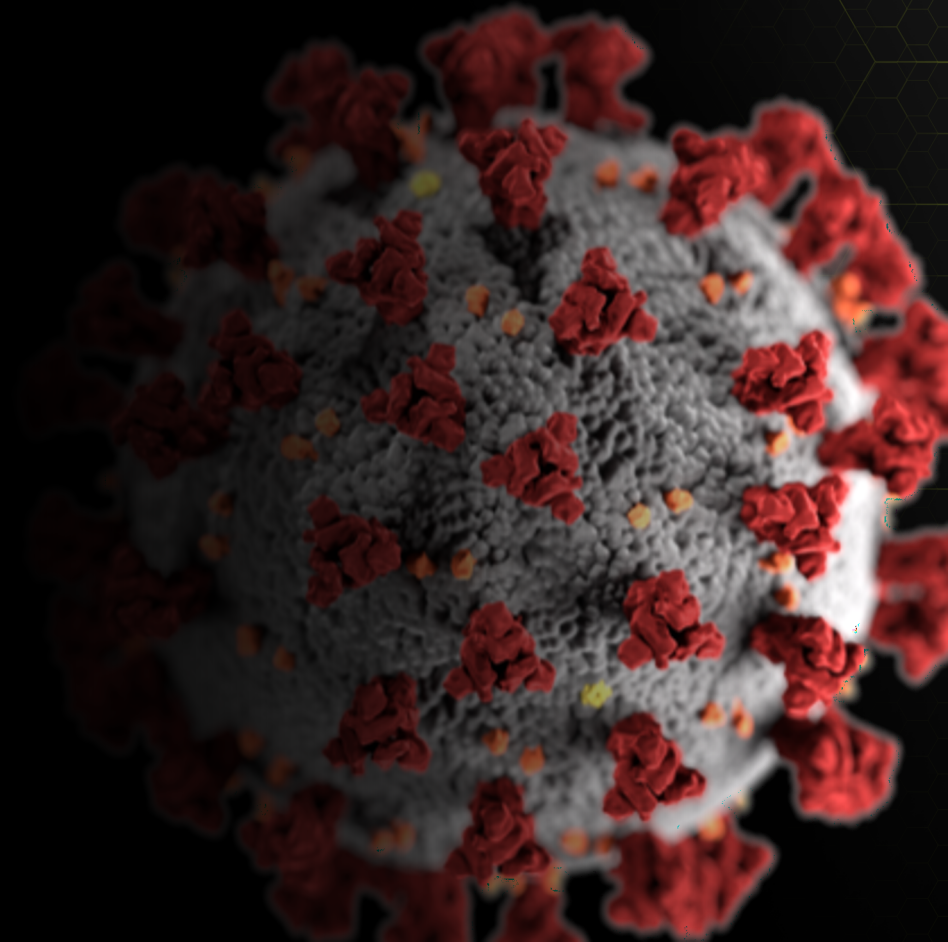


The Biology of SARS-CoV-2



What is a virus?

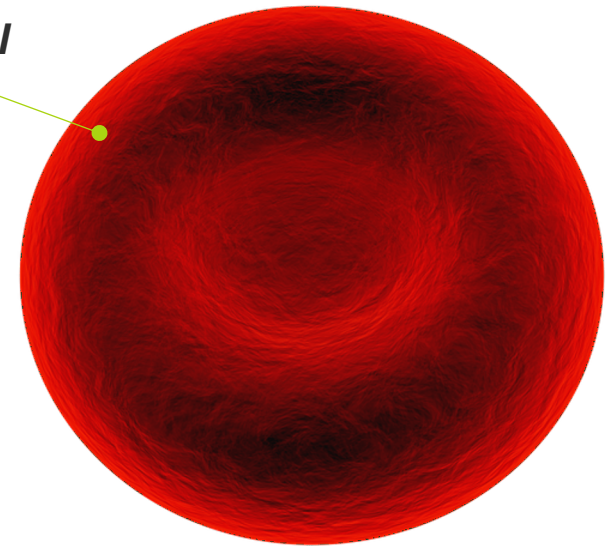
- **Viruses...**

- are much smaller than cells
- have nucleic acid (either DNA or RNA) wrapped in a protein coat
- may have a lipid envelope (from the host cell membrane)
- Have no metabolism
- Cannot replicate (reproduce) on their own
- Can multiply only within the living cells of a host

Watch [Viruses with the Amoeba Sisters](#) (6:49 min) to learn more about viruses

Virus
~100 nm

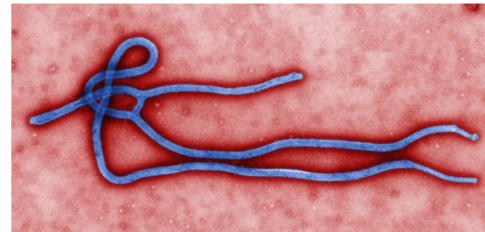
Red blood cell
~7,000 nm



Types of viruses

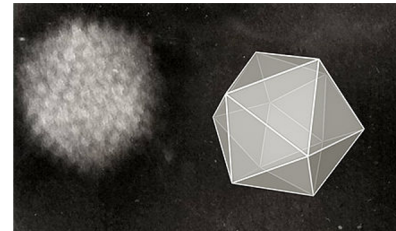
- **Viruses are classified by**
 - Morphology (shape)
 - Genome material (RNA or DNA)
 - Type of replication
 - Host
 - Type of disease

Ebola virus



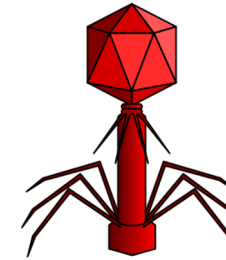
Centers for Disease Control and Prevention's Public Health Image Library (PHIL)

Adenovirus



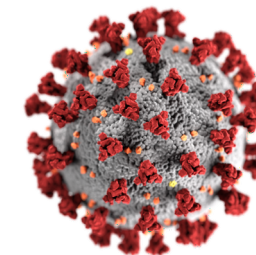
GrahamColm at English Wikipedia, CC BY-SA 3.0, commons.wikimedia.org/w/index.php?curid=5839864

Bacteriophage



Ninjatacoshell - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=35782607>

Coronavirus



CDC/ Alissa Eckert, MS; Dan Higgins, MAM - commons.wikimedia.org/w/index.php?curid=86444014

Are viruses living?

Curriculum connections

Cell theory

The chemistry of life

Living Organisms

- Composed of one or more cells
- Organelles for specialized functions (eukaryotes)
- Energy flow (metabolism) occurs within the cells
- Arise from pre-existing cells (can self-replicate)

Viruses

- Composed of genetic material (DNA or RNA) surrounded by protein and sometimes a lipid bilayer
- No organelles
- Do not metabolize (no energy flow)
- Cannot reproduce on their own (need a host cell for replication)

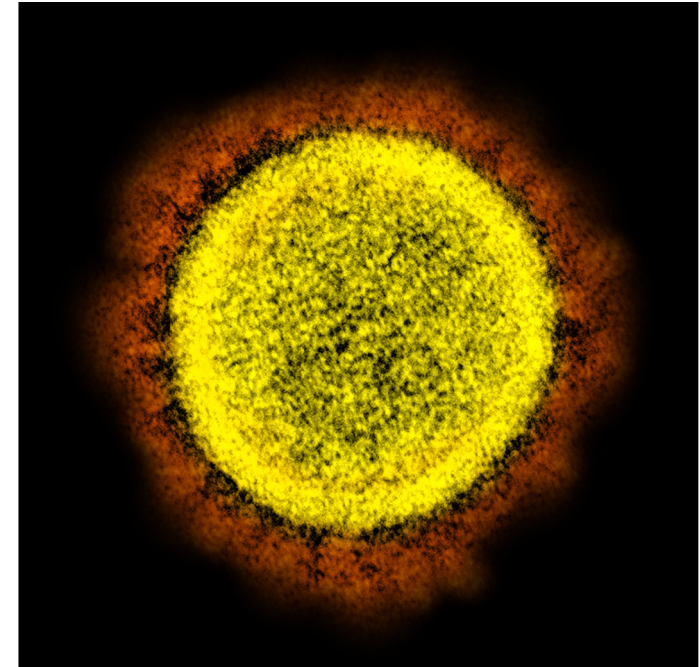
Coronavirus — What's in a name?

Coronavirus (CoV) — a large family of viruses that can cause disease in humans and animals

SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2) — the strain of virus causing the current pandemic

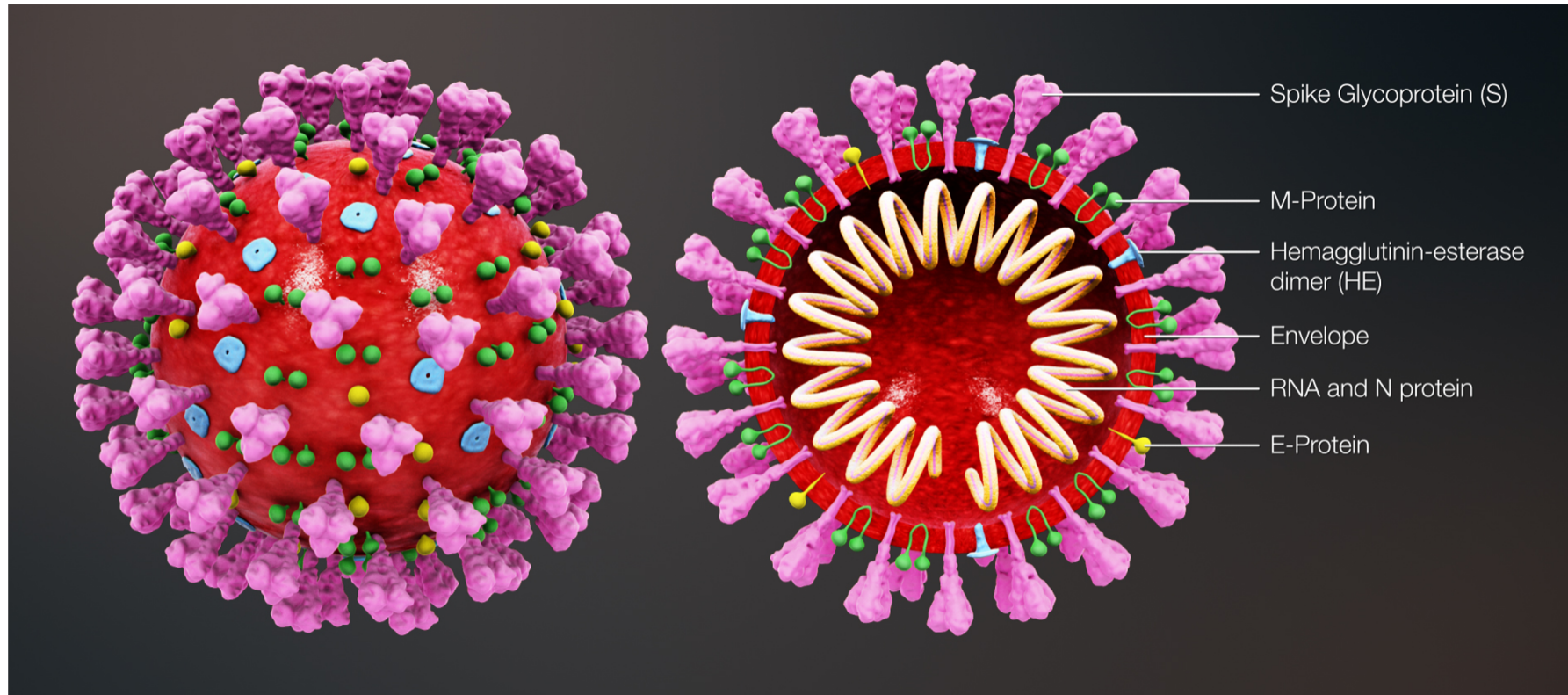
COVID-19 (Coronavirus Disease 2019) — the set of symptoms caused by SARS-CoV-2

corona – latin for crown



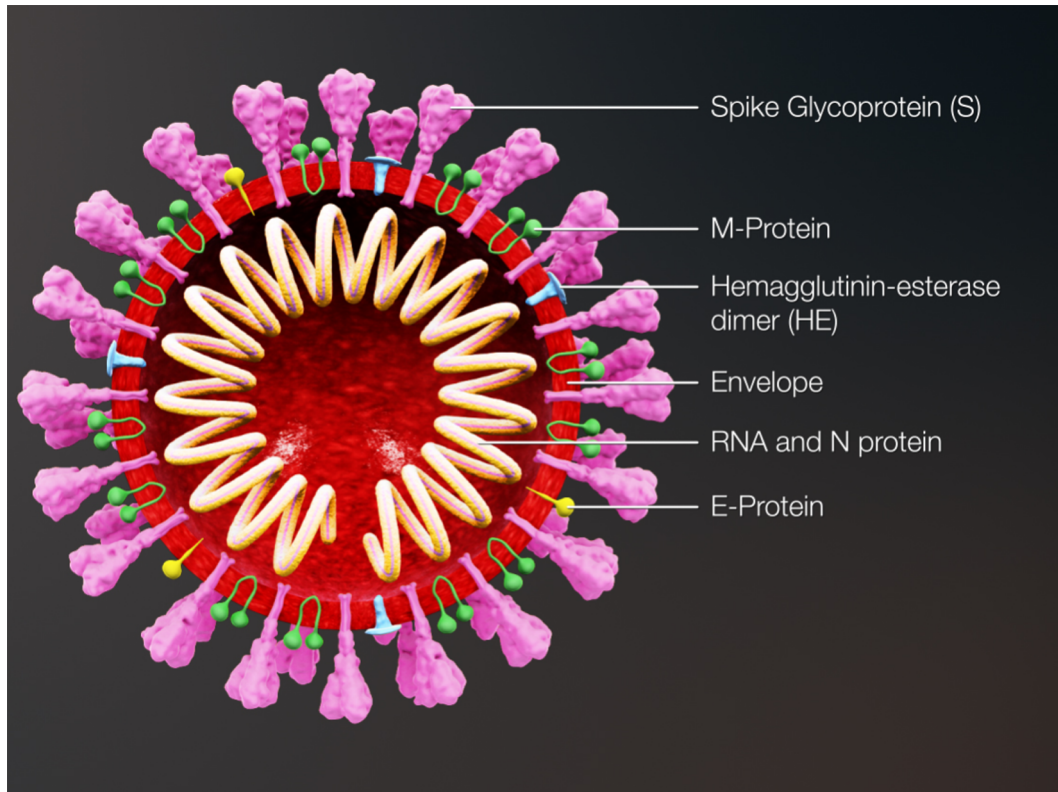
Transmission electron micrograph of SARS-CoV-2 virus particles, isolated from a patient.
Credit: National Institute of Allergy and Infectious Diseases, NIH

SARS-CoV-2 Structure



www.scientificanimations.com/wiki-images/, CC BY-SA 4.0 commons.wikimedia.org/w/index.php?curid=86436446

SARS-CoV-2 Structure



www.scientificanimations.com/wiki-images/, CC BY-SA 4.0 commons.wikimedia.org/w/index.php?curid=86436446

Spike protein (S)

- ~150 kDa
- Attaches to ACE-2 receptor

Membrane protein (M)

- ~25–30 kDa
- Provides shape

Envelope protein (E)

- ~8–12 kDa
- Guides assembly and release

Nucleocapsid protein (N)

- ~50 kDa
- Protects RNA

RNA viral genome

- ~30,000 nucleotides (huge!)
- Encodes 29 proteins

Lipid envelope

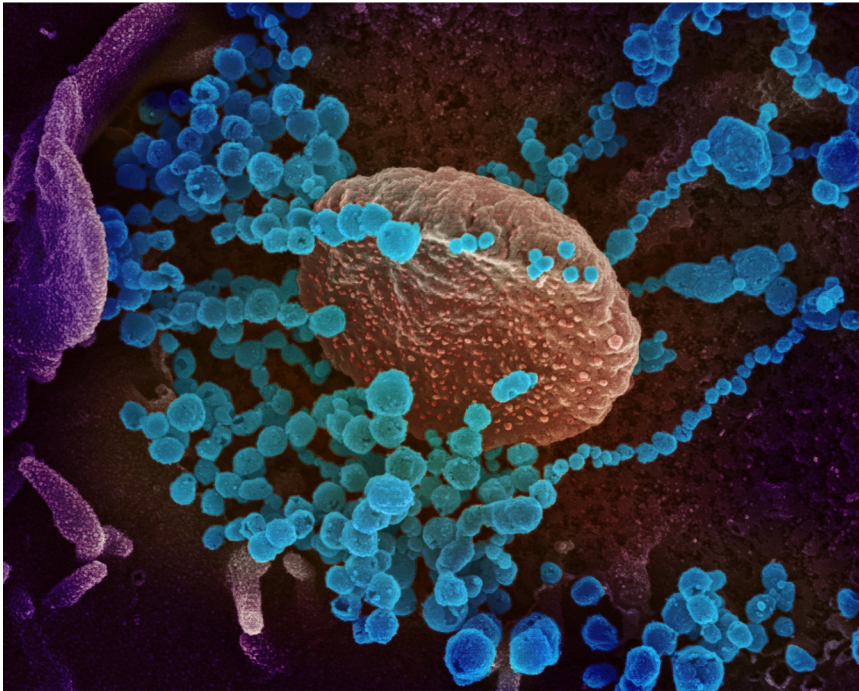
- Acquired from host cell

Why is washing with soap an effective way to remove SARS-CoV-2?

How does SARS-CoV-2 infect a cell?

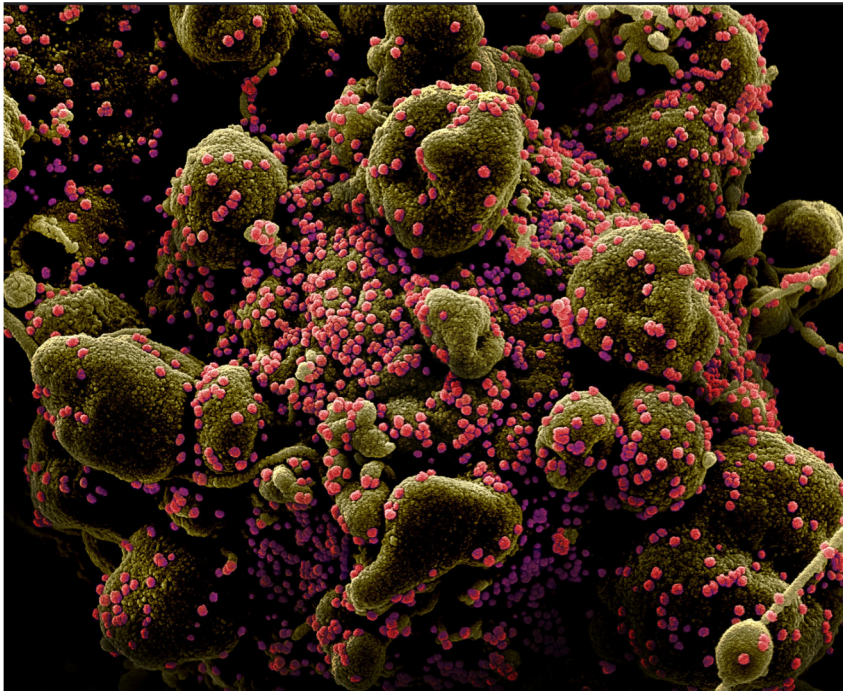
- 1. Virus particles enter the body through the nasal passages.**
- 2. The spike protein attaches to cell receptors — angiotensin-converting enzyme 2 (ACE2).**
- 3. Viral membrane fuses with the cell membrane**
- 4. The RNA genome is released into the cell.**
- 5. The cell replicates the virus using its RNA genome**

Images of Infected Cells (colorized)



Credit: NIAID-RML

This scanning electron microscope image shows SARS-CoV-2 (round blue objects) emerging from the surface of cells cultured in the lab.



Credit: National Institute of Allergy and Infectious Diseases, NIH

Colorized scanning electron micrograph of an apoptotic cell (greenish brown) heavily infected with SARS-COV-2 virus particles (pink), isolated from a patient sample.