



The Genetics of Viruses

- First identified by Stanley in 1935-Tobacco Mosaic Virus
- The **capsid** is a protein shell enclosing the viral genome.
 - built of a large number of protein subunits called *capsomeres*
 - limited diversity

(a) Tobacco mosaic virus

(b) Adenoviruses

- Tobacco mosaic virus has over 1,000 copies of the same protein.
- Adenoviruses have 252 identical proteins arranged into a polyhedral capsid

(a) Tobacco mosaic virus

(b) Adenoviruses

- Some viruses have **viral envelopes**, membranes cloaking their capsids.
- These envelopes are derived from the membrane of the host cell.
- They also have some viral proteins and glycoproteins.

(c) Influenza viruses
Fig. 18.2c

- The most complex capsids are found in viruses that infect bacteria, called **bacteriophages** or **phages**.
- The T-even phages that infect *Escherichia coli* have a 20-sided capsid head that encloses their DNA and a protein tail piece that attaches the phage to the host and injects the phage DNA inside.

(d) Bacteriophage T4

Life Cycle

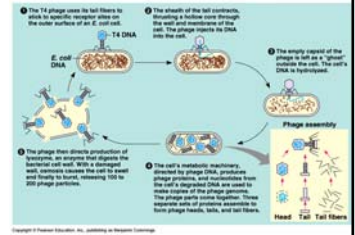
- Obligate intracellular parasites
- Range varies, depends upon receptor sites
- Some with broad range-ex. Rabies
- Some with very narrow range-ex. Human cold virus

Genome Replication

- DNA → DNA uses host DNA polymerase
- RNA → RNA virus has gene for RNA replicase
- RNA → DNA → RNA usually virus contains gene for reverse transcriptase

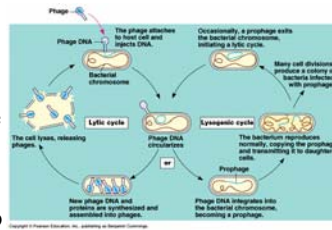
Lytic Cycle

- Virus uses cells enzymes, ribosomes, tRNAs, amino acids ATP, etc.
- Viral particles *self-assemble*
- Lytic cycle is fatal to cell
- Called Virulent viruses



Lysogenic Cycle

- Virus coexists within the host
- Called temperate viruses
- Viral genome is incorporated into the host's genome
- Called a *Prophage*



Animal Viruses

Table 18.1 Classes of Animal Viruses, Grouped by Type of Nucleic Acid

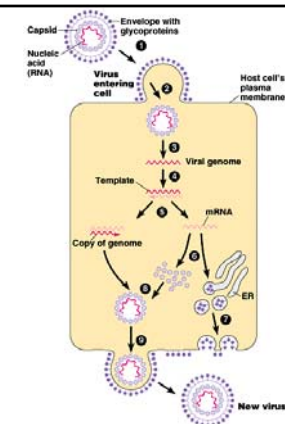
Class*	Examples/Diseases
I. dsDNA**	
Papovavirus	Papilloma (human warts, cervical cancer); polyoma (tumors in certain animals)
Adenovirus	Respiratory diseases; some cause tumors in certain animals
Herpesvirus	Herpes simplex I (cold sores), herpes simplex II (genital sores); varicella zoster (chicken pox, shingles); Epstein-Barr virus (mononucleosis, Burkitt's lymphoma)
Poxvirus	Smallpox; vaccinia, cowpox
II. ssDNA	
Parvovirus	Roseola; most parvoviruses depend on co-infection with adenoviruses for growth
III. dsRNA	
Reovirus	Diarrhea; mild respiratory diseases
IV. ssRNA that can serve as mRNA	
Picornavirus	Poliovirus; rhinovirus (common cold); enteric (intestinal) viruses
Togavirus	Rubella virus; yellow fever virus; encephalitis viruses
V. ssRNA that is a template for mRNA	
Rhabdovirus	Rabies
Paramyxovirus	Measles; mumps
Orthomyxovirus	Influenza viruses
VI. ssRNA that is a template for DNA synthesis	
Retrovirus	RNA tumor viruses (e.g., leukemia viruses); HIV (AIDS virus)

*The subclasses within each class differ mainly in capsid structure and in the presence or absence of a membranous envelope.
**ds = double-stranded; ss = single-stranded.

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Reproductive Cycles of Animal Viruses

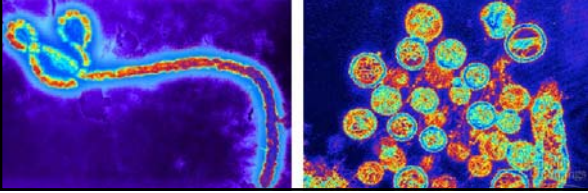
- Attachment-glycoprotein spikes attach to receptor sites
- Entry-envelope fuses with plasma membrane, entire virus moves in via *receptor mediated endocytosis*
- Uncoating- genome exposed
- Viral RNA and protein synthesis
- Assembly and release- virion "buds" through the surface, envelope is cells phospholipids with virus-specific glycoproteins



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Emerging Viruses

- Make a sudden appearance.
- Not new, just a new territory
- Examples: HIV, hantavirus, Ebola
- Flu

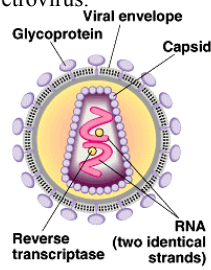


Influenza epidemic



Human Immunodeficiency Virus (HIV)

- Virus that causes AIDS (acquired immunodeficiency syndrome) is a retrovirus.
 - The viral particle includes an envelope with glycoproteins for binding to specific types of red blood cells
 - a capsid containing two identical RNA strands as its genome and two copies of reverse transcriptase.



(a) The structure of HIV, the virus that causes AIDS

Smallpox



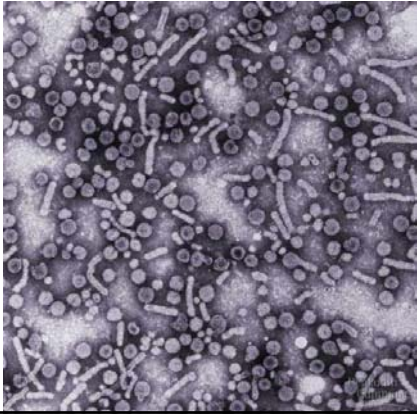
Measles



Polio



Hepatitis



Viruses and Cancer

Some tumor viruses cause cancer in animals

VIRAL GROUP

- Retrovirus
- Herpesvirus
- Papovavirus
- Hepatitis B virus

CANCER TYPE

- Leukemia
- Burkitt's lymphoma
- Cervical cancer
- Liver cancer

Plant Viruses

RNA viruses spread by

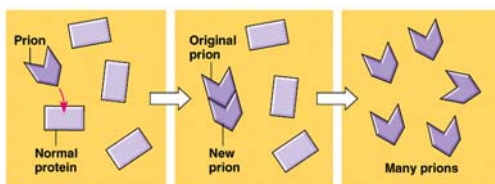
- *Horizontal transmission*
 - from an external source
 - insects, freezing, injury
- *Vertical transmission*
 - from parent
 - Asexual: propagation
 - Sexual: via infected seeds



Viroids and Prions

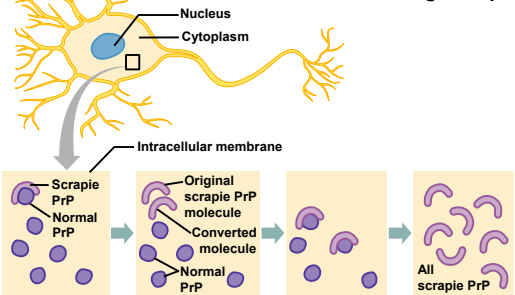
- Viroids are naked circular RNA
 - Self replicating, infectious
- Probably disrupt metabolism, development, and growth
- Plant pathogen
- Prions are proteins
 - Self replicating, infectious
 - Cause degenerative brain diseases
 - “Mad cow” disease
 - Creutzfeldt-Jakob disease
 - Scrapie in sheep
 - Hypothesis: misfolded and convert normal proteins to the prion version
 - Chain reaction

How Prions reproduce



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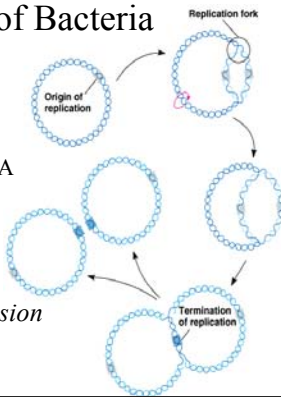
Prions Change Shape



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The Genetics of Bacteria

- Genome
 - one double-stranded DNA
- Few histones
- May contain *plasmid*
 - extrachromosomal DNA
- Reproduce by *binary fission*

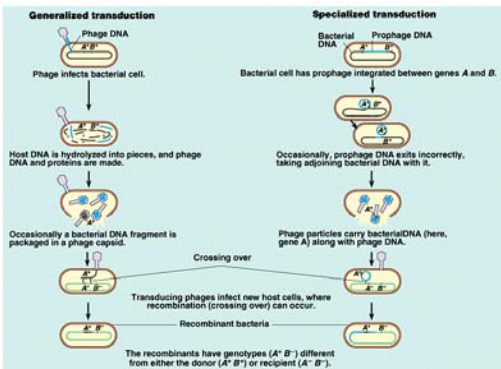


Bacteria Recombination

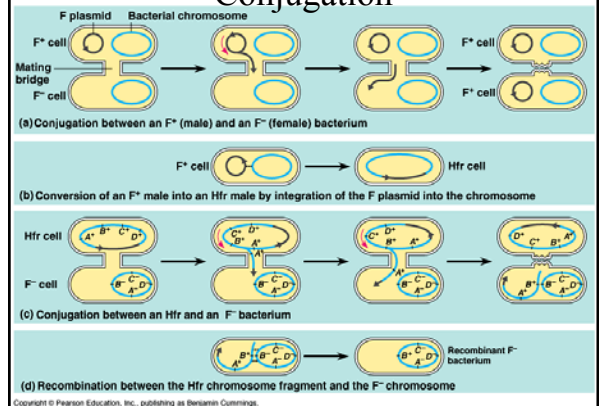
- Transformation foreign DNA is *assimilated*
- Conjugation gene transfer via pilus
- Transduction gene transfer via a vector (virus)



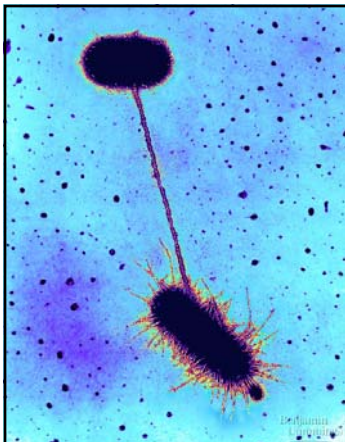
Bacterial Transduction



Conjugation



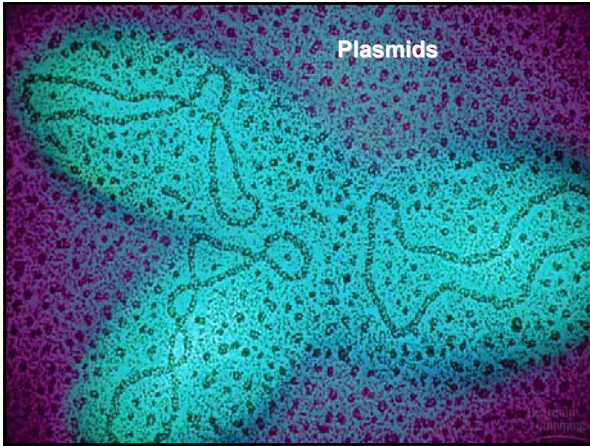
Bacteria with Pilus



Plasmids

- Small, circular, double-stranded DNA with extrachromosomal genes
- Not required for survival of cell
- Replicate independently
- Episomes
 - plasmids that can incorporate into the main chromosome
- R plasmid
 - carry resistance to antibiotics





Transposons

- Pieces of DNA that move from one chromosome to another
- Conservative
 - moves to another location
- Replicative
 - copies are produced that move

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- **Insertion sequence**
 - consists of the transposase gene, flanked by a pair of *inverted repeat* sequences.
 - The simplest bacterial transposon
 - consists only of the DNA necessary for the act of transposition

Insertion sequence (simple transposon)

Composite transposons (complex transposons) include extra genes sandwiched between two insertion sequences.

- two insertion sequences end up relatively close together and travel as a single transposon along with all the DNA between them.

Composite transposon