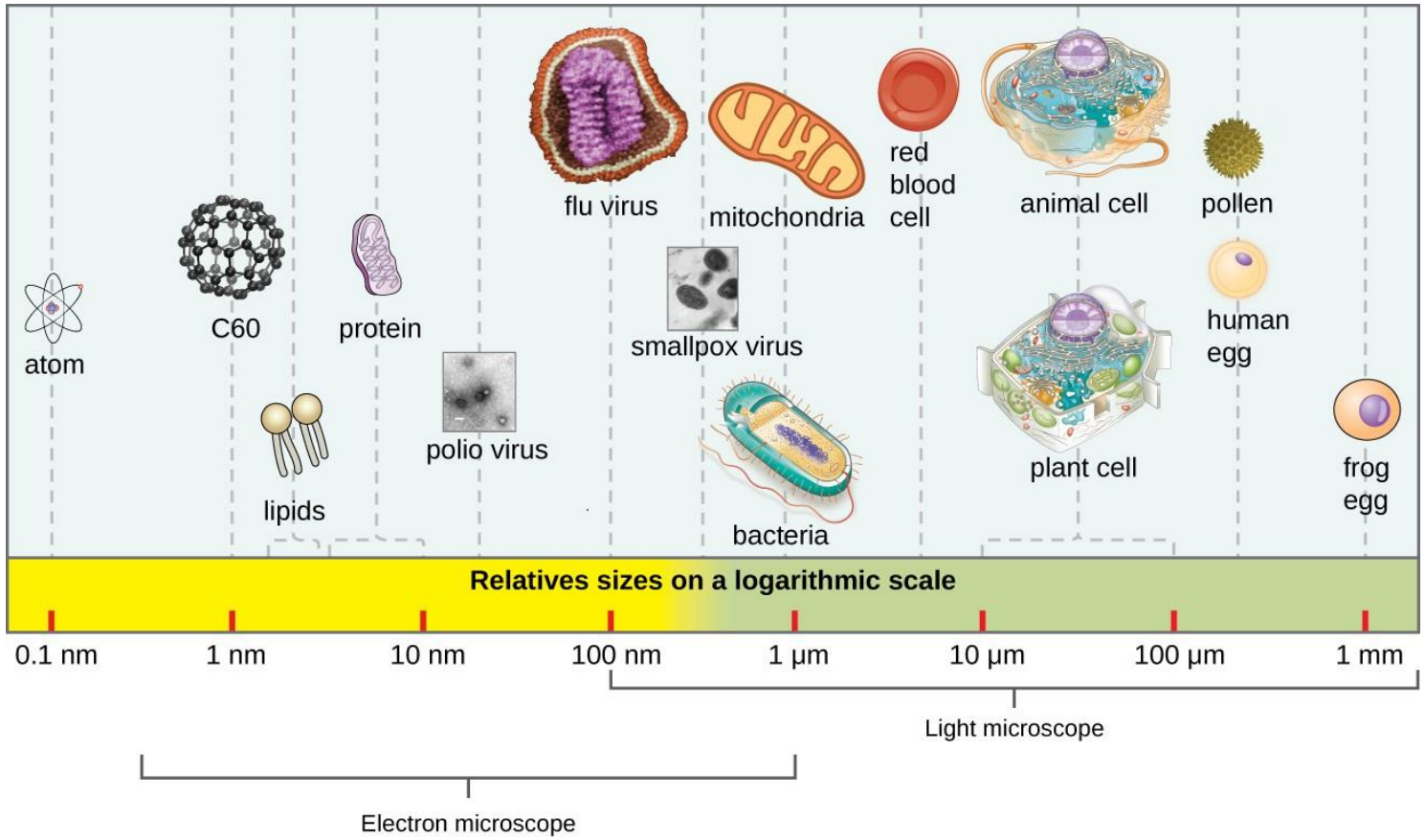
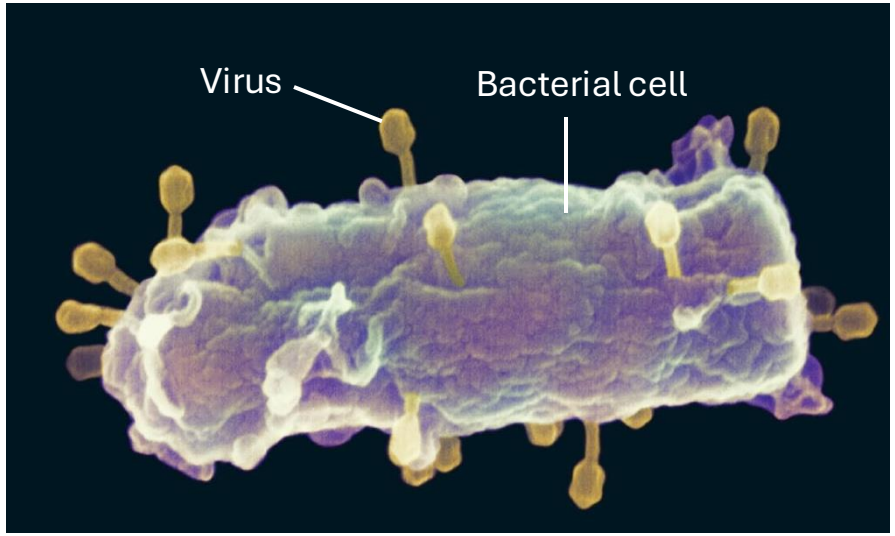
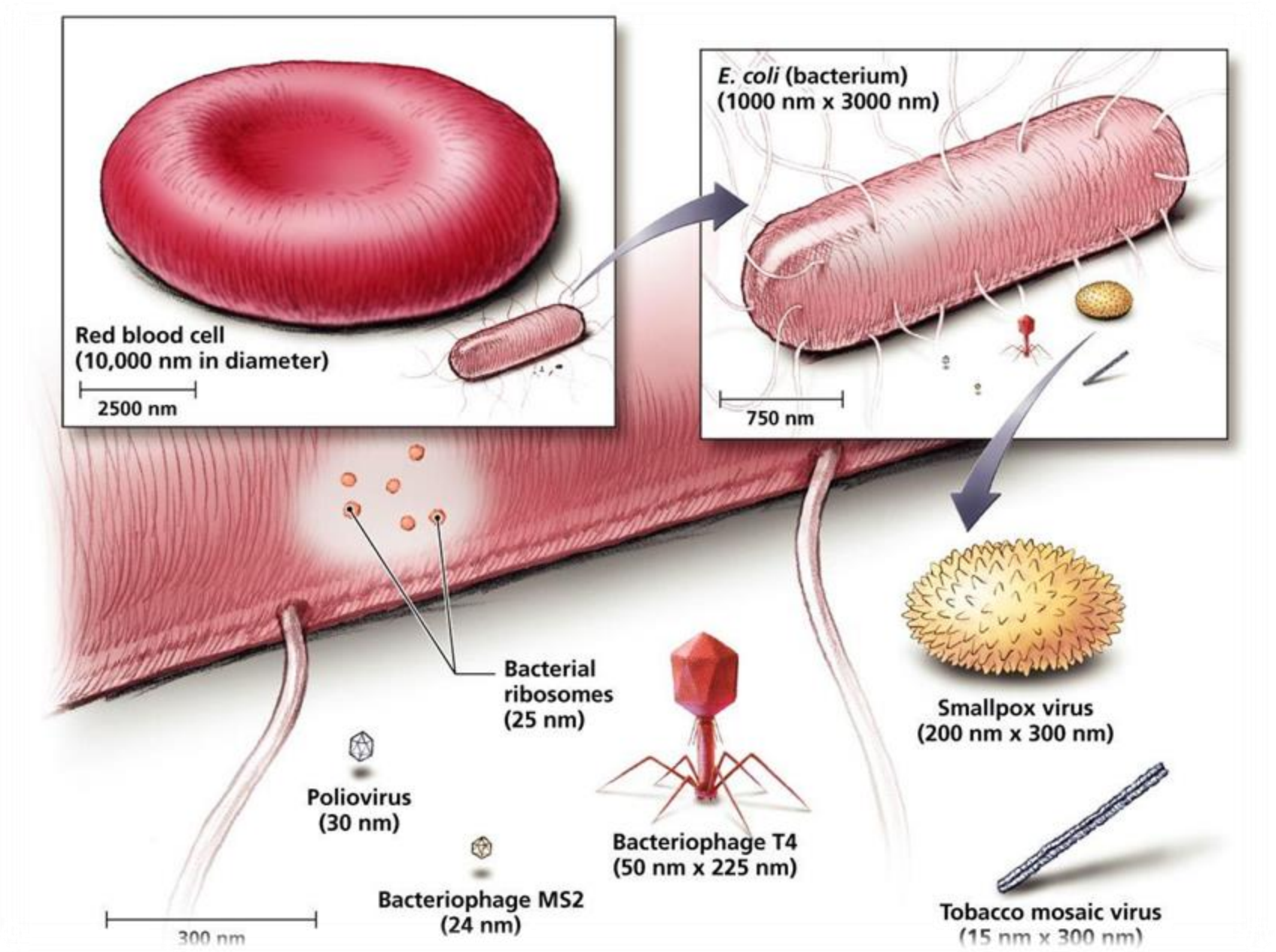
Viruses

Viruses are Tiny Ultra-Microscopic Particles

Viruses are **much smaller than prokaryotes**, ranging in size from about 20–300 nanometers (nm). They **can only be seen with an electron microscope**

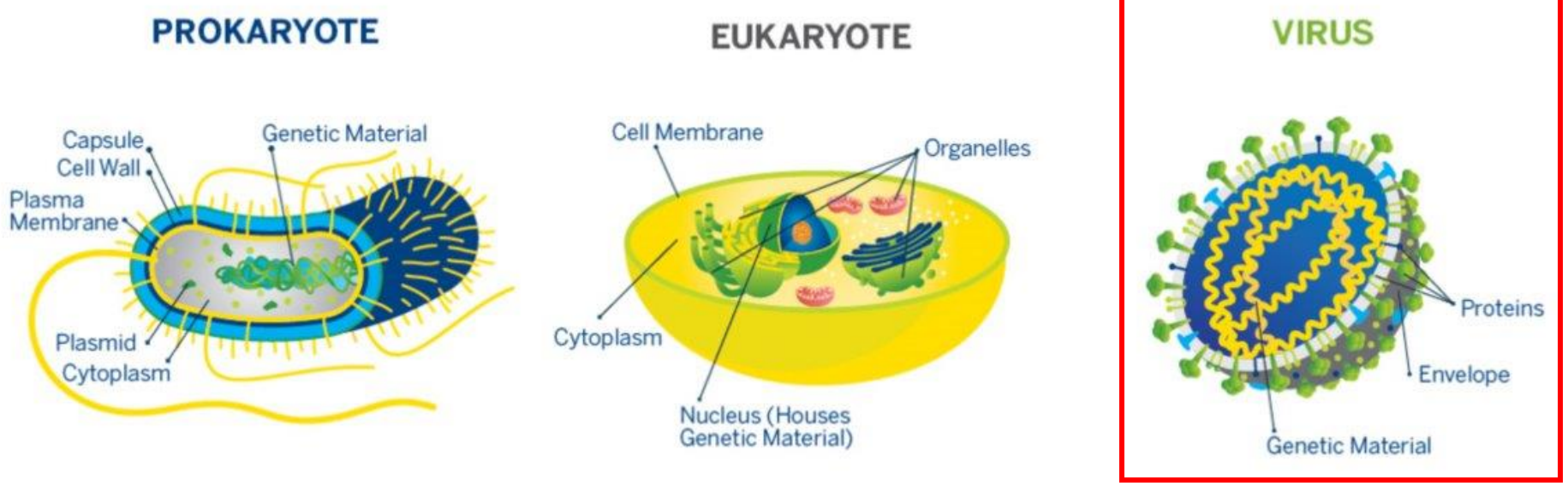





Red blood cell
(10,000 nm in diameter)
2500 nm
E. coli (bacterium)
(1000 nm x 3000 nm)
750 nm
Bacterial
ribosomes
(25 nm)
Poliovirus
(30 nm)
Bacteriophage MS2
(24 nm)
300 nm
Bacteriophage T4
(50 nm x 225 nm)
Smallpox virus
(200 nm x 300 nm)
Tobacco mosaic virus
(15 nm x 300 nm)

Viruses are Not Cells (Acellular)

- Compared with eukaryotic and even prokaryotic cells, most viruses are much **smaller and simpler** in structure
- They **lack any cellular structure;** they have no cell nucleus, organelles, or cytoplasm. They are only consisting of **nucleic acid enclosed in a protein coat and sometimes a membranous viral envelope**



Viruses Replicate only in Host Cells

- They are **obligate intercellular parasites.** They can only live and multiply within the host living cell
- Viruses are lacking the structures and metabolic machinery found in a cell, so they use **enzymes, ribosomes, and small molecules of host cells** to synthesize more viruses
- Each virus has a **host range**, a limited number of host cells that it can infect**.** They can infect **humans, plants, animals, bacteria and fungi**
- Viruses can cause a **wide variety of diseases**

Are Viruses Alive or Not?

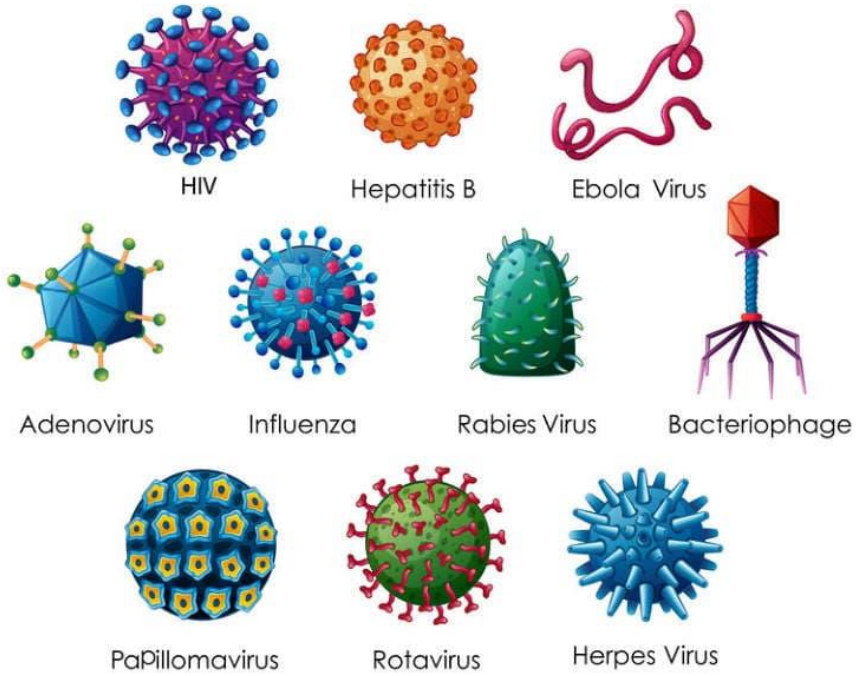
In fact, viruses exist in shady area between a living organism and a nonliving entity!!!

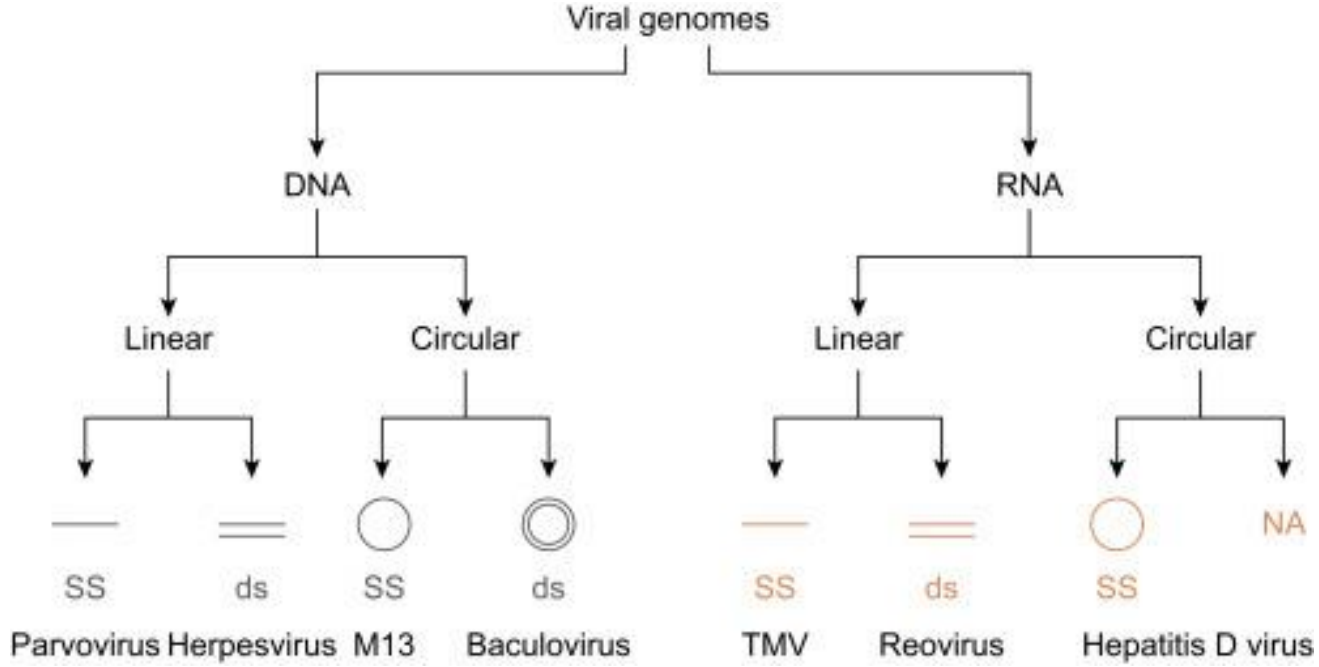
Living	Non-living
Possess genetic material either DNA or RNA	Are non-cellular
Possess a protein coat	Cannot reproduce by themselves
Can replicate (inside a living cell)	Only have one type of nucleic acid (living things have both DNA and RNA)

Diversity of Viruses

Viruses are very diverse

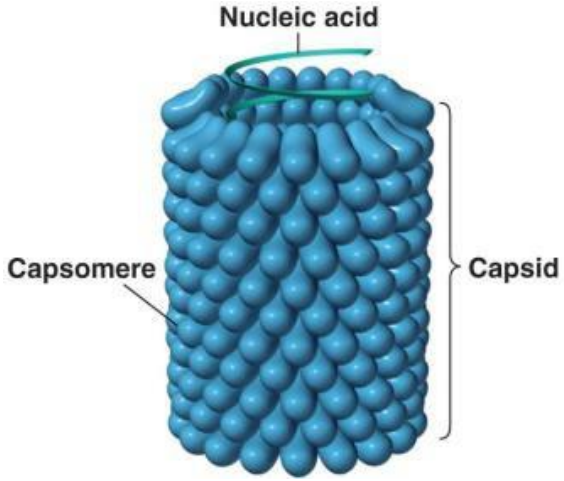
- They come in different shapes and structures
- Have different kinds of genomes
- Infect different hosts

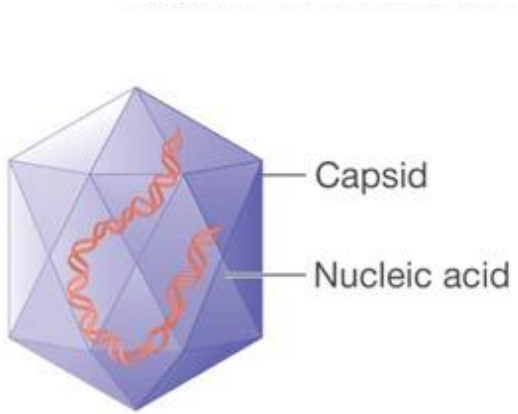


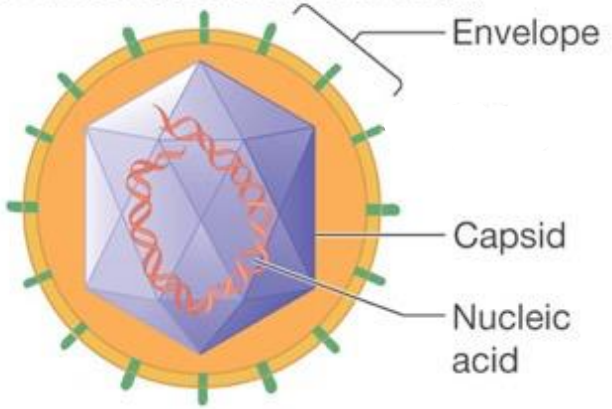


Viral Structure

- All viruses consist of:
    1. **A nucleic acid genome** made of single- or double-stranded DNA or RNA **(but not both)**
    2. **A protective protein shell, or capsid.** Capsids are built from protein subunits called **capsomeres**. A capsid can have various shapes
- Some viruses have an external membrane **envelope** surrounding the capsids of many animal viruses



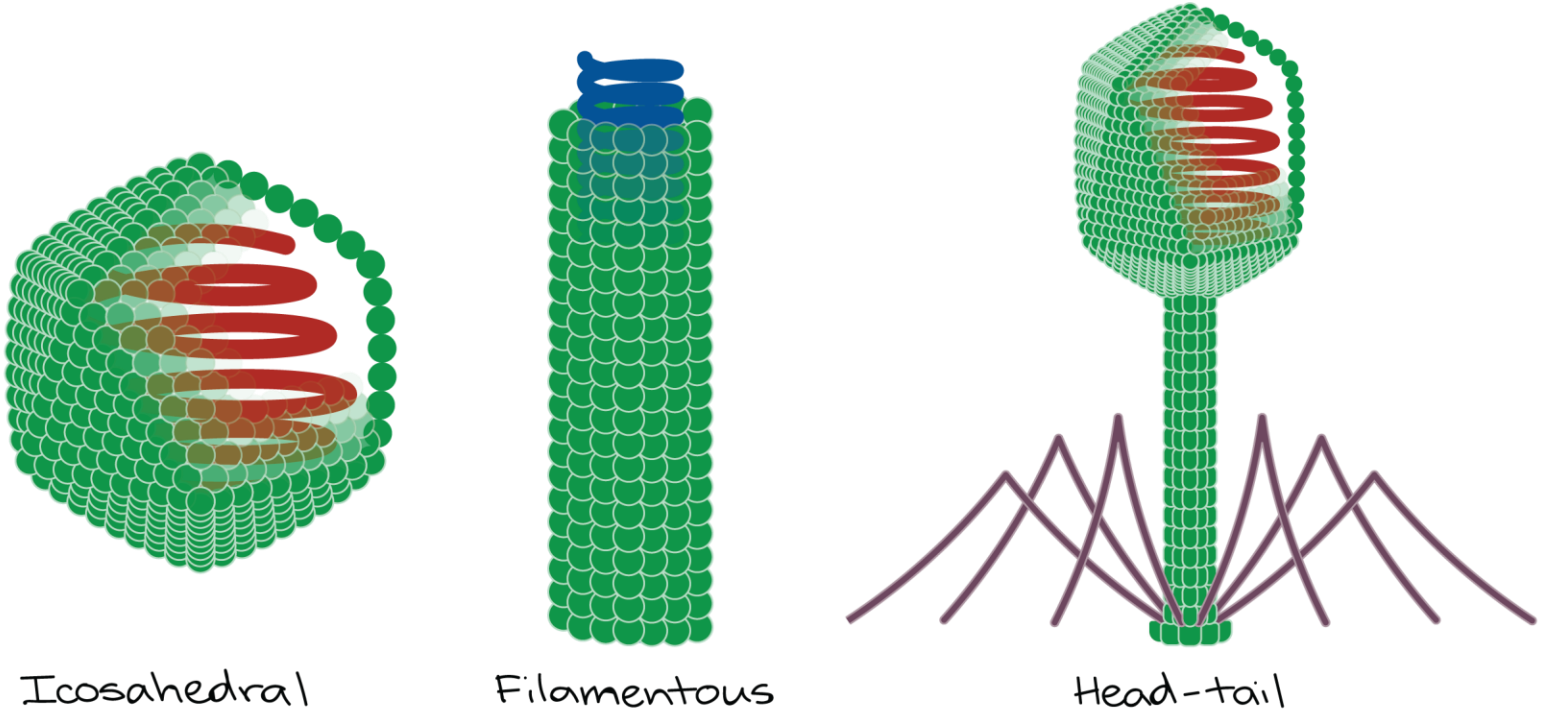


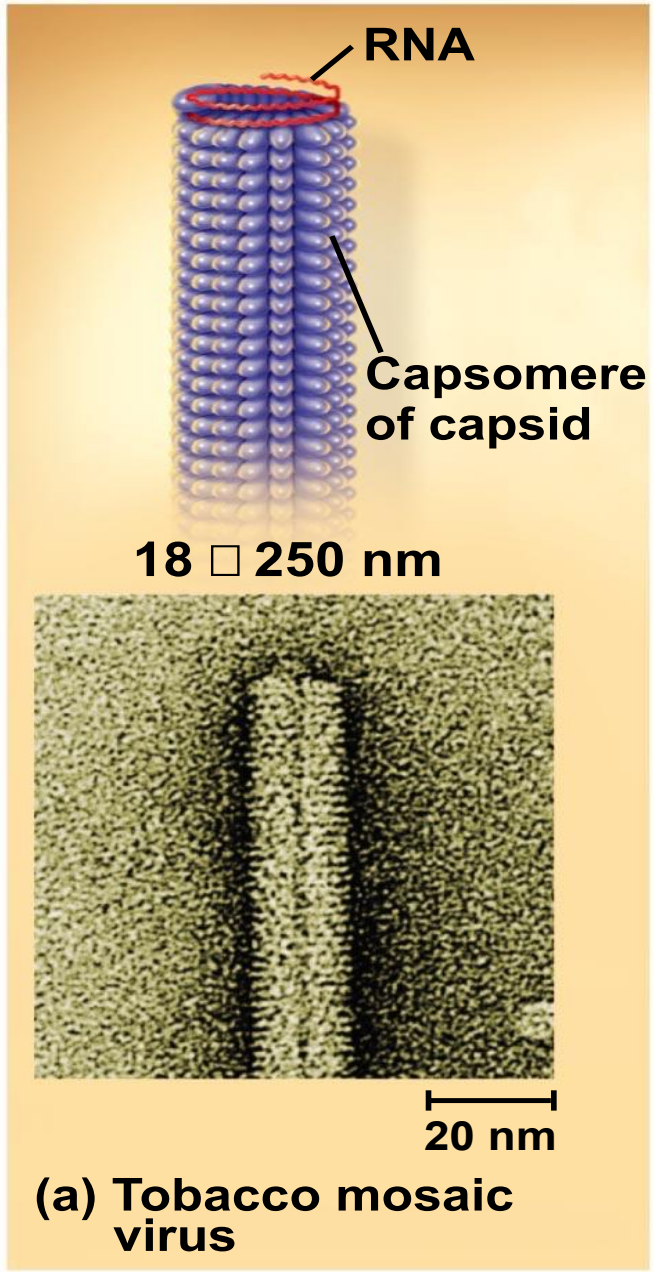


Viral Shapes

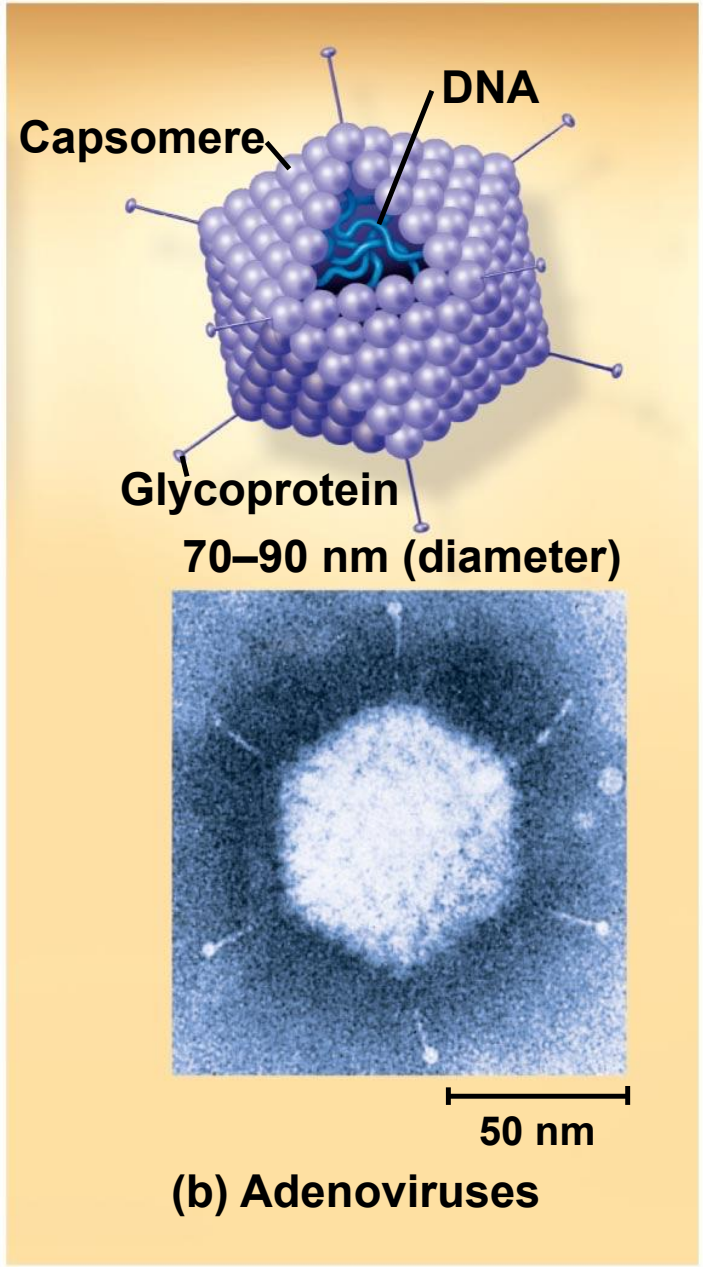
The **shape of the capsid can classify viruses into:**

1. **Icosahedral:** a polyhedral capsid with 20 triangular facets
2. **Helical/filamentous:** a long filamentous tube or rod-like structure
3. **Complex/Head-tail:** a hybrid between the helical and icosahedral shapes

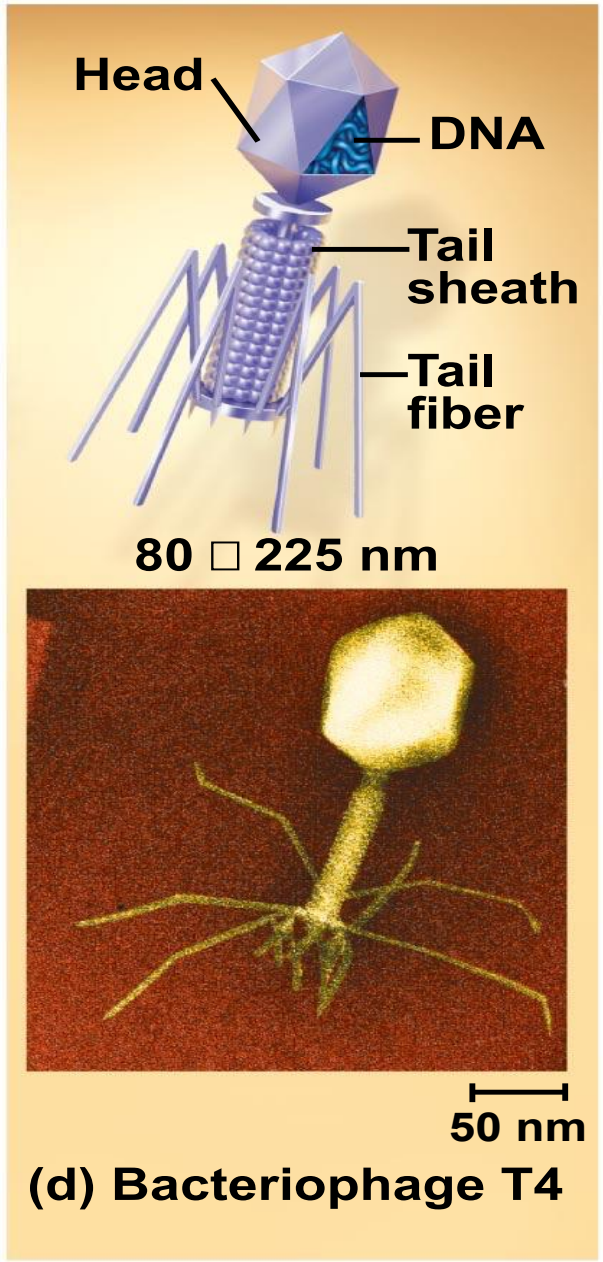




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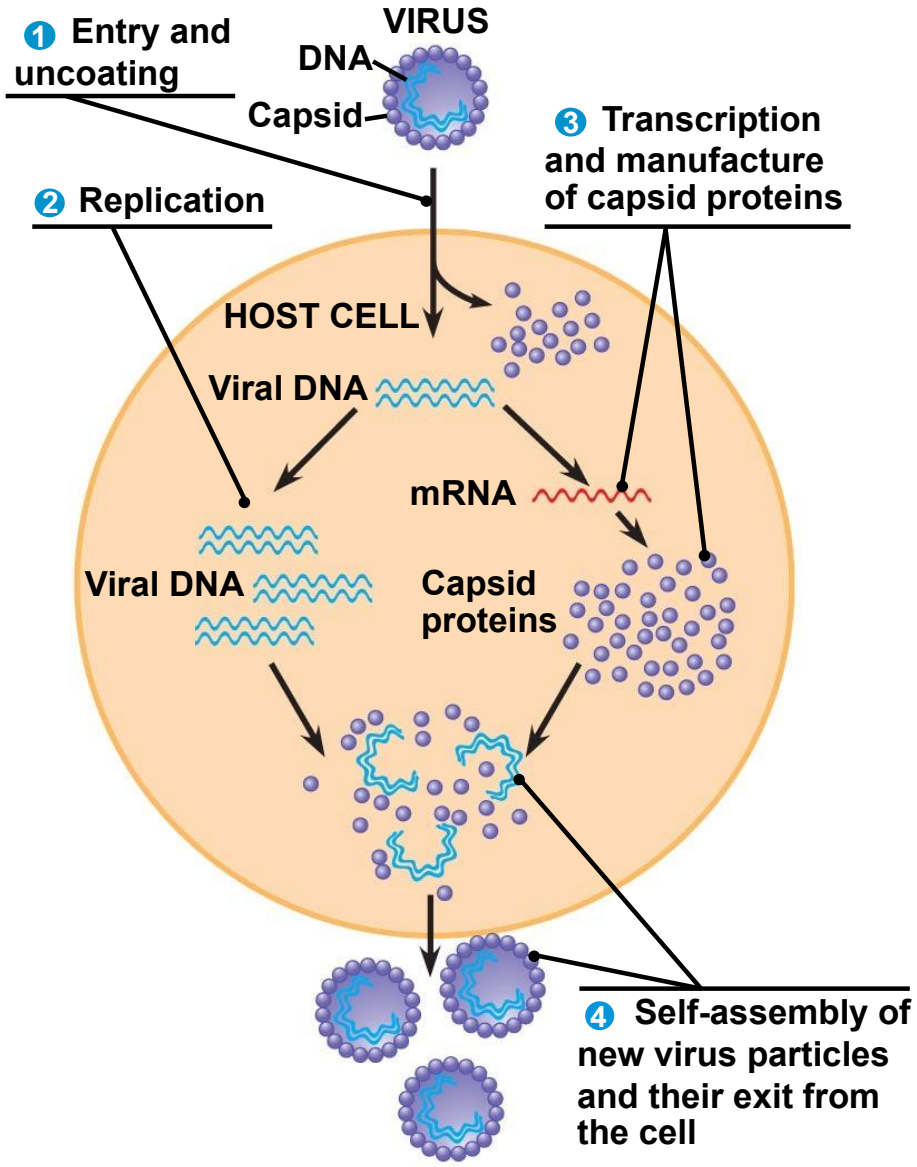
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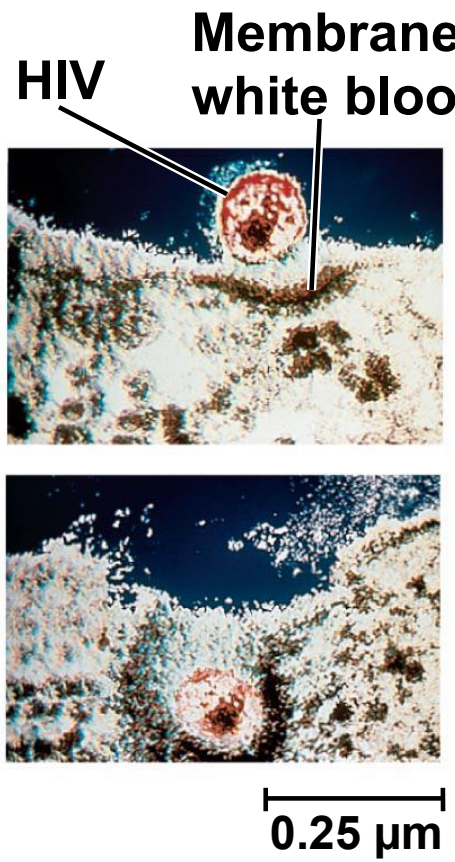


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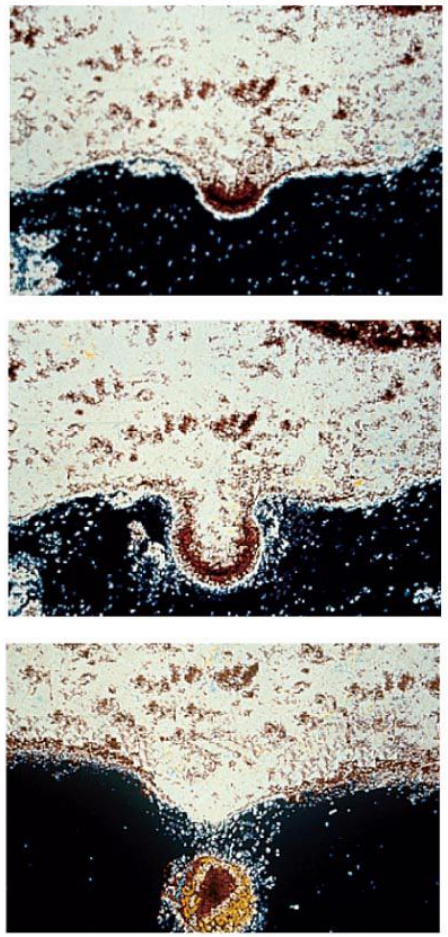
General Features of Viral Reproductive Cycles

- Once a viral genome has entered a cell, the cell begins to manufacture viral proteins
- The virus makes use of host enzymes, ribosomes, tRNAs, amino acids, ATP, and other molecules
- Viral nucleic acid molecules and capsomeres spontaneously self-assemble into new viruses





HIV entering a cell



New HIV leaving a cell

The reproductive cycle of HIV, the retrovirus that causes AIDS

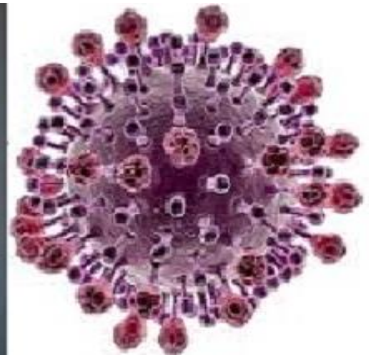
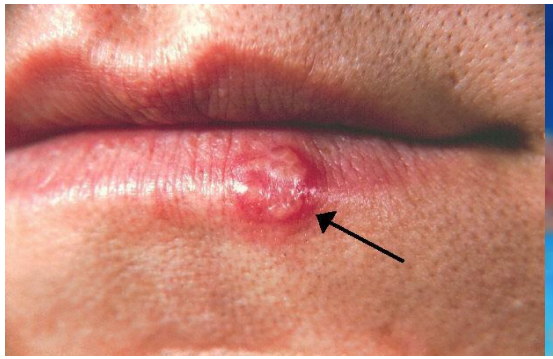
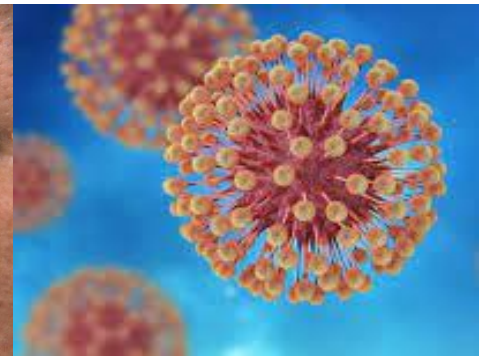
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Roles of Viruses in our Lives: 1. Cause Varaity of Diseses

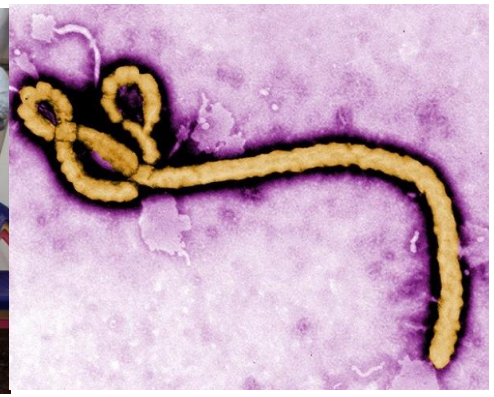
Diseases caused by viruses affect humans, agricultural crops, and livestock worldwide

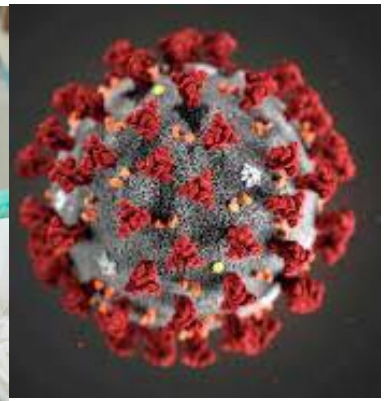
A. In Human

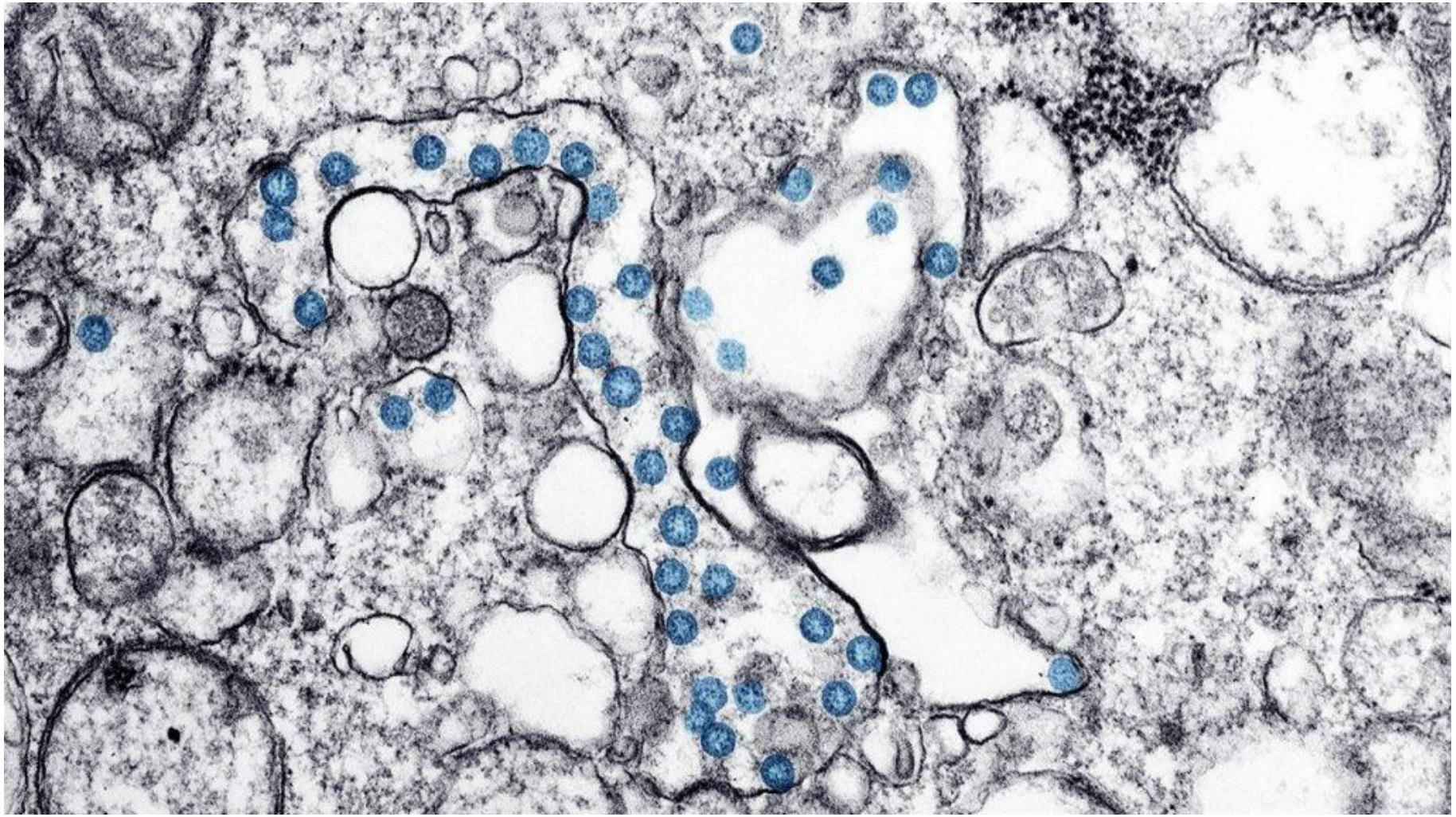
Common human diseases: Influenza and cold sore (herpes)

Serious diseases: Ebola and Covid

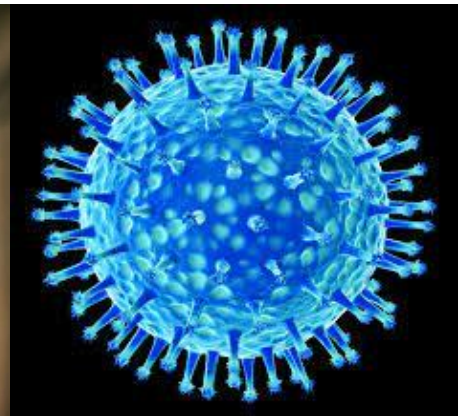
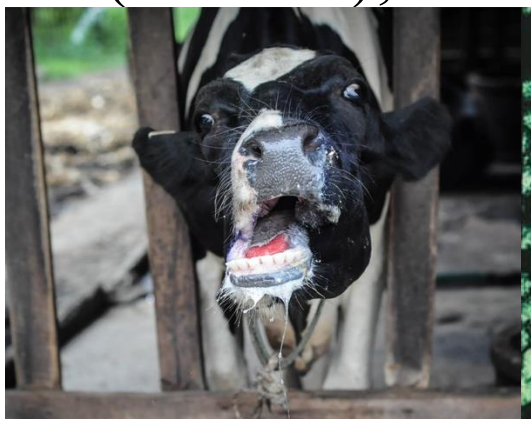
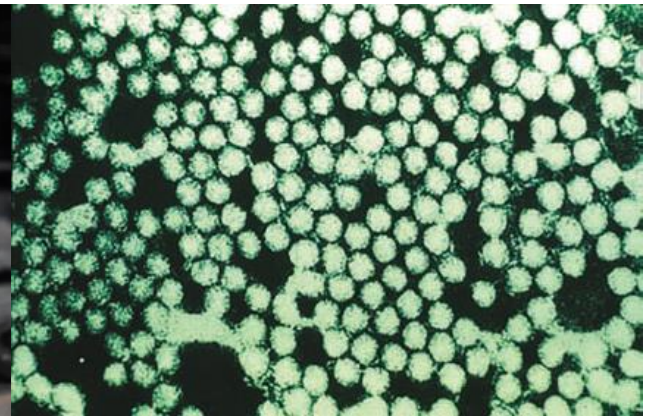




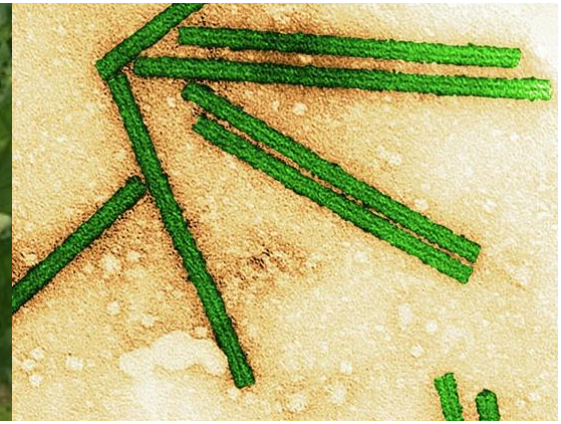
Electron microscope image of the first U.S. case of COVID-19. The spherical viral particles, colored blue, contain a cross-section of the viral genome, in the form of black dots.

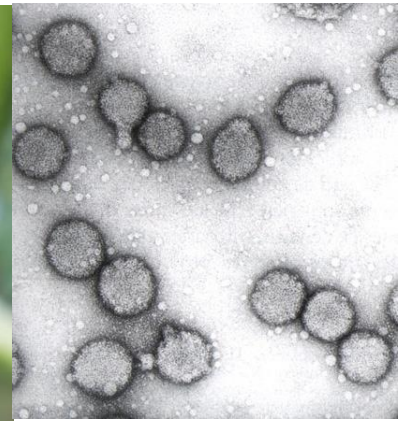
Roles of Viruses in our Lives: 1. Cause Varaity of Diseses

B. In Animals: such as Avian influenza (bird flu), and Foot and Mouth Disease

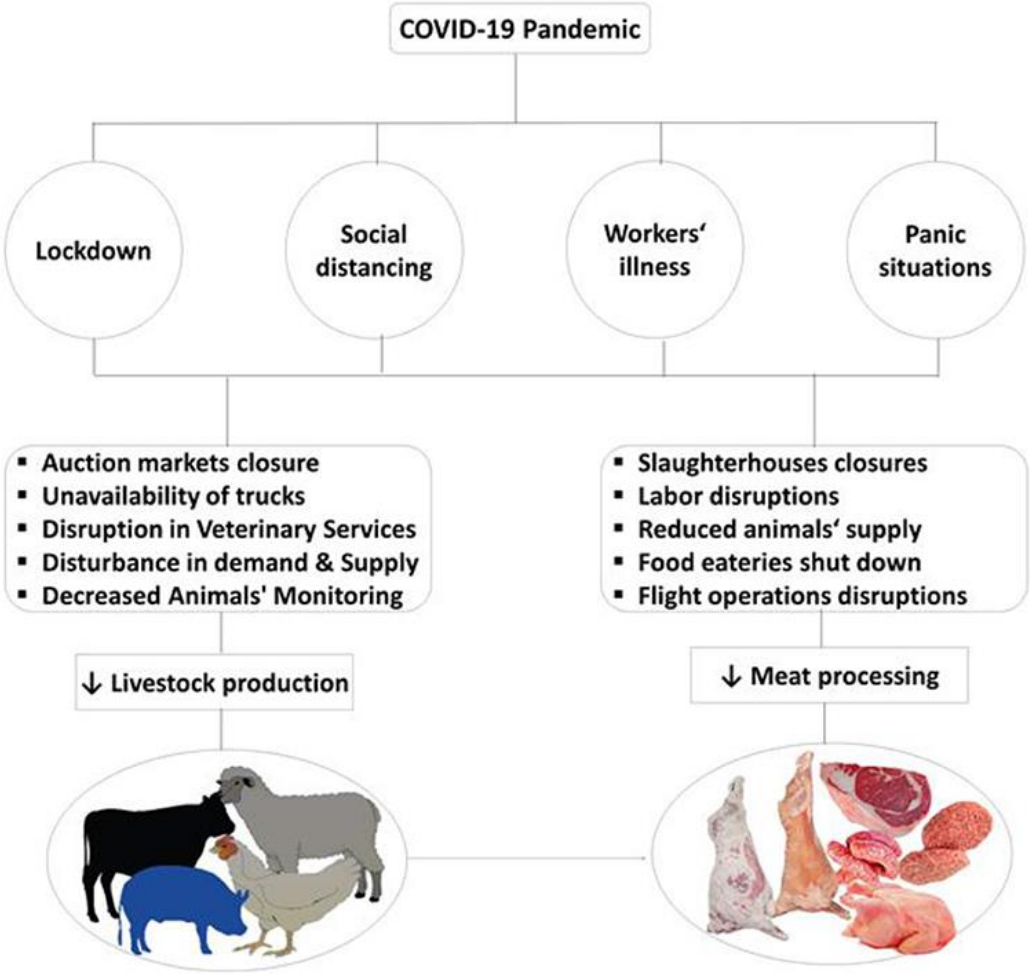
C. In plants: such as tobacco mosaic virus, and Tomato spotted wilt virus



Roles of Viruses in our Lives: 2. Economical losses

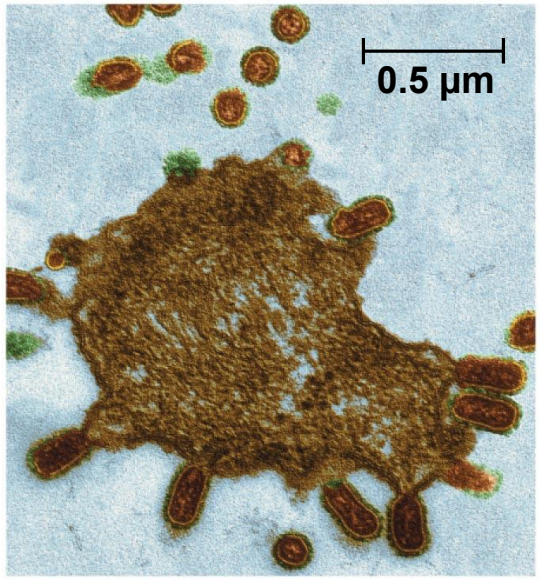
Lead to economical losses such as in livestock, agriculture and food industry





(a) The 1918 flu pandemic

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(b) Influenza A H5N1 virus

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(c) Vaccinating ducks

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Roles of Viruses in our Lives: 3. Medical Applications

A. Vaccines Production:

- **Viruses** are used to produce **vaccines** which can **prevent certain viral illnesses**
- **Vaccines** are harmless derivatives of pathogenic microbes that stimulate the immune system to mount defenses against the actual pathogen
- Viral infections **cannot be treated by antibiotics**
- **Antiviral drugs** can help to treat (stopping viral reproduction) though not cure viral infections

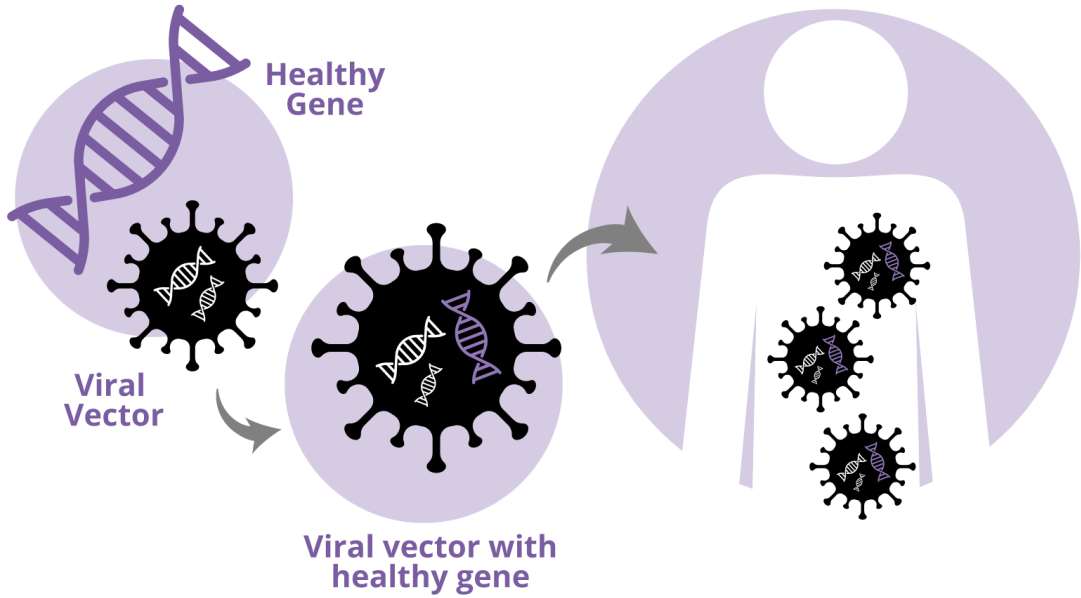


Roles of Viruses in our Lives: 3. Medical Applications

B. Gene Therapy:

Viruses are beginning to play **major roles in medical therapies** and in advancing **medical technology**

Humans now possess the technology to **reengineer natural viruses** and use them as **vectors** to combat **cancer and cure genetic diseases**



Roles of Viruses in our Lives: 4. Biological Control

Viruses play an important role in the biological control against pathogenic bacteria and insect pests

