VIRUS OUTLINE-- CHAPTER 19

Viruses, Viroids, and Prions

Are Viruses Living or Non-living? (SEE p 483 FIGURE 19-11 in book)

Viruses are both and neither

They have some properties of life but not others

For example, viruses can be killed, even crystallized like table salt

However, they can't maintain a constant internal state (homeostasis).

What are Viruses?

A virus is a non-cellular particle made up of genetic material and protein that can invade living cells.

Viral History

Discovery of Viruses

Beijerinck (1897) coined the Latin name "virus" meaning poison

He studied filtered plant juices & found they caused healthy plants to become sick

Tobacco Mosaic Virus

Wendell Stanley (1935) crystallized sap from sick tobacco plants

He discovered viruses were made of nucleic acid and protein

Smallpox

Edward Jenner (1796) developed a smallpox vaccine using milder cowpox viruses

Deadly viruses are said to be virulent

Smallpox has been eradicated in the world today

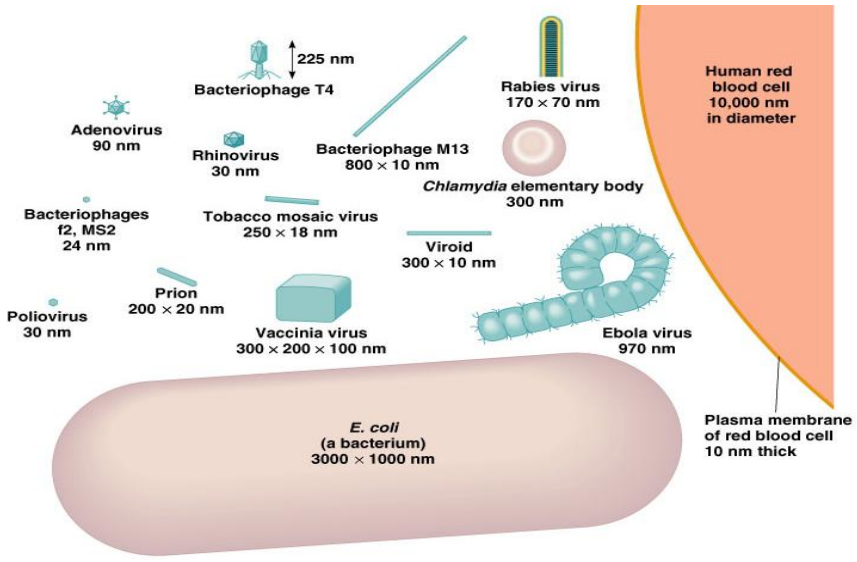
Viewing Viruses

Viruses are smaller than the smallest cell

Measured in nanometers

Viruses couldn't be seen until the electron microscope was invented in the 20th century

Size of Viruses



Viral Structure (VIEW p 479 FIGURE 19-9 in book)

Characteristics

Non living structures

Noncellular

Contain a protein coat called the capsid

Have a nucleic acid core containing DNA or RNA

Capable of reproducing only when inside a HOST cell

Characteristics

Some viruses are enclosed in an protective envelope

Some viruses may have spikes to help attach to the host cell

- Most viruses infect only SPECIFIC host cells
- Characteristics
  - Viral capsids (coats) are made of individual protein subunits
  - Individual subunits are called capsomeres
- Characteristics
  - Outside of host cells, viruses are inactive
  - Lack ribosomes and enzymes needed for metabolism
  - Use the raw materials and enzymes of the host cell to be able to reproduce
- Characteristics
  - Some viruses cause disease
  - Smallpox, measles, mononucleosis, influenza, colds, warts, AIDS, Ebola
  - Some viruses may cause some cancers like leukemia
  - Virus-free cells are rare

Viral Shapes

- Viruses come in a variety of shapes
  - Some may be helical shape like the Ebola virus
  - Some may be polyhedral shapes like the influenza virus
  - Others have more complex shapes like bacteriophages
- Helical Viruses
- Polyhedral Viruses
- Complex Viruses

Taxonomy of Viruses

- Viral Taxonomy
  - Family names end in -viridae
  - Genus names end in -virus
  - Viral species: A group of viruses sharing the same genetic information and ecological niche (host).
    - Common names are used for species
  - Subspecies are designated by a number
- Viral Taxonomy Examples
  - Herpesviridae
  - Herpesvirus
    - Human herpes virus 1, HHV 2, HHV 3
  - Retroviridae
  - Lentivirus
    - Human Immunodeficiency Virus 1, HIV 2
  - Herpes Virus
    - Simplex I and II
  - Adenovirus
    - Common cold
  - Influenza Virus
  - Chickenpox Virus
  - Papillomavirus – Warts!

Used for Virus Identification

- RNA or DNA Virus
- Do or do NOT have an envelope
- Capsid shape
- HOST they infect

Bacteriophages

- Phages (see p 479 FIG 19-9)

Viruses that attack bacteria are called bacteriophage or just phage

T-phages are a specific class of bacteriophages with icosahedral heads, double-stranded DNA, and tails

T-phages

The most commonly studied T-phages are T4 and T7

They infect *E. coli* , an intestinal bacteria

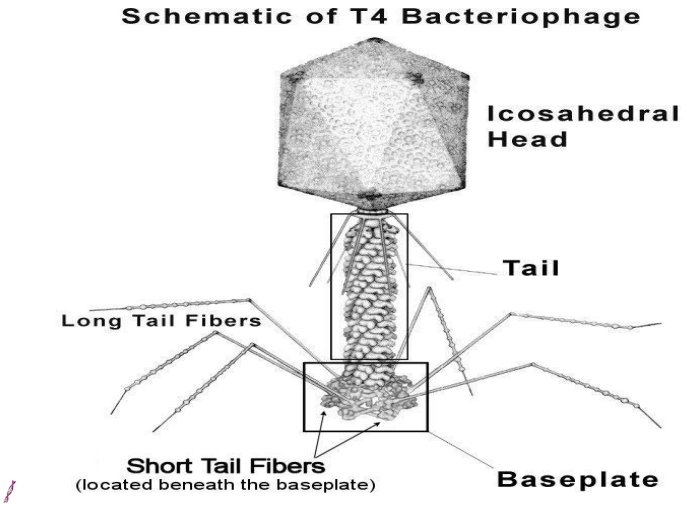
Six small spikes at the base of a contractile tail are used to attach to the host cell

Inject viral DNA into cell

Escherichia Coli Bacterium

T-Even Bacteriophages

Diagram of T-4 Bacteriophage



Head with 20 triangular surfaces

Capsid contains DNA

Head & tail fibers made of protein

Retroviruses

Characteristics of Retroviruses

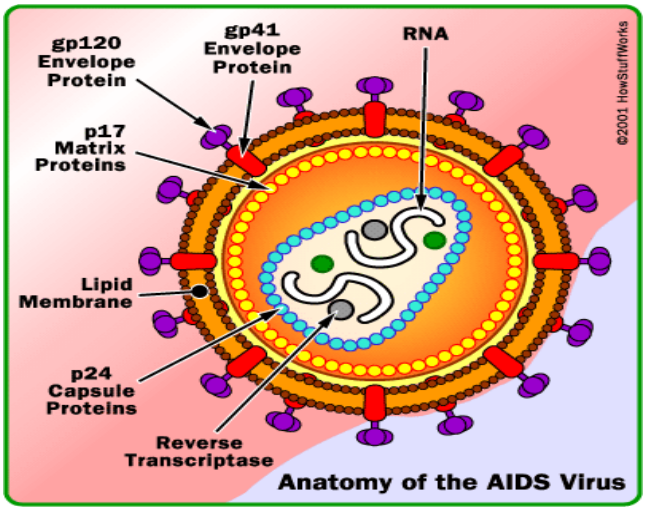
Contain RNA, not DNA

Family Retroviridae

Contain enzyme called Reverse Transcriptase

When a retrovirus infects a cell, it injects its RNA and reverse transcriptase enzyme into the cytoplasm of that cell

Retroviruses



The enzyme reverse transcriptase (or RTase), which causes synthesis of a complementary DNA molecule (cDNA) using virus RNA as a template

Retroviruses

HIV, the AIDS virus, is a retrovirus

Feline Leukemia Virus is also a retrovirus

Viroids & Prions

Viroids

Small, circular RNA molecules without a protein coat

Infect plants

Potato famine in Ireland

Resemble introns cut out of eukaryotic

Prions

Prions are "infectious proteins"

They are normal body proteins that get converted into an alternate configuration by contact with other prion proteins

They have no DNA or RNA

The main protein involved in human and mammalian prion diseases is called "PrP"

Prion Diseases

Prions form insoluble deposits in the brain

Causes neurons to rapidly degeneration.

Mad cow disease (bovine spongiform encephalitis: BSE) is an example

People in New Guinea used to suffer from kuru, which they got from eating the brains of their enemies

Viral Replication

Viral Attack

Viruses are very specific as to which species they attack

HOST specific

Humans rarely share viral diseases with other animals

Eukaryotic viruses usually have protective envelopes made from the host cell membrane

5 Steps of Lytic Cycle (p 481 FIGURE 19-10 in book)

1. Attachment to the cell
2. Penetration (injection) of viral DNA or RNA
3. Replication (Biosynthesis) of new viral proteins and nucleic acids
4. Assembly (Maturation) of the new viruses
5. Release of the new viruses into the environment (cell lyses)

Bacteriophage Replication

Bacteriophage inject their nucleic acid

They lyse (break open) the bacterial cell when replication is finished

Lytic Cycle Review

Attachment- Phage attaches by tail fibers to host cell

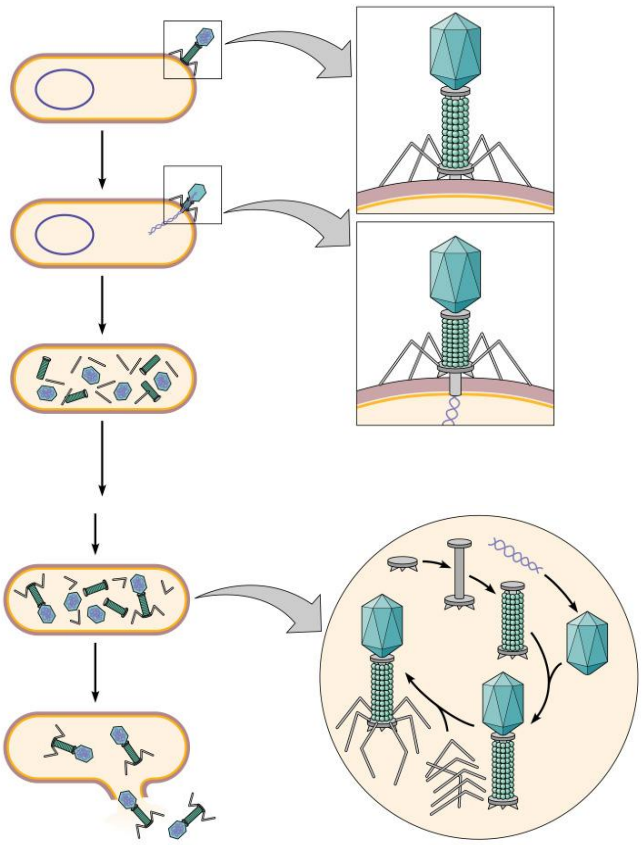
Penetration-Phage lysozyme opens cell wall, tail sheath contracts to force tail core and DNA into cell

Biosynthesis-Production of phage DNA and proteins

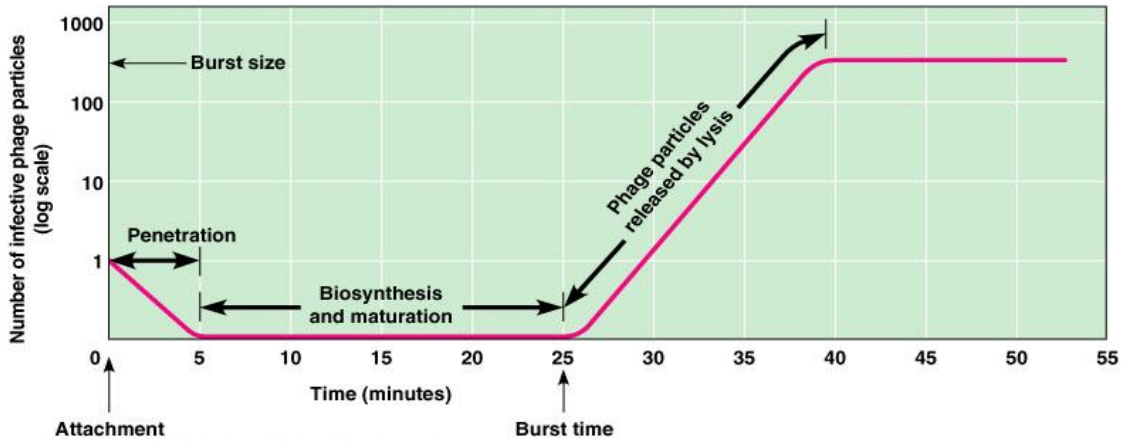
Maturation- Assembly of phage particles

Release-Phage lysozyme breaks cell wall

LABEL and describe the steps:



One-step Growth Curve



Viral Latency

- Some viruses have the ability to become dormant inside the cell
- Called latent viruses
- They may remain inactive for long periods of time (years)
- Later, they activate to produce new viruses in response to some external signal
- HIV and Herpes viruses are examples

Lysogenic Cycle

- Phage DNA injected into host cell
- Viral DNA joins host DNA forming a prophage
- When an activation signal occurs, the phage DNA starts replicating

Lysogenic Cycle (FIGURE 19-10)

- Viral DNA (part of prophage) may stay inactive in host cell for long periods of time
- Replicated during each binary fission

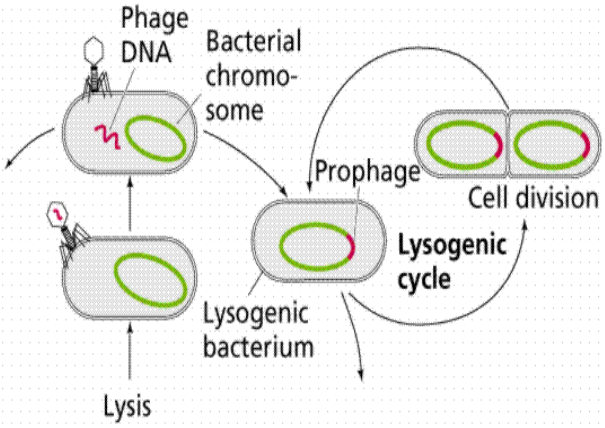
Over time, many cells form containing the prophages

Viral Latency

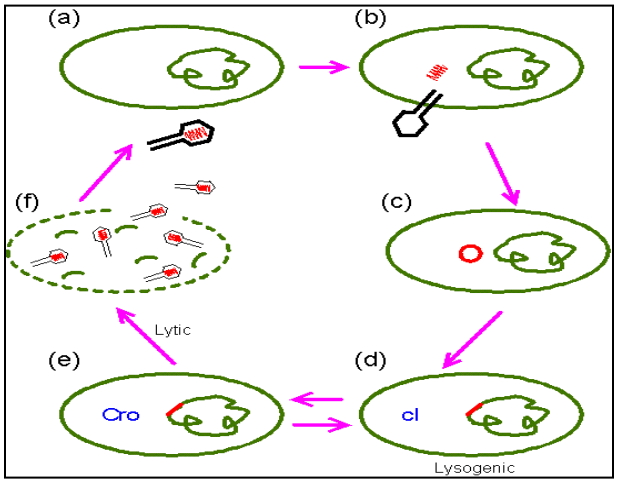
Once a prophage cell is activated, host cell enters the lytic cell

New viruses form a & the cell lyses (bursts)

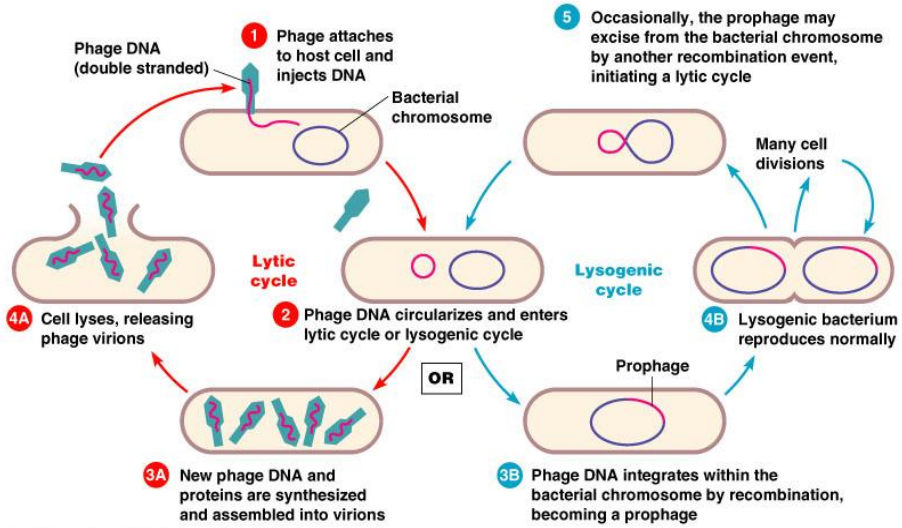
Virus said to be virulent (deadly)



Virulent Viruses



The Lysogenic Cycle



Latency in Eukaryotes

Some eukaryotic viruses remain dormant for many years in the nervous system tissues

Chickenpox (caused by the virus *Varicella zoster*) is a childhood infection

It can reappear later in life as shingles, a painful itching rash limited to small areas of the body

Latency in Eukaryotes

Herpes viruses also become latent in the nervous system

A herpes infection lasts for a person's lifetime

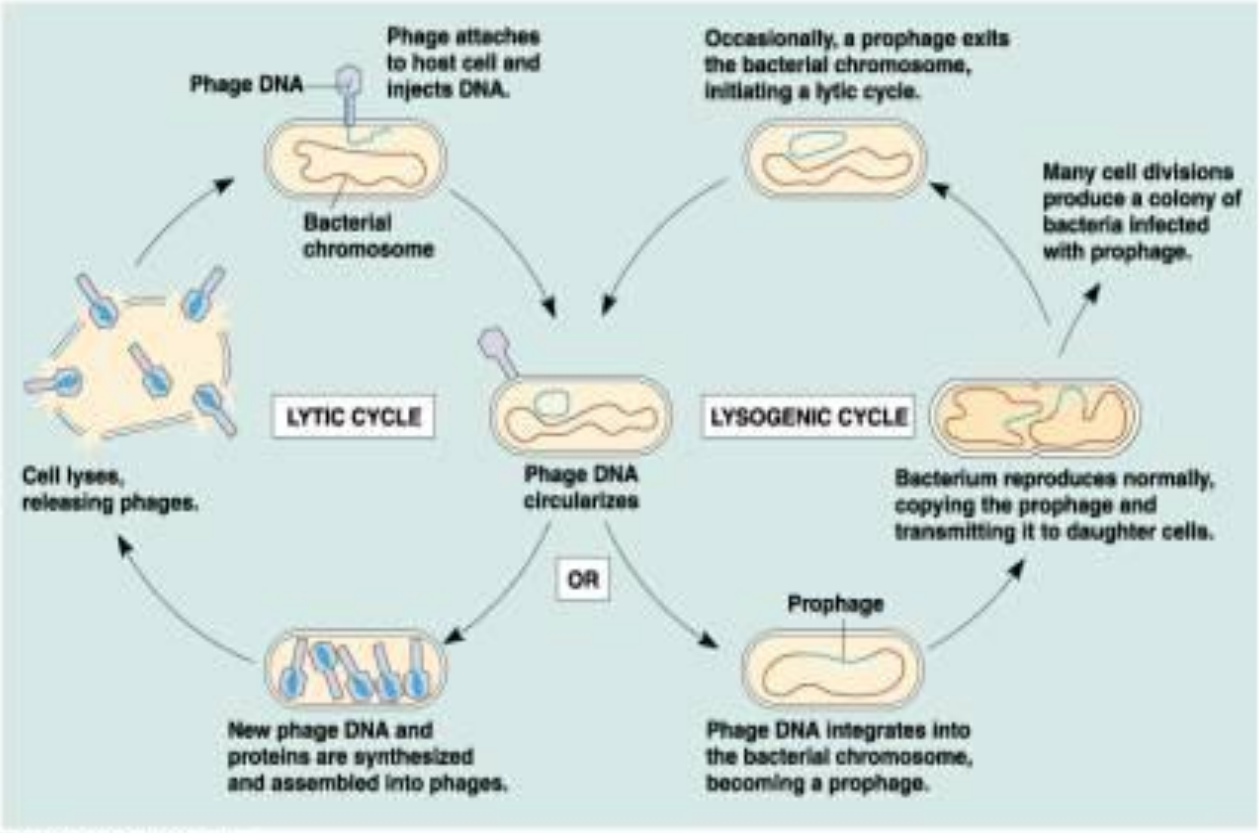
Genital herpes (Herpes Simplex 2)

Cold sores or fever blisters (Herpes Simplex1)

Virulence

VIRUS DESTROYING HOST CELL

Lytic and Lysogenic Cycles (a different version of FIG 19-10)



Treatment for Viral Disease

Vaccines

An attenuated virus is a weakened, less vigorous virus

"Attenuate" refers to procedures that weaken an agent of disease (heating)

A vaccine against a viral disease can be made from an attenuated, less virulent strain of the virus

Attenuated virus is capable of stimulating an immune response and creating immunity, but not causing illness

Other Viral Treatments

Interferon are naturally occurring proteins made by cells to fight viruses

Genetic altering of viruses (attenuated viruses)

Antiviral drugs (AZT)

Protease inhibitors – prevent capsid formation

COMPARE VIRUSES TO CELLS---See FIGURE 19-11