

Good teaching is more a giving of right questions than a giving of right answers.
 – Josef Albers

Viruses

Chapter 19

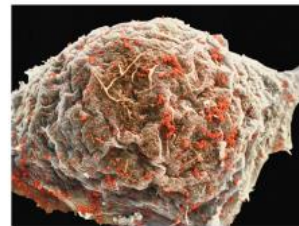
A Borrowed Life

Virus: an infectious particle incapable of replicating outside of a cell, which consists of an RNA or DNA genome enclosed in a protein coat (_____)

- ▶ _____ parasites

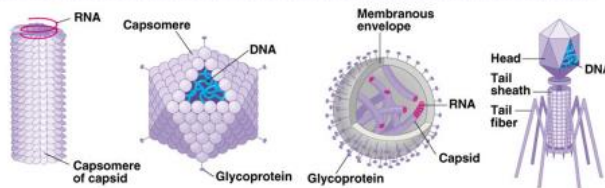
Arguments for describing viruses as non-living

- ▶ Can not _____ outside of host cell
- ▶ Can not carry out _____ outside of host cell
 - ▶ Lack _____ and enzymes

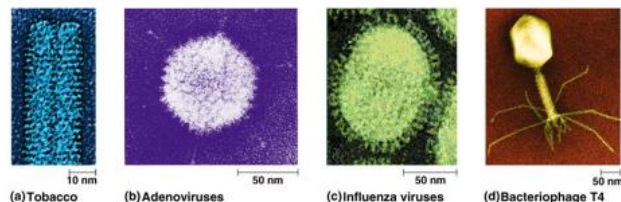


Structure of Viruses

- ▶ Capsids are made up of protein subunits called _____.



- ▶ **Viral envelopes:** membranous envelope made up of phospholipids and membrane proteins that surrounds the capsids of some viruses



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Virus Classification

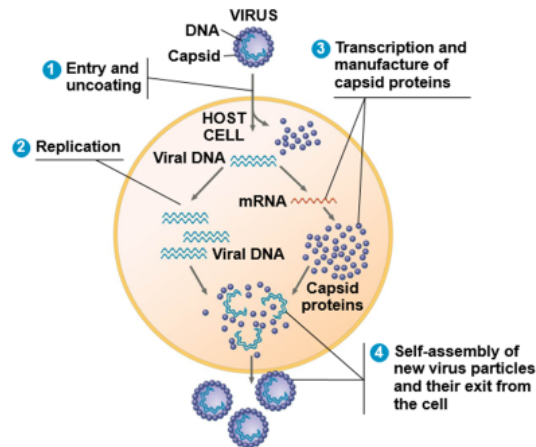
Table 19.1 Classes of Animal Viruses

Class/Family	Envelope?	Examples That Cause Human Diseases
I. Double-Stranded DNA (dsDNA)		
Adenovirus (see Figure 19.3b)	No	Respiratory viruses; tumor-causing viruses
Papillomavirus	No	Warts, cervical cancer
Polyomavirus	No	Tumors
Herpesvirus	Yes	Herpes simplex I and II (cold sores, genital sores); varicella zoster (shingles, chicken pox); Epstein-Barr virus (mononucleosis, Burkitt's lymphoma)
Poxvirus	Yes	Smallpox virus; cowpox virus
II. Single-Stranded DNA (ssDNA)		
Parvovirus	No	B19 parvovirus (mild rash)
III. Double-Stranded RNA (dsRNA)		
Reovirus	No	Rotavirus (diarrhea); Colorado tick fever virus

Class/Family	Envelope?	Examples That Cause Human Diseases
IV. Single-Stranded RNA (ssRNA); Serves as mRNA		
Picornavirus	No	Rhinovirus (common cold); poliovirus; hepatitis A virus; other intestinal viruses
Coronavirus	Yes	Severe acute respiratory syndrome (SARS)
Flavivirus	Yes	Yellow fever virus; West Nile virus; hepatitis C virus
Togavirus	Yes	Rubella virus; equine encephalitis viruses
V. ssRNA; Serves as Template for mRNA Synthesis		
Filovirus	Yes	Ebola virus (hemorrhagic fever)
Orthomyxovirus	Yes	Influenza virus (see Figures 19.3c and 19.9a)
Paramyxovirus	Yes	Measles virus; mumps virus
Rhabdovirus	Yes	Rabies virus
VI. ssRNA; Serves as Template for DNA Synthesis		
Retrovirus	Yes	Human immunodeficiency virus (HIV/AIDS; see Figure 19.8); RNA tumor viruses (leukemia)

Virus Reproduction

1. Virus enters host cell after host cell recognition
2. Host enzymes replicate virus DNA
3. Host enzymes transcribe viral DNA into viral mRNA, which is used to make capsid proteins
4. New virus particles assemble and leave host cell



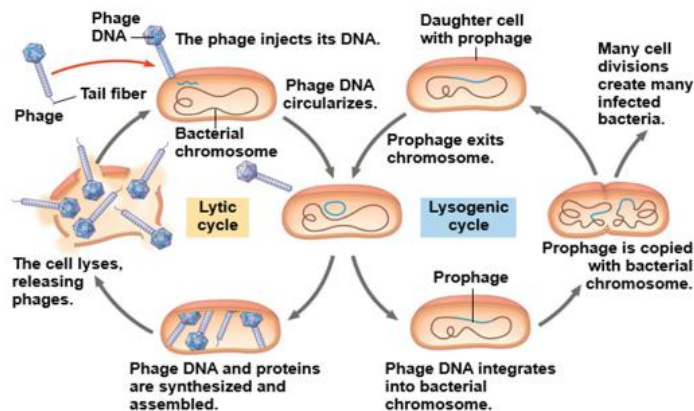
Replication of Phages

Lytic cycle: host cell _____ when releasing phages = cell death

- ▶ Surface proteins
- ▶ Restriction enzymes
- ▶ **CRISPR**

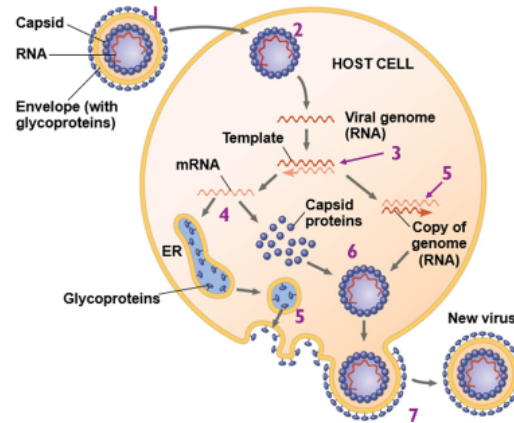
Lysogenic cycle: _____ of phage genome ≠ cell death

- ▶ Prophage



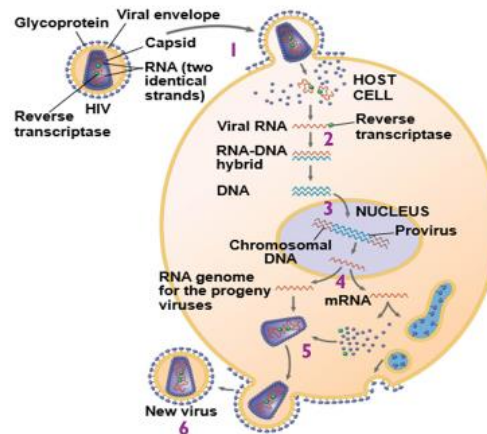
Replication of Animal Viruses (Class V)

1. Glycoproteins on viral envelope bind to receptors on host cell
2. Cellular enzymes digest capsid
3. Viral genome copied by viral RNA polymerase to make mRNA
4. Viral RNA functions as mRNA, which is translated to make capsid proteins and glycoproteins
5. mRNA transcribed to make a copy of the viral genome
6. Vesicles transport viral envelope to plasma membrane
7. Capsid assembles around viral genome
8. New virus buds from host cell



Replication of Retroviruses (Class VI)

1. Glycoproteins on viral envelope bind to _____ on immune cell then fusing with plasma membrane and releasing capsid proteins and RNA into the host cell
2. _____ synthesizes DNA from viral RNA then subsequent DNA strands complementary to the first
3. Double stranded viral DNA incorporated into host cells DNA (_____)
4. Proviral genes transcribed to make RNA genome for progeny viruses and mRNA for translation into viral proteins
5. Capsids assembled around viral genomes
6. New viruses with viral envelope glycoproteins bud from host cell



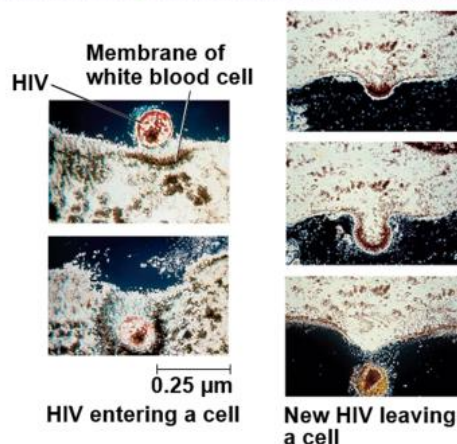
Human Immunodeficiency Virus (HIV)

Description:

- ▶ Class VI: ssRNA that is template for DNA synthesis
- ▶ _____
- ▶ Infects vital human immune system cells
 - ▶ Helper T cells, macrophages

Treatment:

- ▶ Azidothymidine (AZT)
 - ▶ Blocks reverse transcriptase
- ▶ Protease inhibitors
 - ▶ Blocks building of capsid



Ebola Virus

Description:

- ▶ Class V: ssRNA that is template for mRNA synthesis
- ▶ Infects human _____ system cells
- ▶ Causes hemorrhagic fever
 - ▶ Small blood clots throughout body
 - ▶ Fever, vomiting, bleeding, organ failure

Treatment:

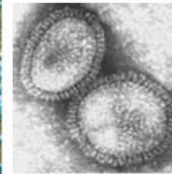
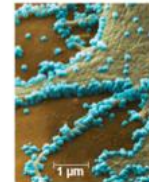
- ▶ No known treatment
 - ▶ Vaccines currently being tested



Influenza Virus

Description:

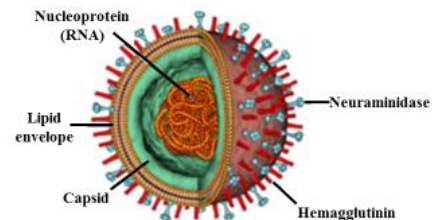
- ▶ Class V: ssRNA that is template for mRNA synthesis
- ▶ Infects epithelial cells of _____ system
- ▶ H1N1 refers to surface proteins of virus
 - ▶ Hemagglutinin (H) and Neuraminidase (N)



H1N1 influenza A virus

Treatment:

- ▶ Rest and wait for immune response
 - ▶ Shortened and less severe when vaccinated
- ▶ Antiviral drugs
 - ▶ Neuraminidase inhibitors block _____ from host cell
 - ▶ M2 proton inhibitors block virus from _____ host cell



Hepatitis

Description:

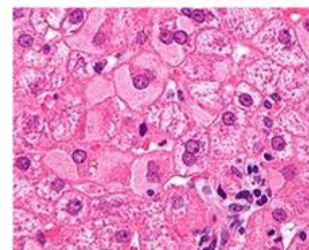
- ▶ At least five different unrelated viruses
- ▶ Causes _____

Hep A

- ▶ ssRNA _____ envelope
- ▶ Ingestion of contaminated food or water
- ▶ Vaccination

Hep C

- ▶ ssRNA _____ envelope
- ▶ Transmitted through contact with blood
- ▶ Antiviral drugs



Poliomyelitis

Description:

- ▶ Class IV: ssRNA that can serve as mRNA
- ▶ ___% of infections target human nerve cells
 - ▶ Do not divide and cannot be replaced
- ▶ Infected feces entering the mouth



Treatment:

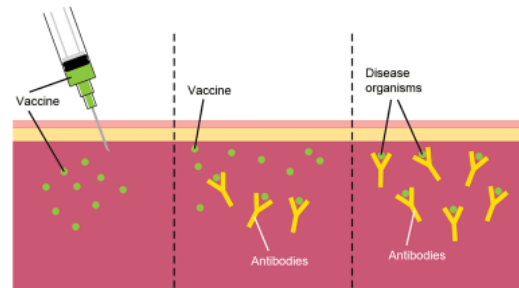
- ▶ Few people show symptoms
- ▶ Iron lung
- ▶ _____ developed vaccine
- ▶ No cure for polio



Vaccination

- ▶ **Vaccine:** a weakened or harmless form of a pathogen that when administered to an organism, causes the organism's immune system to build up an immunity to the pathogen without the individual contracting the disease.

- ▶ **Pathogen:** a bacteria, virus or other microorganism that causes a disease
- ▶ **Antibodies:** specialized proteins produced by the immune cells to help destroy pathogens



Check Your Understanding

1. True or False: Virus replication occurs via the prophage in the lysogenic cycle
2. True or False: Some viruses can replicate outside of a host cell

Check Your Understanding

Which of the following viruses replicates by incorporating its DNA into the DNA of the host?

- a. Ebola
- b. Poliomyelitis
- c. HIV
- d. Influenza



Check Your Understanding

Draw and describe the replication of a Class V virus with your neighbor

