

Phage

Bacteriophage Viruses

Viruses are small packages of genes
Consist of protein coat around nucleic acids (DNA or RNA)

Labels: Head, Membrane of bacterial cell, Tail, Tail fiber, Viral DNA

Classification of Viruses

(a) Tobacco mosaic virus: helical RNA-virus
 (b) Adenoviruses: polyhedral DNA-virus
 (c) Influenza viruses: enveloped helical RNA-virus
 (d) Bacteriophage: complex-polyhedral DNA-virus

Figure 18.4. Colorized TEMs

Viruses

Obligate intracellular parasites

- Cannot grow or reproduce by itself
- Have no independent metabolic pathways for energy synthesis
- Reproduce (replicate) only by using host cell machinery
- Non-cellular
- (Is it living?)

Figure 18.1: T4 Bacteriophages infecting an *E. coli* bacterium cell

The Lytic Cycle (virulent phage)

• **Bacteriophage T4**

- Attachment.** The T4 phage uses its tail fibers to bind to specific receptor sites on the outer surface of an *E. coli* cell.
- Entry of phage DNA and degradation of host DNA.** The sheath of the tail contracts, injecting the phage DNA into the cell and leaving an empty capsid outside. The cell's DNA is hydrolyzed.
- Synthesis of viral genomes and proteins.** The phage DNA directs production of phage proteins and copies of the phage genome by host enzymes, using components within the cell.
- Assembly.** Three separate sets of proteins self-assemble to form phage heads, tails, and tail fibers. The phage genome is packaged inside the capsid as the head forms.
- Release.** The phage directs production of an enzyme that damages the bacterial cell wall, allowing fluid to enter. The cell swells and finally bursts, releasing 100 to 200 phage particles.

Phage assembly

Head Tails Tail fibers

Figure 18.6

Culture of virulent (lytic) phages

• **Bacteriophage**

- Agar plate with "bacterial lawn" (solid white field of bacteria)
- Plaques: clear, bacteria-free region growing around one original viral-infected bacterium = pfu: plaque-forming unit

Koch's postulates

In order to prove definitively that a particular pathogen causes a disease, researchers must:

1. Find the pathogen in each individual that has the disease.
2. Isolate the pathogen from a diseased individual, and grow the pathogen in a pure culture.
 - But cannot grow viruses independent of host cells.
3. Induce the disease in healthy individuals by infecting them with the pure pathogen.
4. Isolate the pathogen from the newly infected individuals.