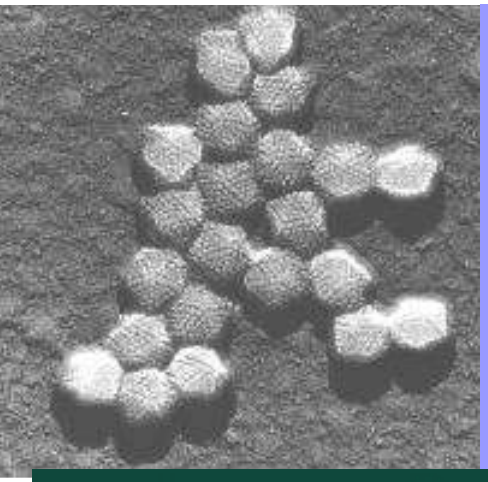
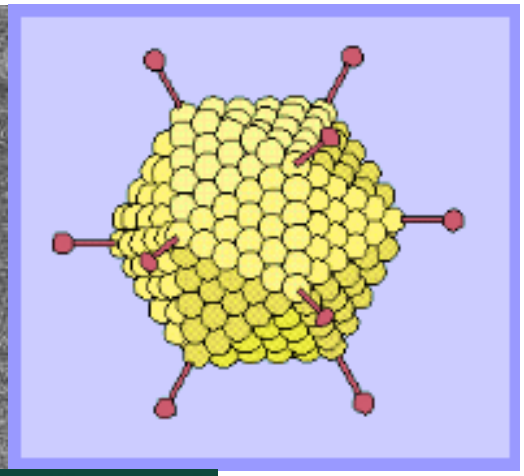
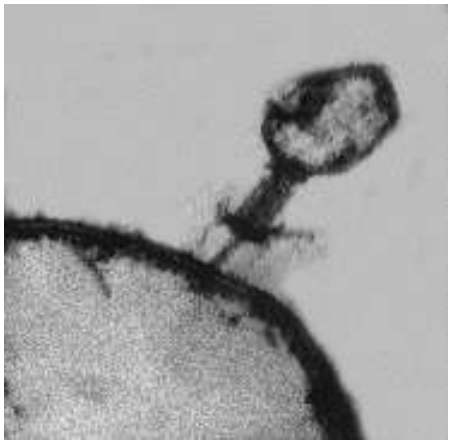
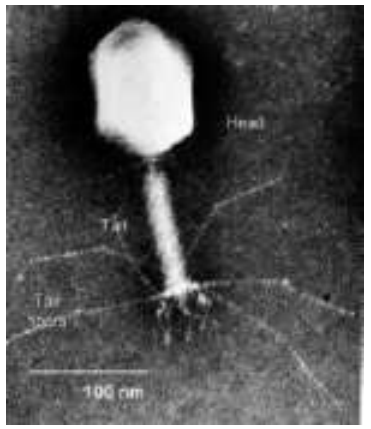
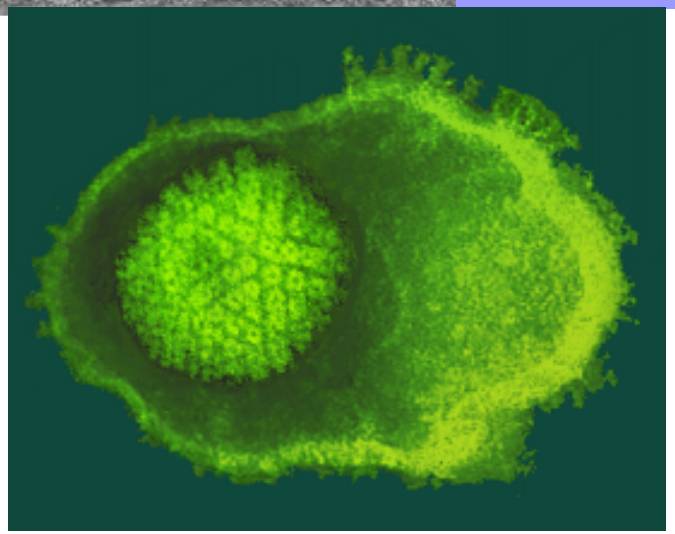
Viral Structure, Lifecycles and Aids

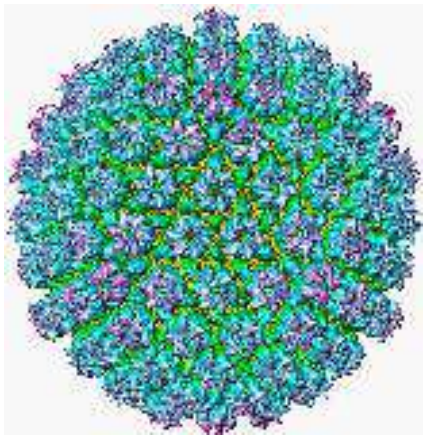


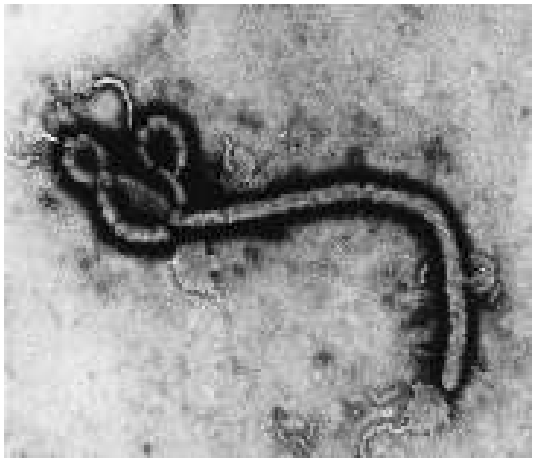












I. Virus- segment of DNA or RNA wrapped in a protein coat

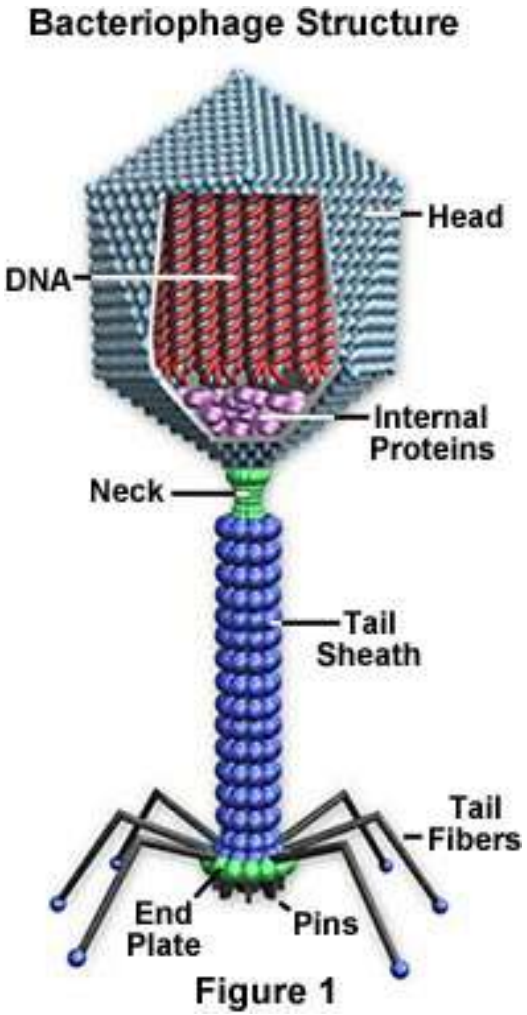


Figure 1

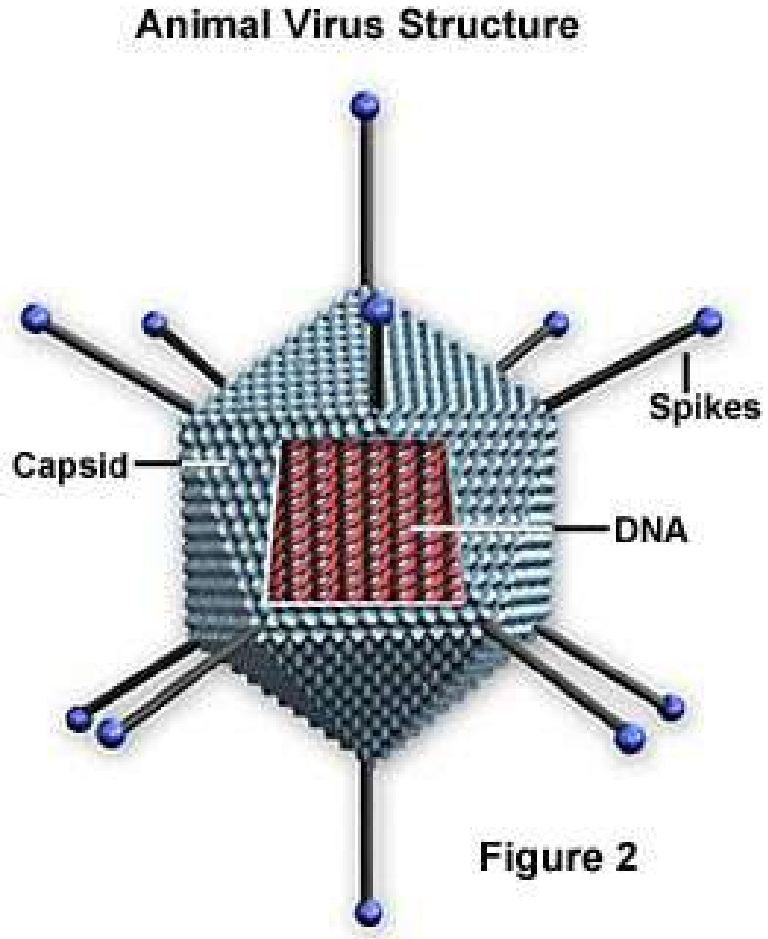


Figure 2

A. Characteristics

1. Non-cellular
2. No organelles
3. May be crystallized
4. No growth, respiration or reproduction outside a cell
5. Obligated parasites. Reproduction within cells
6. Contain nucleic acids
7. Have limited enzyme activity

B. Structure

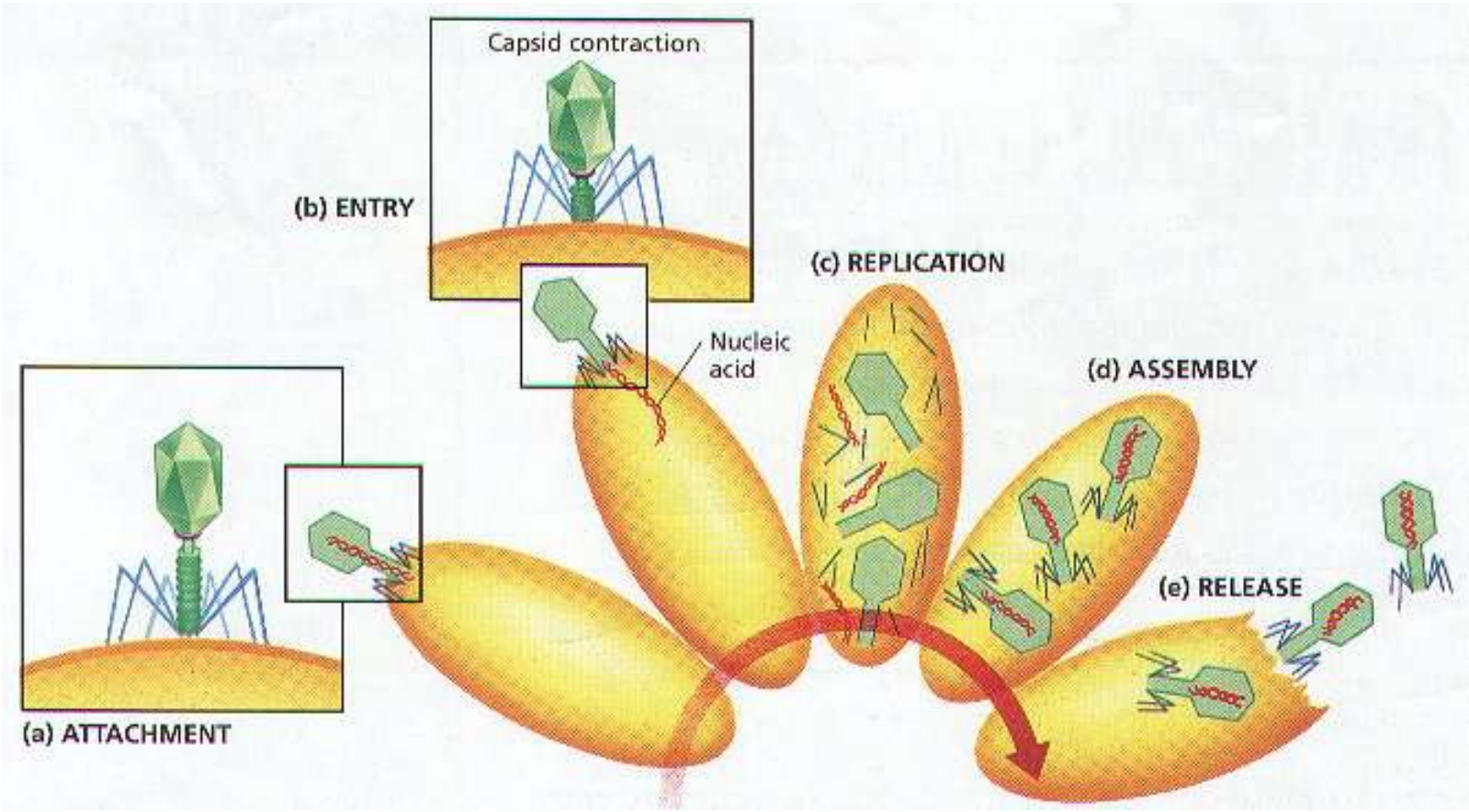
- Viral genome may be contained in Single stranded or double stranded DNA or Single stranded or double stranded RNA depending on the virus
- **Capsid** - protein shell that encloses the viral genome. Usually constructed of a large number or repeating protein units called capsomeres
- Capsid shape is variable. Many are rod, polyhedral, and spherical.

4. The most complex shapes are found in bacterial viruses called bacteriophages or simply **phages**.
5. Some viruses incorporate an **envelope** - a layer of membrane which covers their capsid and may facilitate attaching to the host cell.

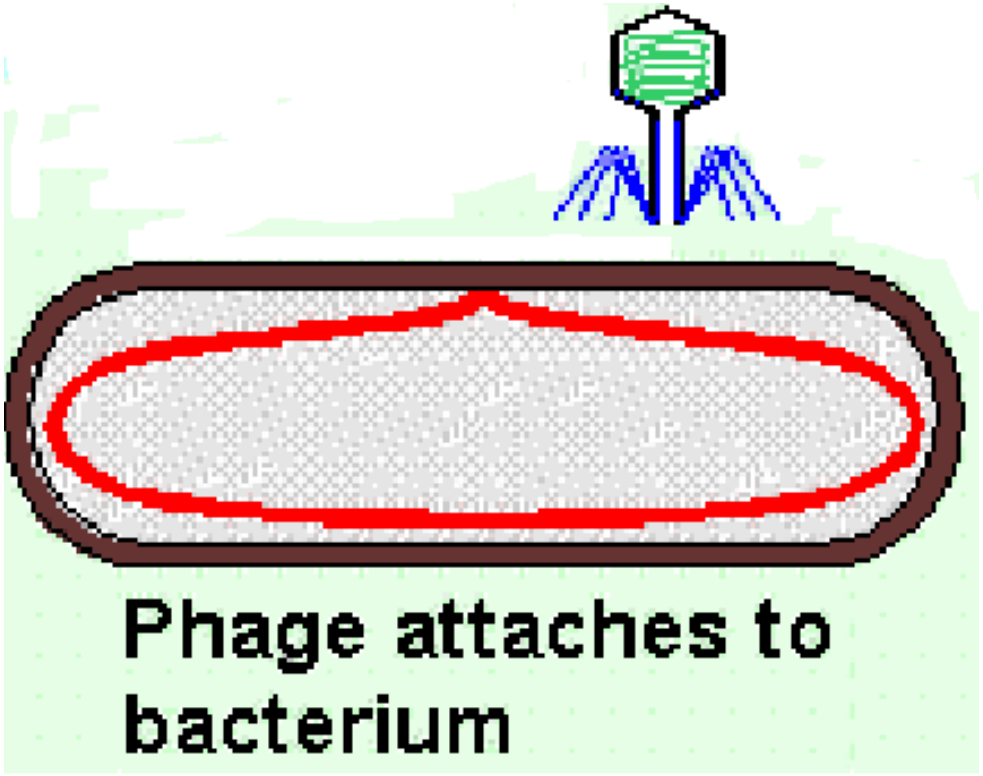
C. Host Range

- Each type of virus can infect a limited number of host cells called the **host range**. For example, rabies can infect a large number of Mammals. On the other hand, tobacco mosaic virus can only attack tobacco plants, even more specifically, epithial cells of tobacco leaves.

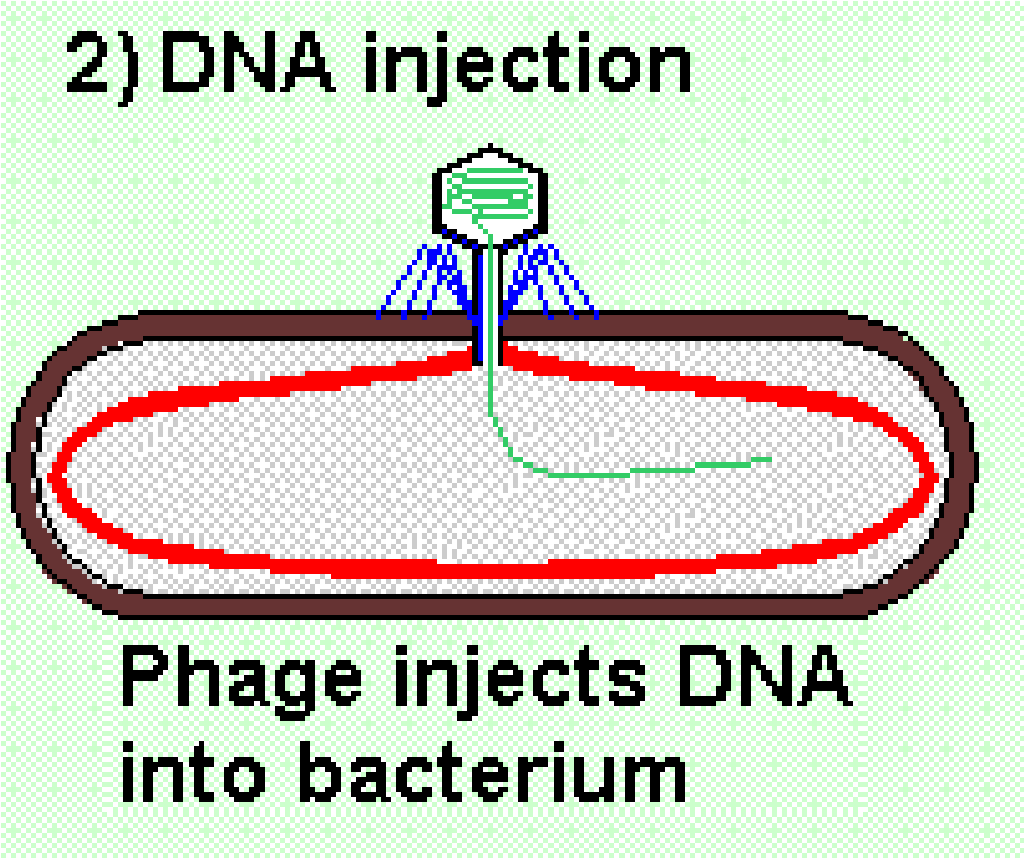
D. Lytic Cycle- reproductive cycle of a virus that culminates in the death of the host cell. Viruses that are dependent on the lytic cycle are called virulent viruses.



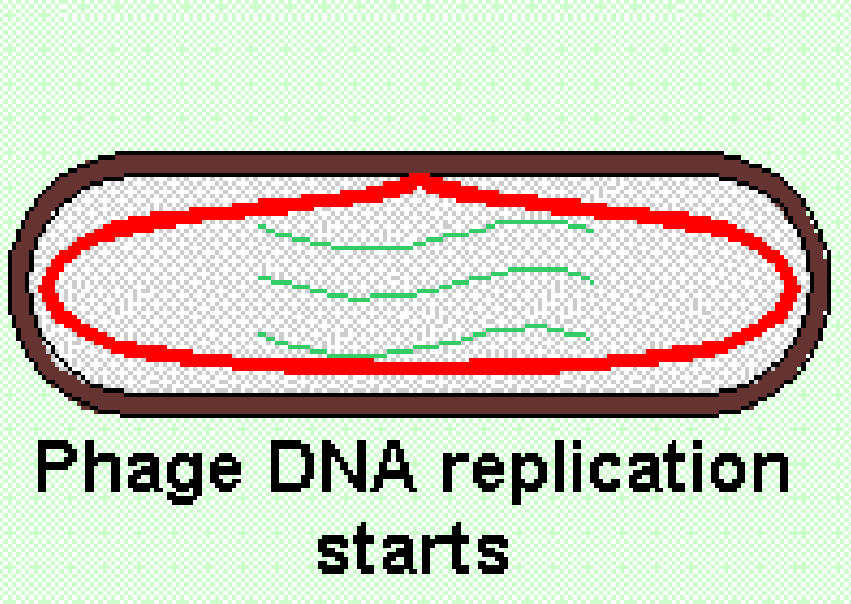
1. **Attachment**- The virus attaches to a specific area on the host cell called a receptor site

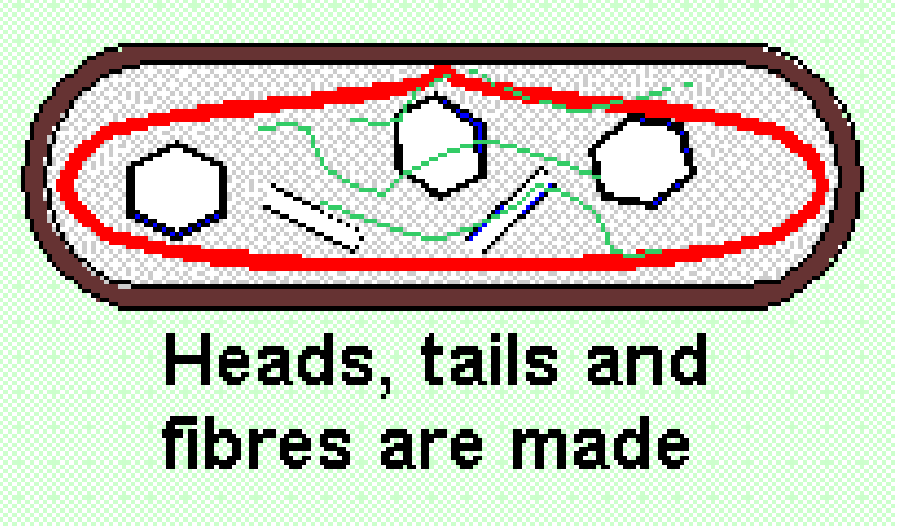


2. **Entrance**- the viral nucleic acid is then injected into the host cell.

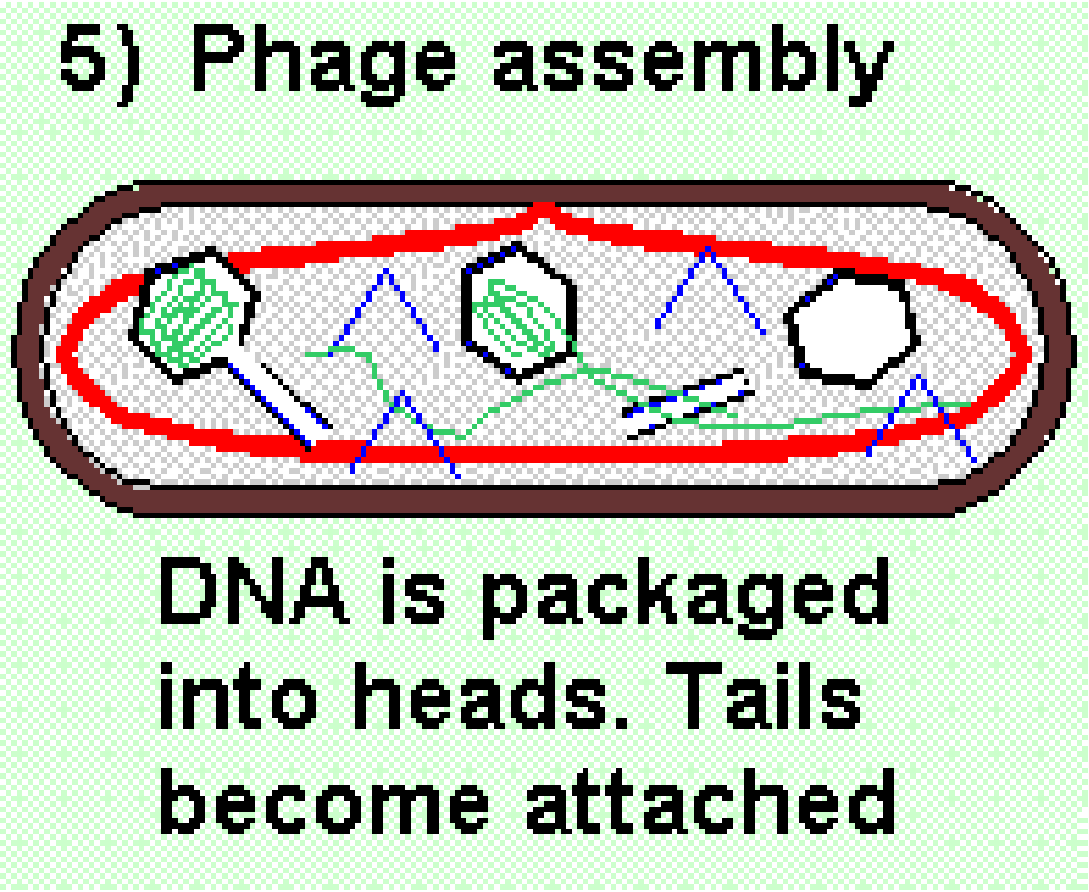


3. **Replication**- host DNA is hydrolyzed, viral nucleic acid is replicated, and viral components are manufactured

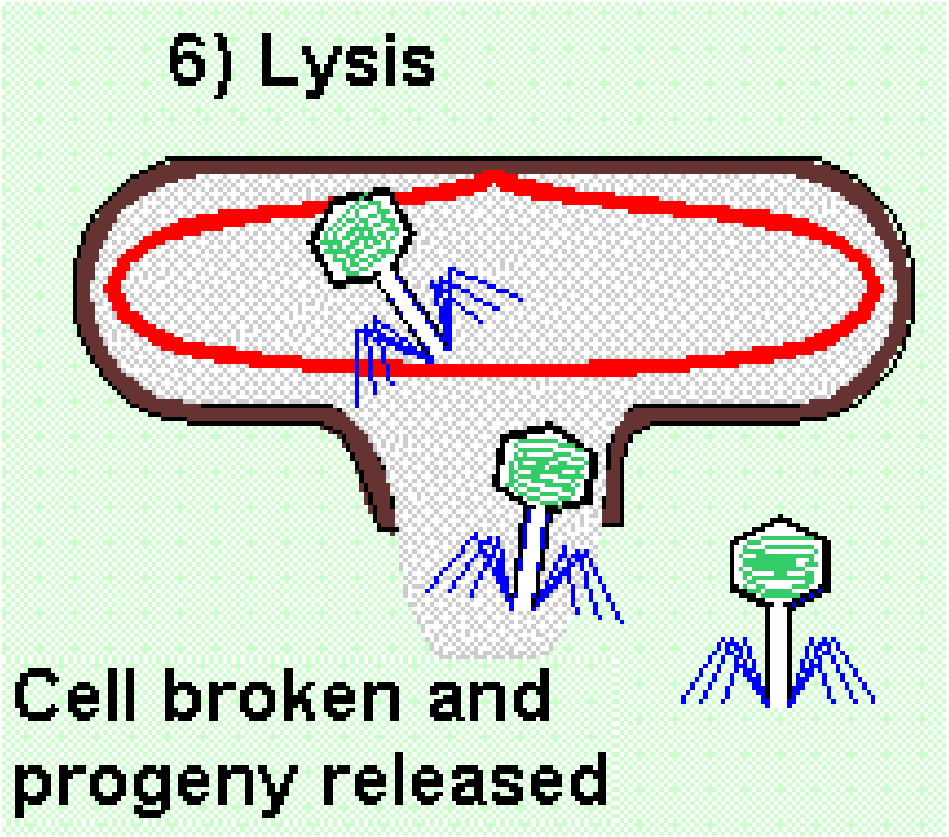




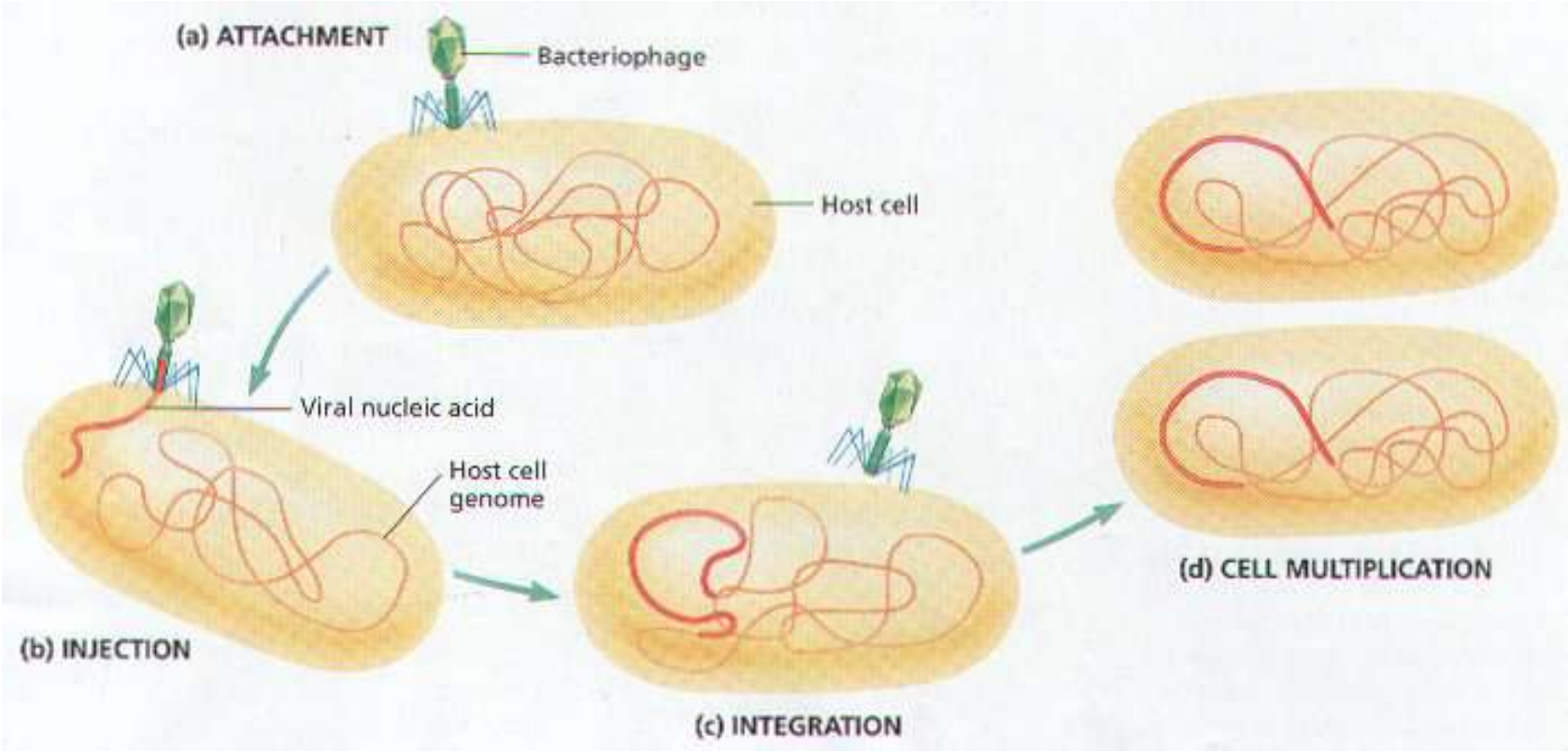
4. **Assembly**- viral components are assembled into mature viruses.



5. **Lysis**- viruses direct the production of an enzyme that digest the host's cell wall or the cell membrane simply bursts due to the number of viruses within. This releases as many as 200 new viruses in as little as 20 minutes.



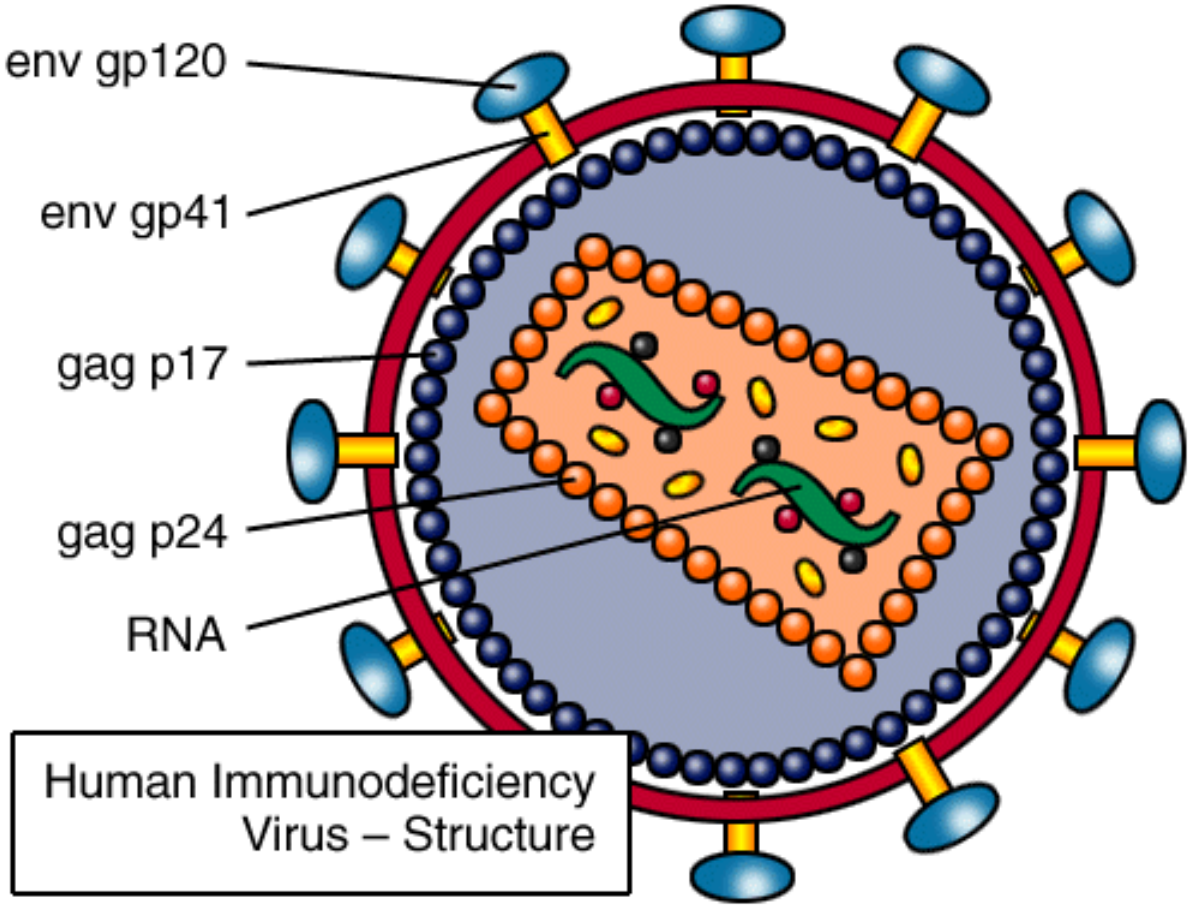
E. **Lysogenic Cycle**- reproduces the viral genome without destroying the host cell. Viruses reproducing in this manner are referred to as temperate viruses.



Lysogenic Cycle

- **Attachment** and **entrance** are the same as in the lytic cycle.
- **Integration**- viral DNA integrates itself into the host cell's DNA forming a provirus which is latent
- **Cell Division**- As the host cell's DNA is replicated for cell division, the prophage is also replicated, thus spreading the virus to new cells.
- **Activation**- for reasons not well understood, environmental pressure, i.e., stress, chemicals, reverts the virus back to the lytic cycle

II. **AIDS**- Acquired Immune Deficiency Syndrome



Human Immunodeficiency Virus – Structure

HIV Genome (Very few genes)

- Gag- **Group Antigen**- codes for the core protein in the virus
- Pol- **polymerase enzyme**- which is reverse transcriptase. This allows HIV to convert its RNA to DNA
- Env- **envelope**- codes for the spiked outer protein
- LTRs- **long terminal repeats**- on both ends of the viral RNA , allows viral DNA to insert itself into the host cells DNA

HIV Genome

- Tat- **transactivation of transcription**- works with pol
- Art- **antirepression of translation**- fights the cells attempts to stop reverse transcription
- **Sor and lor**- functions are not understood
- **Psi**- packages new RNA into the protein coats

B. Transmission

- Blood
- Semen
- Vaginal secretions
- Breast milk

C. Disease Progression

- **Well**- Disease is in lysogenic cycle, spreading through budding and replication
- **PGL**- persistent generalized lymphoma. Continuously swollen glands indicate infection
- **ARC**- Aids related complex. Weight loss, fatigue, sweats, gastrointestinal difficulties, thrush, shingles and other small infections
- **AIDS**- first pneumonia, discoloration of the skin, brain damage. Immune system shut down