READING PASSAGE

A Look inside the Lab: Liquid Nitrogen Freezer
COVID-19 mRNA vaccines and the role of temperature

Temperature is an important measurement that we use in daily life. We rely on temperature to help us keep our food safe and our homes comfortable.

Temperature is also important in scientific research. In many labs, scientists rely considerably on temperature. Accurate temperatures can mean the difference between an experiment, medicine, or vaccine working or not. For example, scientists often use human cells to study diseases. They need to grow the cells at a temperature close to that of the human body because that is what the cells are used to. Another example can be seen in the need to store the novel COVID-19 mRNA vaccines at specific temperatures.

mRNA is very fragile and can easily be broken down by enzymes. So, the vaccines must be handled in a way that protects the mRNA, or they will not work when given to people. The mRNA can be protected in a few ways:

- **Physical protection** - The mRNA is protected in lipid nanoparticles and by making minor changes to the structure of the mRNA, so it is less susceptible to breakdown by enzymes.
- **Temperature** - Freezing the vaccines contributes to their stability by slowing down or stopping the effects of enzymes. The first two COVID-19 mRNA vaccines released (those produced by Pfizer and Moderna) are both frozen shortly after they are manufactured, but they were initially stored at different temperatures. The Pfizer vaccine had to be stored at -70 degrees Celsius (°C), whereas the Moderna one could be stored at -20°C.

Why are the two vaccines stored at different temperatures if they both contain mRNA?

Three things contribute to the temperature differences between these vaccines:

1. Minor differences in the lipid nanoparticles
2. Small changes to the mRNA made in the lab
3. Thermal stabilization experiments - These studies test how stable a vaccine is at different temperatures. This research is done early in the process of developing a vaccine, even before it is tested in people.

Companies can make changes or conduct additional studies to address storage temperatures, but they must prove the vaccine is still as safe and works as well in people. For example, the Pfizer vaccine initially required very low temperatures and special storage equipment, but within a few months of approval, the company submitted data from additional studies demonstrating that the vaccine is stable at -25°C to -15°C. These higher storage temperatures, which are more typical of equipment at medical facilities, make it easier to get people vaccinated in more places.