COVID-19 mRNA vaccines: how they work and why they are safe

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COVID-19 mRNA vaccines: how they work and why they are safe

First, the basics!

The nucleus of your cells houses all of the instructions (DNA) to make the molecules (proteins) that allow your cells to function. However, the factor that makes proteins (ribosomes) are outside of the nucleus (cytoplasm)! To get the information where it needs to go, cells copy pieces of the DNA (transcription) into messenger RNA molecules (mRNA), get it out, which leave the nucleus to find the ribosomes and make proteins (translation). Scientists call this process ‘The Central Dogma.’ The coronavirus is different than your cells, it is made of proteins and genetic information, but not in the form of DNA! Scroll on to find out why that is important!

How coronavirus hijacks your cells

1. Coronavirus
2. Receptor
3. Envelope
4. Spike protein
5. Envelope protein
6. Membrane protein
7. Nucleocapsid protein
8. Ribonucleic acid (RNA)
9. mRNA
10. Translation
11. Protein

The proteins covering coronavirus (spike protein) attach to proteins on the outside of cells (cell receptors), like a lock and key, allowing the virus to enter the cell.

The newly-made coronaviruses exit the cell to go on and infect more cells, repeating this same process over and over.

The cell has made all the pieces necessary to make more virus particles.

All of the pieces of the coronavirus are now assembled.

The cell’s ribosomes keep churning out lots of spike, nucleocapsid, membrane, and envelope viral proteins.

The mRNAs copy
mRNA copy
Spike mRNA
Nucleocapsid mRNA
Membrane mRNA
Envelope mRNA

The polyomavirus protein makes copies of the RNA genome and mRNA instructions to make more viral proteins.

Upon entry, the virus sheds its protein coat, releasing the RNA genome in the cell’s cytoplasm. The cell’s ribosomes can’t tell the difference between the virus mRNA and cell mRNA, so it makes a viral protein (polyomavirus) necessary to make copies of the virus.

How mRNA vaccines work

1. Injection of the mRNA vaccine into the cell and find/ribosomes.
2. The mRNAs are the vaccine delivery instructions to make the coronavirus spike protein.
3. The spike protein is produced.
4. Once made, the antibodies wait for the opportunity to attack the spike protein if you are infected by the coronavirus in the future.
5. Your immune cells recognize that your cells shouldn’t be making spike proteins, so they produce antibodies to fight off the perceived invaders.
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Dispelling common myths about mRNA vaccines

The vaccine was developed quickly, isn’t it safe?

Scientists have been developing and using mRNA vaccine technology for decades. Approval processes were not changed for these vaccines. Because the groundwork had already been laid, scientists were able to remove mRNA information from a different virus and shock in coronavirus-specific mRNA for the spike protein. All new vaccines and medications require 3 phases of human trials.

Will the mRNA vaccine change my DNA?

No, mRNA vaccines cannot change your DNA! Why? Because the mRNA in the vaccine cannot and will never enter the nucleus, where your DNA is stored. The ‘Central Dogma’ from above tells mRNA leaves the nucleus to find the ribosomes in the cytoplasm. The vaccine delivers these mRNAs to the cytoplasm to be translated. Once the spike protein is made, it is recycled, or broken down, and cannot be saved for later.

Does the vaccine affect fertility?

No, there are no data to support this myth falsely claiming that a vaccine made from the vaccine may affect the placenta. There is no evidence that COVID-19 mRNA vaccines (including those approved for use that use a (vaccine-produced) affect fertility. In fact, during the Pfizer vaccine trial, 23 women conceived (10 in the vaccine and 11 in the placebo group). Although protective antibodies might be passed to the baby, the mRNA cannot because it is destroyed too quickly.