

Viruses

Chapter 19



What you must know:

- The components of a virus.
- How viruses replicate
- The differences between lytic and lysogenic cycles.
- Types of viruses including RNA viruses and HIV

Bacteria vs. Viruses

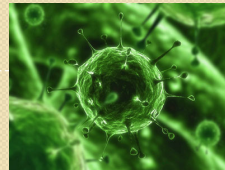
Bacteria

- Prokaryotic cell
- Most are free-living (some parasitic)
- Relatively large size
- *Antibiotics* used to kill bacteria



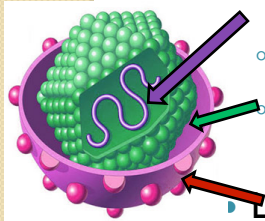
Virus

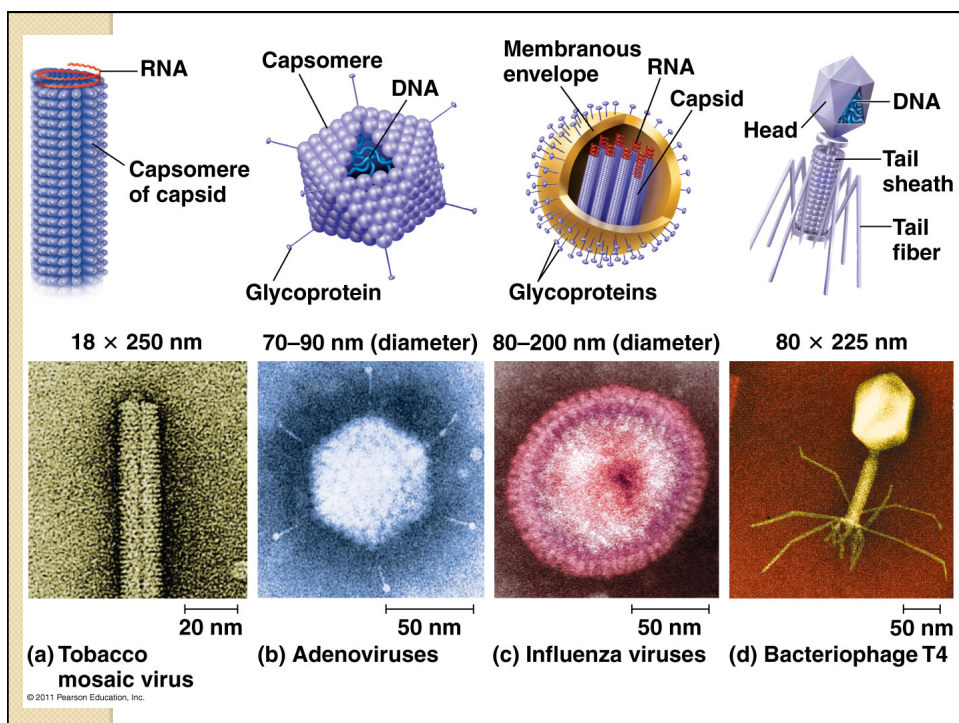
- Not a living cell (genes packaged in protein shell)
- Intracellular parasite
- 1/1000 size of bacteria
- *Vaccines* used to prevent viral infection
- Antiviral treatment



Viruses

- Very small (<ribosomes)
- Components = nucleic acid + capsid
 - **Nucleic acid**: DNA or RNA (double or single-stranded)
 - **Capsid**: protein shell
- Some viruses also have **viral envelopes** that surround the capsid
- Limited host range (eg. human cold virus infects upper respiratory tract)
- Reproduce within host cells
- **Bacteriophage** = viruses that infect bacteria





How does a virus work?

- The capsid contains proteins that allow **the virus to enter the host cell** by binding to receptors on the surface of the cell and “tricking” the cell into allowing it to enter.
 - Most viruses are highly specific to the type of cell which they infect since they must match the appropriate receptor.
- The cell **transcribes and translates** the genetic material of virus and makes copies of the virus.

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
Papovavirus	No	Papillomavirus (warts, cervical cancer); polyomavirus (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

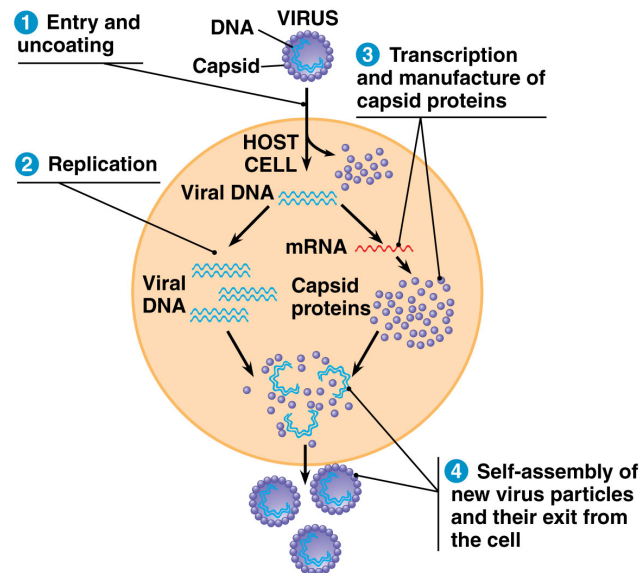
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Table 19.1 Classes of Animal Viruses (continued)

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 enteric (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; Template for mRNA Synthesis		
Filovirus	Yes	Ebola virus (hemorrhagic fever)
Orthomyxovirus (see Figures 19.3c and 19.9a)	Yes	Influenza virus
Paramyxovirus	Yes	Measles virus; mumps virus
Rhabdovirus	Yes	Rabies virus
VI. ssRNA; Template for DNA Synthesis		
Retrovirus (see Figure 19.8)	Yes	Human immunodeficiency virus (HIV/AIDS); RNA tumor viruses (leukemia)

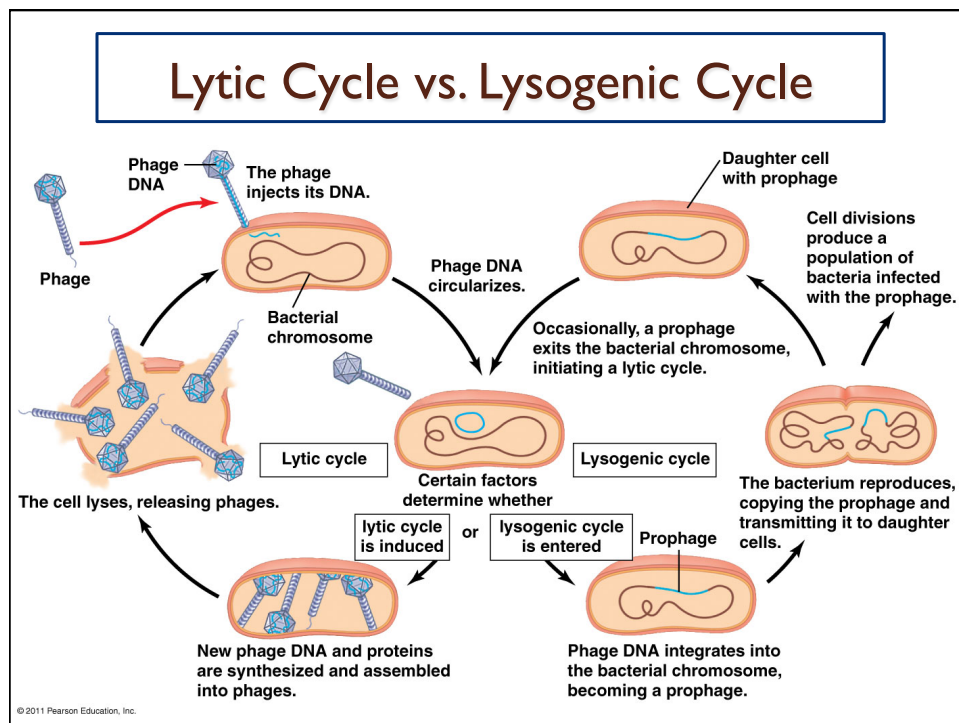
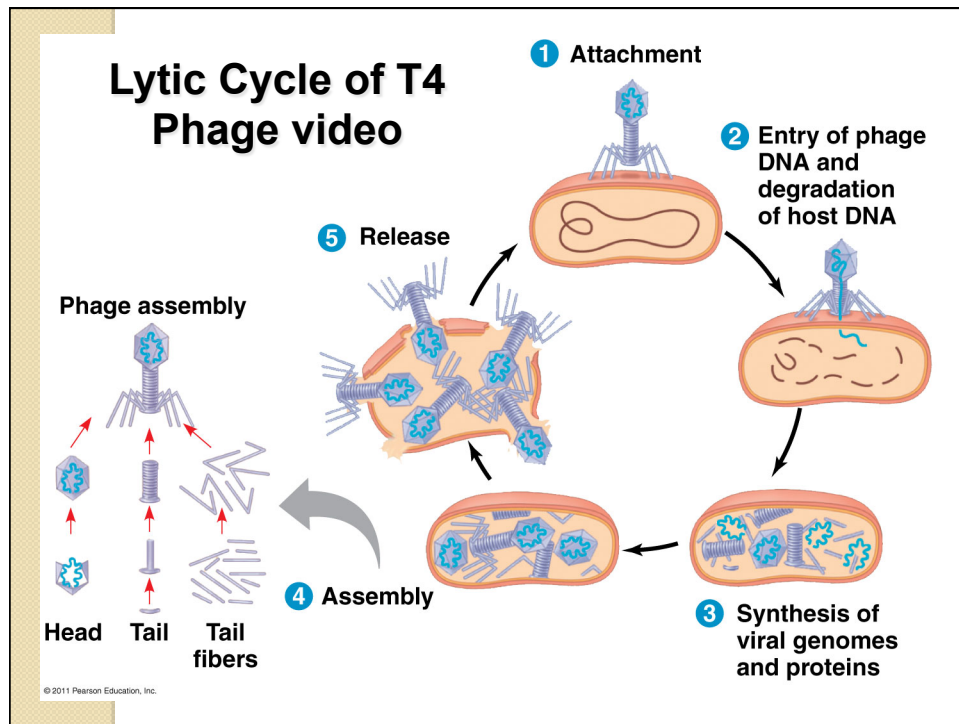
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Simplified viral replicative cycle

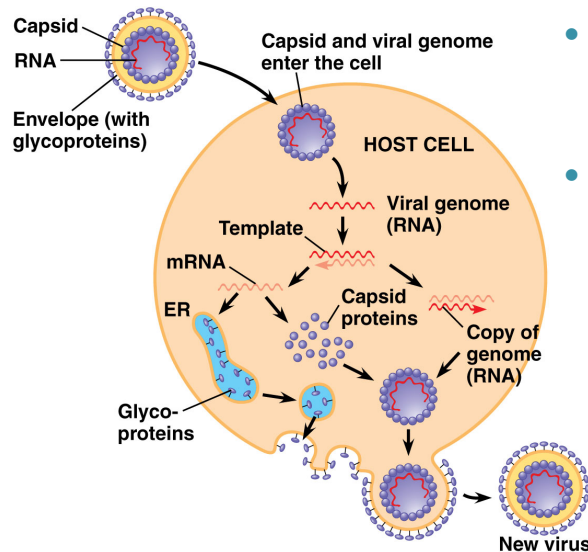


Lytic vs. Lysogenic cycles

- **Lytic Cycle:**
 - Use host machinery to make copies of virus
 - Death of host cell by rupturing it (**lysis**)
 - Virulent phages replicate by this method
- **Lysogenic Cycle:**
 - DNA incorporated into host DNA and replicated along with it
 - Phage DNA = **prophage**
- ***Temperate Phage:*** uses both methods of replication



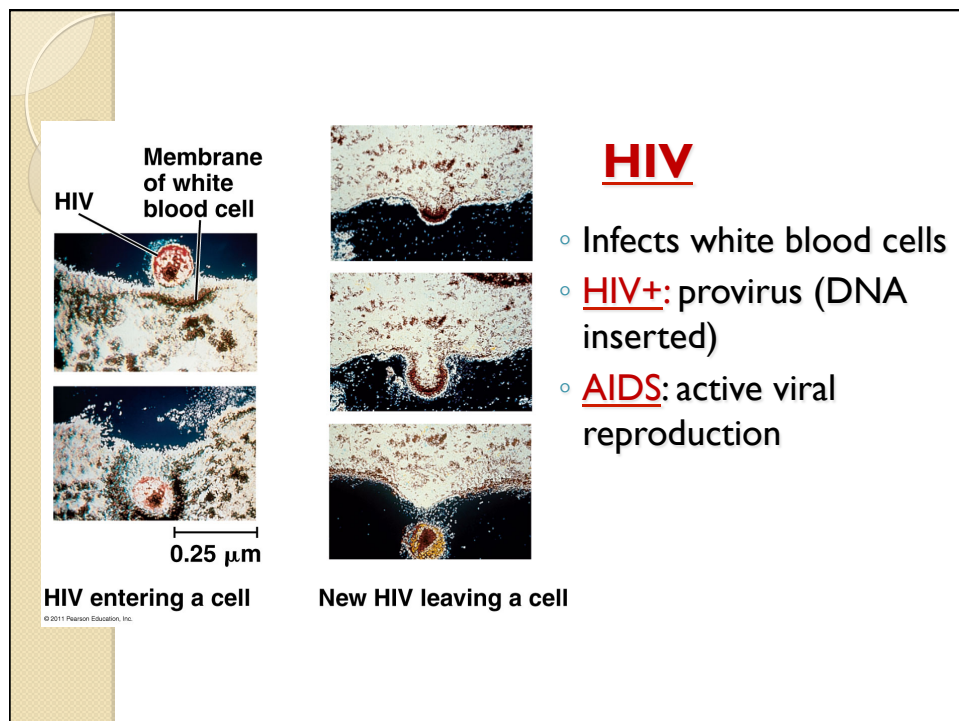
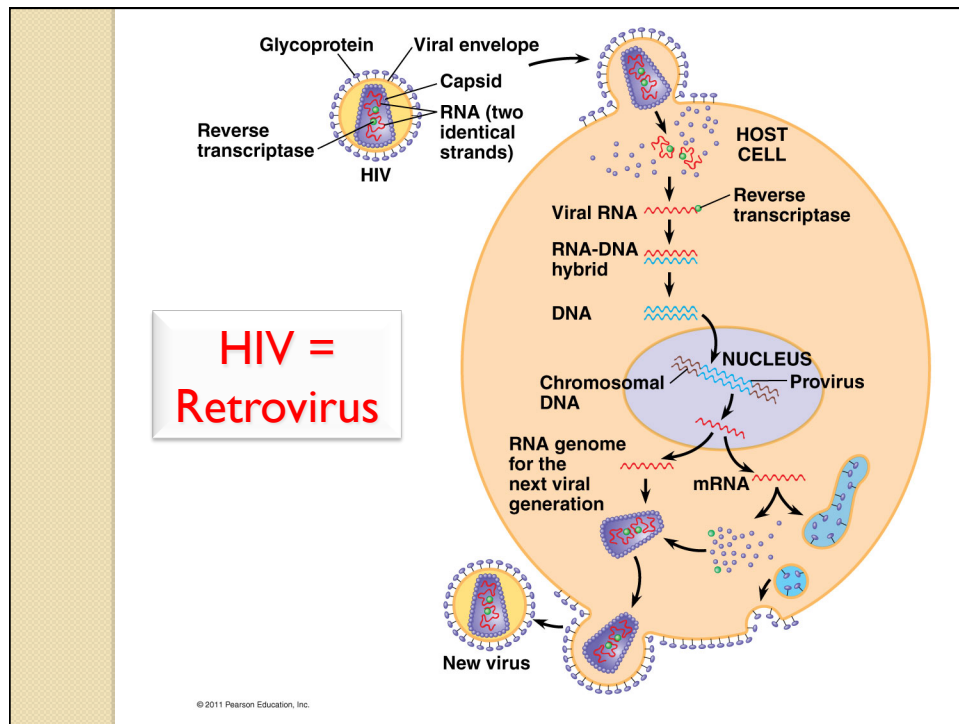
Animal viruses have a membranous envelope



- Host membrane forms around exiting virus
- Difficult for host immune system to detect virus

Retrovirus

- RNA virus that uses reverse transcriptase (RNA → DNA)
- Newly made viral DNA inserted into chromosome of host
- Host transcribes viral DNA (= provirus) to make new virus parts
- **Example: HIV (Human Immunodeficiency Virus)**



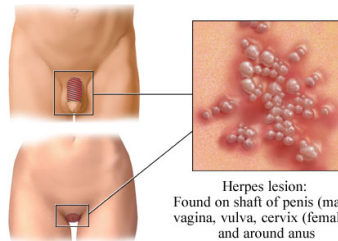
Other human viruses

- Herpes virus

Herpes Simplex Virus 1 (HSV-1)

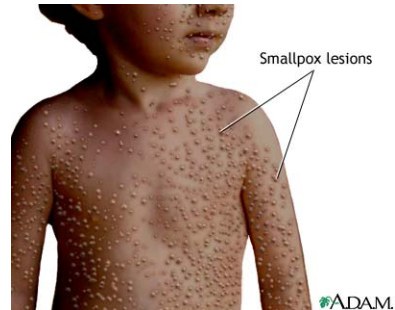


Herpes Simplex Virus 2 (HSV-2)



Herpes lesion:
Found on shaft of penis (male),
vagina, vulva, cervix (female),
and around anus

- Smallpox



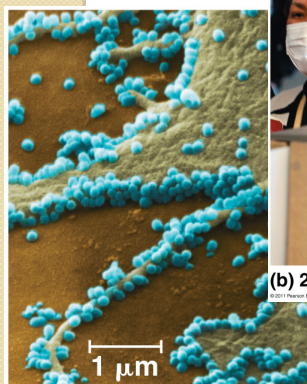
Eradicated in 1979 due to
worldwide vaccination campaigns

Vaccines

- Weakened virus or part of pathogen that triggers immune system response



Emerging viruses = mutation of existing viruses



(a) 2009 pandemic H1N1 influenza A virus

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(b) 2009 pandemic screening

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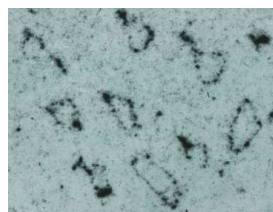


(c) 1918 flu pandemic

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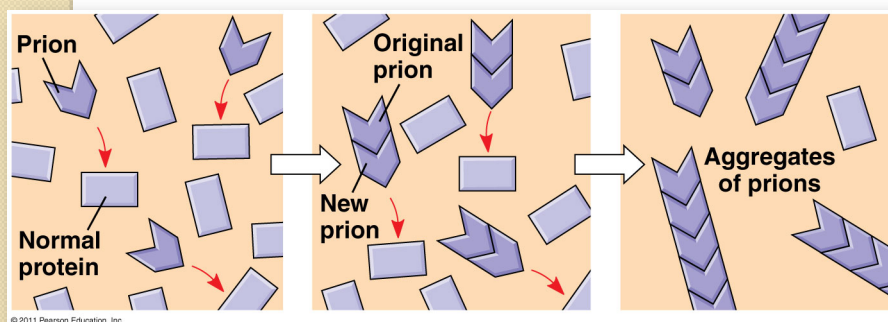
Viroids

- Small, circular RNA molecules that infect plants
- Cause errors in regulatory systems that control plant growth
- Eg. coconut palms in Philippines



Prions

- Misfolded, infectious **proteins** that cause misfolding of normal proteins
- Eg. mad cow disease (BSE), Creutzfeldt-Jakob disease (humans), scrapie (sheep)



Diseases caused by prions

- Prions act slowly – incubation period of at least 10 years before symptoms develop
- Prions are virtually indestructible (cannot be denatured by heating)
- No known cure for prion diseases

