Vaccine Chat or: How I Learned to Stop Worrying and Love Adaptive Immunity

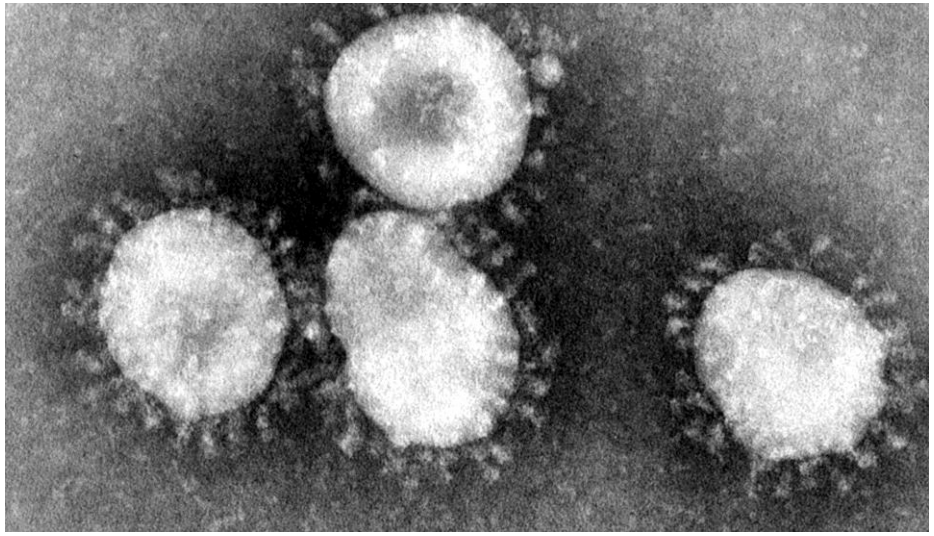
Talk Overview

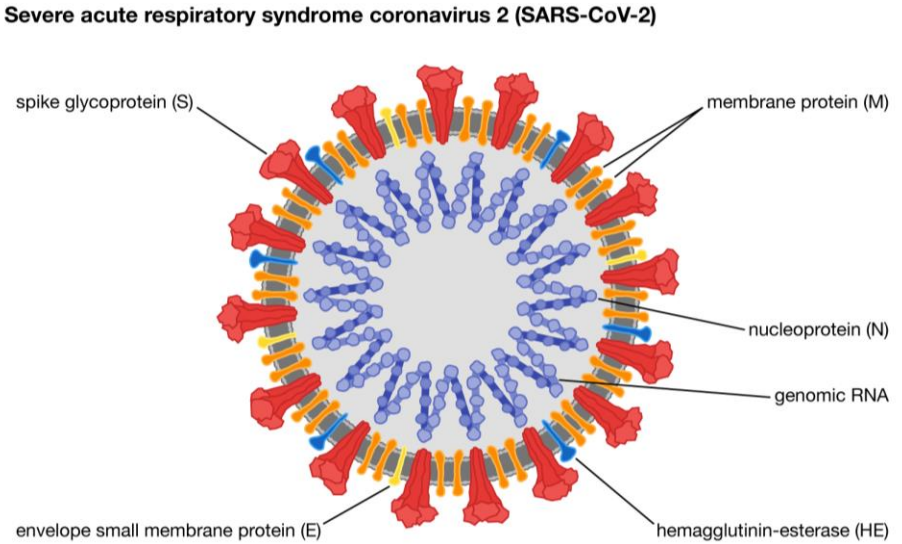
- Background on COVID-19
- COVID-19 Mitigations
- How Vaccines Work
- Types of Vaccines
- COVID-19-Specific Vaccines
- COVID-19 Vaccine Side Effects and a Word on Variants

COVID-19 Background & Mitigations

What is COVID-19?

- **SARS-CoV-2** (Severe Acute Respiratory Syndrome Coronavirus 2) is the causative agent of **COVID-19** (COronaVIrus Disease 2019)
- Coronaviruses were discovered in the 1960s
  - Named for appearance under microscope
  - Make up 30% of viruses that cause the common cold
  - Usually present very mild symptoms, resolve in days





https://en.wikipedia.org/wiki/File:Coronaviruses_004_lores.jpg https://www.britannica.com/science/coronavirus-virus-group

Serious Coronavirus Outbreaks in History

SARS-CoV (Severe Acute Respiratory Syndrome)

- Outbreak occurred Nov. 2002 – July 2003, primarily in China
- ~8000 cases, 774 deaths (9.6% mortality rate)
- No new cases since 2004

MERS-CoV (Middle East Respiratory Syndrome)

- Outbreak began June 2012 in Saudi Arabia
- ~2500 cases worldwide, 862 deaths (34% mortality rate)
- 200-300 new cases every year

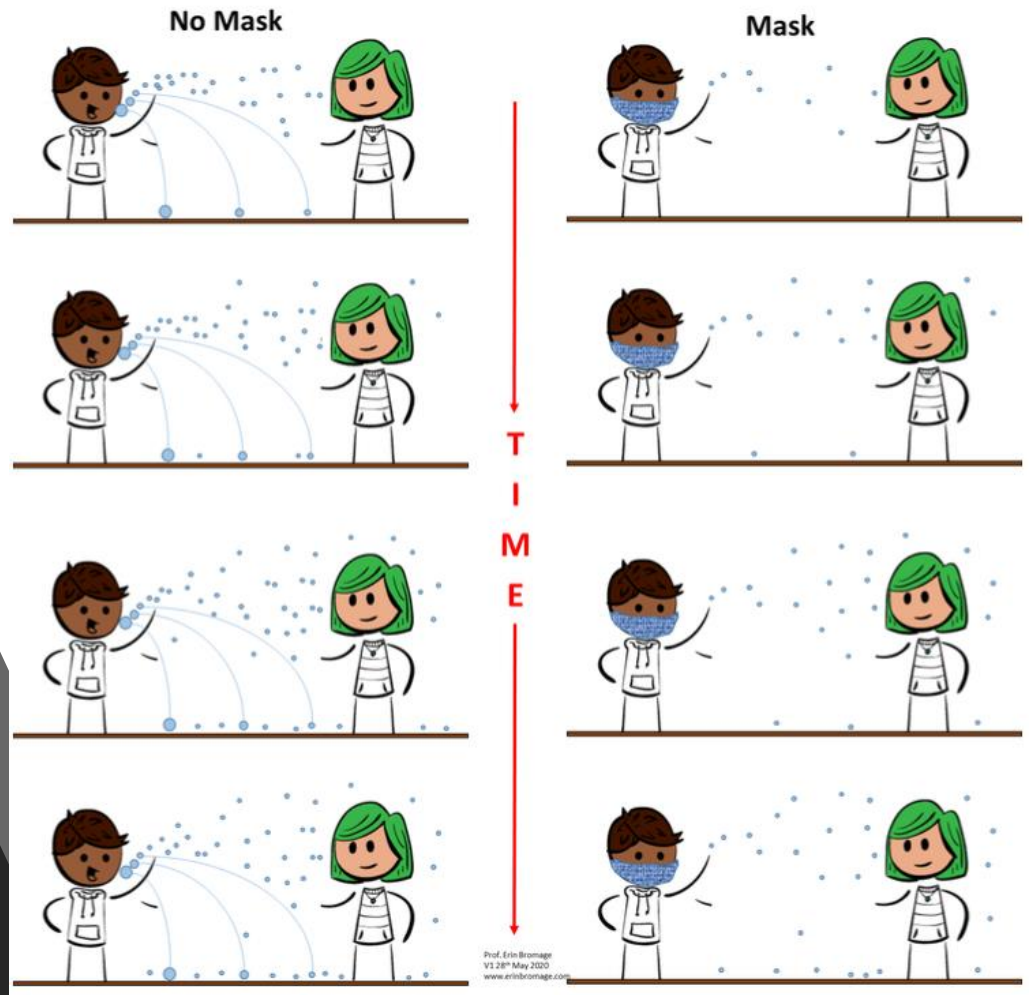
SARS-CoV-2 (COVID-19)

- Outbreak began December 2019 in China
- Millions of worldwide cases, hundreds of thousands of deaths (true mortality rate unknown)
- Thousands of new cases and deaths every day

COVID-19 Mitigations

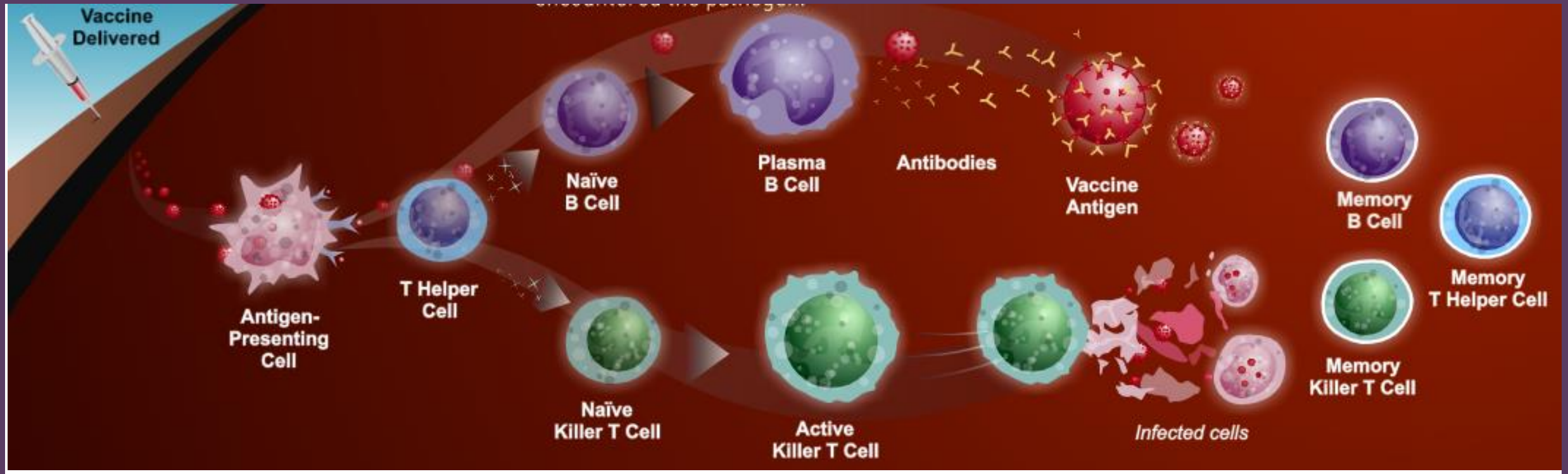
Successful infection = Virus Exposure *x* Time

- Masks
  - Masks can catch virtually all droplets and ~50% of droplet nuclei
  - Masking is a “social contract”
  - Simulations show high rate of mask usage could significantly decrease infections and deaths
- Shared Spaces
  - Minimize time in shared spaces -> minimize chances of viral infection
  - Minimize interactions with large groups
- Hygiene
  - Wash/sanitize hands frequently
  - Do not touch your face with unclean hands!



https://www.erinbromage.com/post/the-risks-know-them-avoid-them

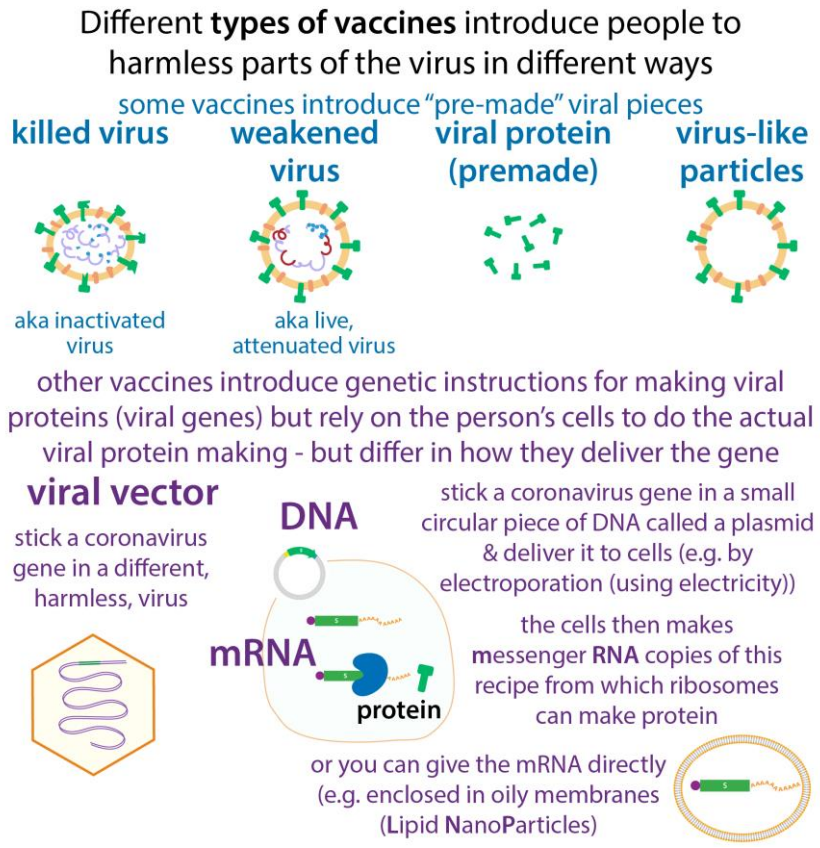
Vaccine Background

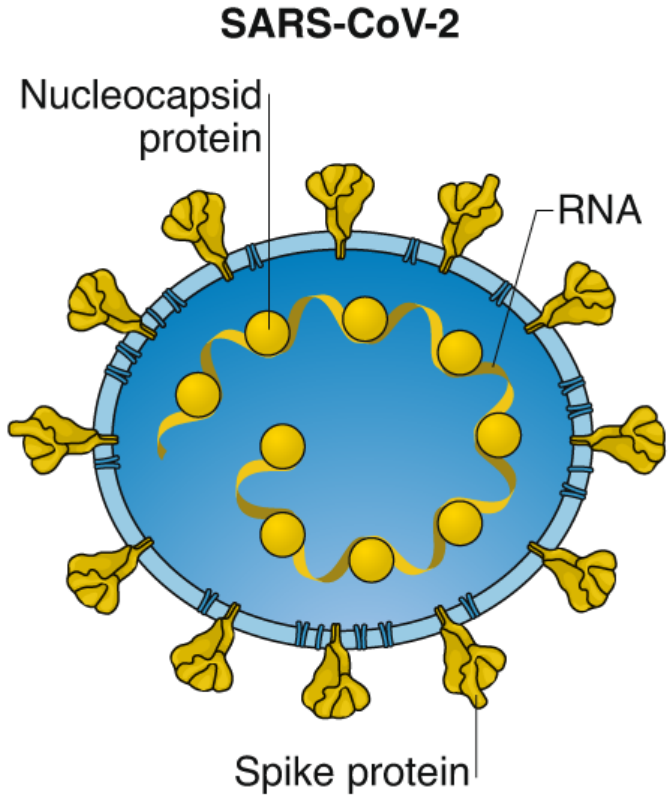


How Do Vaccines Work?

https://www.historyofvaccines.org/content/how-vaccines-work

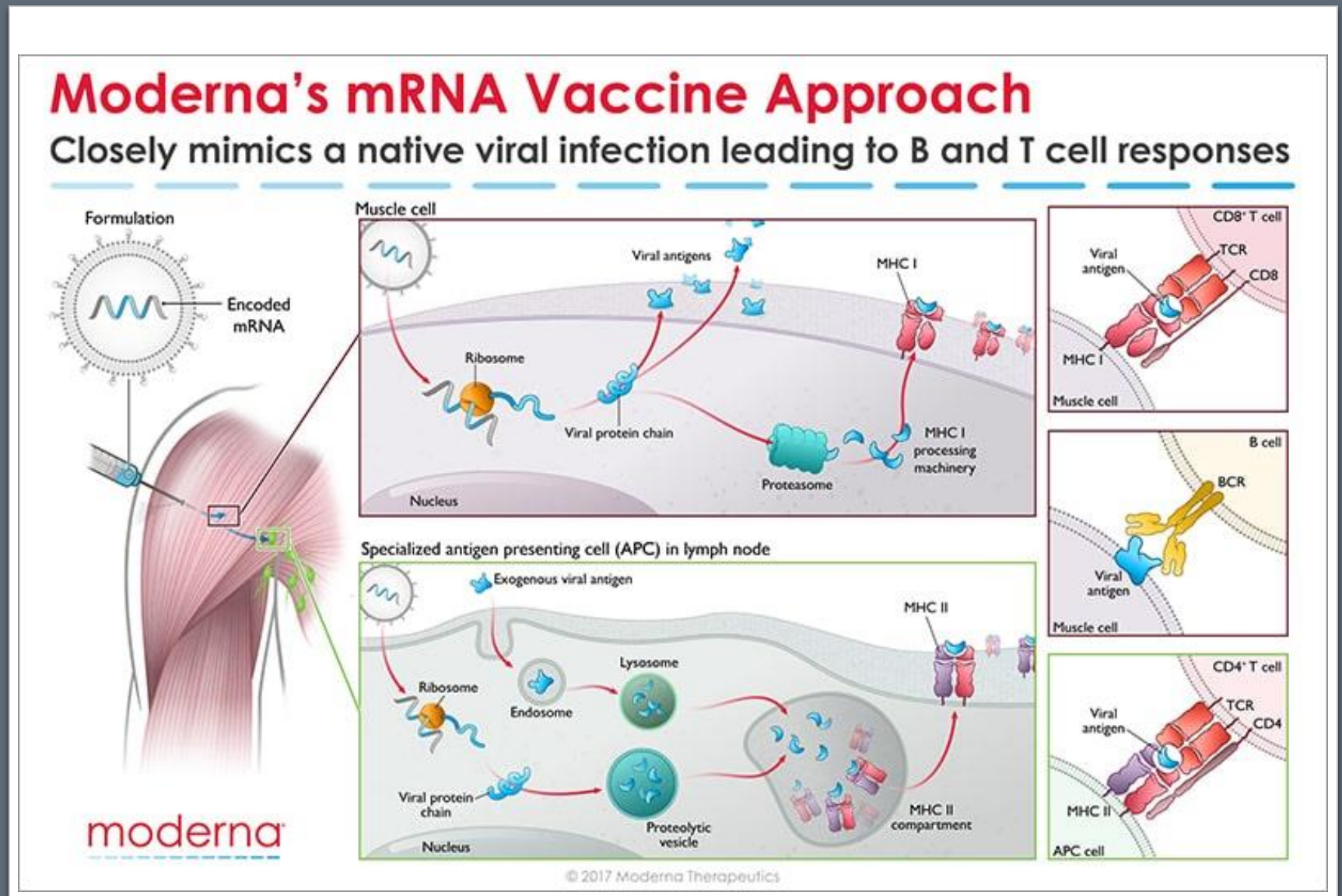
Types of Vaccines





http://thebumblingbiochemist.com/365-days-of-science/vaccine-types-the-hunt-for-a-coronavirus-vaccine/

COVID-19 Vaccines – How They Work, Side Effects, and Efficacy



Specific Example – mRNA-1273 (Moderna – Pfizer's vaccine works the same way)

https://www.research.ox.ac.uk/Article/2020-07-19-the-oxford-covid-19-vaccine

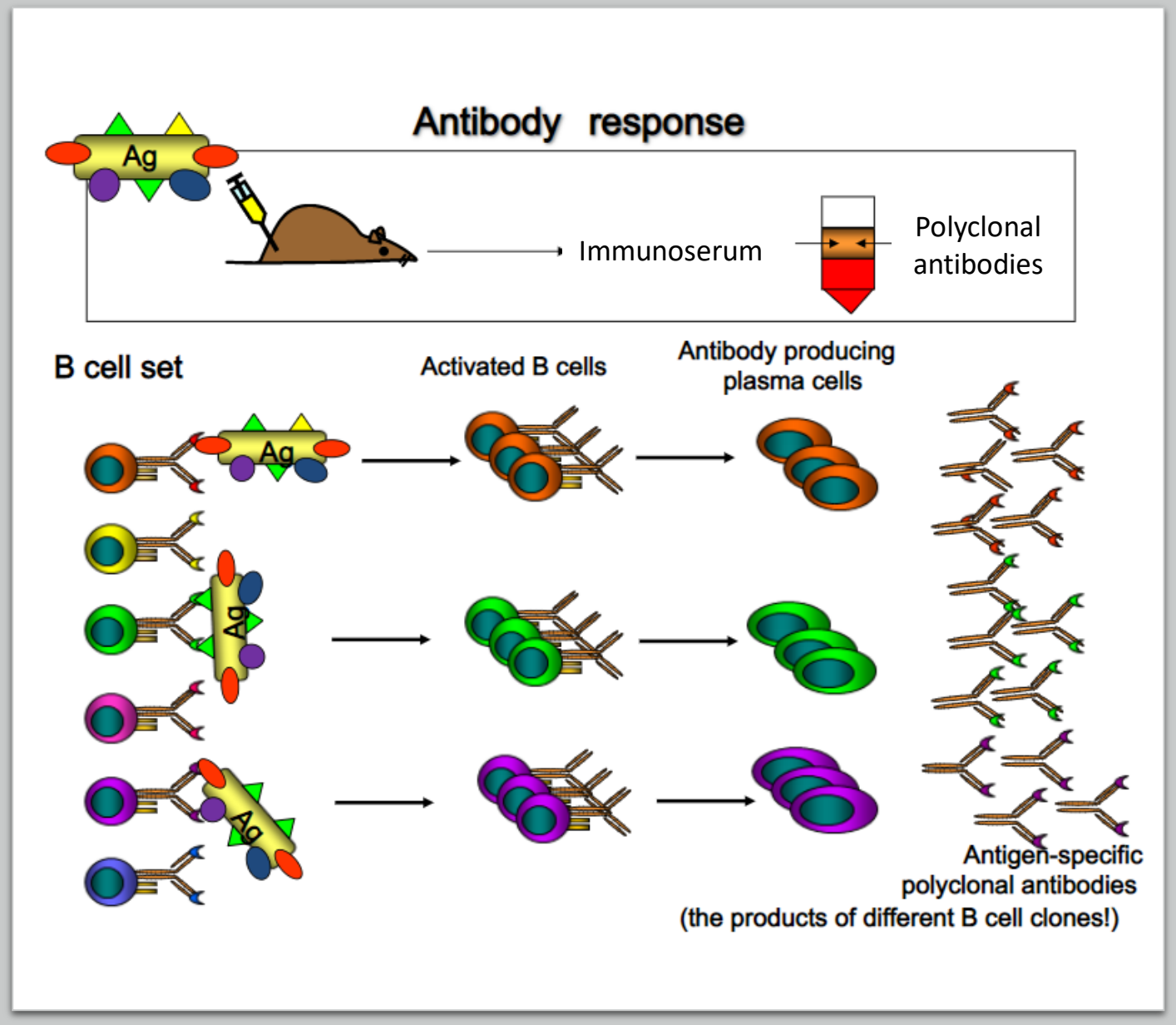
COVID-19 Vaccines Myths

- COVID-19 vaccines can give a person COVID-19
  - Myth: These vaccines contain only a piece of the viral particle, not the full virus; infection with SARS-CoV-2 from the vaccine is not possible
- mRNA vaccine technology is brand-new and was rushed out in an unsafe manner
  - Myth: mRNA vaccines have been under development for ~30 years, and they have been trialed in humans for diseases like rabies, Zika, influenza, and cytomegalovirus
- There is a risk of the genetic material contained within mRNA vaccines of interfering with our DNA/proteins/etc. long-term
  - Myth: Without highly specialized enzymes, RNA cannot interfere with DNA; further, mRNA is transient, and both it and the protein it encodes are degraded by our cells in a number of days
- It’s a bad thing when vaccine trials are paused to examine adverse events
  - Myth: All clinical trials have the potential to produce adverse events; it would be worrying if the trials were NOT paused to examine them

Vaccine Side Effects?

- Both Pfizer and Moderna have released safety and efficacy data to the FDA, which released it to the public
- Each vaccine will require two doses spaced roughly 3-4 weeks apart
  - Booster is required to see ~10-fold increase in antibodies against SARS-CoV-2
  - 95% efficacy for protection at Day 28 post-first dose (assuming two doses given)
- Those who are older (>55) tend to experience less/more mild side effects than those who are younger
- SEVERE side effects are vanishingly rare, like other vaccines (e.g. flu)
- Side effects typically last 12-24 hours and resolve rapidly

Side Effect Comparison	Pfizer (BNT162b2)	Moderna (mRNA-1273)
Side Effect #1 (**Dose 1/Dose 2/Placebo 2**)	Fatigue (**47.4%/59.4%/22.8%**)	Fatigue (**38.5%/67.6%/24.5%**)
Side Effect #2 (**Dose 1/Dose 2/Placebo 2**)	Headache (**41.9%/51.7%/24.1%**)	Headache (**35.4%/62.8%/25.4%**)
Side Effect #3 (**Dose 1/Dose 2/Placebo 2**)	Muscle Pain (**21.3%/37.3%/8.2%**)	Chills (**9.2%/48.3%/5.9%**)
Side Effect #4 (**Dose 1/Dose 2/Placebo 2**)	Chills (**14.0%/35.1%/3.8%**)	Joint Pain (**16.6%/45.2%/10.5%**)
Side Effect #5 (**Dose 1/Dose 2/Placebo 2**)	Joint Pain (**11.0%/21.9%/5.2%**)	Nausea (**9.4%/21.3%/7.3%**)



SARS-CoV-2 Variants and the Vaccines

Rhoda Ellis via SlidePlayer

Questions?