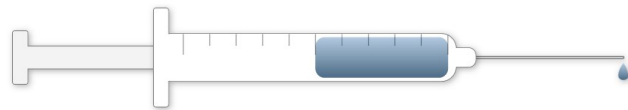


How the Novavax Vaccine Works

By [Jonathan Corum](#) and [Carl Zimmer](#) Dec. 30, 2020

U.S.A. ▾ World ▾ Health ▾



The Maryland-based company Novavax has developed a protein-based coronavirus vaccine called **NVX-CoV2373**. The vaccine produced strikingly high levels of antibodies in early clinical trials. In September, the vaccine entered a Phase 3 clinical trial in the United Kingdom, and another one in the United States at the end of December. Those trials will show whether the vaccine is safe and effective.

Coronavirus Proteins

The SARS-CoV-2 virus is studded with proteins that it uses to enter human cells. These so-called spike proteins make a tempting target for potential vaccines and treatments.

Spikes

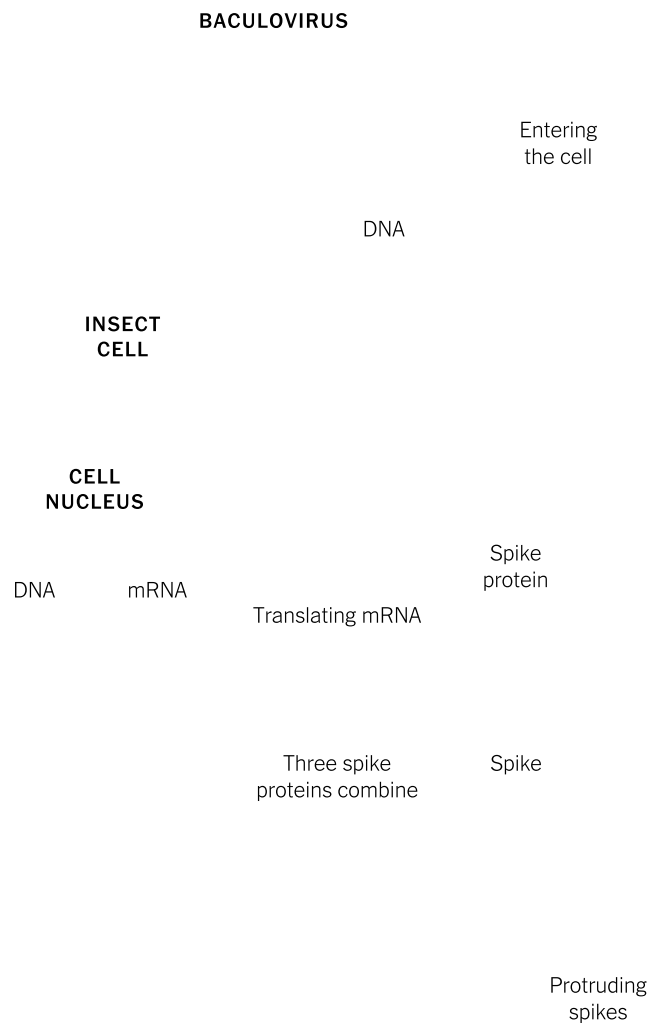
CORONAVIRUS

Spike
protein
gene

The Novavax vaccine works by teaching the immune system to make antibodies to the spike protein.

Growing Spike Proteins

To create their vaccine, Novavax researchers started with a modified spike gene. They inserted the gene into a different virus, called a baculovirus, and allowed it to infect insect cells. The infected cells produced spike proteins that spontaneously joined together to form spikes, as they do on the surface of the coronavirus.



A similar method of growing and harvesting virus proteins is already used to make licensed vaccines for diseases including influenza and HPV.

Building Nanoparticles

The researchers harvested the spike proteins from the insect cells and assembled them into nanoparticles. While the nanoparticles mimicked the molecular structure of the coronavirus, they could not replicate or cause Covid-19.

Nanoparticle
studded with
spikes

Presenting the Spike

The vaccine is injected into the muscles of the arm. Each injection includes many spike nanoparticles, along with a compound extracted from the soapbark tree. The compound attracts immune cells to the site of the injection and causes them to respond more strongly to the nanoparticles.

Vaccine
nanoparticles

Immunity-priming
compound

Spotting the Intruder

Immune cells called antigen-presenting cells encounter the vaccine nanoparticles and take them up.

**VACCINE
NANOPARTICLES**

Engulfing
the vaccine

**ANTIGEN-
PRESENTING
CELL**

Digesting
spike proteins

Presenting
spike protein
fragments

**HELPER
T CELL**

An antigen-presenting cell tears apart the spike proteins and displays some of their fragments on its surface. A so-called helper T cell may detect the fragments. If a fragment fits into one of its surface proteins, the T cell becomes activated. Now it can recruit other immune cells to respond to the vaccine.

Making Antibodies

Another type of immune cell, called a B cell, may also encounter the vaccine nanoparticles. B cells have surface proteins in a huge variety of shapes, and a few might have the right shape to latch onto a spike protein. If a B cell does latch on, it can pull the vaccine particle inside and present spike protein fragments on its surface.

If a helper T cell activated against the spike protein latches onto one of these fragments, it activates the B cell. Now the B cell proliferates and pours out antibodies that have the same shape as its surface proteins.

**ACTIVATED
HELPER
T CELL**

Activating
the B cell

Matching
surface proteins

**VACCINE
NANOPARTICLE**

B CELL

SECRETED
ANTIBODIES

Stopping the Coronavirus

If vaccinated people are later exposed to the coronavirus, their antibodies can lock onto the spike proteins. The coronavirus cannot enter cells, and the infection is blocked.

ANTIBODIES

VIRUS

Killing Infected Cells

The Novavax vaccine can also trigger another kind of protection by destroying infected cells. When a coronavirus invades, infected cells put fragments of its spike protein on their surface. Antigen-presenting cells can activate a type of immune cell called a killer T cell. It can recognize coronavirus-infected cells and destroy them before they have a chance to produce new viruses.

**ANTIGEN-
PRESENTING
CELL**

Presenting a
spike protein
fragment

**ACTIVATED
KILLER
T CELL**

**INFECTED
CELL**

Beginning
to kill the
infected cell

Remembering the Virus

Novavax's vaccine would be easier to distribute and store than the vaccines from Pfizer-BioNTech and Moderna. While those vaccines have to be kept frozen, NVX-CoV2373 can stay stable for up to three months in a refrigerator. But if the vaccine does turn out to be effective, scientists won't know for sure how long it may

First dose

Second dose
21 days later

create a group of specialized B cells and memory T cells. These cells can remember the coronavirus for years or even decades and launch a counterattack in response to a new infection.

Vaccine Timeline

January, 2020 Novavax begins work on a coronavirus vaccine.



A screen showing protein structures at a Novavax lab in Maryland. Andrew Caballero-Reynolds/Agence France-Presse

May Novavax launches clinical trials for their vaccine.

July The U.S. government awards Novavax \$1.6 billion to support the vaccine's clinical trials and manufacturing.

August Novavax launched a Phase 2 trial on 2,900 people in South Africa.



Preparing an injection in Johannesburg, South Africa. Joao Silva/The New York Times

September Novavax launches a Phase 3 trial with up to 15,000 volunteers in the United Kingdom. The trial is expected to deliver results in early 2021.

Dec. 28 Novavax launches a Phase 3 trial with 30,000 people in the United States. The trial had been delayed because of problems with manufacturing the doses required for the study.

2021 If its clinical trials succeed, Novavax expects to deliver 100 million doses for use in the United States in 2021.

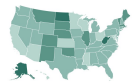
Sources: National Center for Biotechnology Information; Nature Reviews Immunology; Science; Maria Elena Bottazzi, Baylor College of Medicine.

Tracking the Coronavirus

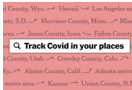
United States



Latest Maps and Data
Cases and deaths for every county



Vaccine Distribution
Where vaccines have been reported given



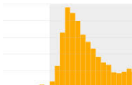
Your Places
Build your own dashboard to track cases



Hospitals Near You
Patients hospitalized and I.C.U. beds remaining



Restrictions
What is open and closed in each state



Deaths Above Normal
The true toll of the pandemic in the U.S.



Cities and Metro Areas
Where it is getting better and worse

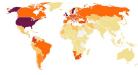


Nursing Homes
The hardest-hit states and facilities

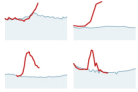


Colleges and Universities
Cases at more than 1,700 schools

World



Latest Maps and Data
Cases and deaths for every country

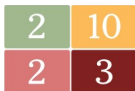


Deaths Above Normal
The true toll of coronavirus around the world

Health



Vaccines
Track their development



Treatments
Rated by effectiveness and safety

Countries

Brazil	Germany	Mexico	U.K.
Canada	India	Spain	United States
France	Italy		

States, Territories and Cities

Alabama	Iowa	New Hampshire	South Dakota
Alaska	Kansas	New Jersey	Tennessee
Arizona	Kentucky	New Mexico	Texas
Arkansas	Louisiana	New York	Utah
California	Maine	New York City	Vermont
Colorado	Maryland	North Carolina	Virginia
Connecticut	Massachusetts	North Dakota	Washington
Delaware	Michigan	Ohio	Washington, D.C.
Florida	Minnesota	Oklahoma	West Virginia
Georgia	Mississippi	Oregon	Wisconsin
Hawaii	Missouri	Pennsylvania	Wyoming
Idaho	Montana	Puerto Rico	
Illinois	Nebraska	Rhode Island	
Indiana	Nevada	South Carolina	

Data

[Frequently Asked Questions About the Covid Data](#)

[Access the Open Source Covid Data](#)