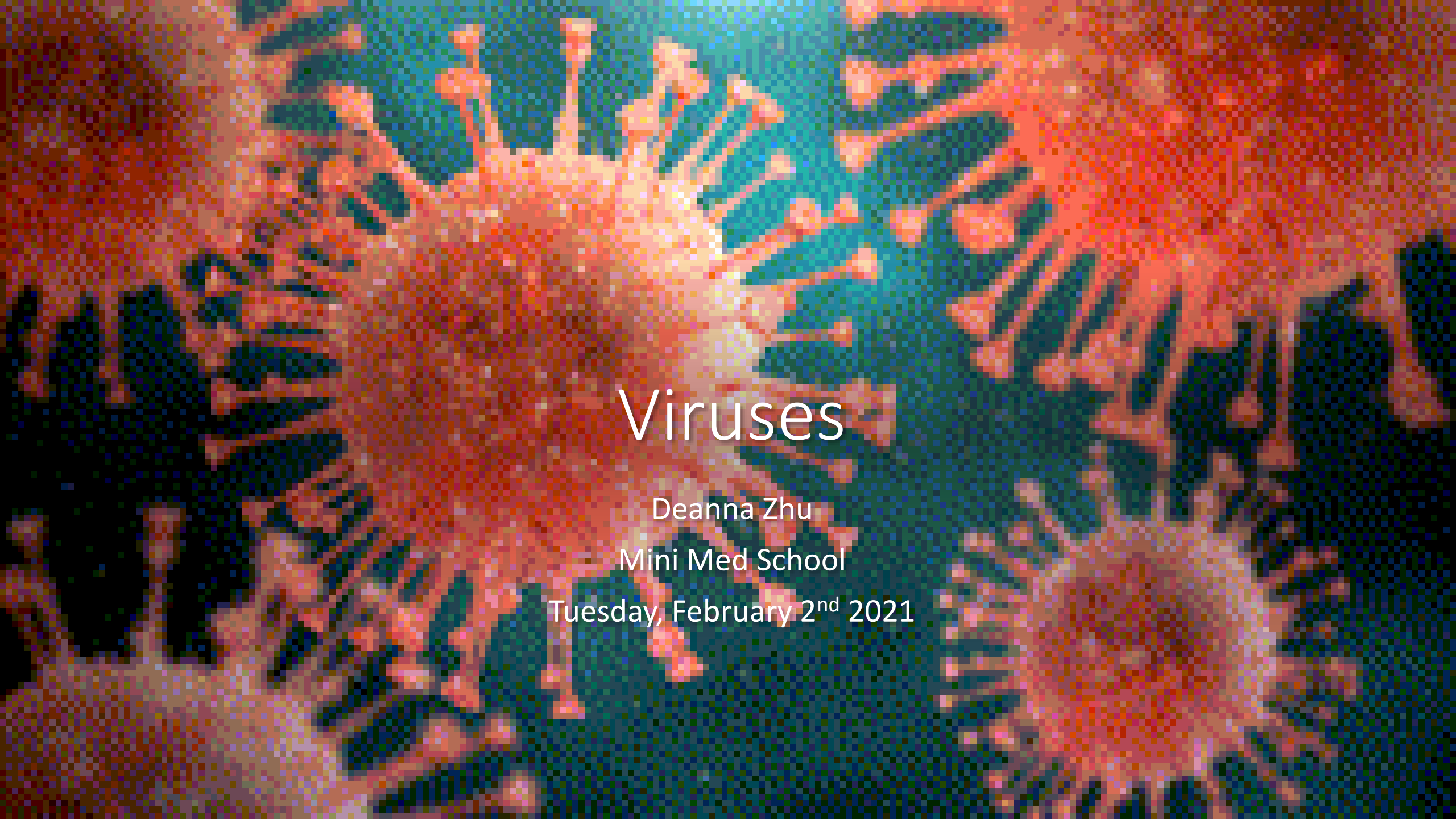


Viruses

Deanna Zhu

Mini Med School

Tuesday, February 2nd 2021

Goals of this talk

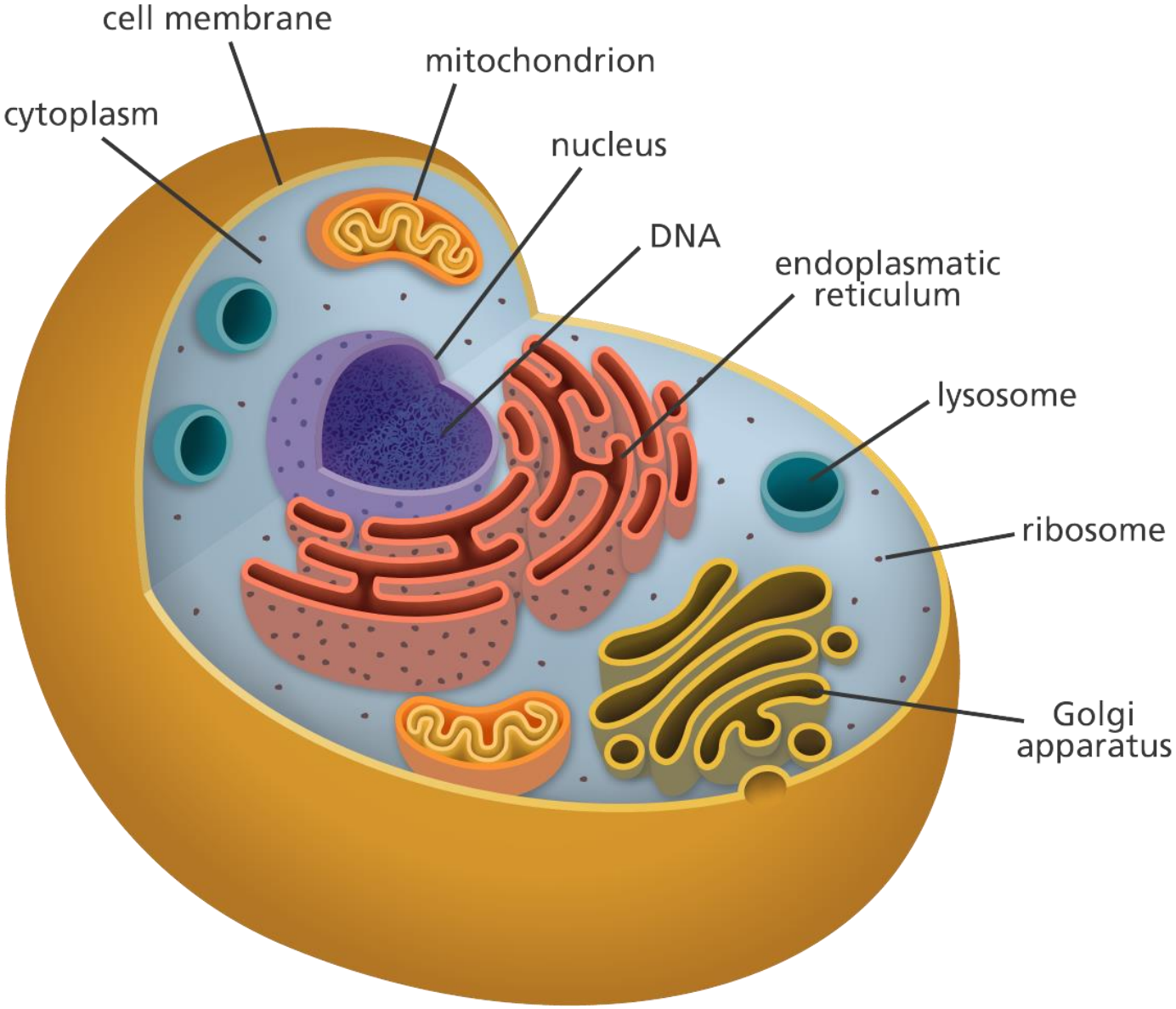
- To be familiar with characteristics of viruses
- To understand the viral replication cycle
- To know the ecological constraints on viruses and how they persist in populations
- Consider how to prevent and treat viral diseases

Some background

What is a cell?

- “Building block” of all living things
- Bound by a membrane

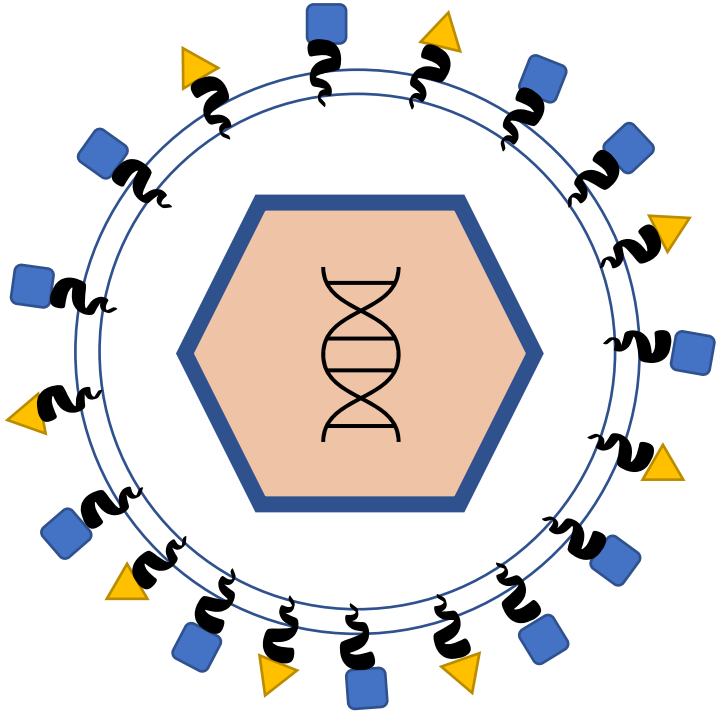
- DNA (genetic code) is located in the nucleus
- Cell machinery (organelles) processes the genetic code to build proteins and other molecules necessary for life



https://www.thinglink.com/scene/843571408968613890

What is a virus?

Viruses are non-living, infectious agents that replicate inside a living cell



They are made of
1) Genetic material
2) A capsid, or protein coat

Sometimes contain
3) Envelope – two layers of lipids with proteins on outer membrane

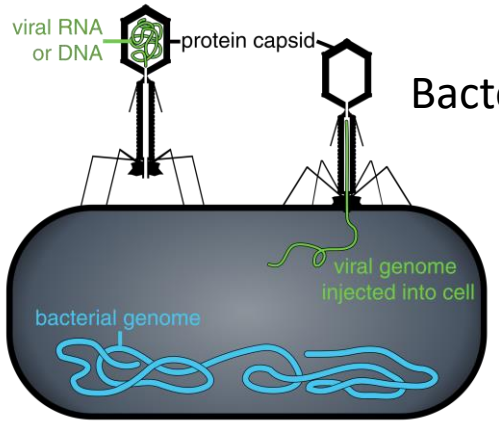
Viruses are amazingly diverse

Tobacco mosaic virus on orchid

VIRUSES THAT INFECT FUNGI

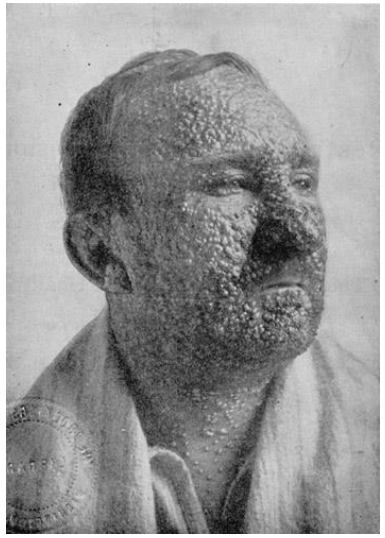
MICHAEL HOLLINGS AND OLWEN M. STONE

Glasshouse Crops Research Institute, Littlehampton, Sussex, England



Bacteriophage

Rinderpest outbreak 18th century Netherlands, Jan Smit (II) 1745



Smallpox victim, 1912, Illinois

Wikimedia commons

(Some) ways to describe and categorize viruses

- Structure
- Genome
- Genome replication
- Hosts
- Tropism

(Some) ways to describe and categorize viruses

- Structure
  - Enveloped or not
  - Shape
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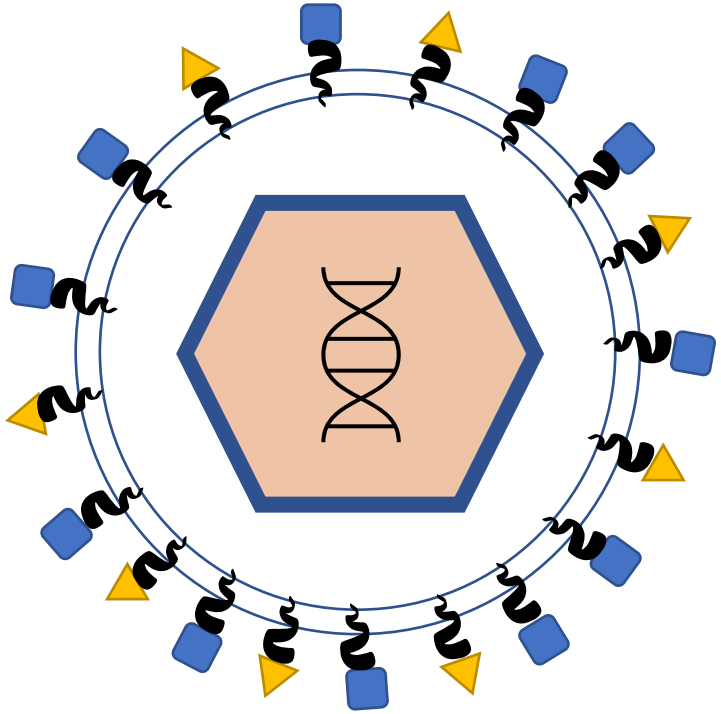

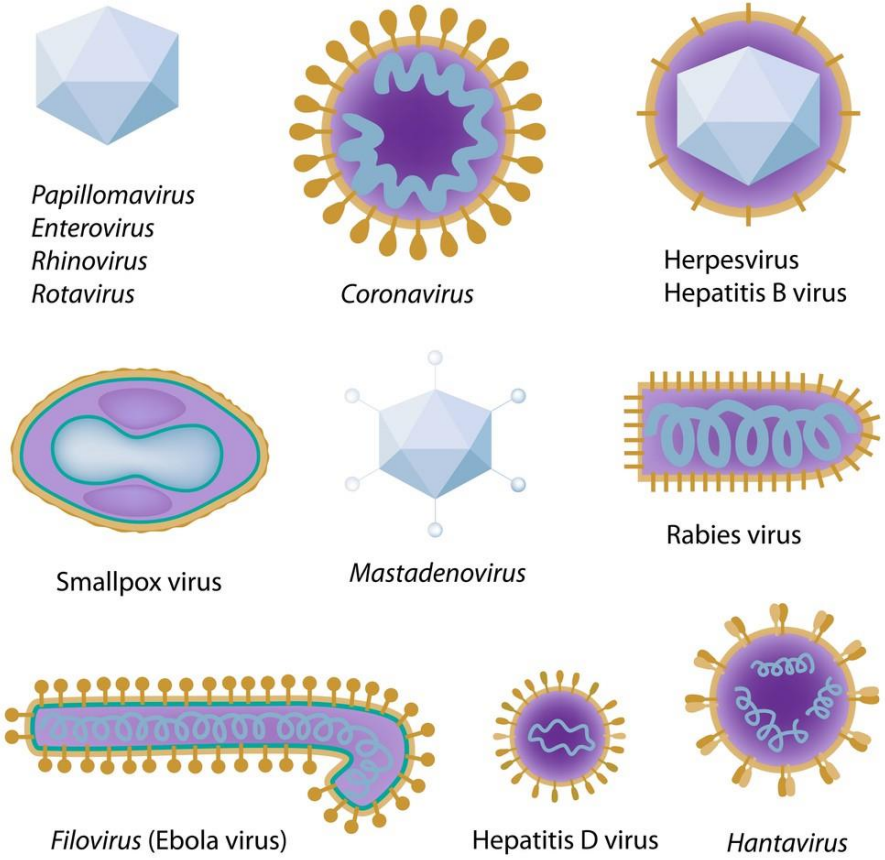

(Some) ways to describe and categorize viruses

- Structure
  - Enveloped or not
  - Shape
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  - DNA or RNA
  - Double or single stranded
- Genome replication
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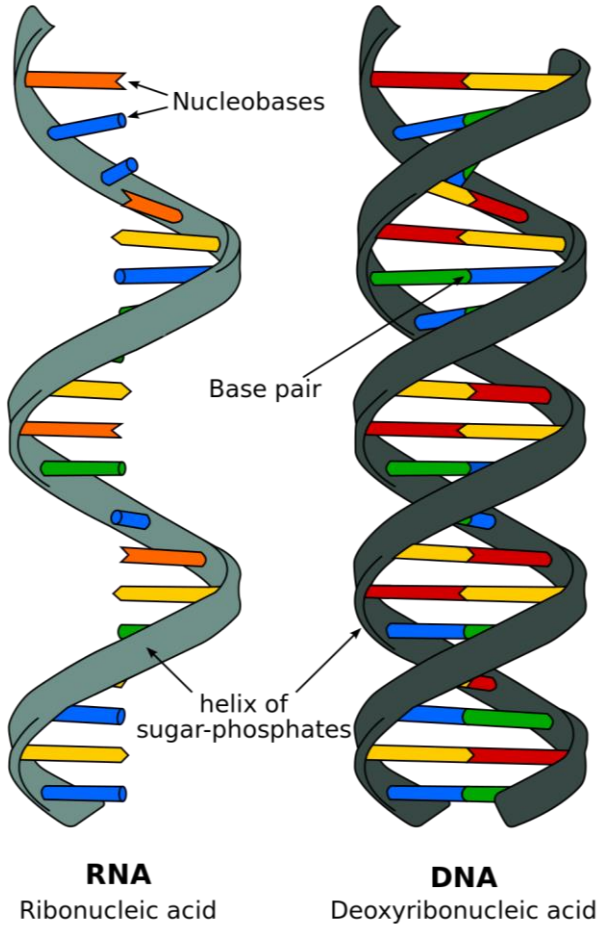
- Tropism



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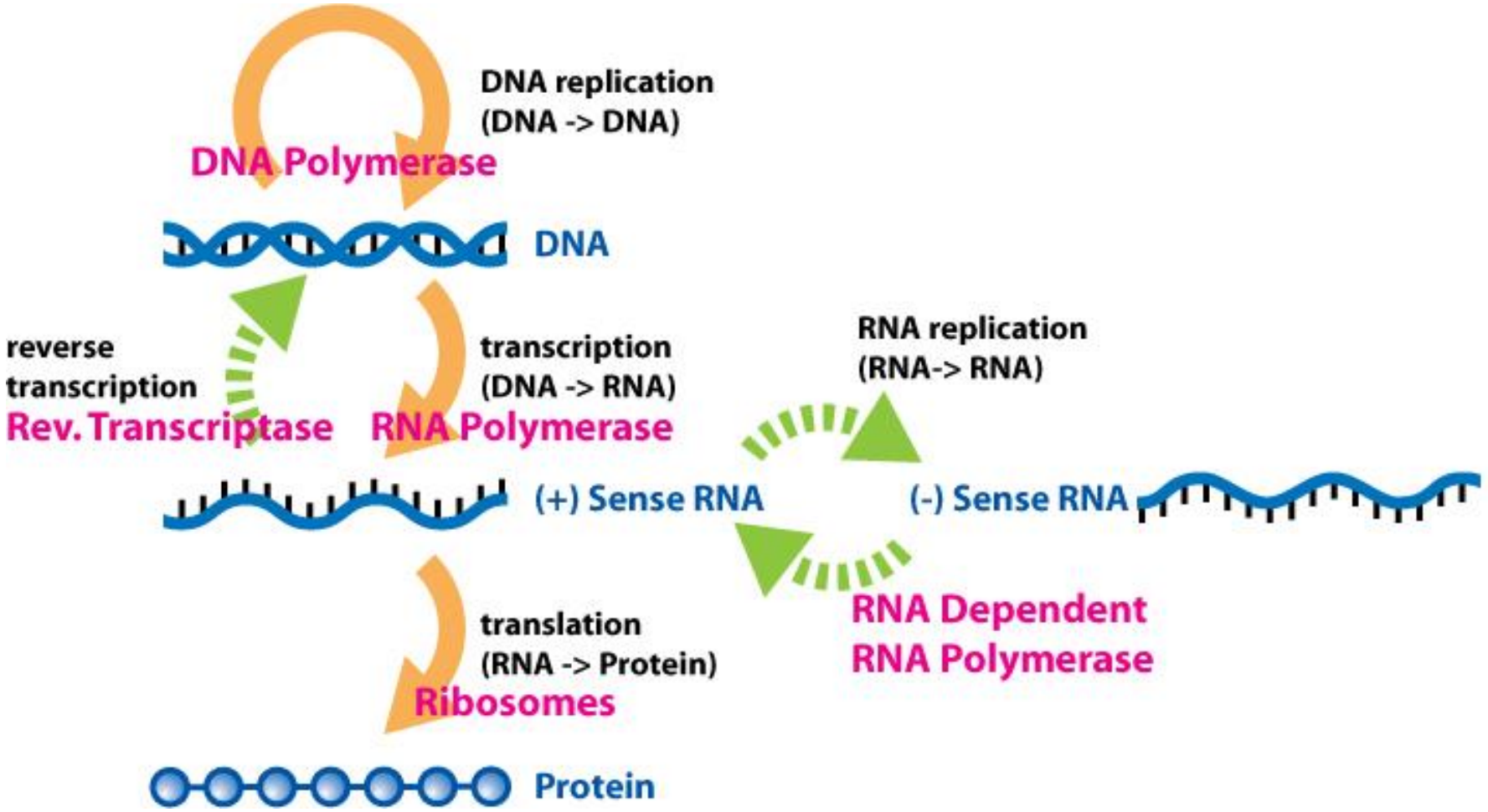


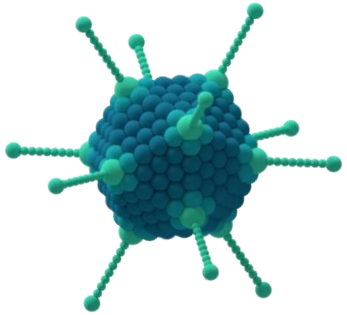
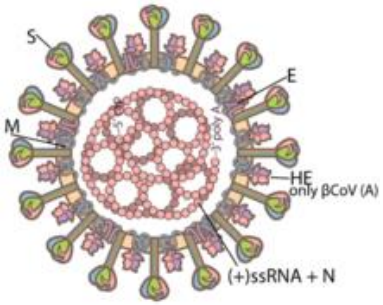
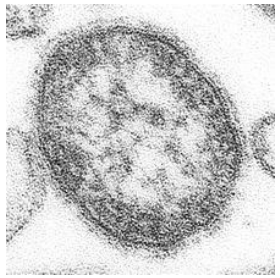
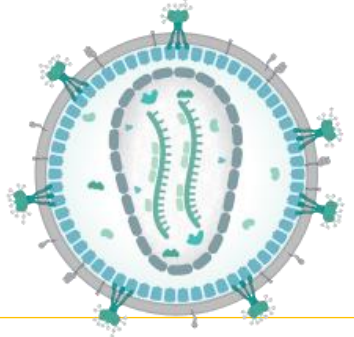
How does it replicate its genome & what proteins does it require

(Some) ways to describe and categorize viruses

- Structure — Enveloped or not; Shape
- Genome — DNA or RNA; Double or single stranded
- Genome replication — How does it replicate its genome & what proteins does it require
- Hosts — Organisms it infects
- Tropism

(Some) ways to describe and categorize viruses

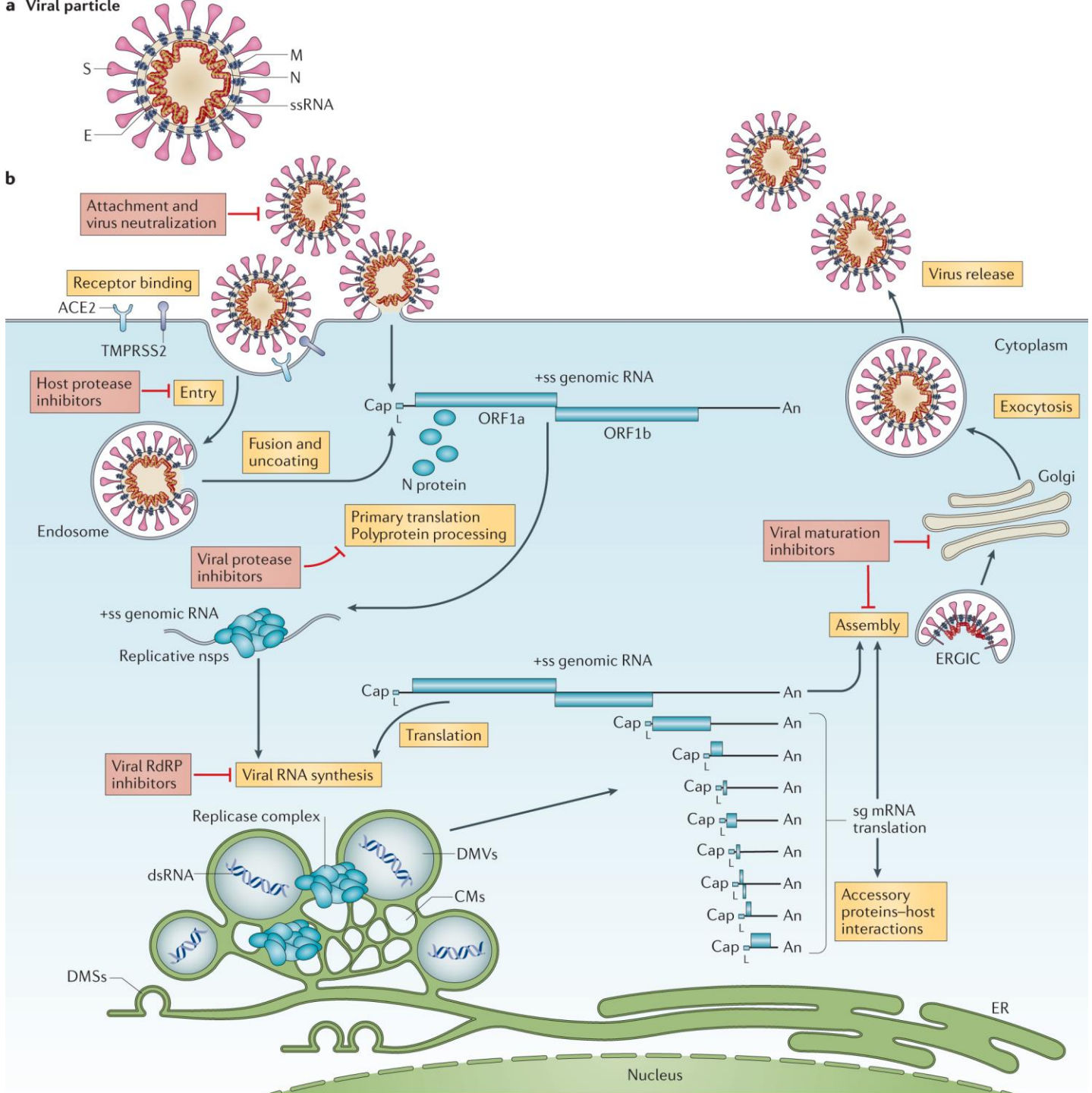
- Structure — Enveloped or not; Shape
- Genome — DNA or RNA; Double or single stranded
- Genome replication — How does it replicate its genome & what proteins does it require
- Hosts — Organisms it infects
- Tropism — What tissues and cell types does it infect

	Adenovirus	Coronavirus	Measles virus	Human immunodeficiency virus
				
Structure	Non-enveloped, spherical capsid	Enveloped	Enveloped, spherical	Enveloped, spherical
Genome	Double-stranded DNA	Single-stranded RNA	Single- stranded RNA	Single-stranded RNA
Genome replication	Both strands encode genes	Positive sense	Negative sense	Positive sense
Hosts	Mammals, birds, reptiles	Mammals, birds	Humans	Human, primates
Tropism	Respiratory, renal, gastrointestinal, ocular	Respiratory, gastrointestinal, neural	Lymph, skin, neural	Immune cells

Virus schematics by Thomas Splettstoesser

How do viruses replicate and spread in a host?

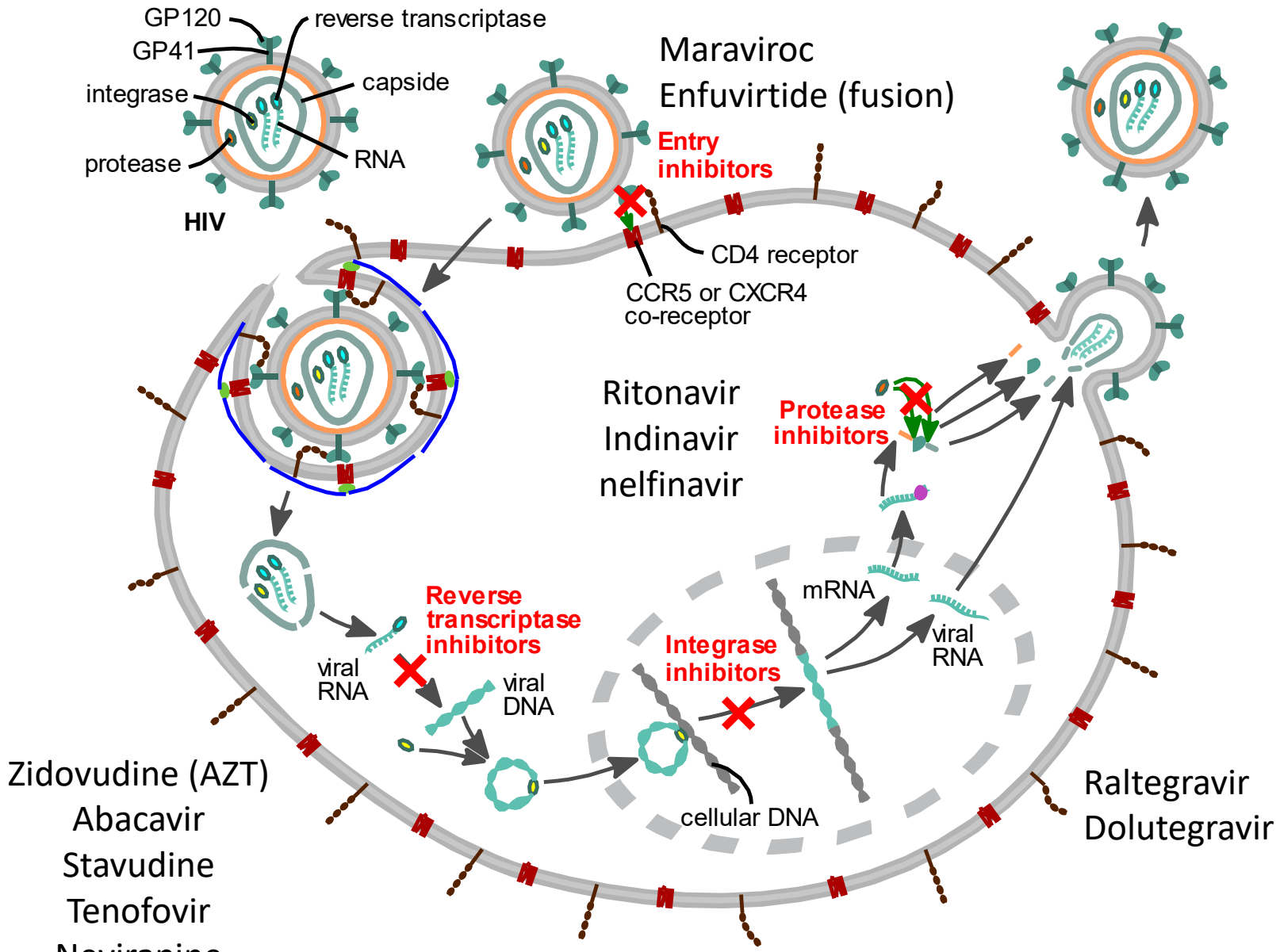
How do viruses replicate and spread in a host?



V'kovski P, Kratzel A, Steiner S, Stalder H, Thiel V. Nat Rev Microbiol. 2020 Oct 28:1–16.

Studying viral replication leads to discovery of effective treatments

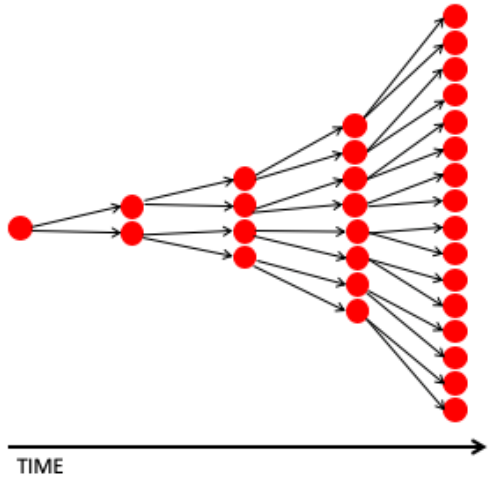
Example: HIV



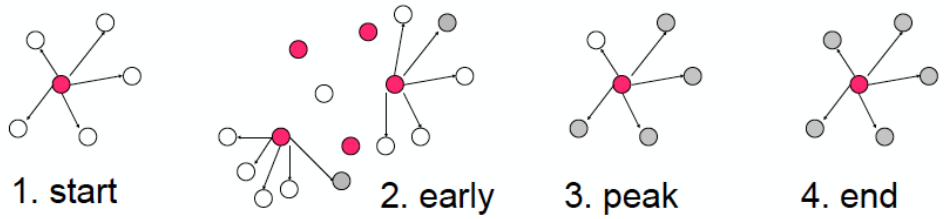
Thomas Splettstoesser

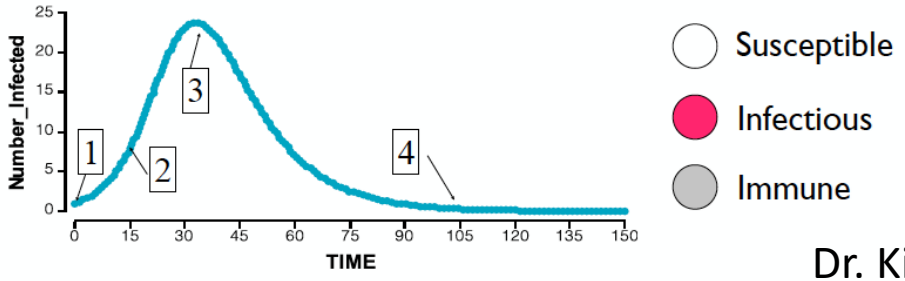
What does it take for a virus to survive?

- In a population:
  - Replicate in a host and infect other hosts
  - Escape effective immune responses
- Viruses vary in how many secondary infections they cause
  - Measles: 12-18
  - Influenza: 2-4
  - Coronavirus: ~2.3



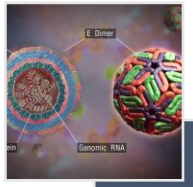
https://www.epimodel.org/





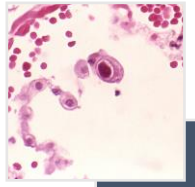
Dr. Kim Powers

Examples of different viral strategies



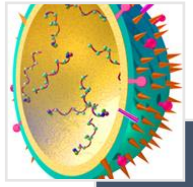
Dengue

- Mosquito-transmitted
- Multiple serotypes can cause reinfection



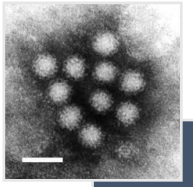
Cytomegalovirus

- Virus lies dormant (latent) in healthy host
- You don't know if you have it



Influenza virus

- Mutations allow it to evade immune responses



Norovirus

- Highly infectious (only ~20 particles required)

Prevention of viral diseases requires good public health and governance

- Conduct disease surveillance
  - Provide testing services
  - CDC notifiable disease list
- Prevent or reduce transmission
  - Provide treatments
  - Provide vaccinations
  - Enforce regulations that reduce transmission
- Educate
- Promote trust

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

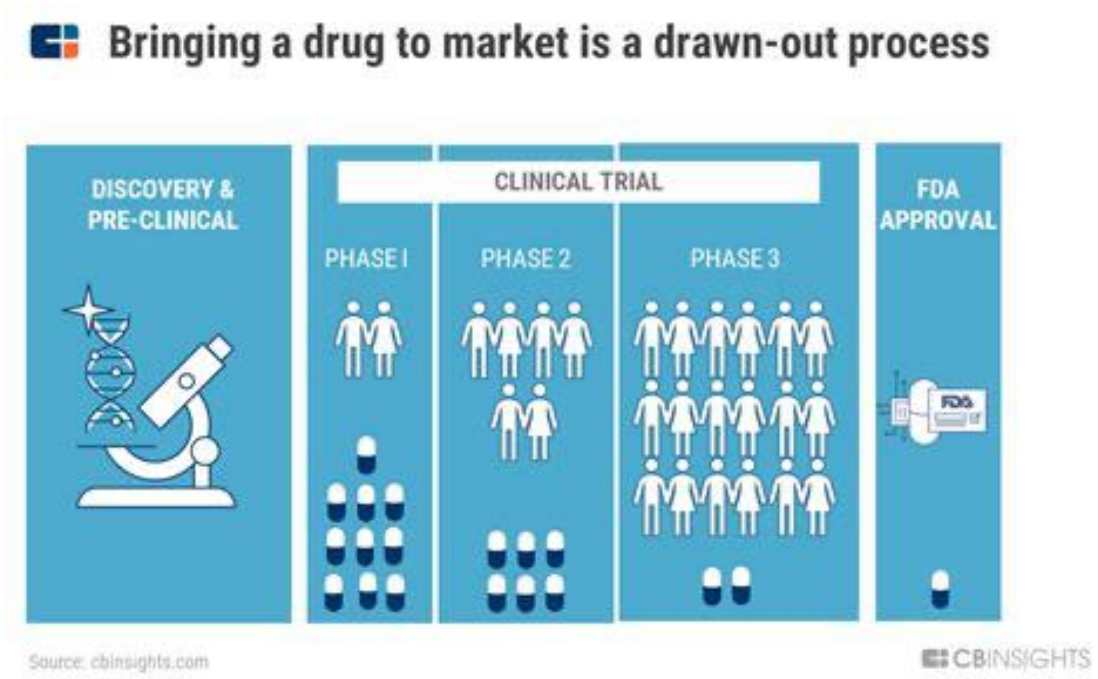
Treatment of viral diseases needs:

- Research to discover new treatments for existing and emerging diseases

Pfizer

Treatment of viral diseases needs:

- Research to discover new treatments for existing and emerging diseases
- Pipeline for drug and vaccine development



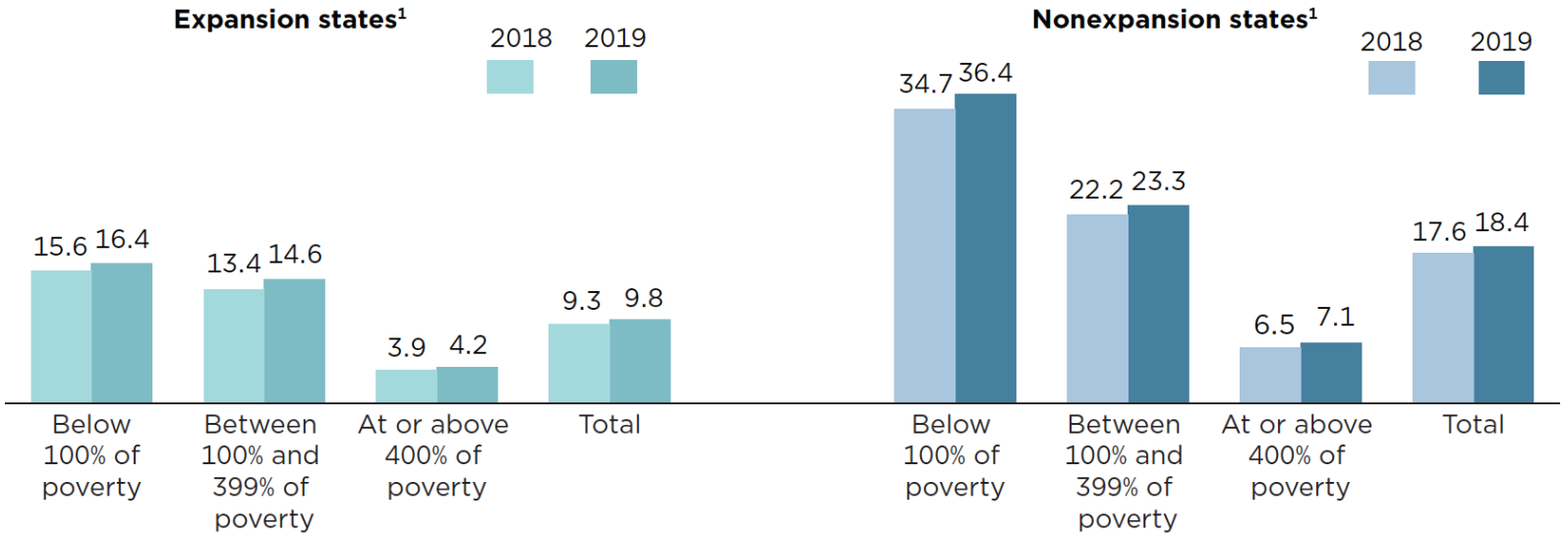
Treatment of viral diseases needs:

- Research to discover new treatments for existing and emerging diseases
- Pipeline for drug and vaccine development
- Access to healthcare

Figure 6.

Uninsured Rate by Poverty Status and Medicaid Expansion of State for Adults Aged 19 to 64: 2018 to 2019

(Civilian noninstitutionalized population, adults aged 19 to 64)




QUESTIONS?