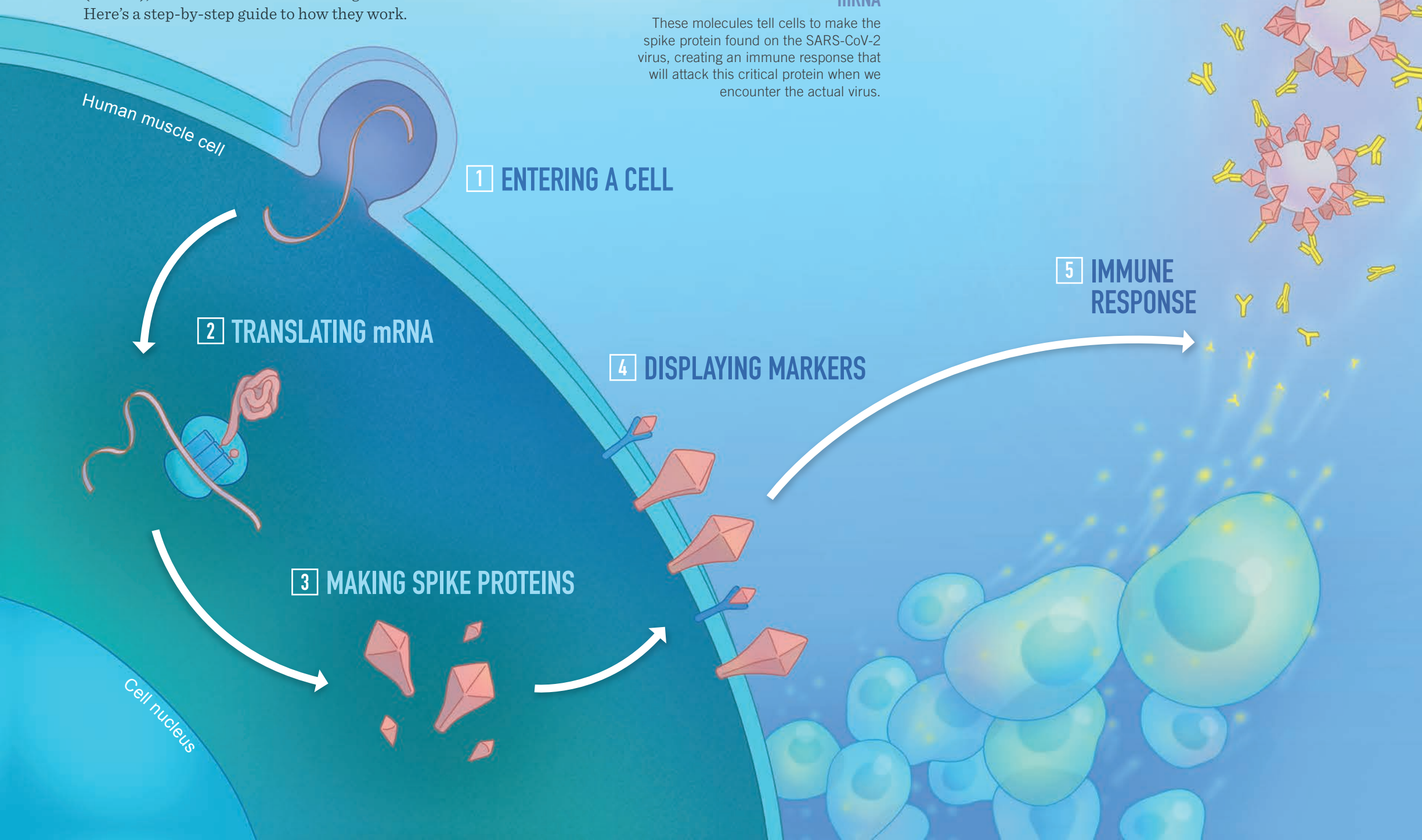
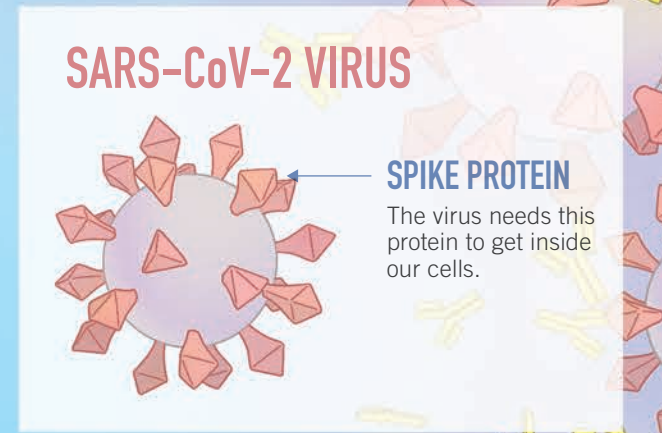
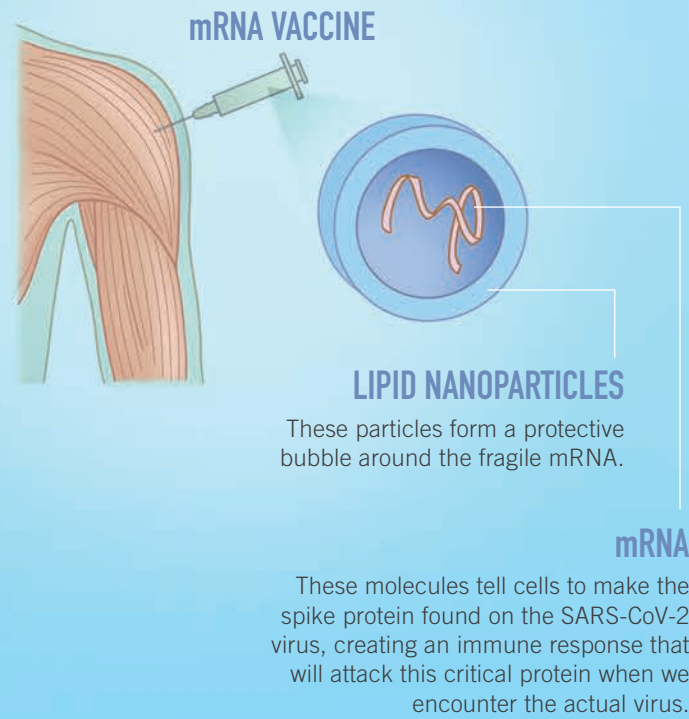


ANALYSIS

HOW THE mRNA VACCINES WORK TO FIGHT COVID-19

Multiple vaccines are now available to help curb the threat of COVID-19, caused by the SARS-CoV-2 virus. Two of the earliest vaccines approved in the US were delivered by Moderna and Pfizer-BioNTech. Neither vaccine contains any real virus. Instead, each carries molecular instructions, called messenger RNA (mRNA), that tell our bodies how to fight off the virus. Here's a step-by-step guide to how they work.



1 Entering a Cell

The oily nanoparticles merge with the oily surface of our cells, then mRNA slips inside.

2 Translating mRNA

The cell's genetic machinery reads the mRNA's instructions, and any leftover mRNA is ultimately destroyed by the cell.

3 Making Spike Proteins

Those instructions tell the cell to make spike proteins. These proteins combine to form the telltale spikes on the SARS-CoV-2 virus.

4 Displaying Markers

Spikes and spike protein fragments move to the outside of the cell and protrude from the surface where they will be recognized by the immune system.

5 Immune Response

Some immune cells latch onto the spikes and produce antibodies—Y-shaped molecules that will recognize spike proteins and block them from getting inside other cells. Other immune cells will be activated that can seek out and destroy future coronavirus-infected cells displaying the spike.

WHY BASIC RESEARCH MATTERS:

In 1964, American biochemist Robert Holley became the first person to isolate transfer RNA (tRNA)—molecules that help mRNA build proteins—and map its structure. Four years later, while a professor at the Salk Institute, Holley shared the Nobel Prize for his work on how these genetic molecules control protein synthesis. The development of the COVID-19 mRNA vaccines was possible, in part, because of the groundwork Holley's foundational science provided.

