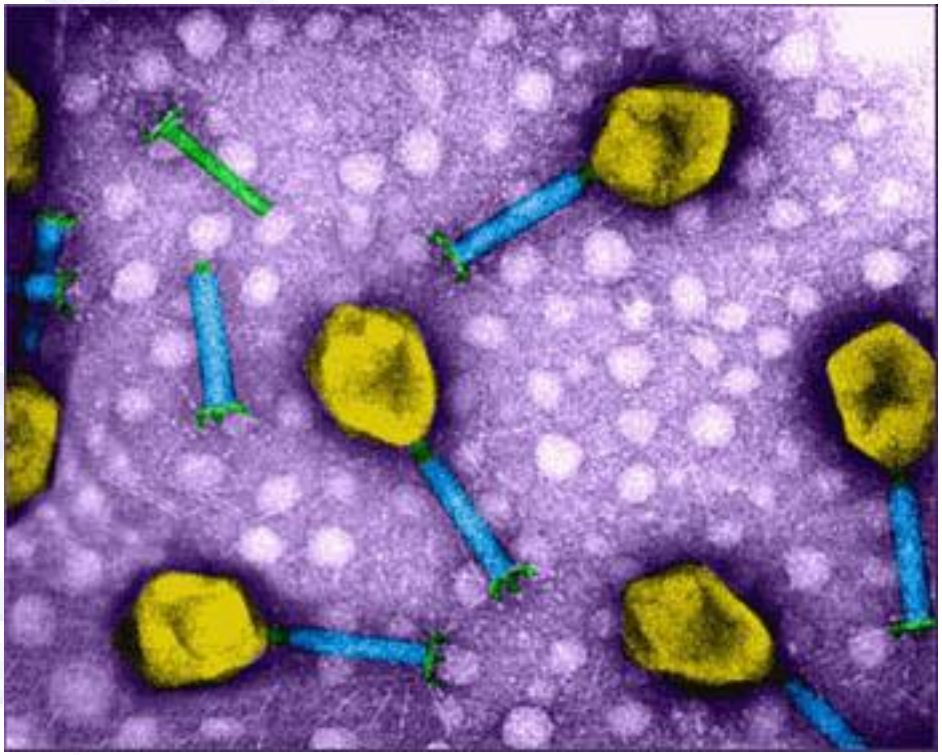
Viruses



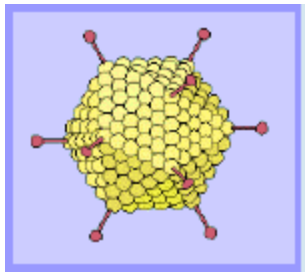
Section 19-2

- **Virus: the Latin word meaning "poison"**
- **Ivanovski (1892) a Russian biologist who first studied the disease of tobacco plants**
- **During Ivanovski's day, scientists thought that bacteria were the smallest possible agents of disease.**

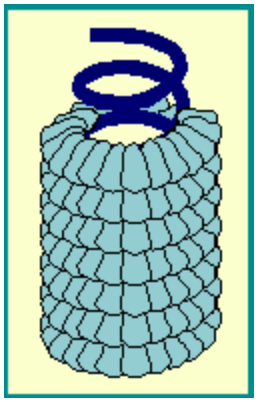
Discovery of Viruses

- **Berijerinck (1897) coined the Latin name "virus" meaning poison for the substance infecting tobacco plants**
- **Wendell Stanley (1935) crystallized sap from tobacco leaves infected with Tobacco Mosaic Virus (TMV) & found virus was made of nucleic acid & protein**

- **Edward Jenner developed smallpox vaccine using milder cowpox viruses**
- **Virology - study of viruses**
- **Deadly viruses are said to be virulent**
- **Viruses couldn't be seen until electron microscope invented**

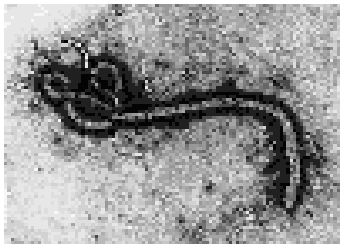


Viral Characteristics



- **Not living organisms**
- **Noncellular or Subcellular**
- **Consist of a nucleic acid core (DNA or RNA) and a protein coat called the capsid**
- **Cannot grow or replicate on their own (inactive particles)**

- **Can only reproduce inside of a living host cell using its raw materials & enzymes**
- **Lack ribosomes & enzymes needed for protein synthesis or metabolism**
- **Are extremely small particles ranging from 20 - 250 nanometers on average**
- **Largest virus is 800 nanometers in dimension. Some can cause disease (smallpox, measles, mononucleosis, influenza, colds, AIDS, Ebola)**

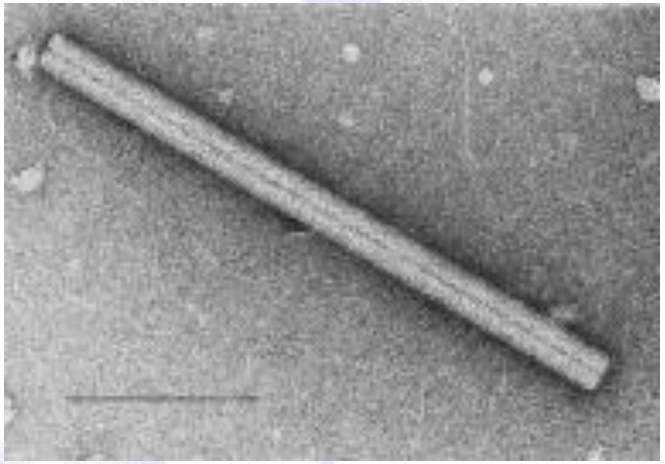


- **Highly host specific (only infect certain cells)**
  - **Bacteria, plant and animal viruses**
- **Referred to as phages**
- **Viruses are classified into 2 main groups by their nucleic acid --- DNA or RNA Viruses**
- **DNA & RNA viruses are subdivided by capsid shape & whether they do or don't have an envelope**

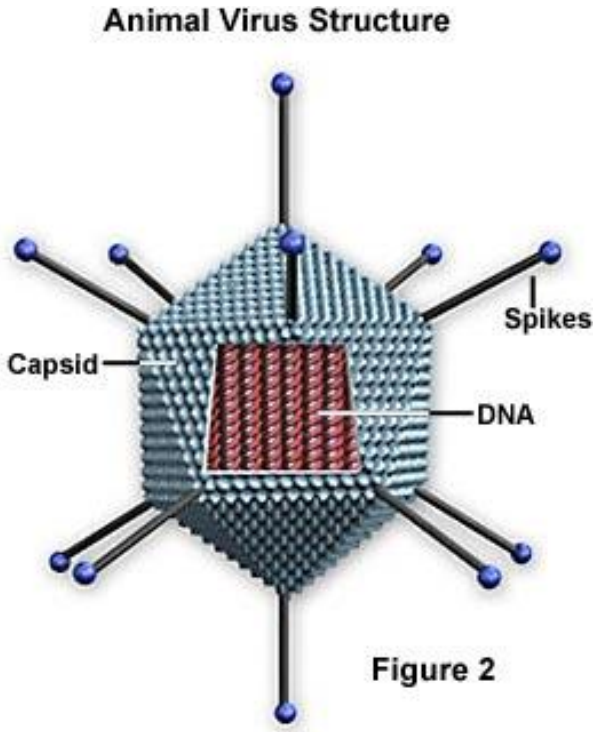
Viral Structure

- DNA or RNA core surrounded by protein sheath called capsid
- Nucleocapsid includes the viral nucleic acid & its capsid
- Some form lipid rich covering around capsid called the envelope
- Envelope usually formed from host cell membrane
- Envelope may have spikes to help chemically recognize & attach to the host cell

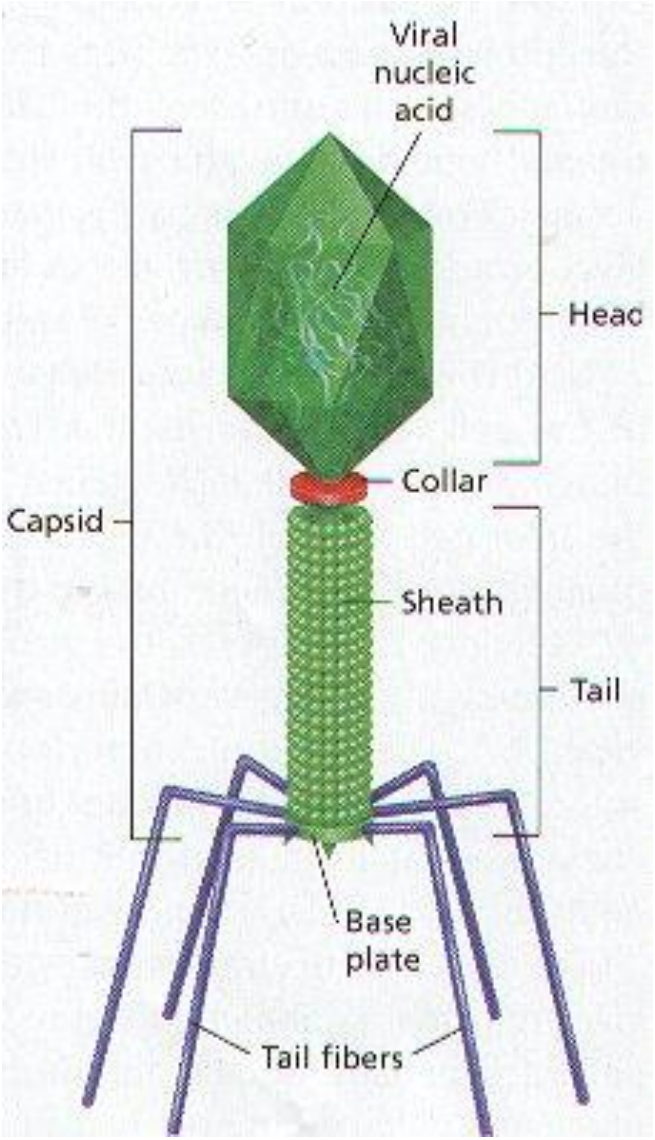
- **Shape determined by the arrangement of proteins making up the capsid**
- **TMV is rod shaped**



- **Adenovirus & polio viruses are icosohedral (20 sided)**



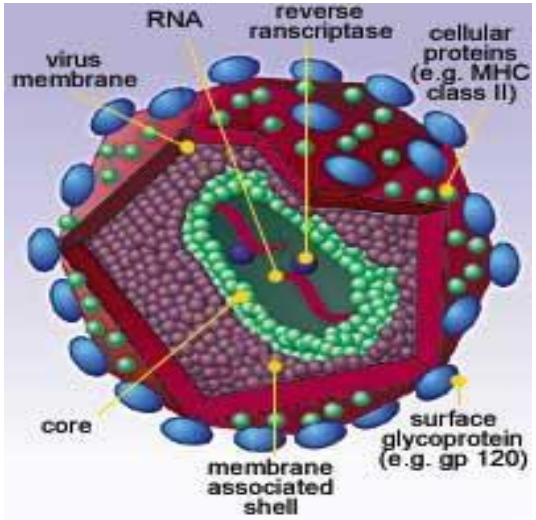
- **Measles & rabies viruses are helical**
- **T -phages have a head & tail**



Bacteriophages or T-Phages

- Among the most complex viruses
- Attack bacterial cells
- Composed of a icosohedral head, tail, base plate, & tail fibers
- Long DNA molecule is inside the head
- Tail helps inject the viral DNA into host cell
- Tail fibers used to attach to host

Retroviruses



- **Contain RNA**
- **Have an enzyme called reverse transcriptase which helps use the RNA to make DNA**
- **Use the host cell's ribosomes & raw materials to make viral proteins**
- **Cause some cancers & AIDS**

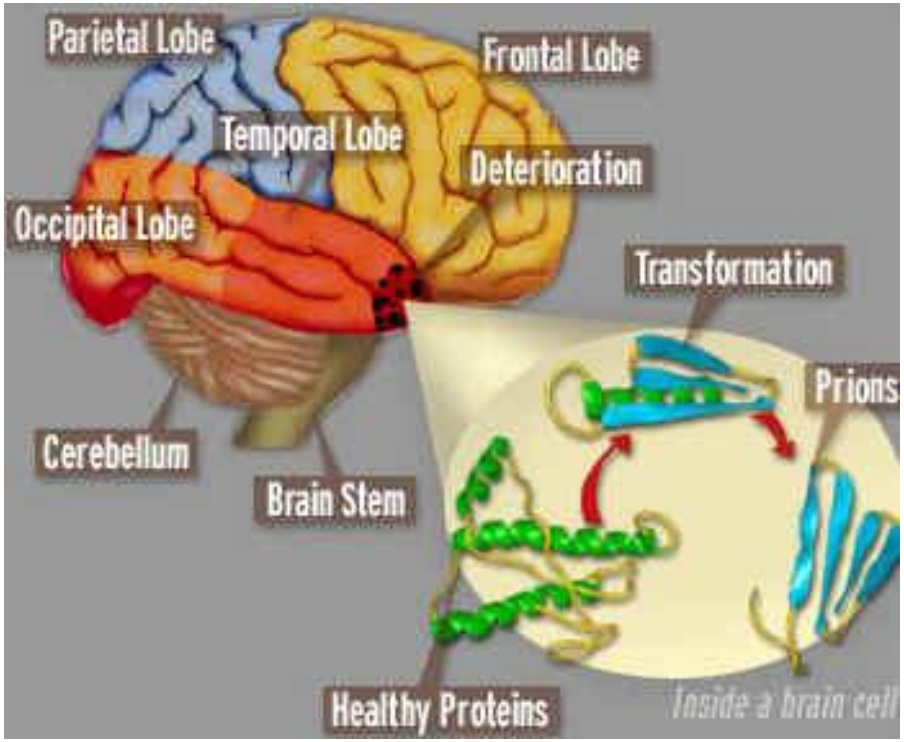
Viroids

- **Smallest particle able to replicate**
- **Made of a short, single strand of RNA with no capsid**
- **Cause disease in plants**

Viroid Attack on Potatoes

Prions

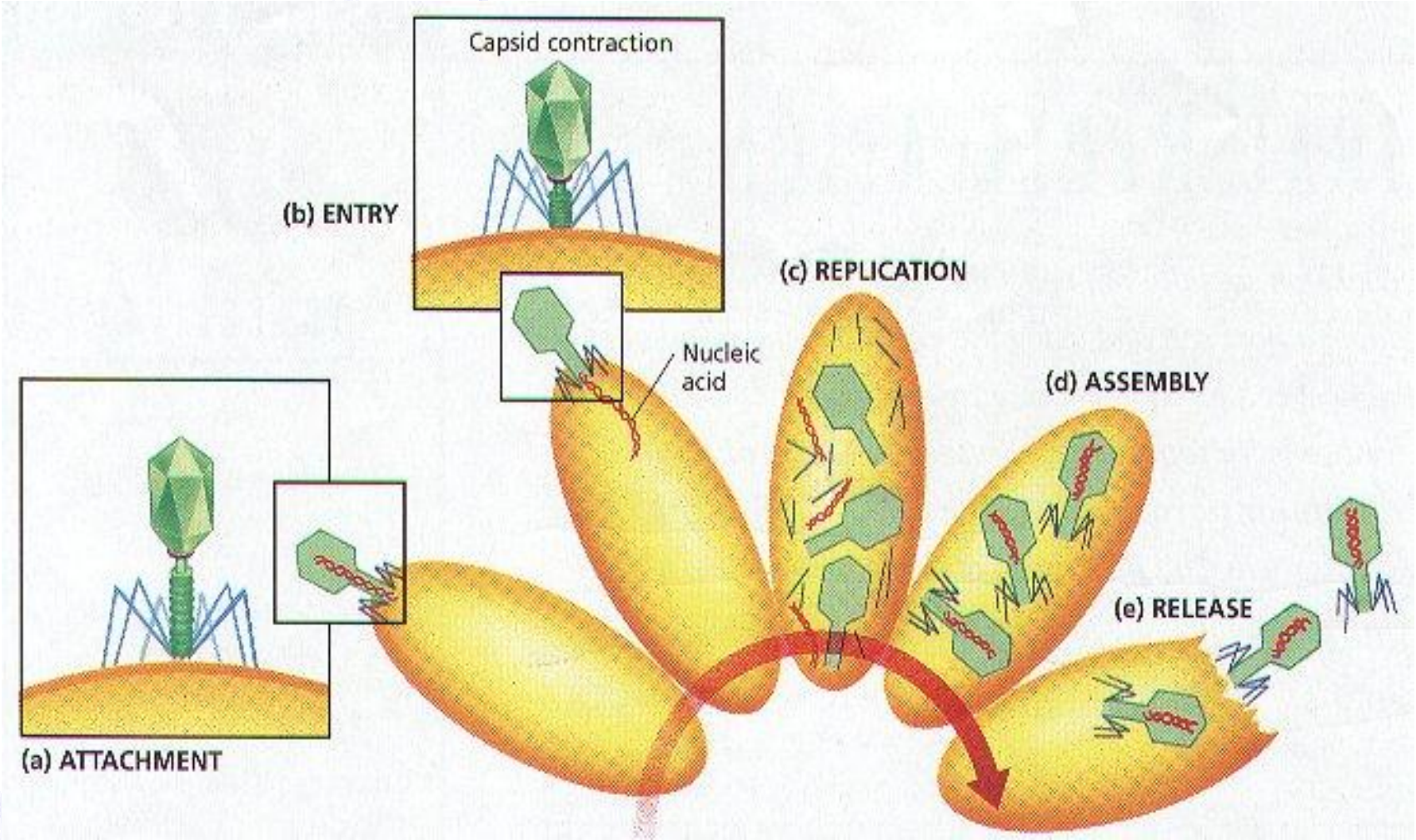
- No nucleic acid or capsids
- Made of protein particles that have folded incorrectly
- Attacks the central nervous system
- Cause animal diseases in cows (Mad Cow disease), sheep, & humans



Lytic Cycle

- **Viral replication that rapidly kills the host cell causing it to lyse or burst**
- **Involves 5 steps ----- Attachment, Entry, Replication, Assembly, & Release**
- **Attachment --- phage attaches to cell membrane of host**
- **Entry --- nucleic acid (DNA) of virus injected into host cell**
- **Replication --- viral DNA inactivates host cell's DNA & uses host's raw materials & ribosomes to make viral DNA, capsids, tails, etc.**
- **Assembly --- new viral parts are combined to make new phages**
- **Release --- enzymes weaken & destroy the cell membrane causing it to lyse releasing new viruses that infect other cells**

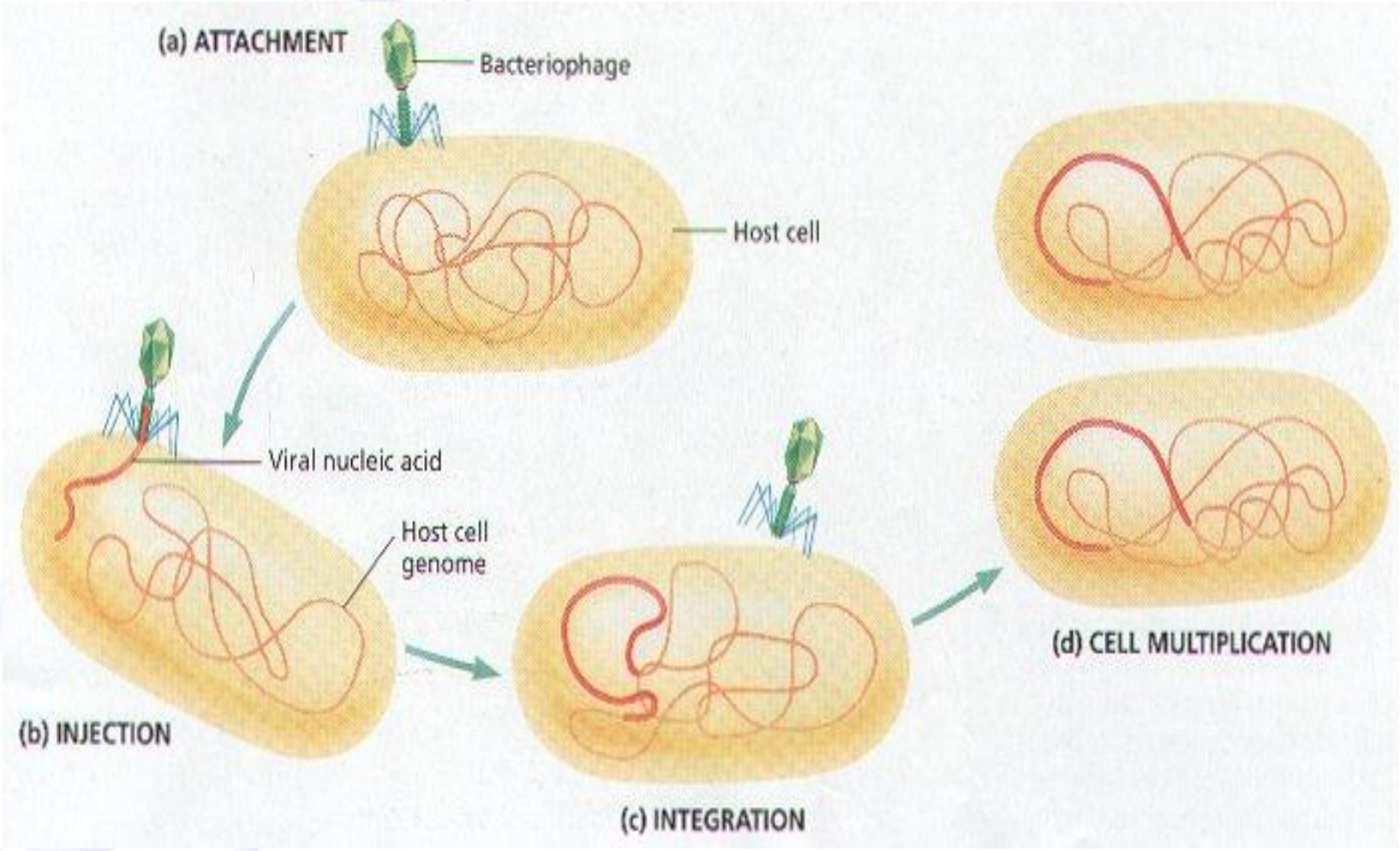
Lytic Cycle


Capsid contraction
(b) ENTRY
(c) REPLICATION
Nucleic acid
(d) ASSEMBLY
(e) RELEASE
(a) ATTACHMENT

Lysogenic Cycle

- Replication in which the virus stays inactive inside of the host cell & doesn't immediately kill it
- Viruses are called temperate phages
- Lysogenic steps include attachment, injection, integration, cell multiplication, activation, replication, assembly, & release
- Integration ---Viral DNA joins with host cell DNA forming an inactive prophage
- Host cell reproduces normally until activated by an external stimuli
- External stimuli unknown, but could be ultraviolet radiation, carcinogens, etc.
- Once activated, prophage forms new viruses & destroys host cell
- HIV is an example of a temperate phage

Lysogenic Cycle



Viral Diseases in Humans

- **Viruses attack and destroy certain cells in the body**
  - **-Poliovirus infects cells of the nervous system**
  - **-Papillomavirus infects the outermost layer of skin cells causing warts**
  - **-Viruses CANNOT be treated with antibiotics!**
  - **-Vaccines are used for prevention of viral disease**
    - **– Smallpox has been eliminated due to vaccination of millions**

TABLE 25-2 *Some Common Viruses of Humans*

Viral group	Nucleic acid	Shape and structure	Examples of diseases they cause
Papovaviruses	DNA	icosahedral, non-enveloped	warts, cancer
Adenoviruses	DNA	icosahedral, non-enveloped	respiratory and intestinal infections
Herpesviruses	DNA	icosahedral, enveloped	herpes simplex, chickenpox, shingles, infectious mononucleosis
Poxviruses	DNA	complex brick-shaped, enveloped	smallpox, cowpox
Picornaviruses	RNA	icosahedral, non-enveloped	poliomyelitis, hepatitis, cancer
Myxoviruses	RNA	helical, enveloped	influenza A, B, and C
Rhabdoviruses	RNA	helical, enveloped	rabies
Retroviruses	RNA	icosahedral, enveloped	AIDS, cancer