

SARS-CoV-2 and **COVID-19**

송명수, 이하연

Table of Contents

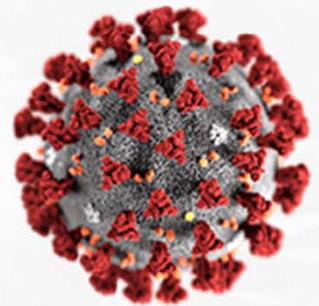
1. What is Virus?

2. Corona Virus

3. COVID-19

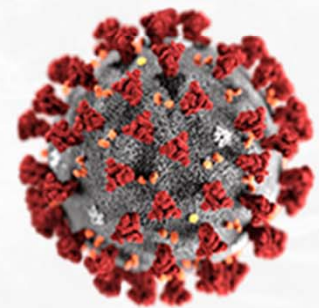
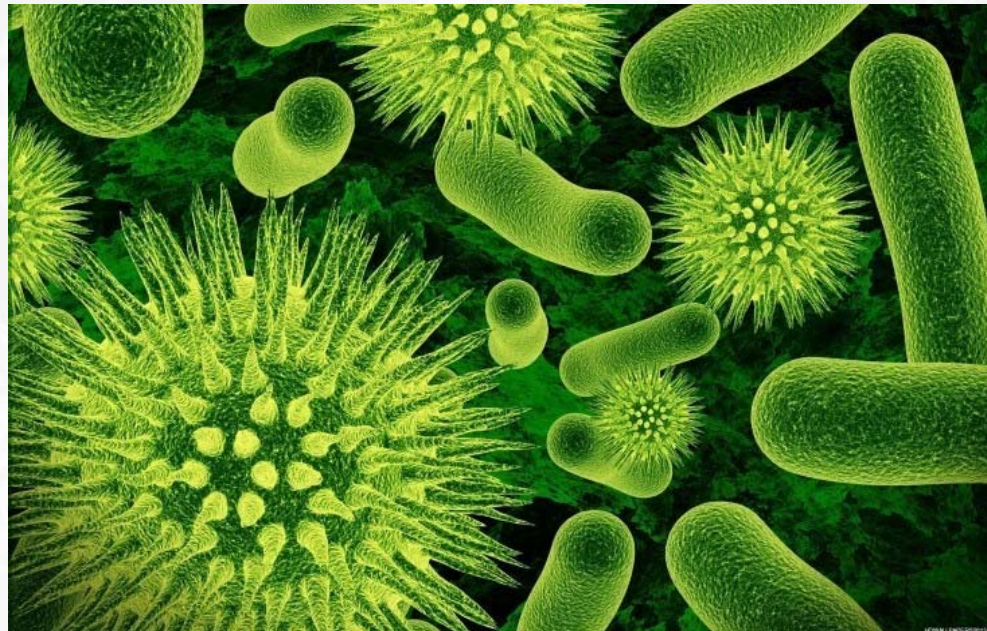
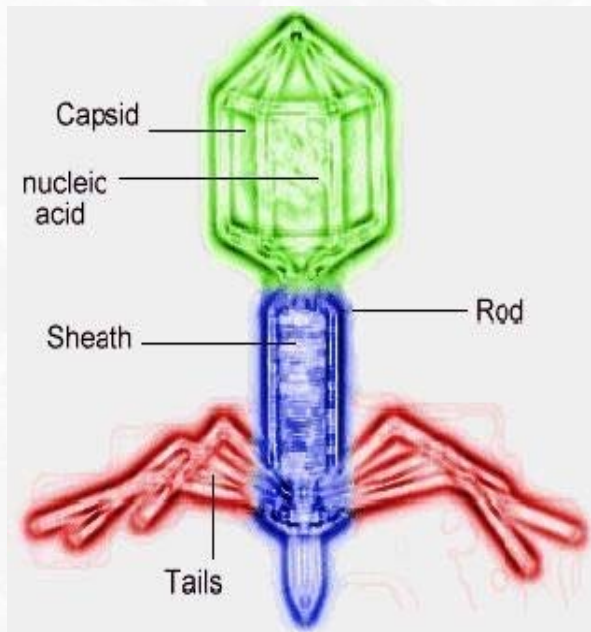
4. Treatment for COVID-19

5. Vaccines for COVID-19



What Is Virus?

- Infectious particle
- Have both animate and inanimate features



What Is Virus?

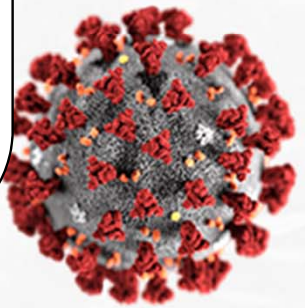
- Features of virus

Animate features

- Have genome
- Self-organization process and reproduction (only in the host cells)
- Mutagenic
- evolvable

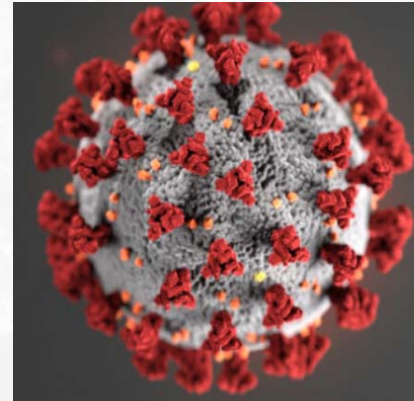
Inanimate features

- Don't have cellular organisms.
- Unable to metabolize by oneself.

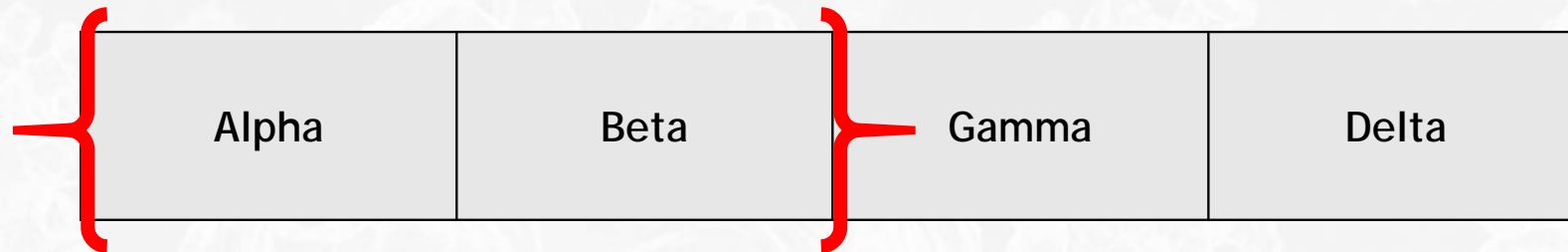


Corona Virus

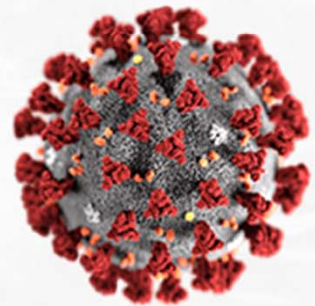
- Named for its crown-shaped spike on its surface



- There are four types of corona virus



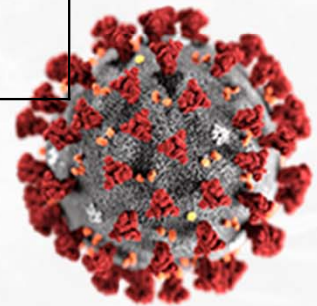
Infection in Humans



Corona Virus

- There are seven types of viruses that can infect people

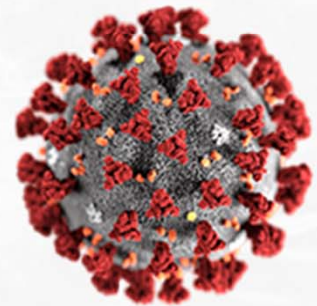
229E (alpha)	NL63 (alpha)	OC43 (beta)	HKU1 (beta)
MERs-CoV(beta)	SARS-CoV(beta)	SARS-Cov-2 (COVID-19) (beta)	



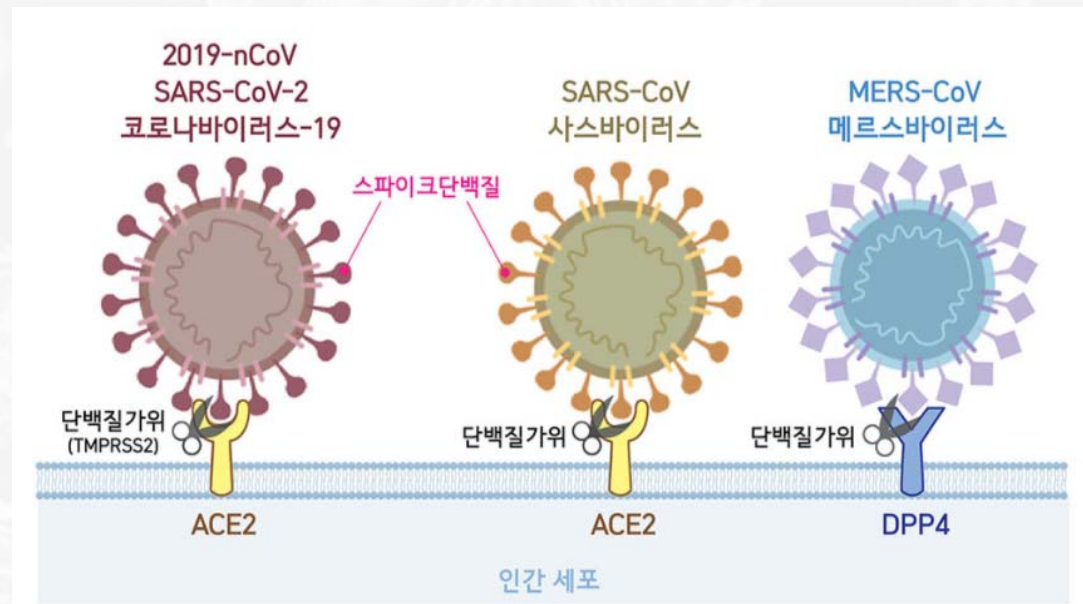
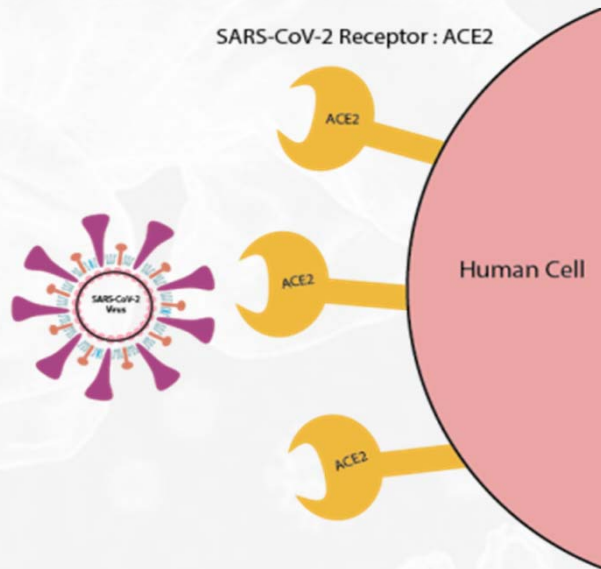
Corona Virus

■ 코로나바이러스 분류표

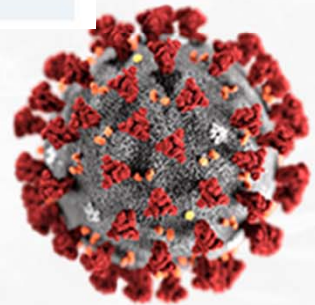
속(genus)	사람-코로나 바이러스	사람 이외에 감염하는 코로나 바이러스
알파-코로나 바이러스 (alphacoronavirus)	229E, NL63,	돼지 유행성 설사 바이러스(porcine epidemic diarrhea virus : PEDV), (돼지) 전염성 위장염 바이러스 (transmissible gastroenteritis virus : TGEV), 개코로나 바이러스(canine coronavirus : CCoV), 고양이 코로나 바이러스 (feline coronavirus : FCoV), Miniopterus bat(박쥐) coronavirus 1, Miniopterus bat(박쥐) coronavirus HKU8, Rhinolophus bat(박쥐) coronavirus HKU2, Scotophilus bat(박쥐) coronavirus 512
베타-코로나 바이러스 (betacoronavirus)	OC43, HKU1, SARS-CoV, MERS-CoV	돼지 혈구 응집성뇌척수염 바이러스(porcine hemagglutinating encephalomyelitis virus : PHEV), 우코로나 바이러스(bovine coronavirus : BCoV), 말코로나 바이러스 (equine coronavirus : EqCoV), 쥐코로나 바이러스(murine coronavirus : MuCoV), Tylonycteris bat(박쥐) coronavirus HKU4, Pipistrellus bat(박쥐) coronavirus HKU5, Rousettus bat(박쥐) coronavirus HKU9
감마-코로나 바이러스 (gammacoronavirus)	없음	새코로나 바이러스(Avian coronavirus), 흰색 돌고래(Beluga whale)-코로나 바이러스 SW1
델타-코로나 바이러스 (deltacoronavirus)	없음	제주작박구리(Bulbul)-코로나 바이러스 HKU11, 개동지빠귀(Thrush)-코로나 바이러스 HKU12, 킨바라(Munia)-코로나 바이러스 HKU13



Corona Virus

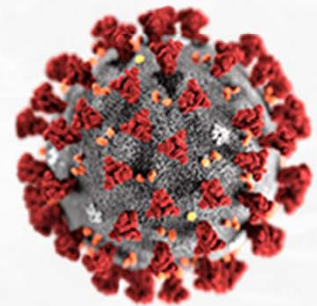


Receptor ACE2 (Human cell)
+ Spike protein (SARS-CoV-2 Virus)
= Get infected !

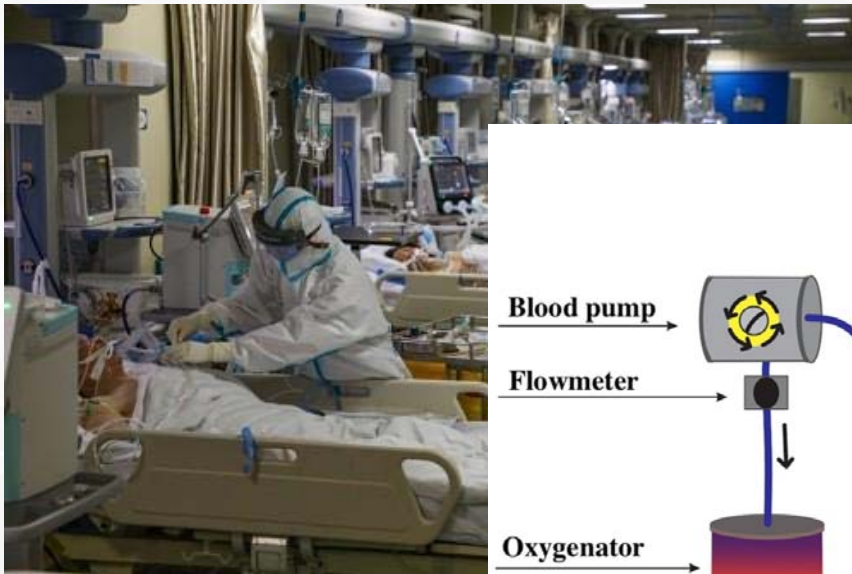


COVID-19

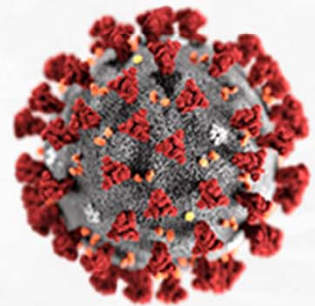
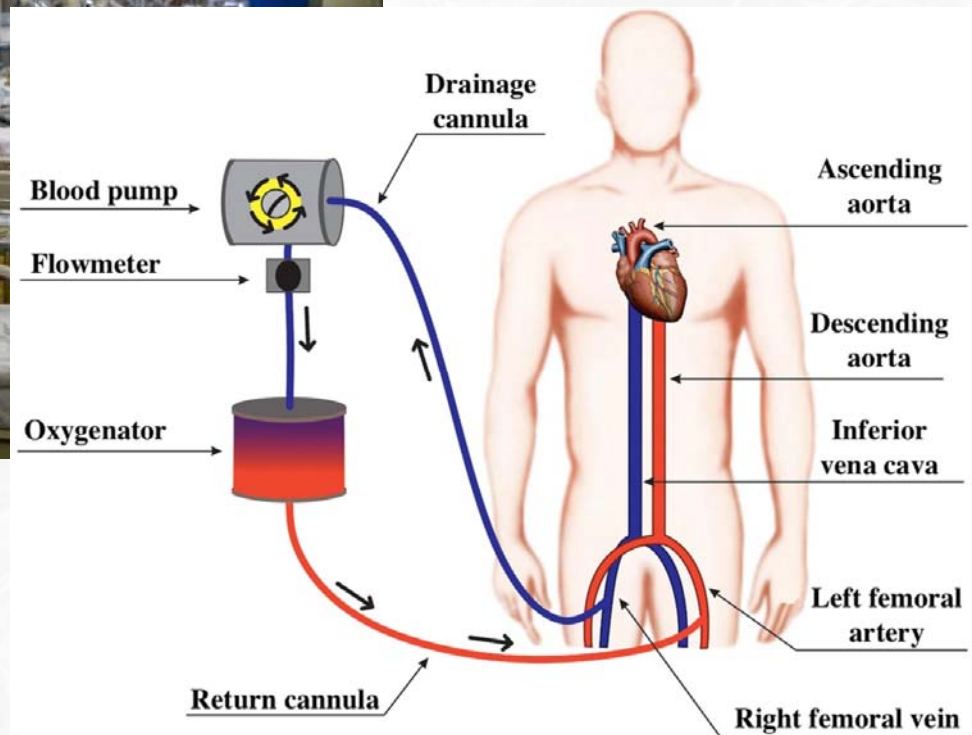
Pathogen	SARS-Cov-2
Infectious source	Assuming it was an animal
Infection route	Animal -> People -> People
Infection symptom	Fever, respiratory symptoms, pneumonia, phlegm, sore throat, headache , etc.
Incubation period	2 days ~ 14 days
Fatality rate	The global mortality rate is about 3.4% (Most of them are elderly, patients with impaired immune function, and patients with underlying diseases.)
Preventive method	Washing hands, disinfect and ventilate the surrounding environment
Treatment method	No antiviral drugs



COVID-19



Extracorporeal Membrane Oxygenation

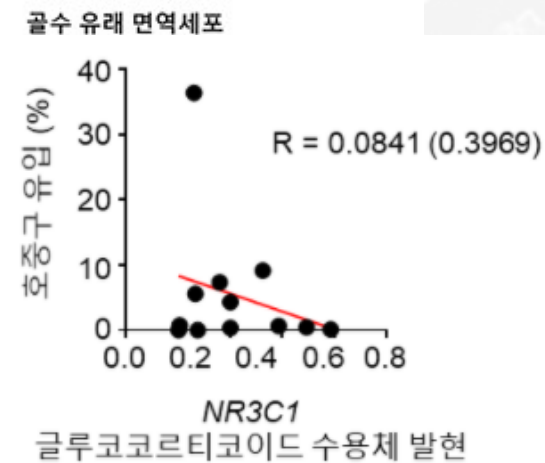
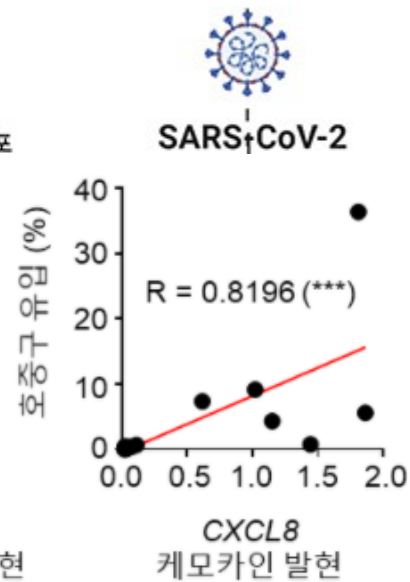
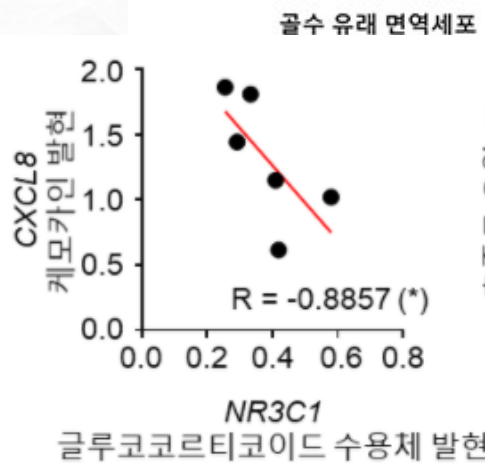


COVID-19

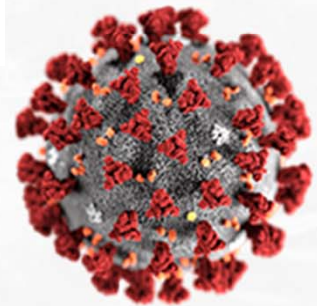
Mild case 경증 환자

중증 환자 Serious patient

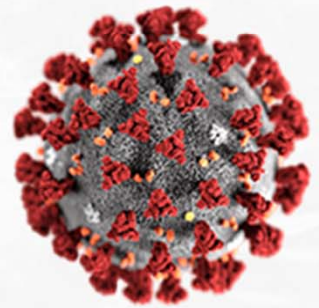
Glucocorticoid



id

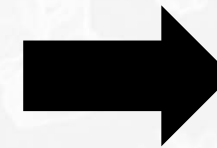
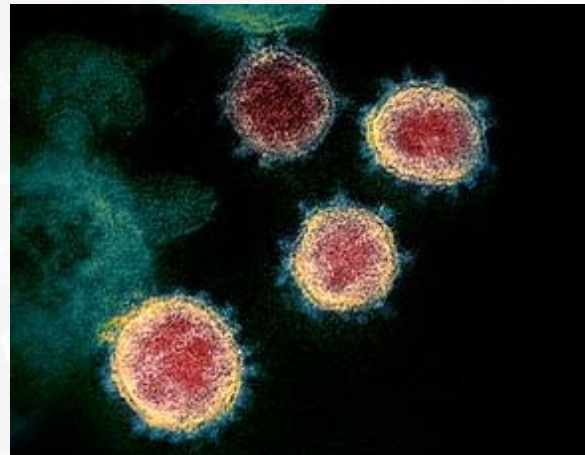
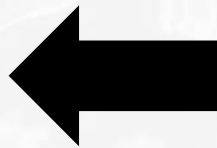


How do people deal with COVID-19?



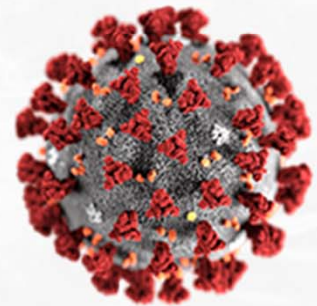
Countermeasure of COVID-19

Before
infection

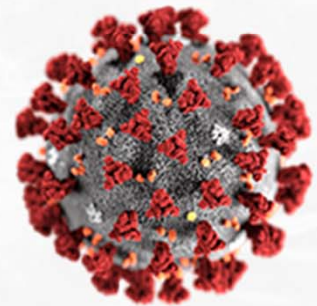
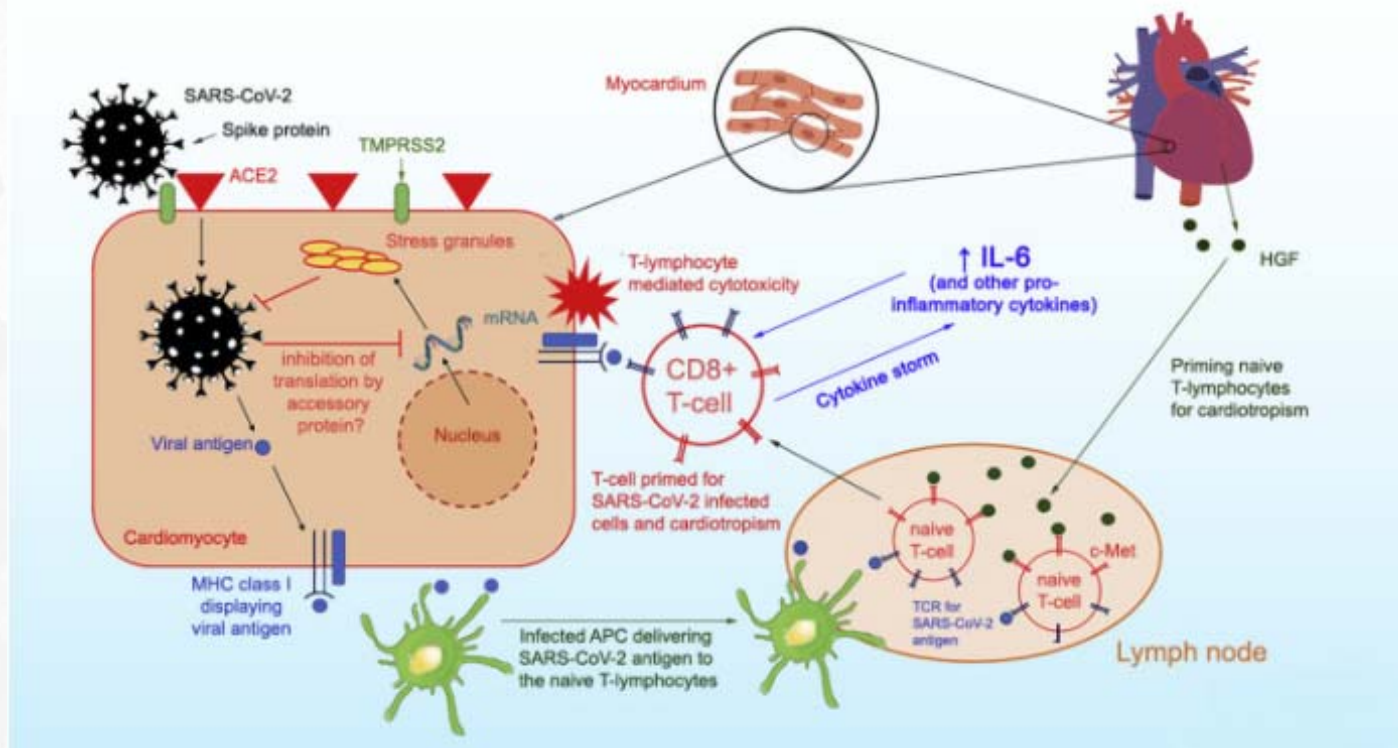


After
infection

Both cases use our immune system



Immune Response to SARS-CoV-2



<[https://www.heartrhythmjournal.com/article/S1547-5271\(20\)30422-7/fulltext](https://www.heartrhythmjournal.com/article/S1547-5271(20)30422-7/fulltext)>

Treatment of COVID-19 After infection

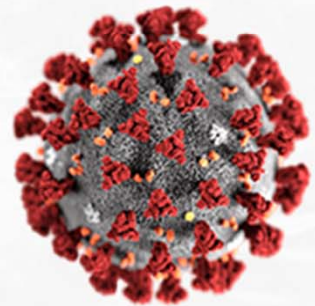
Currently, there is no obvious therapeutic agent

Drug Treatment

- Antiviral agents (e.g. Lopinavir, Remdesivir)
- Antibody

Symptomatic Therapy

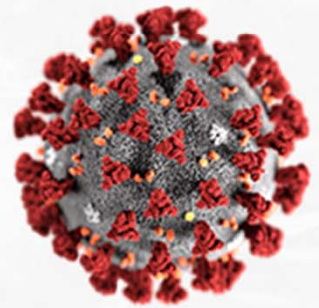
- ECMO
- Immune suppressant drug
(e.g. Dexamethasone, antibiotics)



Before COVID-19 Infection

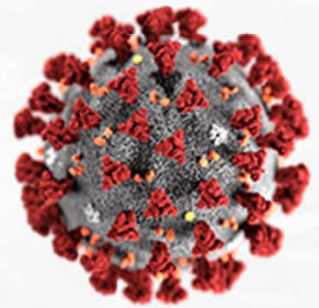


Vaccine !

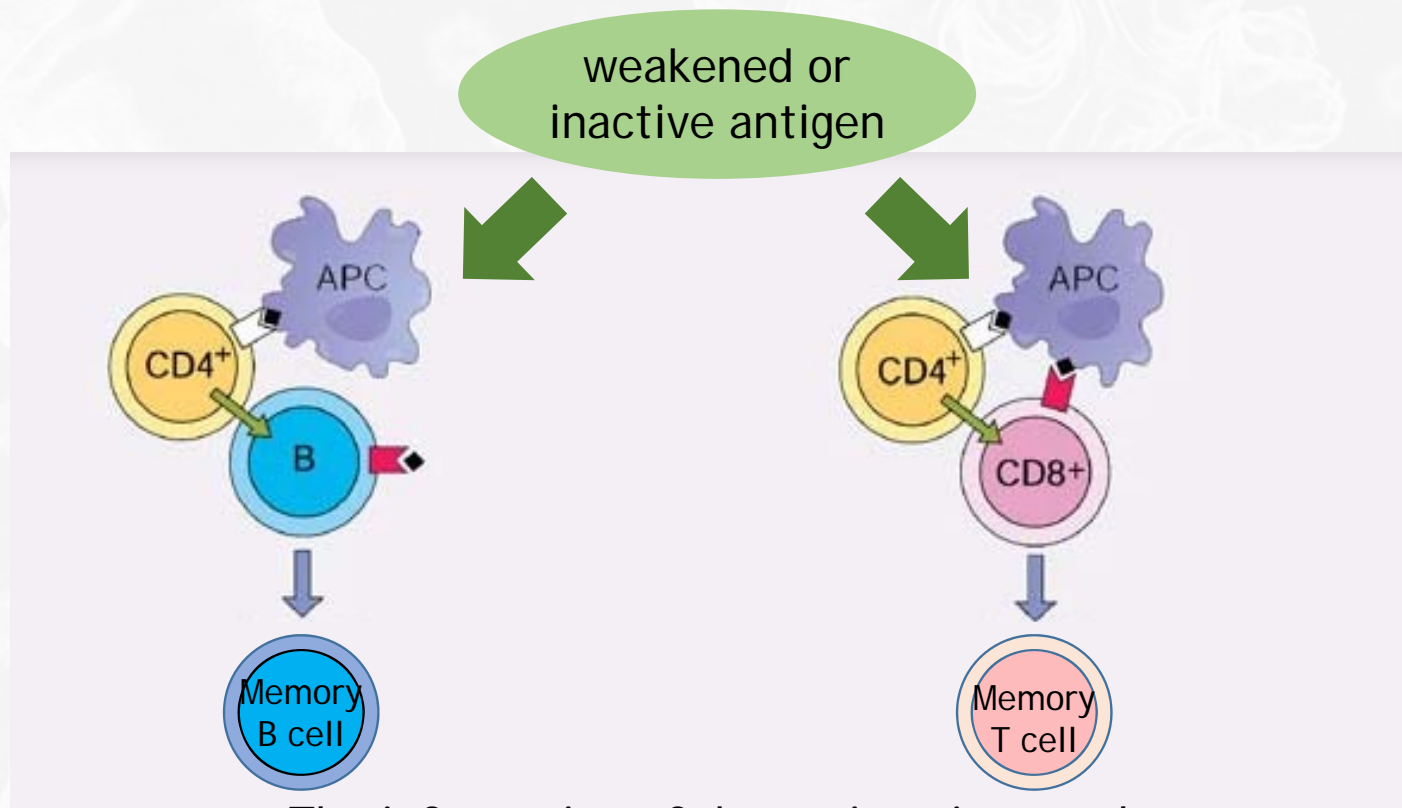


What is Vaccine?

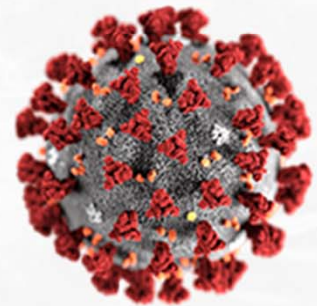
- Vaccine is related to our adaptive immunity
- Composed of weakened or inactive antigen



The Principle of Vaccine



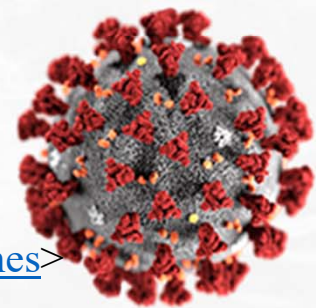
The information of the antigen is stored,
and Long-term immunity is formed



Candidate Vaccines for COVID-19

10 CANDIDATE VACCINES IN PHASE III CLINICAL EVALUATION	VACCINE PLATFORM	LOCATION OF PHASE III STUDIES
Sinovac	Inactivated virus	Brazil
Wuhan Institute of Biological Products / Sinopharm	Inactivated virus	United Arab Emirates
Beijing Institute of Biological Products / Sinopharm	Inactivated virus	China
University of Oxford / AstraZeneca	Viral vector *	United States of America
CanSino Biological Inc. / Beijing Institute of Biotechnology	Viral vector *	Pakistan
Gamaleya Research Institute	Viral vector	Russia
Janssen Pharmaceutical Companies	Viral vector	USA, Brazil, Colombia, Peru, Mexico, Philippines, South Africa
Novavax	Protein subunit	The United Kingdom
Moderna / NIAID	RNA	USA
BioNTech / Fosun Pharma / Pfizer	RNA	USA, Argentina, Brazil

<<https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines>>



Viral Vector Vaccine

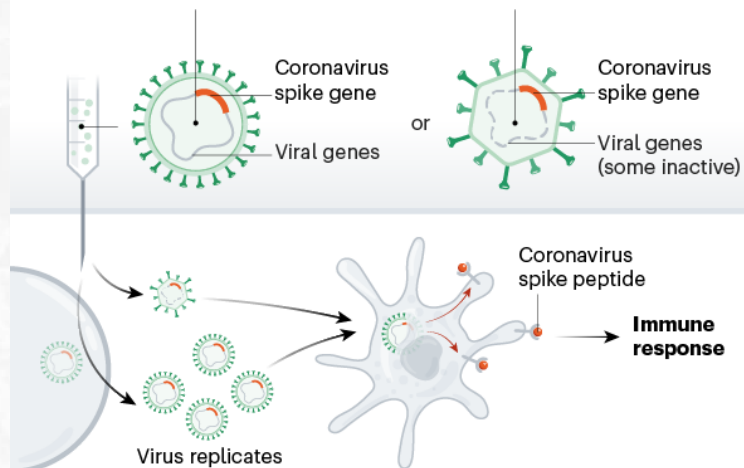
VIRAL-VECTOR VACCINES

Replicating viral vector (such as weakened measles)

The newly approved Ebola vaccine is an example of a viral-vector vaccine that replicates within cells. Such vaccines tend to be safe and provoke a strong immune response. Existing immunity to the vector could blunt the vaccine's effectiveness, however.

Non-replicating viral vector (such as adenovirus)

No licensed vaccines use this method, but they have a long history in gene therapy. Booster shots can be needed to induce long-lasting immunity. US-based drug giant Johnson & Johnson is working on this approach.



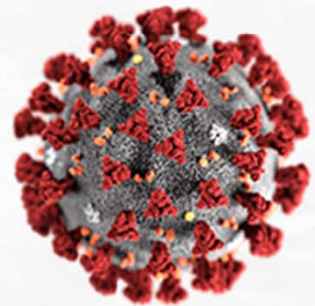
©nature

Advantage

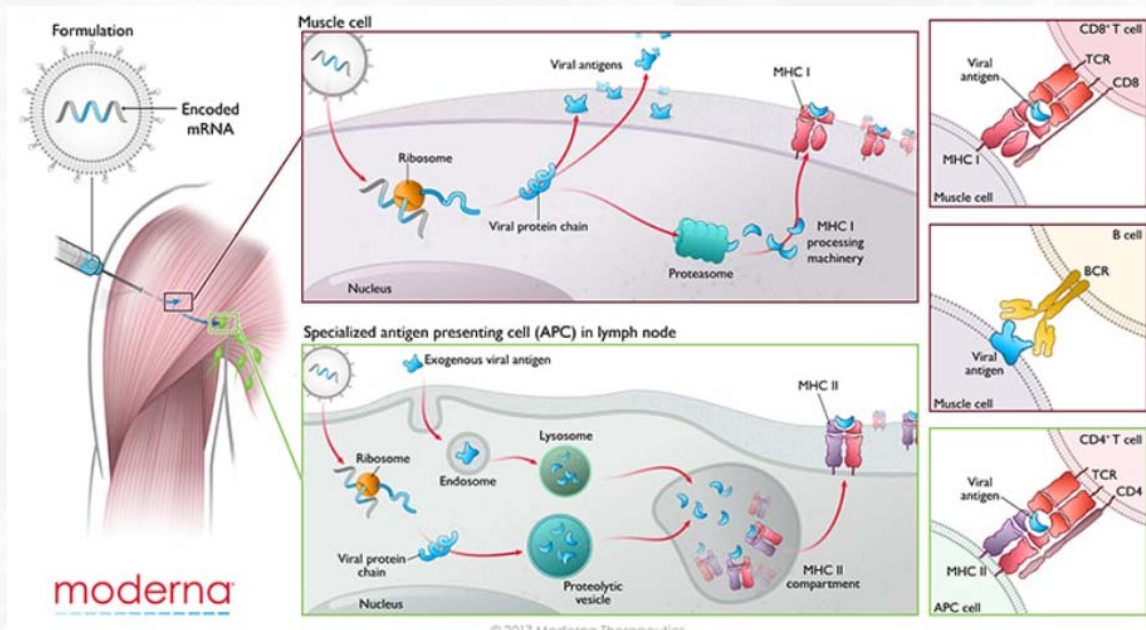
- High safety
- High stability

Disadvantage

- Immunity to the vector can be formed
- Need cells to manufacture



RNA(mRNA) Vaccine



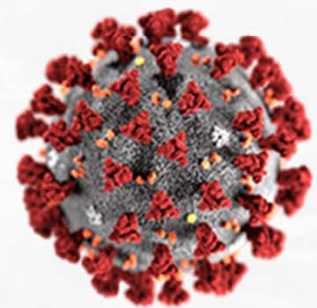
<https://www.modernatx.com/moderna-blog/shedding-light-our-prophylactic-vaccines-moa>

Advantage

- Don't require cell culture
- Short manufacturing time
- High safety

Disadvantage

- Low stability
- Inflammation
- Blood coagulation



Some COVID-19 Vaccine

- Modified RNA vaccine
→ use mRNA(BNT162b2)



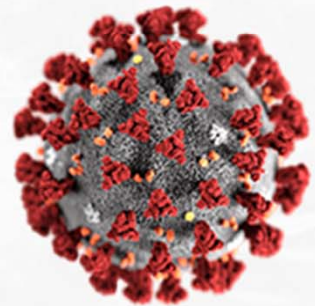
- Vaccine efficacy: 95% ($p < 0.0001$)
→ 170 first confirmed cases
(Placebo: 162 vs Vaccine: 8)

- Modified RNA vaccine
→ use mRNA-1273



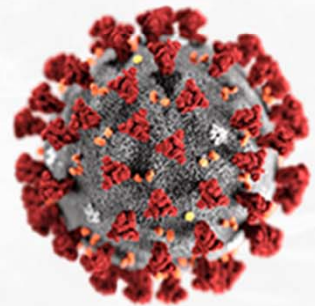
- Vaccine efficacy: 94.5% ($p < 0.0001$)
→ 95 first confirmed cases (Placebo:
90 vs Vaccine: 5)

-
- No severe safety concerns
 - Fever, Swelling rarely occurs



Reference

- Pardi. N, Hogan. M. J, Porter. F. W, Weissman. D, “mRNA vaccine – a new era in vaccinology”. *Nature*. 12 Jan 2018. Web. <<https://www.nature.com/articles/nrd.2017.243#Sec2>>
- Moderna, “Shedding light on our prophylactic vaccines’ mechanism of action”. 26 Sep 2017. <<https://www.modernatx.com/moderna-blog/shedding-light-our-prophylactic-vaccines-moa>>
- Pfizer, “What Makes an RNA Vaccine Different From a Conventional Vaccine?” 5 May 2020. <<https://www.breakthroughs.com/advancing-medical-research/what-makes-rna-vaccine-different-conventional-vaccine>>
- Pfizer, “**A Phase 1/2/3 Study to Evaluate the Safety, Tolerability, Immunogenicity, and Efficacy of RNA Vaccine Candidates Against COVID-19 in Healthy Individuals**”
- Moderna, “A Phase 3, Randomized, Stratified, Observer-Blind, Placebo-Controlled Study to Evaluate the Efficacy, Safety, and Immunogenicity of mRNA-1273 SARS-CoV-2 Vaccine in Adults Aged 18 Years and Older”
- “Immune system”, Wikipedia. <https://en.wikipedia.org/wiki/Immune_system>
- “Vaccine”, Wikipedia. <<https://en.wikipedia.org/wiki/Vaccine>>
- “SARS-CoV-2”, Wikipedia <<https://ko.wikipedia.org/wiki/SARS-CoV-2>>
- WHO, <<https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines>>



Thank you !

