

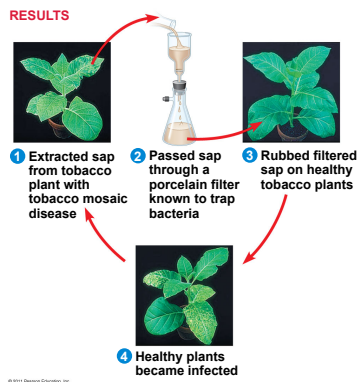
GENETICS  
**CHAPTER 19**  
**VIRUSES**

DATE **2013** COURSE **AP BIOLOGY**

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## Virus Discovery

- \* Virus consists of a nucleic acid surrounded by a protein coat
- \* Tobacco mosaic disease stunts growth of tobacco plants and gives their leaves a mosaic coloration
- \* Late 1800s researchers hypothesized that a particle smaller than bacteria caused the disease
- \* 1935, Wendell Stanley confirmed this hypothesis by crystalizing the infectious particle, tobacco mosaic virus (TMV)

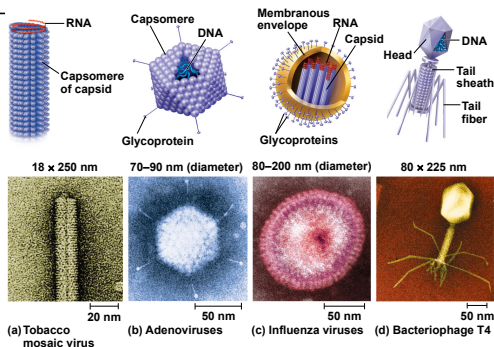


**FIG. 19.2**

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## Virus Structure

**FIG. 19.3**



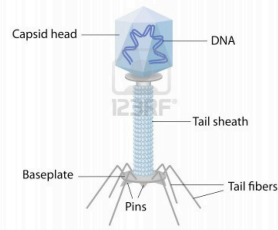
- \* Viruses are not cells
- \* Virus is a small infectious particle consisting of nucleic acid enclosed in a protein coat and, in some cases, a membranous envelope (derived from host cell membrane)
- \* Viral genomes consist of either double- or single-stranded DNA or double- or single-stranded RNA
- \* Capsid is the protein shell that encloses the viral genome (capsids can have many different structures)

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# Bacteriophages

- \* Bacteriophages - viruses that infect bacteria (also called phages)
- \* Have the most complex capsids found among viruses
- \* Phages have an elongated capsid head that encloses their DNA
- \* A protein tail piece attaches the phage to the host and injects the phage DNA inside
- \* Best understood of all viruses

Structure of a Bacteriophage



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# Virus Replication

- \* Viruses are obligate intracellular parasites (they can only replicate within a host cell)
- \* Each virus has a host range (limited number of host cells that it can infect)
- \* Once viral genome enters the cell, the cell begins to manufacture viral proteins
- \* 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

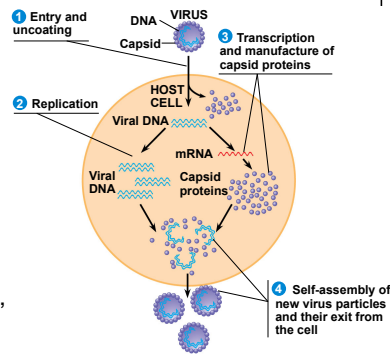


FIG. 19.4

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# Phage Replication

- \* Two reproductive mechanisms
  - \* Lytic Cycle - produces new phages and lyses the host cell to release progeny
    - \* Bacteria have defenses against phages (**restriction enzymes**)
  - \* Lysogenic Cycle - replicates phage genome without destroying host by incorporating the viral genome into the host cell's chromosomes (every time the host cell divides, it copies phage DNA and passes it on to daughter cells)
    - \* Integrated DNA is called a prophage
    - \* Environmental signals will trigger the virus to switch to the lytic mode

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# Animal Viruses

- \* Ways to classify (DNA vs. RNA and single-stranded vs. double stranded)
- \* Viral Envelopes - membrane with glycoproteins that bind to specific receptor molecules on the surface of a host cell
- \* Some formed from host cell's plasma membrane as the viral capsid exits; some from the endomembrane system (Golgi body)

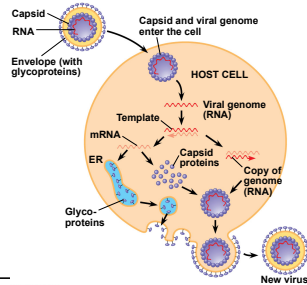


FIG. 19.7

Class/Family	Envelope	Examples That Cause Human Diseases
<b>I. Double-Stranded DNA (dsDNA)</b>		
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
<b>II. Single-Stranded DNA (ssDNA)</b>		
Parvovirus	No	B19 parvovirus (mild rash)
<b>III. Double-Stranded RNA (dsRNA)</b>		
Reovirus	No	Rotavirus (diarrhea); Colorado tick fever virus
<b>IV. Single-Stranded RNA (ssRNA): Serves as mRNA</b>		
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
<b>V. ssRNA: Template for mRNA Synthesis</b>		
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
<b>VI. ssRNA: Template for DNA Synthesis</b>		
Retrovirus (see Figure 19.8)	Yes	Human immunodeficiency virus (HIV/AIDS); RNA tumor viruses (leukemia)

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# RNA as Genetic Material

- \* **Retroviruses** use **reverse transcriptase** to copy their viral genome into DNA
- \* **HIV** (human immunodeficiency virus) is the retrovirus that causes **AIDS** (acquired immunodeficiency syndrome)
- \* Viral DNA integrated into the host genome is called a **provirus**
- \* Host's RNA polymerase transcribes the proviral DNA into RNA

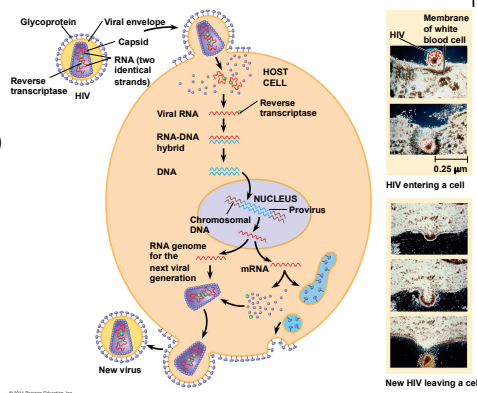


FIG. 19.8

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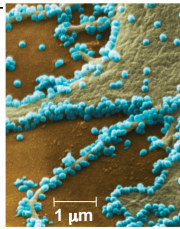
# Evolution of Viruses

- \* Since they can replicate only within cells, they probably evolved as bits of cellular nucleic acid
- \* Candidates for the source of viral genomes are plasmids (circular DNA in bacteria and yeast cells) and transposons (small mobile DNA segments)
- \* Not sure if viruses evolved before cells

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## Pathogenic Properties

- \* Viruses may damage or kill cells by causing the release of hydrolytic enzymes from lysosomes
- \* Some viruses cause infected cells to produce toxins that lead to disease symptoms
- \* **Vaccines** are harmless derivatives of pathogenic microbes that stimulate the immune system
  - \* Vaccines are preventative, antiviral drugs can help treat (cannot cure), antibiotics DO NOT treat viral diseases
- \* Emerging Viruses (those that become suddenly apparent)
  - \* Epidemics are general outbreaks (ex. H1N1)
  - \* Pandemics are outbreaks on a global scale (ex. 2009 influenza "swine flu")
- \* Some viruses can jump species



(a) 2009 pandemic H1N1 influenza A virus



(b) 2009 pandemic screening

FIG. 19.9

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## Viral Diseases in Plants

- \* Most cause spots on leaves or fruits, stunted growth, and damaged flowers or roots
- \* Most plant viruses have an RNA genome
- \* Two major modes of transmission
  - \* Horizontal transmission - entering through damaged cell walls
  - \* Vertical transmission - inheriting the virus from a parent



FIG. 19.10

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## Other Infectious Agents

- \* Viroids - small circular RNA molecules that infect plants and disrupt their growth
- \* Prions - slow acting, virtually indestructible infectious proteins that cause brain diseases in mammals (ex. scrapie, mad cow disease, Creutzfeldt-Jakob disease)
  - \* Propagate by converting normal proteins into prion version

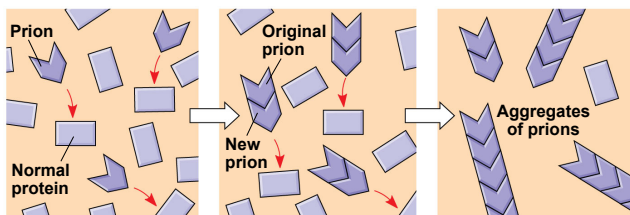


FIG. 19.11

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