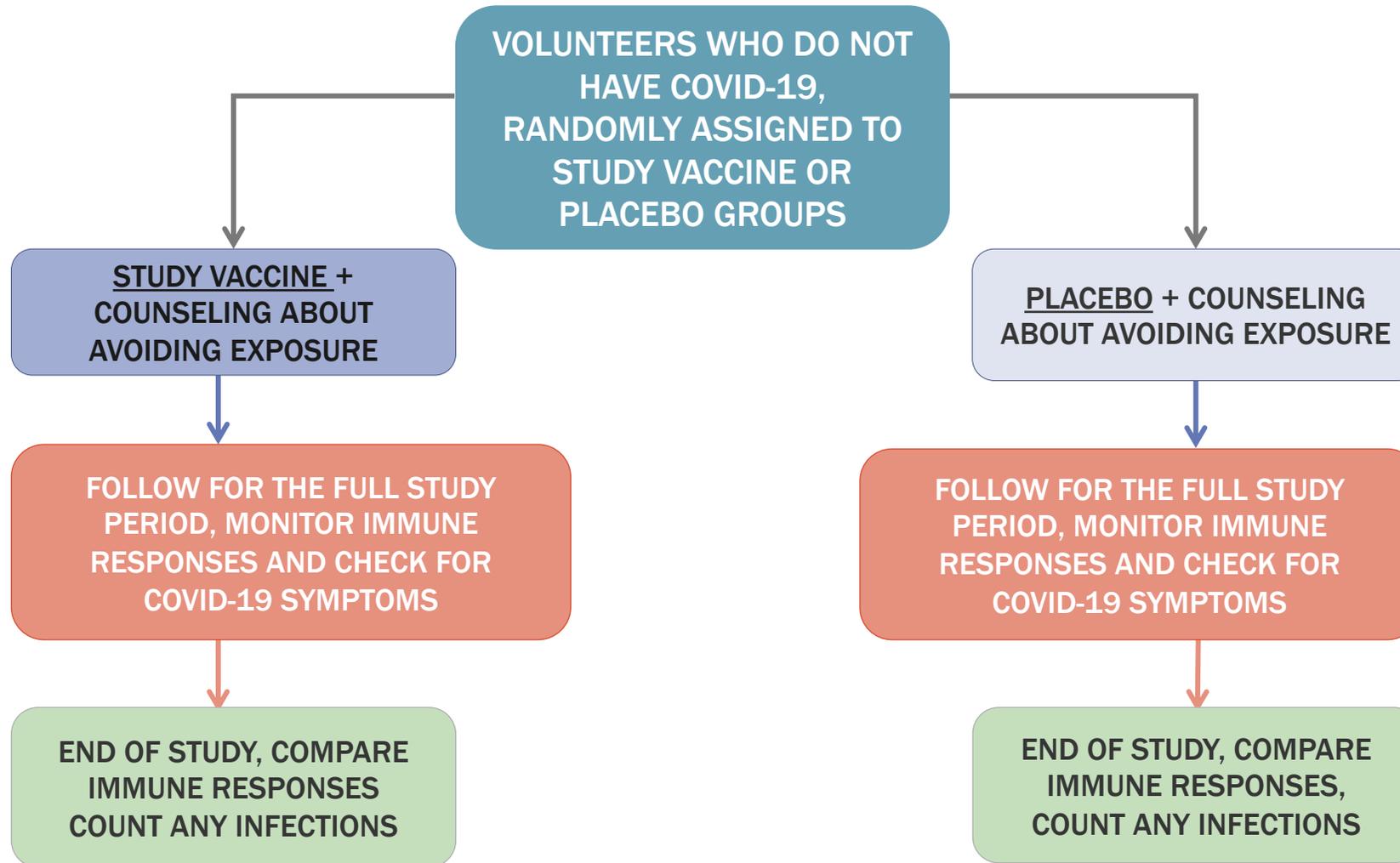
The group you are assigned to is completely **random**, like flipping a coin or rolling dice.

# The studies are “blinded”

- This means that neither the participant nor the researchers know who is getting which product.
- A study is blinded so that everyone is treated the same at the site and so that participants all follow the same precautions.
- The pharmacist is the one person who knows, just in case there is a need to “unblind.”



# All Participants Receive the Best Risk Reduction Education Available



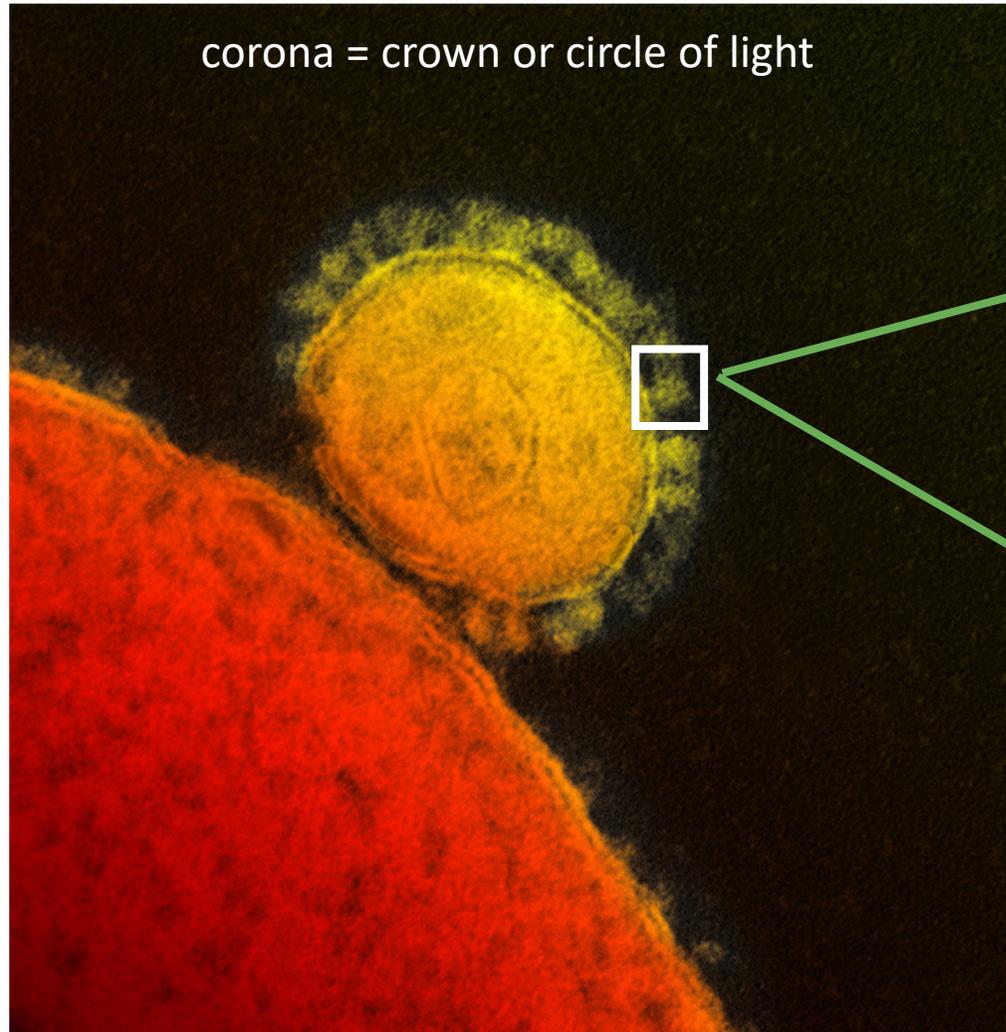


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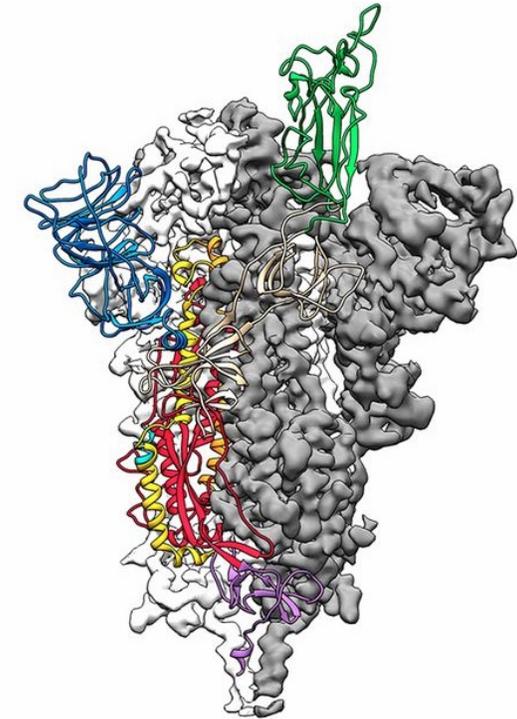
# Understanding Vaccines

# SARS-CoV-2 and its spike protein (the vaccine target)

Slide credit: Vaccine Research Center, NIAID



Spike Protein



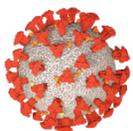
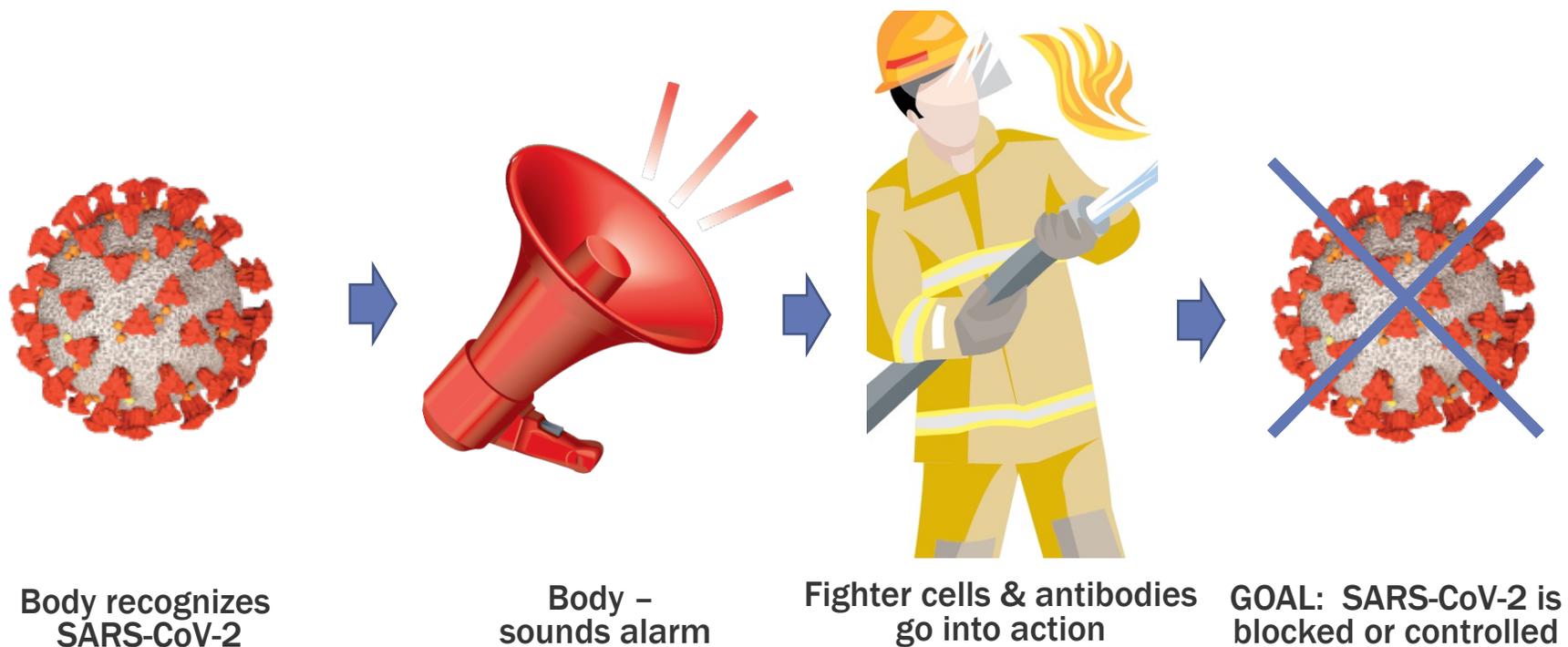
Viral membrane

[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

Image credit: Wrapp D, Wang N, Corbett KS, Goldsmith JA, Hsieh CL, Abiona O, Graham BS, McLellan JS. Cryo-EM structure of the 2019-nCoV spike in the prefusion conformation. Science. 2020 Feb 19:eabb2507. doi: 10.1126/science.abb2507.

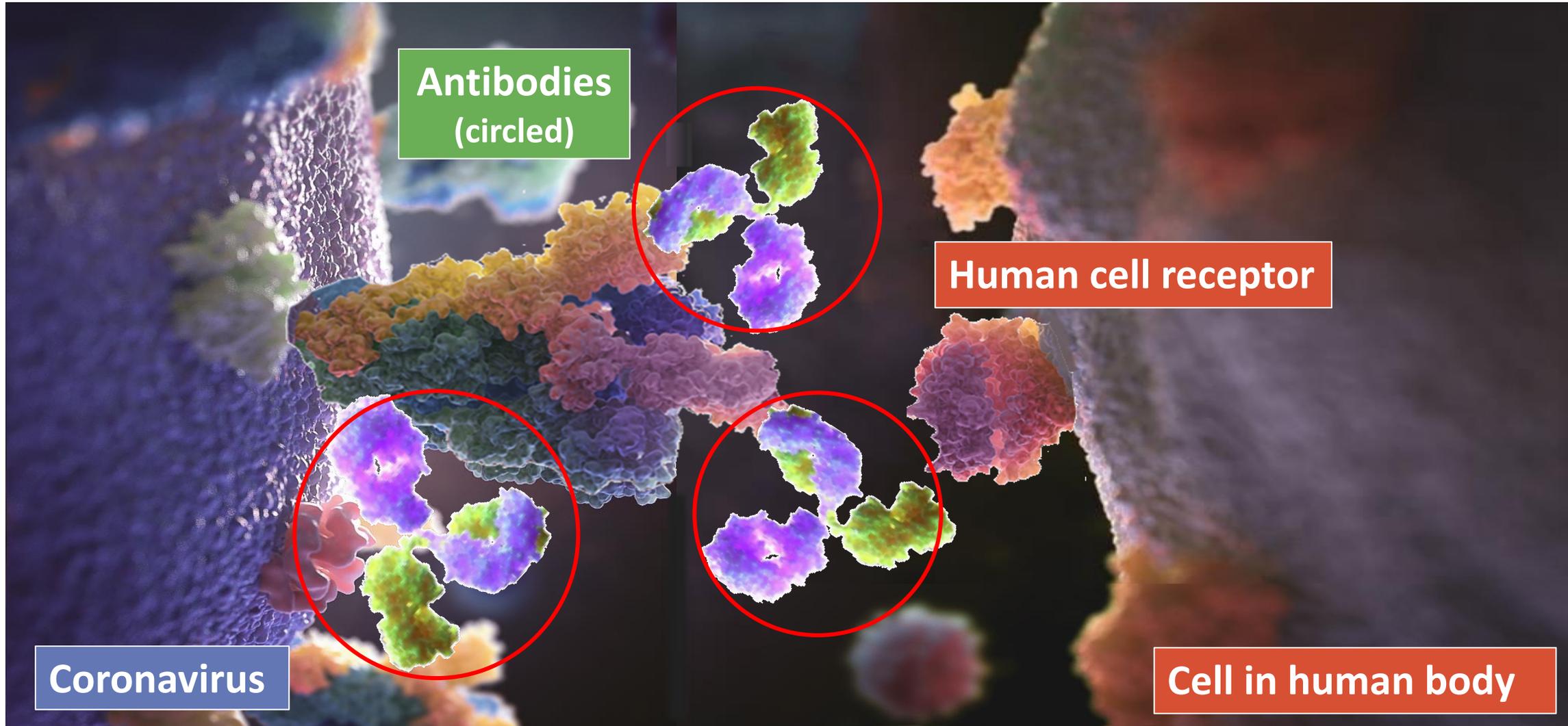
# How does a vaccine work?

By teaching the body to recognize and fight invaders



# The goal of a vaccine: to create antibodies!

Vaccine-induced antibodies can block the spike protein from attaching to human cells

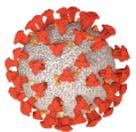


Slide credit: Vaccine Research Center, NIAID

# Traditional approaches for developing a vaccine

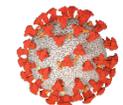
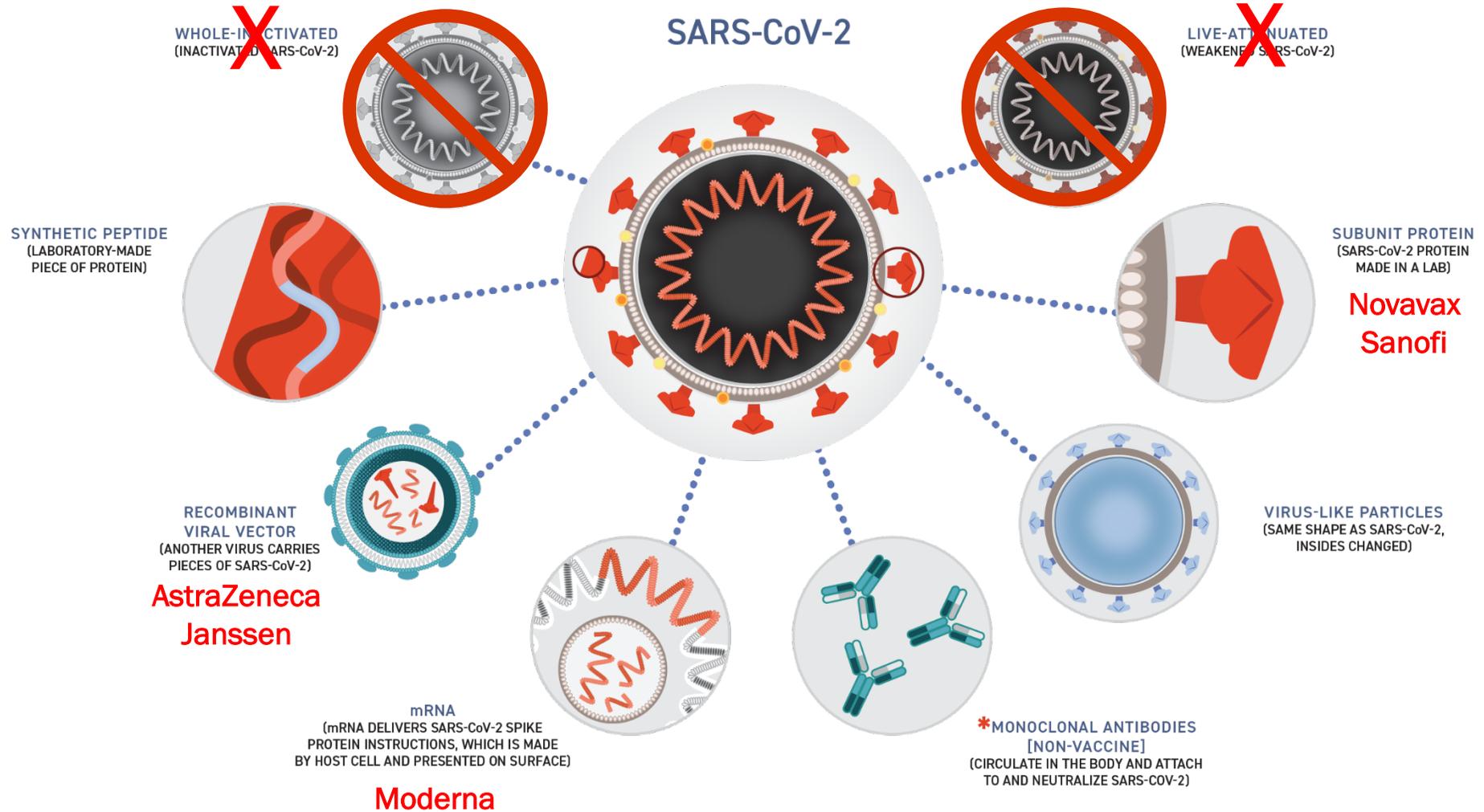


- Traditional approaches are not being used in any of the Operation Warp Speed studies at this time.
- Traditional approaches include:
  - **Live attenuated vaccines:** These are made with a weakened form of the virus that causes the disease
  - **Whole virus inactivated vaccines:** These are made with a version of the whole virus that has been disabled in some way – usually with heat, radiation, or chemicals.



# Vaccine Designs

## SARS-CoV-2 VACCINE AND RELATED\* DESIGNS



# Can vaccines cause SARS-CoV-2 infection or cause COVID-19 illness?

**NO!** The vaccines being tested are made from synthetic (laboratory made) pieces copied from SARS-CoV-2, not the whole virus. Therefore, the vaccines CANNOT cause infection or cause you to get COVID-19 illness.

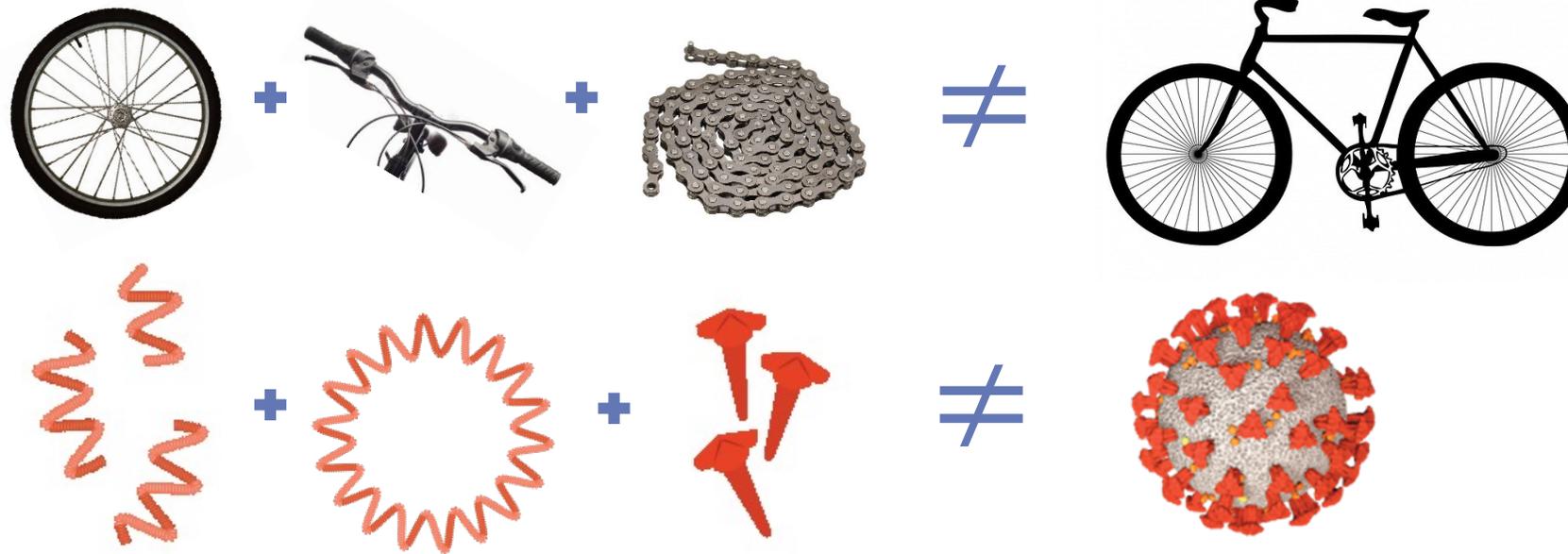
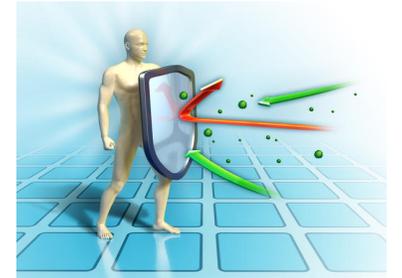


Image Credit: Bridge HIV/SFDPH

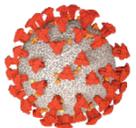
# What are we hoping to learn from these studies?

In general, the vaccines we are studying seek to answer the following main questions:

- Does the vaccine create an immune response that protects people against moderate to severe COVID-19 illness? Or can the immune response protect against infection with SARS-CoV-2?
- Does the vaccine continue to show that it is safe when tested in thousands of people?
- Do the vaccine side effects continue to be well tolerated?



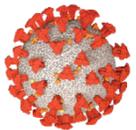
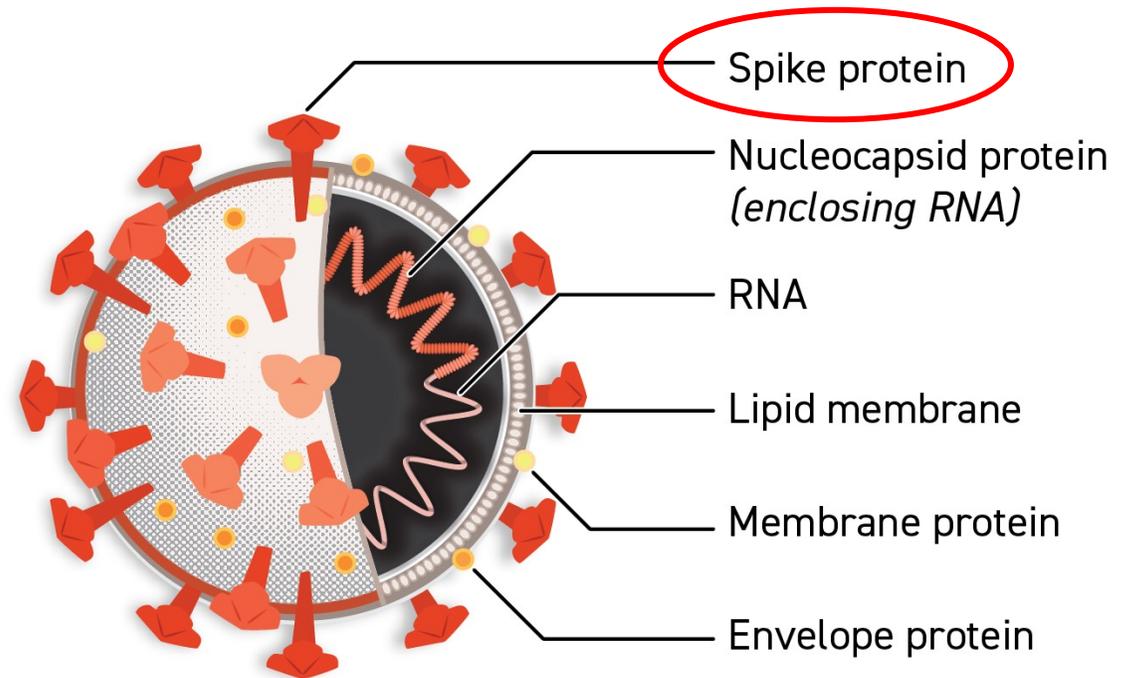
**SIDE EFFECTS**



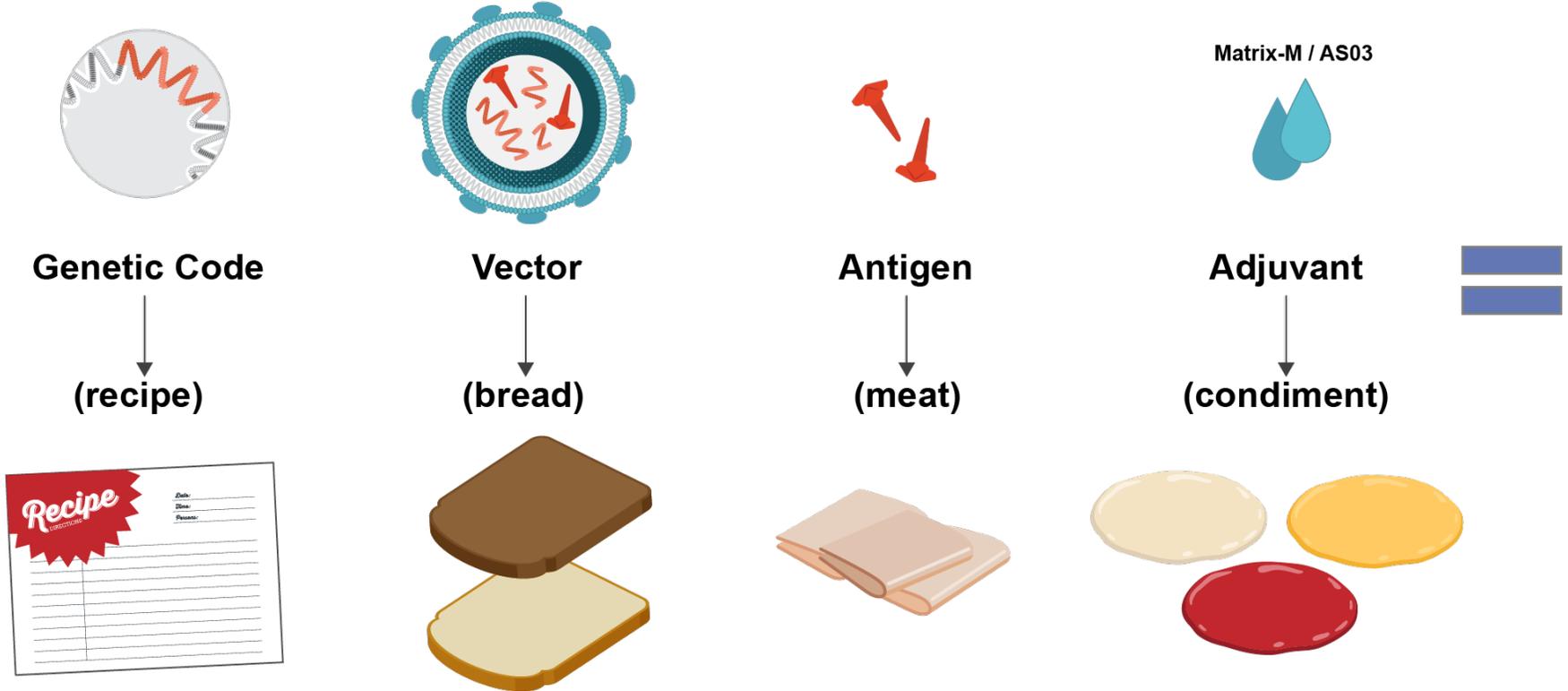
# Vaccine Antigen

- To understand how these vaccines are made, we first need to understand what parts of the virus are used.
- The vaccines in Operation Warp Speed focus on the spike protein of the SARS-CoV-2 virus, which is used as the **antigen**
- An antigen is the ingredient in a vaccine that triggers your body's immune system to build a defense and create antibodies against a virus.
- Remember that the antigen is only a copy of a piece of the virus, usually made in a laboratory, and cannot cause illness.

## SARS-CoV-2



# Pieces of the vaccine “sandwich”

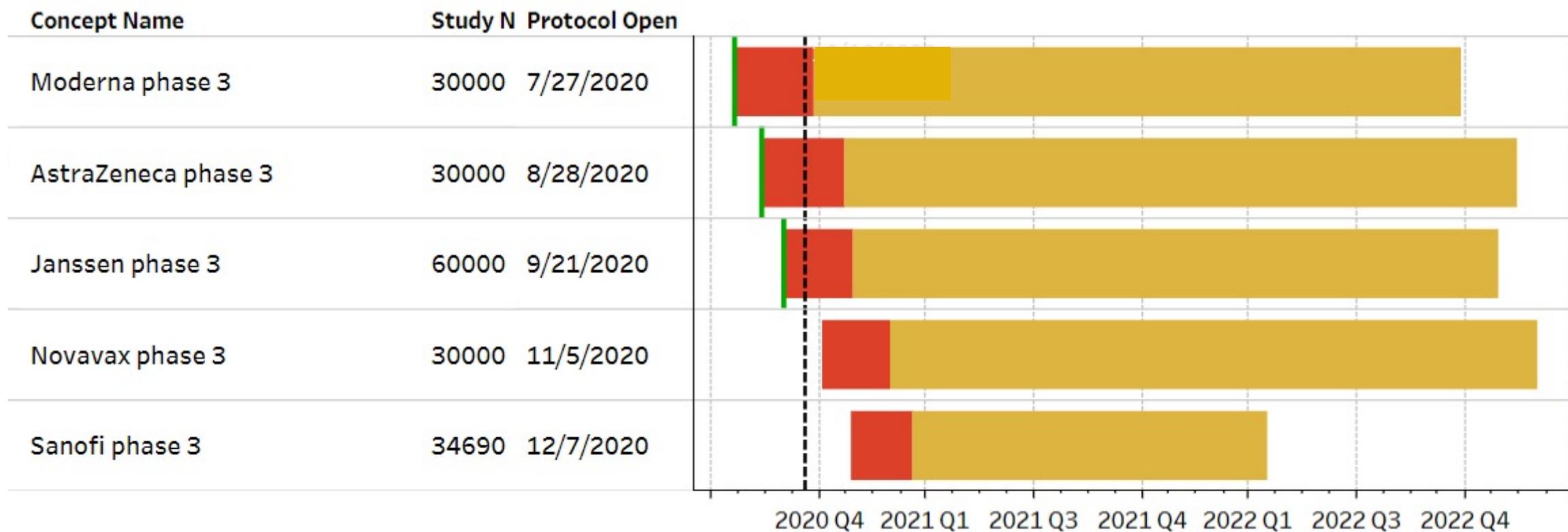




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# The CoVPN Vaccine Pipeline: A Closer Look at the Phase 3 Efficacy Studies

# Phase 3 Vaccine Pipeline



Study opening dates are projections, and subject to change.

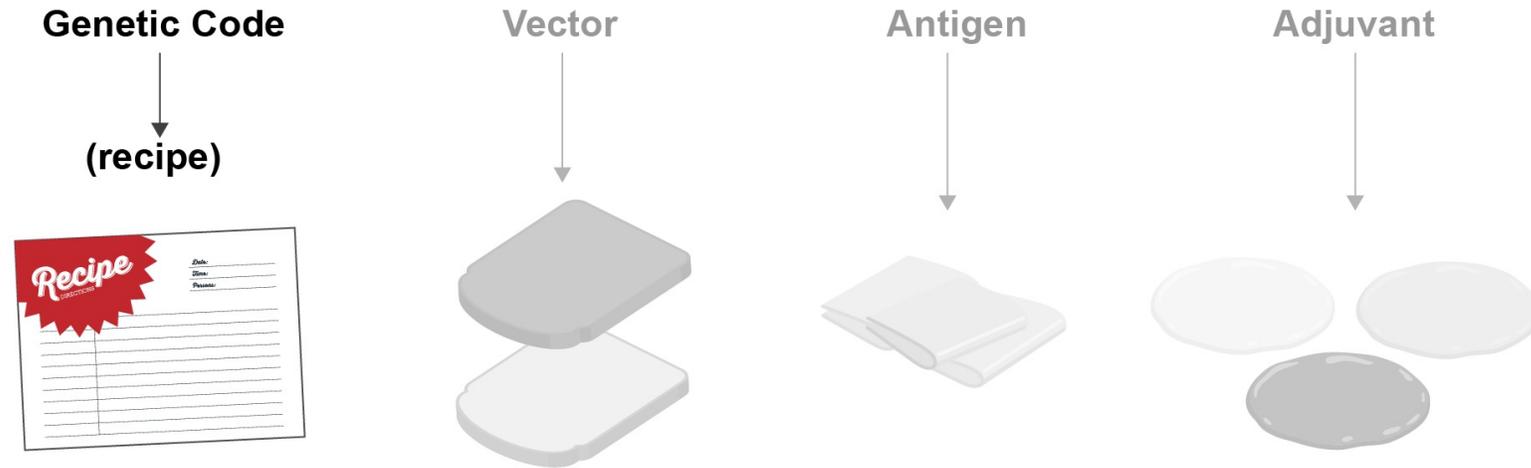
- Legend**
- First participant enrolled
  - Later phase: Enrollment period
  - Later phase: Followup period

# What is the Moderna vaccine?

- The Moderna study is called the “Cove Study.”
- This study tests the experimental vaccine called mRNA-1273.
- The study vaccine is known as a mRNA vaccine.
- The study began enrolling on July 27, 2020 and just completed enrollment on October 22, 2020.
- The study enrolled 30,423 people across 99 clinics in the US, who will now be followed for 2 years.



# Moderna's vaccine "sandwich" recipe



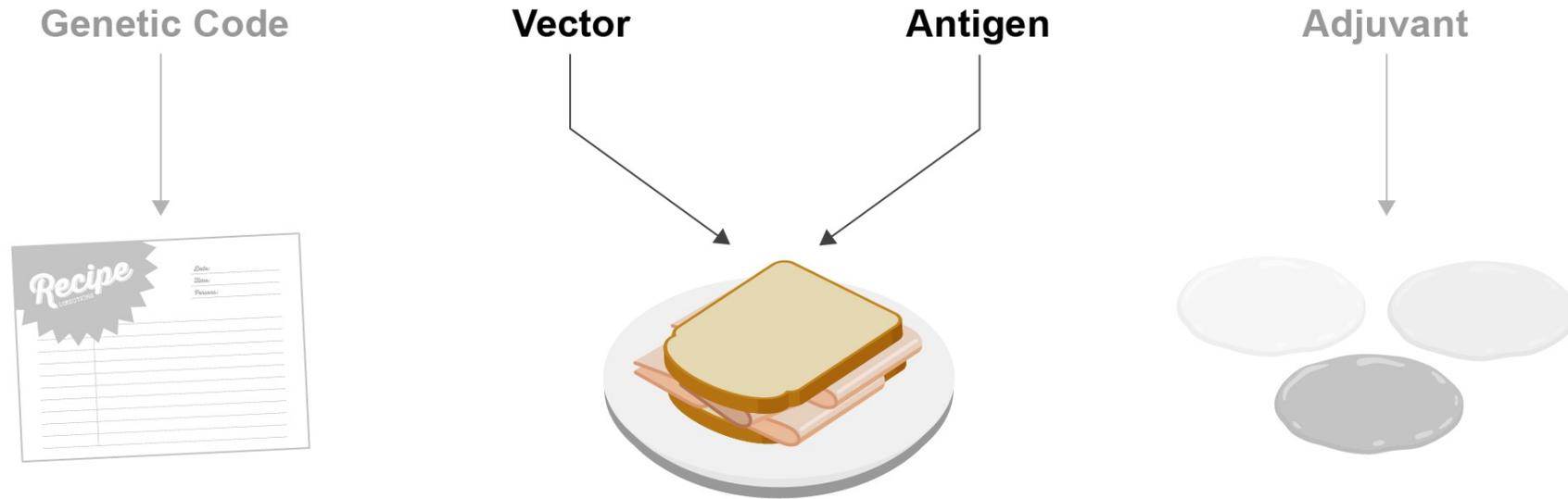
- Moderna's vaccine delivers the instructions for making the spike protein from SARS-CoV-2
- Once inside a human cell, the vaccine delivers the message: "Make protein from SARS-CoV-2"
- Human cells makes the protein and display it on the surface
- The immune system sees the protein, recognizes it as foreign, and creates an immune response to block infection and prevent disease

# What is the AstraZeneca vaccine?

- This study tests the experimental vaccine called AZD1222.
- The study vaccine is commonly known as the “Oxford vaccine” or as “ChAdOx.”
- The study began enrolling on August 29, 2020.
- The study will enroll about 30,000 people in the US.



# AstraZeneca's vaccine "sandwich"



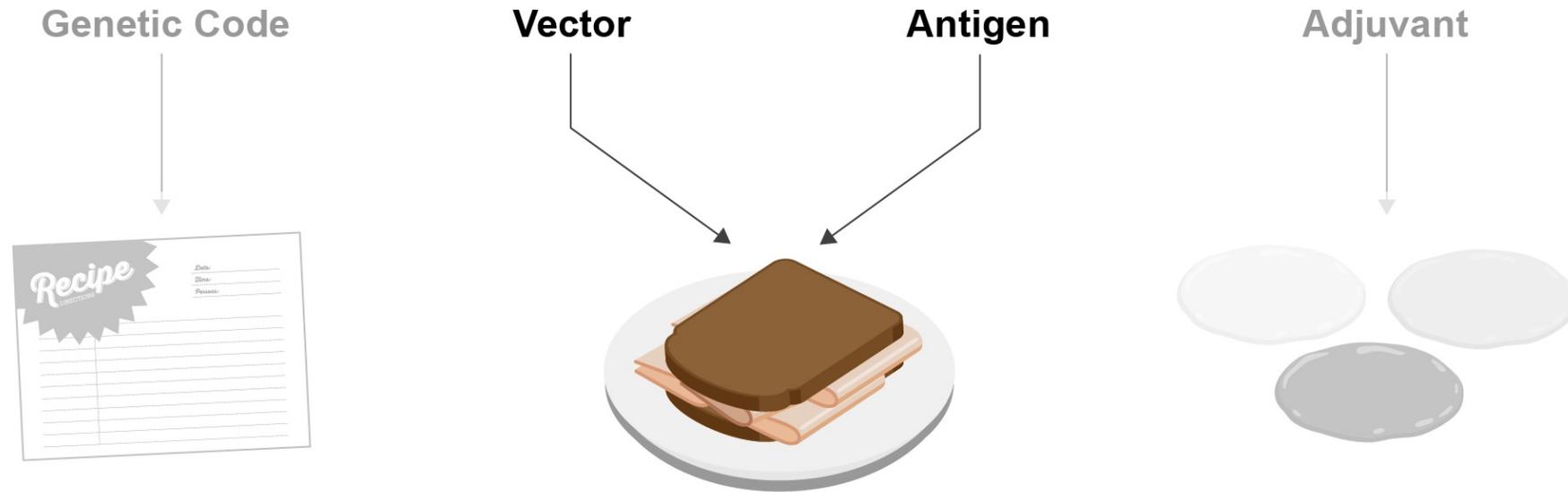
- AstraZeneca's vaccine uses a type of chimpanzee adenovirus as the **vector** (bread). Adenoviruses cause common colds.
- Because the adenovirus is from another species, the human body can easily recognize it as something foreign and the immune system can be put on alert.
- The vaccine **antigen** (sandwich filling) uses copies of the spike protein from SARS-CoV-2.
- This helps the immune system to produce the antibodies and T-cells specific to SARS-CoV-2 in order to protect you if you are ever exposed.

# What is the Janssen vaccine?

- The Janssen study is called the “Ensemble Study.”
- This study tests the experimental vaccine called Ad26.COV2.S.
- The study began enrolling on September 21, 2020.
- The study will enroll about 60,000 people around the world, including in the US, Argentina, Brazil, Chile, Colombia, Mexico, Peru, Philippines, South Africa, and Ukraine.



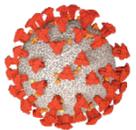
# Janssen's vaccine "sandwich"



- Janssen uses a similar method for making its vaccine as AstraZeneca does.
- Their vector (bread) is a human Adenovirus called Adenovirus-26, or Ad26 for short.
- They also use the spike protein copied from SARS-CoV-2 as the meat, or antigen.
- You can think of the Janssen and AZ vaccines as similar sandwiches using different bread, such as turkey on sourdough and turkey on wheat.

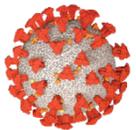
# What is the Novavax vaccine?

- This study tests the experimental vaccine called SARS-CoV-2 rS.
- The study vaccine is known as a recombinant spike protein nanoparticle vaccine.
  - This means that copies of the spike protein are attached to a tiny microscopic particle made of another type of protein that is harmless to people. The particle alerts the immune system that something foreign has entered the body.
- The study will begin enrolling in November, 2020.
- The study will enroll about 30,000 people in the US and Mexico.

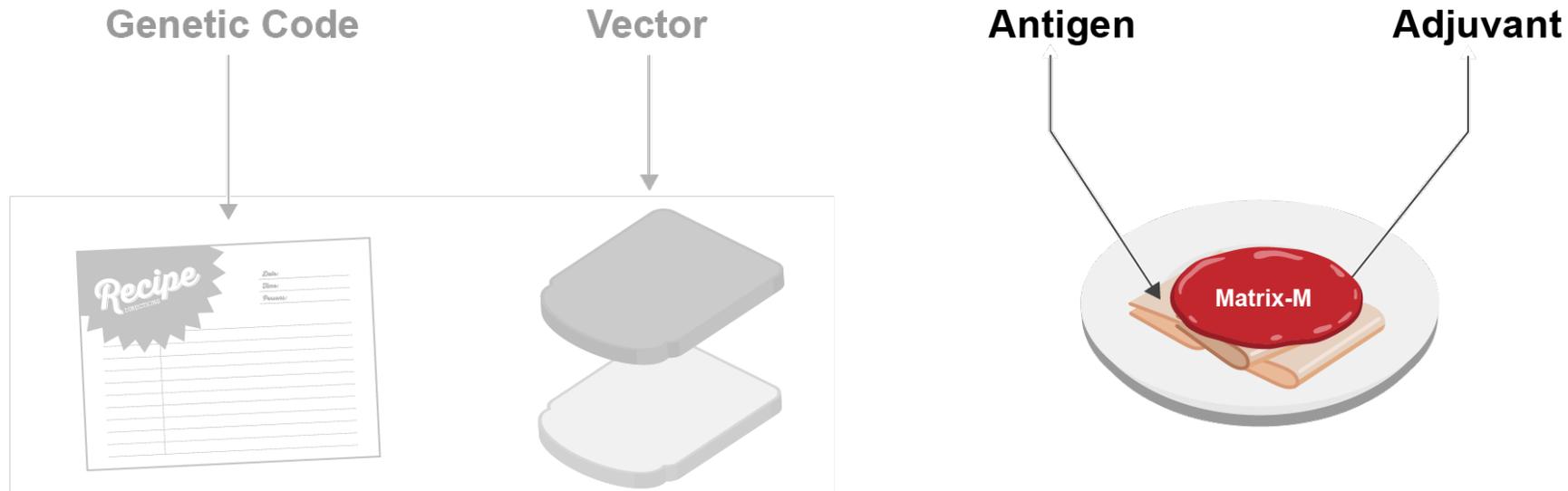


# Vaccine Adjuvants

- The Novavax vaccine uses an **adjuvant** called **Matrix-M™**.
- As a reminder, adjuvants are like condiments on your sandwich: mustard, horseradish, hot sauce, etc. Adjuvants boost the body's reaction to the vaccine and give it that “extra kick” like condiments do for your food. Many licensed vaccines use adjuvants.



# The Novavax vaccine “sandwich”



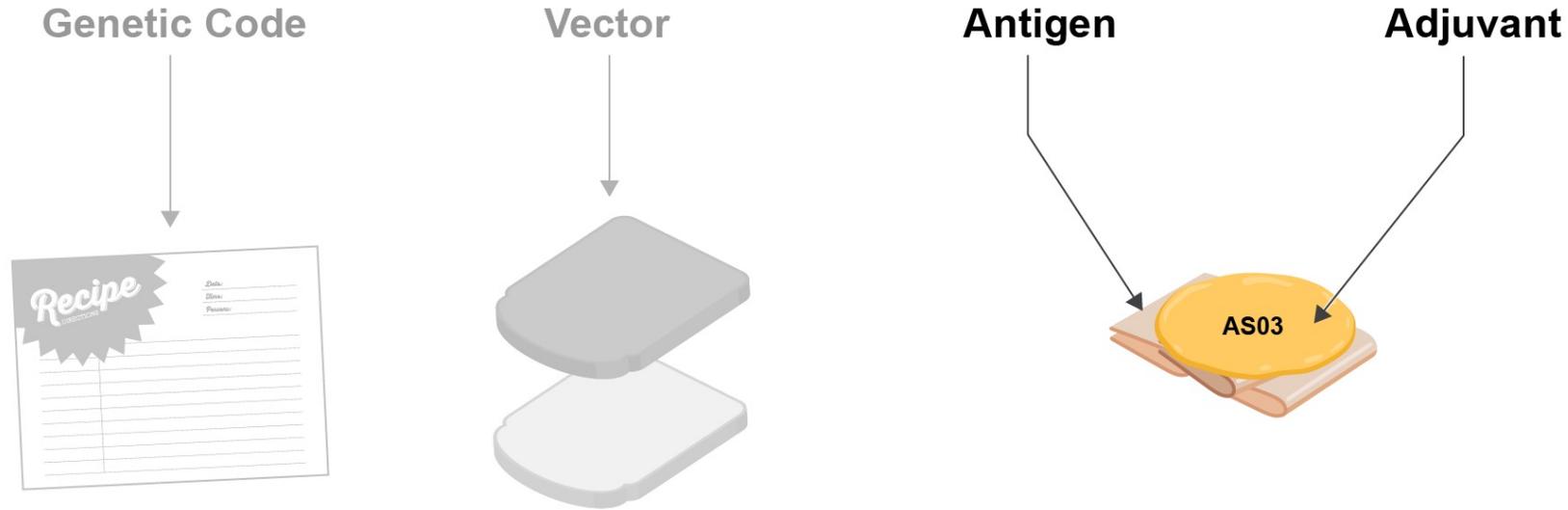
- Novavax makes copies of the spike protein from SARS-CoV-2 in the laboratory, which is once again the antigen/meat of this “sandwich.”
- These proteins are delivered on a microscopic particle. Since this particle isn’t really a vector, we can’t use any bread for this sandwich, just a plate.
- The tiny particle carrying spike proteins puts the immune system on alert that something foreign has entered the body.
- The adjuvant called Matrix-M™ is added to give the immune system an extra kick, similar to how the ketchup gives the meat a lot of added flavor.

# What is the Sanofi vaccine?

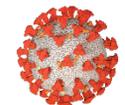
- The Sanofi study tests an experimental vaccine called CoV2 preS dTM.
- The study vaccine is known as a protein subunit vaccine.
  - This means the vaccine introduces a copy of the spike protein into the body. This copy of the spike protein is enough to be recognized by the immune system as something that requires a response.
- The study will begin enrolling in December, 2020.
- The study will enroll about 34,520 people globally, including countries in the US, Latin America, Europe, Asia and Africa.



# The Sanofi vaccine “sandwich”



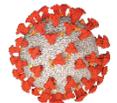
- Sanofi is using a protein subunit vaccine. These vaccines use copies of a piece of the virus.
- The antigen (meat) is the spike protein of the SARS-CoV-2.
- Sanofi also uses an adjuvant called AS03 to boost the body’s reaction to the vaccine, similar to how the mustard on this “sandwich” gives the meat added flavor.



# Summary:

## Variables in Vaccine Development

- **Vaccine platform:** how is the vaccine designed? Does it use:
  - **Messenger RNA** like in Moderna's design?
  - A **viral vector** like the adenovirus in AstraZeneca's or Janssen's designs?
  - A **microscopic particle** delivery like in Novavax's design?
  - **Proteins** like in Sanofi's design?
- **Adjuvant:** will anything be added to the vaccine for that extra kick?
- **Dose:** how much is given per injection?
- **Route:** where and how is the injection given?
- **Timing:** how many injections and how much time between them?



# The variables of vaccine development in each study

Product	Design	Adjuvant	How much?	How do I get the shot?	How often?
Moderna mRNA-1273	mRNA	-	100µg	Shot in the deltoid muscle of your upper arm	Twice: Day 0 and Day 29
AstraZeneca AZD1222	Chimp adenovirus vector	-	$5 \times 10^{10}$ vp		Twice: Day 0 and Day 29
Janssen Ad26.COV2.S	Human adenovirus-26 vector	-	$1 \times 10^{11}$ vp		1 dose – Day 0
Novavax SARS-CoV-2 rS	Protein Subunit Nanoparticle	Matrix-M™	5µg vaccine 50µg adjuvant		Twice: Day 0 and Day 21
Sanofi	Protein Subunit	AS03	5 µg or 15 µg*		Twice: Day 0 and Day 21

\* The dose for the Sanofi trial is tentative, pending the results of their early phase studies.

**Do we want  
more than 1  
type of  
effective  
vaccine?**

**YES.**

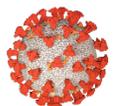
It would be good to have multiple types of vaccines that work.

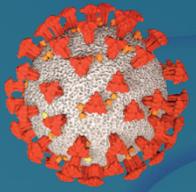
No single vaccine can be manufactured fast enough to immunize the 7+ billion people on this planet.

We want to use all designs that we know of in order to make sure we don't leave any scientific stones unturned.

There is an effort to involve global vaccine manufacturing companies so that we are all working together toward a global solution.

Around the world, we have to work together in a way we have never done before in order to test and manufacture vaccines that will reach every corner of every community.



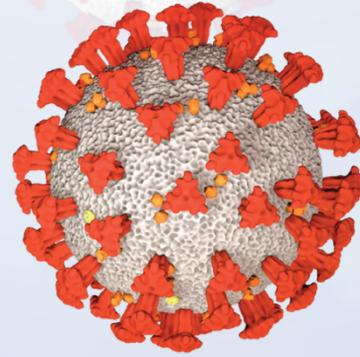


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# Questions?

# Acknowledgements

- **Members of the CoVPN Operations Center staff: *Gail Broder, Michele Andrasik, Lisa Donohue, Francisco Rentas, Huub Gelderblom, Nicole Grunenberg, Larry Corey, Jim Kublin***
- **Operation Warp Speed Community Engagement team: *Chris Beyrer, Jessica Cowden, Jontraye Davis, Liza Dawson, Risha Irvin, Robin Mason, Dr. Nelson Michael, Rona Siskind, Jordan White***
- **The Dale and Betty Bumpers Vaccine Research Center, NIAID: *Julie Ledgerwood***
- **Dr. Anthony Fauci, NIAID**
- **Bridge HIV, San Francisco Dept. of Public Health**
- **Seattle-King County Dept. of Public Health**



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**THANK YOU!**