Viruses

General Characteristics of Viruses

1. Depending on view may be regarded as exceptionally complex aggregates of nonliving chemicals or as exceptionally simple living microbes.
2. Contain a single type of nucleic acid (DNA or RNA) and a protein coat, sometimes enclosed by an envelope composed of lipids, proteins, and carbohydrates.
3. Are obligate intracellular parasites. Multiply by using the host cell's synthesizing machinery to cause the synthesis of specialized elements that can transfer the viral nucleic acid to other cells.
4. Host range: Most viruses infect only specific types of cells in one host species. Determined by specific chemical receptor sites of host cell surface.
5. Viral size is ascertained by electron microscopy.

Viral Structure and General Morphology

1. Basis components

Nucleic acid: singled stranded, double stranded, RNA, or DNA, linear or circular.

Capsid: protein coat that is most of the mass of the virus.

Envelope: some animal viruses are extruded from infected cell and contain host plasma membrane (with lipids, proteins, carbohydrates) with viral proteins.

2. Helical and polyhedral virus Nonenveloped virus and enveloped virus
Complex – Bacteriophage-

Taxonomy of Viruses

1. Based on type of nucleic acid, strategy for replication, and morphology.
a) Nucleic acid type: DNA or RNA, single or double stranded, positive or negative strand.
b) Two types of replication: how it replicates its nucleic acid. Also can be lytic: cell destroyed and lysogenic: host cell lives

c) Morphology: enveloped vs noneveloped, general shape (helical, bullet shape, etc.)

2. Do not have species, so in virology we have genus followed by common names.
Genus *Lentivirus*, common name: *HIV-I, Human Immunodeficiency Virus*

3. Summary of the classification of viruses that infect humans in D. Cultivating and Identifying Viruses in the Laboratory

1. Have to be cultured in living tissue - animals, embryonated eggs, or cell culture.

2. Use cell cultures in clinical lab. - Viruses infect monolayer; deterioration is celled cytopathic effect (CPE). Common test for herpes virus.

Identifying Viruses Using Serology. Common technique.

RFLPs and PCR also used.

Example of Replication of Viruses.
1. Replication- Has few genes. Mostly viral nucleic acid, so invade cells and viral proteins are reproduced.

2. Lytic Cycle- Five stages
a) Attachment
b) Penetration
c) Biosynthesis
d) Maturation
e) Release

3. Lysogeny- Some may not proceed to lysis. Example is bacteriophage of E. coli.
a) Latent or inactive- Genes are suppressed so phage doesn't multiply
b) Each time host cells replicate it also replicates.
c) UV or chemicals can activate.
d) Results of Lysogeny
(1) Lysogenic cells are immune to reinfection by the same phage.
(2) Host cell may exhibit new properties
(a) C. diptheria – Toxin production requires phage virus.

(b) Specialized transduction- packages host DNA along with its own DNA.

4. Multiplication of Animal Viruses

a) General pattern just described
b) Differences
(1) Have no tail
(2) Penetration- Endocytosis of fusion.
(3) Biosynthesis- DNA viruses- Multiplication usually in nucleus.
(4) Biosynthesis of RNA viruses. Similar- Takes place in cytoplasm- Transcription of DNA to
RNA is not needed. Differences in formation on mRNA.Also have reverse transcriptase viruses.
(5) Maturation & Release
(a) Enveloped viruses- Budding-
(b) Nonenveloped viruses- Cause lysis and death of cell

Viruses and Cancer

1. When activated animal oncogenes transform normal cells into cancer cells. Can be activated by chemicals, radiation, and viruses. Viruses integrate with host DNA

2. Code for one or more elements along host cell growth pathway. Cells are called Transformed.

3. Viruses capable of producing tumors are called oncogenic viruses. About 10% of cancers are virus induced.
a) Example:
b) DNA viruses. Papillomaviruses: uterine (cervical) cancer; HBV Viral Hepatitis: liver cancer. RNA viruses. Retroviridae HTLV-1 &2: adult T-cell leukemia and lymphoma. (similar to feline leukemia virus (FeLV)that is transmissible among cats.)

4. The genetic material of oncogenic viruses become integrated into the host's DNA and replicates with host DNA.

5. Transformed cells lose contact inhibition, contain virusspecific abnormalities, and can produce tumors when injected into susceptible animals.

Latent Viral Infections

1. A latent viral infection remains in the host cell for long periods, often many years, without producing disease.

2. Examples are cold sores (Herpes simplex) and shingles (Herpes zoster, varicella or chickenpox).

3. Both are latent in nerve cells .*H. Persistent (Slow) Viral Infections*
1. Disease processes over a long period of time and are usually fatal. Caused by conventional viruses that accumulate.
Example: measles virus can later cause subacute sclerosing panencephalitis (SSPE).

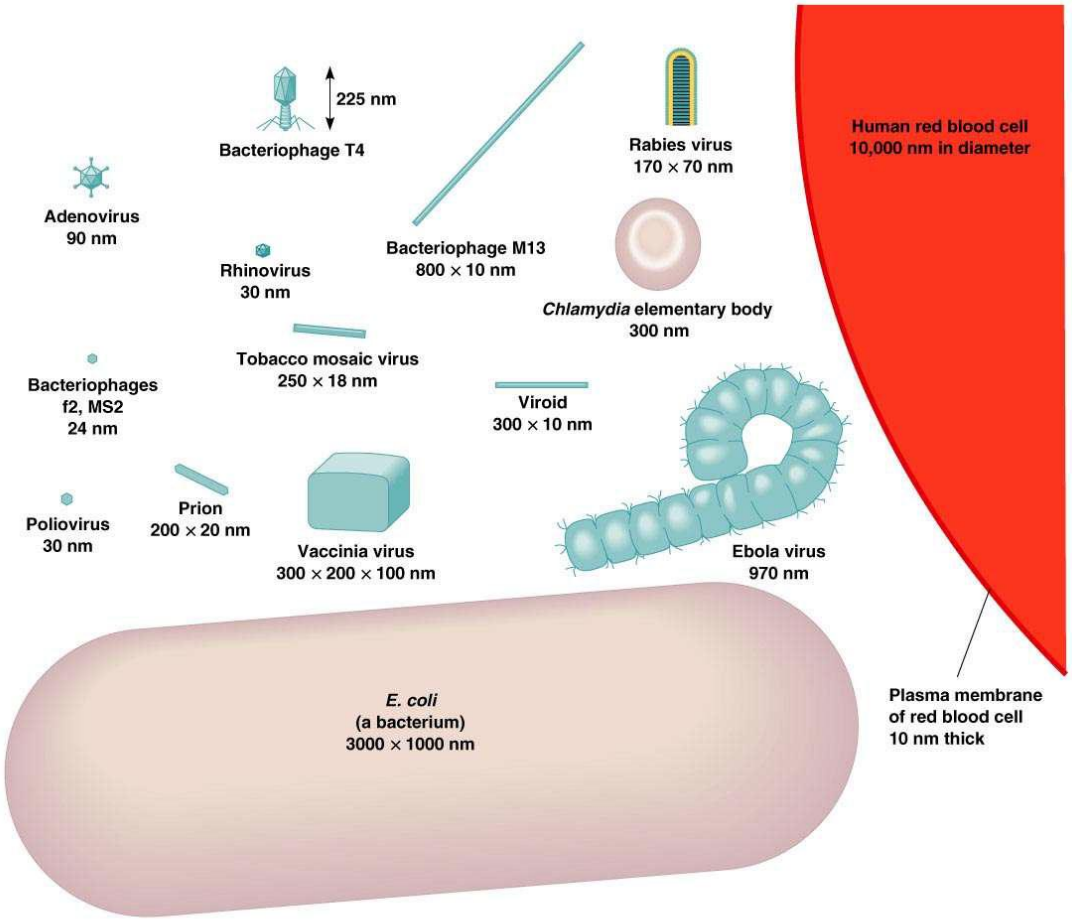
Prions

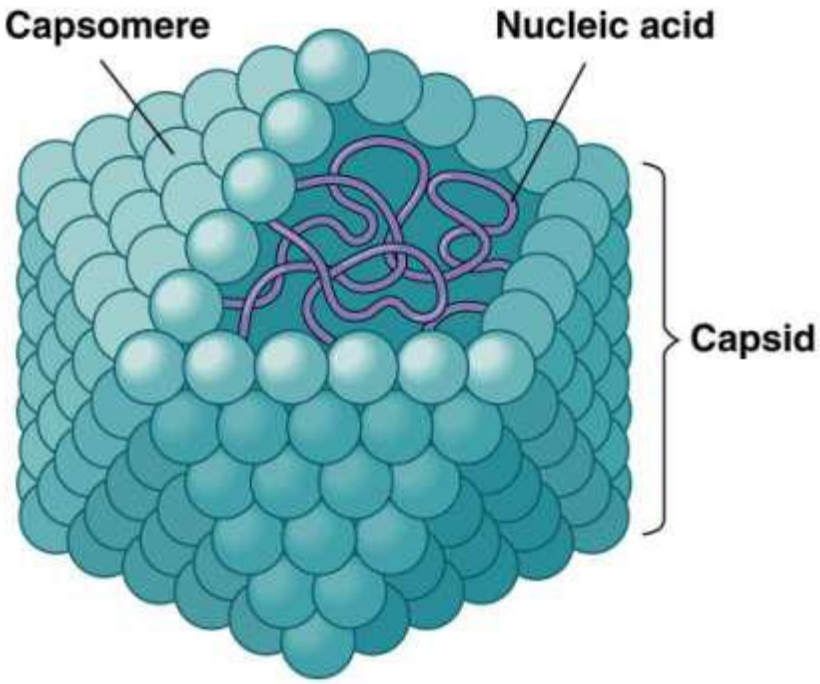
1. Prion = Infectious proteins. Proteinaceous infectious particle. Normal = PrPC Abnormal = PrPSc .

2. Diseases include Human origin: kuru,Creutzfeld-Jakob Disease (CJD). Animal origin: mad cow disease. All involve degeneration of brain tissue by accumulation of PrPSc causing plaques. Prion

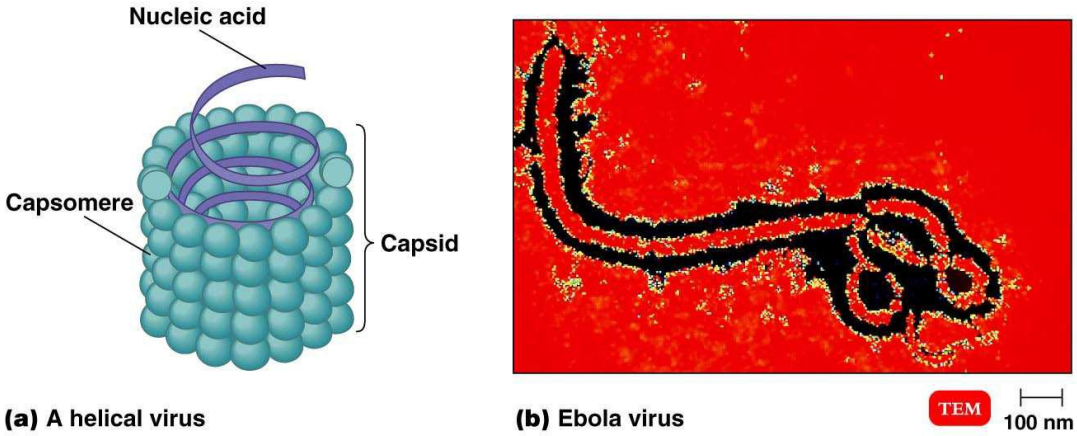
TABLE 13.1 Viruses and Bacteria Compared

	Bacteria	Viruses	
	Typical Bacteria	Rickettsias/ Chlamydias	
Intracellular parasite	No	Yes	Yes
Plasma membrane	Yes	Yes	No
Binary fission	Yes	Yes	No
Pass through bacteriological filters	No	No/Yes	Yes
Possess both DNA and RNA	Yes	Yes	No
ATP-generating metabolism	Yes	Yes/No	No
Ribosomes	Yes	Yes	No
Sensitive to antibiotics	Yes	Yes	No
Sensitive to interferon	No	No	Yes

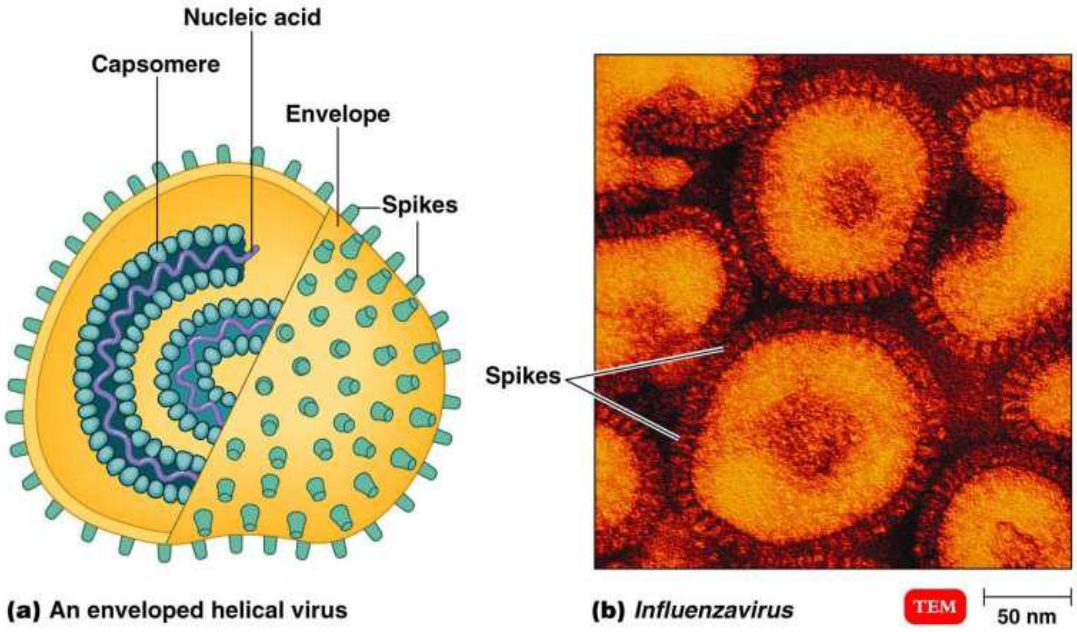




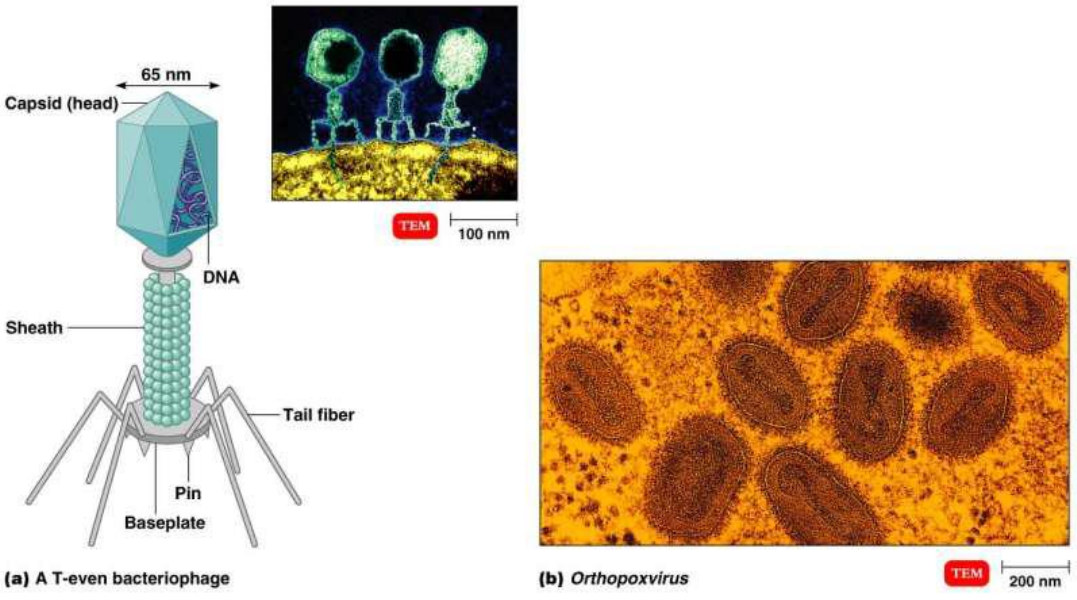
(a) A polyhedral virus



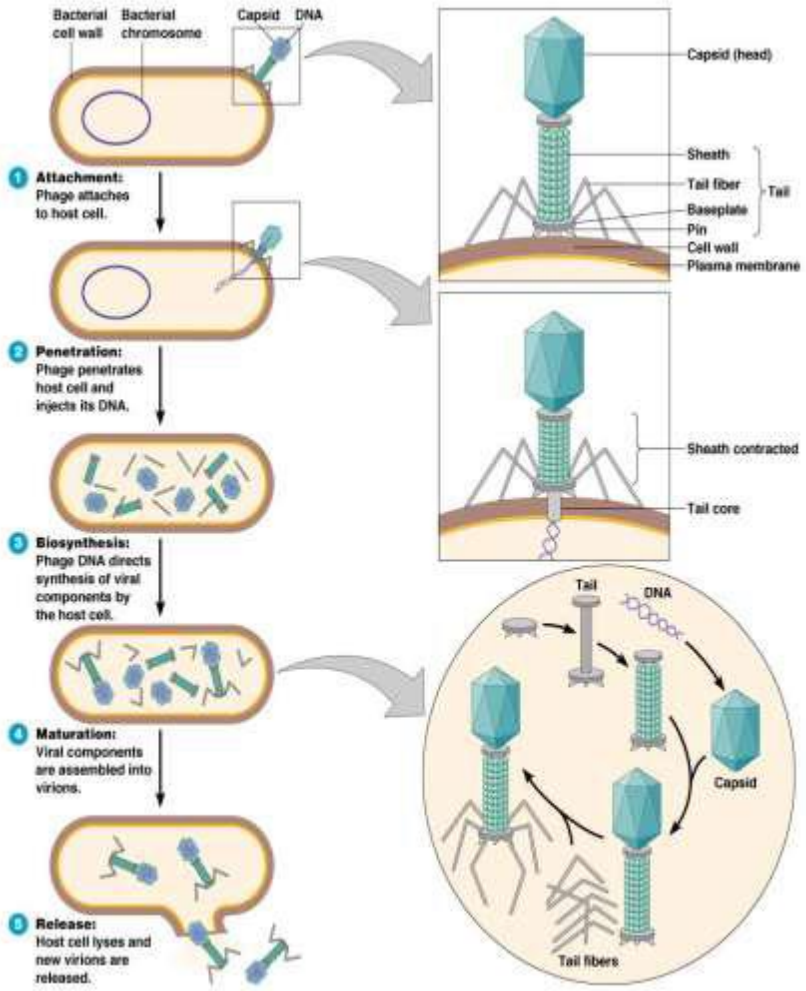
(a) A helical virus **(b)** Ebola virus

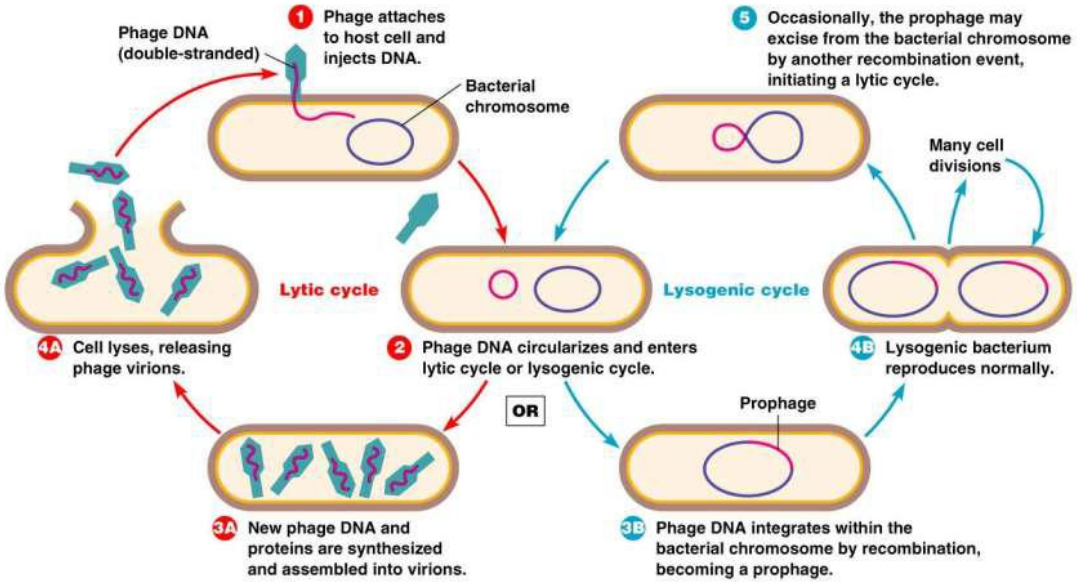


(a) An enveloped helical virus **(b)** *Influenzavirus*



(a) A T-even bacteriophage **(b)** *Orthopoxvirus*





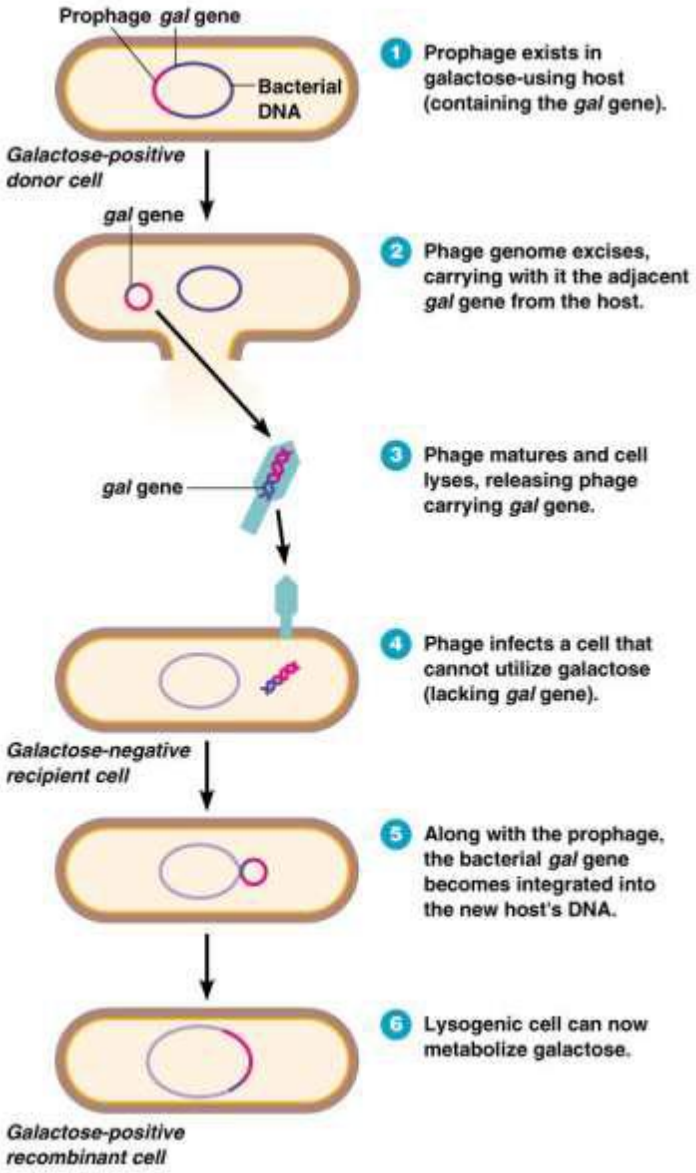
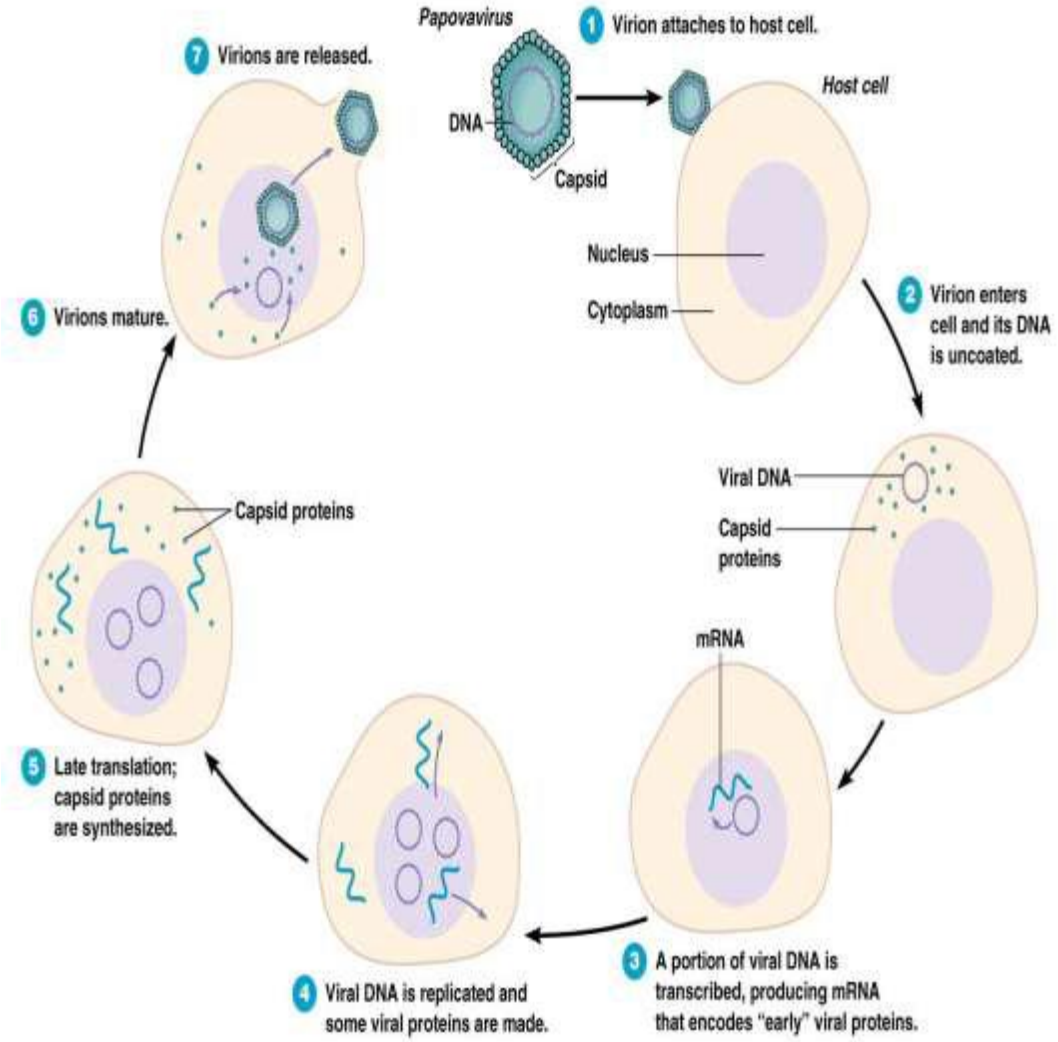
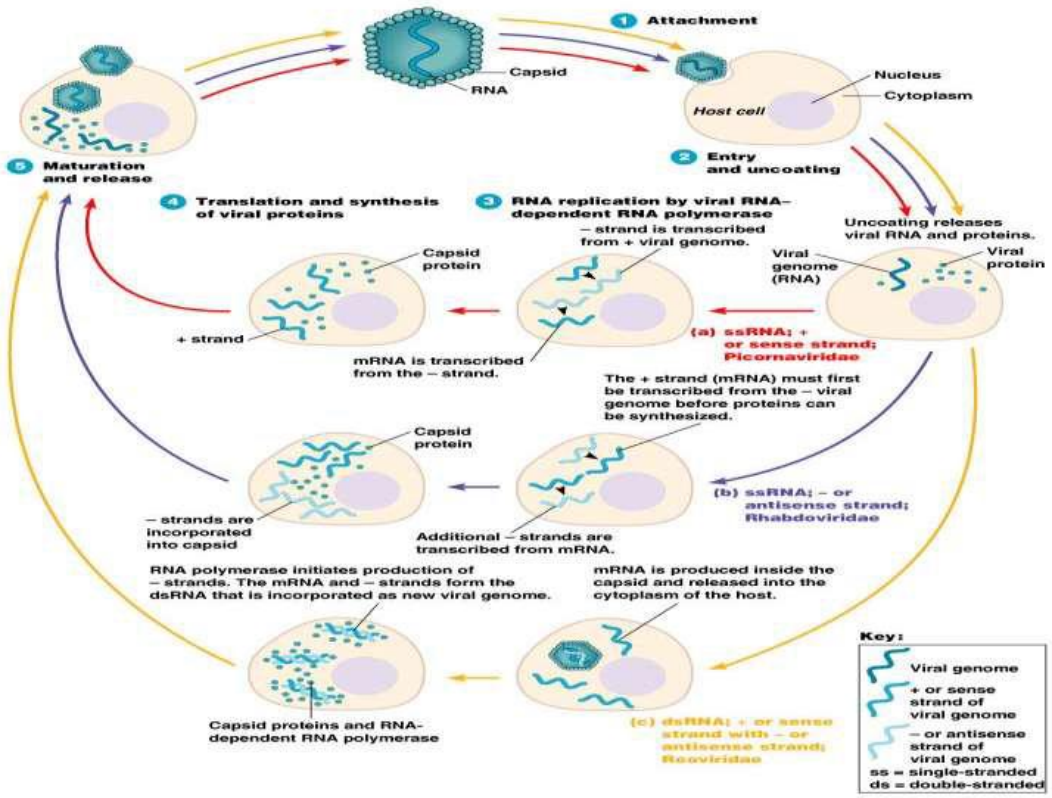


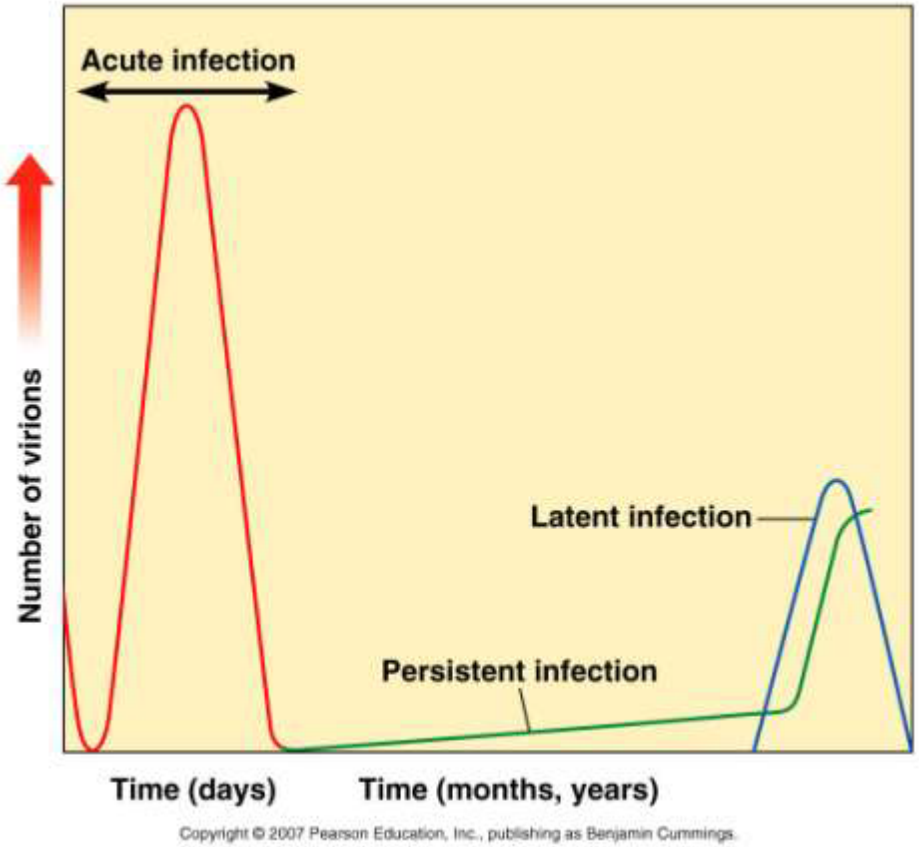
TABLE 13.3 Bacteriophage and Viral Multiplication Compared

Stage	Bacteriophages	Animal Viruses
Attachment	Tail fibers attach to cell wall proteins	Attachment sites are plasma membrane proteins and glycoproteins
Entry	Viral DNA injected into host cell	Capsid enters by endocytosis or fusion
Uncoating	Not required	Enzymatic removal of capsid proteins
Biosynthesis	In cytoplasm	In nucleus (DNA viruses) or cytoplasm (RNA viruses)
Chronic infection	Lysogeny	Latency; slow viral infections; cancer
Release	Host cell lysed	Enveloped viruses bud out; nonenveloped viruses rupture plasma membrane

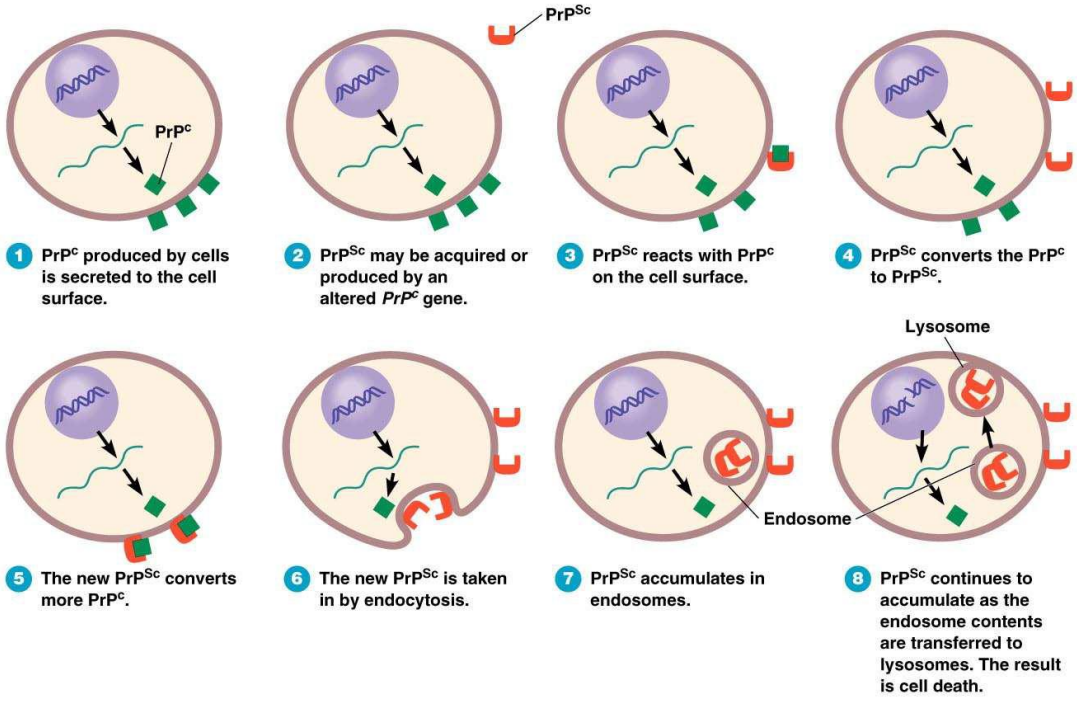


Multiplication of animal viruses





Latent viral infections



pirons