Bacterial Viruses, Viroids, and Prions

Viruses

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- Contain a protein coat
- Some are enclosed by an envelope
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- Most viruses infect only specific types of cells in one host
- Host range is determined by specific host attachment sites and cellular factors

- Obligate intracellular parasites
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- generally species specific
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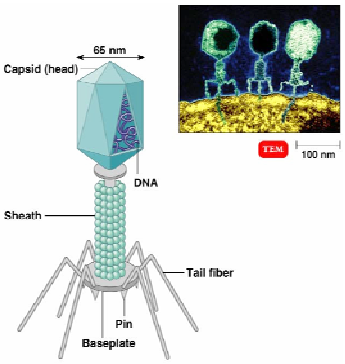
- hosts = invertebrates, vertebrates, plants, protists, fungi, bacteria, archaea

Comparison: Viruses and Bacteria

	Viruses	Bacteria
size(nm)	24-1000nm	avg. 1000-3000nm (0.5mm max)
intracellular parasite	yes	no (exceptions)
binary fission	no	yes
DNA + RNA	no (not both)	yes
ATP production	no	yes
ribosomes	no	yes
antibiotic sensitivity	no	yes
can pass thru filters	yes	no (exceptions)

Helical Viruses
Polyhedral VirusesEnveloped Viruses



Complex Viruses

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Viral Taxonomy

- Family names end in -
- Genus names end in -
- 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

- Herpesviridae
  - *Herpesvirus*
    - Human herpes virus HHV-1, HHV-2, HHV-3

- Retroviridae
  - *Lentivirus*
    - Human immunodeficiency virus HIV-1, HIV-2

Growing Viruses

- Viruses must be grown in living cells.
  - Bacteriophages form plaques on a lawn of bacteria.

- Animal viruses may be grown in living animals or in embryonated eggs.

- Animal and plants viruses may be grown in cell culture.
  - Continuous cell lines may be maintained indefinitely.

Virus Identification

- Cytopathic effects -
- Serological tests
  - Detect antibodies against viruses in a patient.
  - Use antibodies to identify viruses in neutralization tests, viral hemagglutination, and Western blot.
- Nucleic acids
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Multiplication of Bacteriophages (Lytic Cycle)

- 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:
- Maturation: Assembly of phage particles.
- Release:

- Lytic cycle: Phage causes lysis and death of host cell.
- Lysogenic cycle: Prophage DNA incorporated in host DNA.

Lysogenic Cycle

- if lysogenic, circular DNA inserts into host chromosome =
- prophage remains dormant, replicating along with host
  - λ repressor proteins bind to operators repressing transcription of λ genes
  - prophage can be induced to excising $\rightarrow$
  - induction to lytic cycle can be the result of:
    - a spontaneous event
    -
    - certain chemicals
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Consequences of Lysogeny

- host lives and is protected from subsequent infection by lytic λ phages
- λ phage may bring genes that host can express
- *C. diphtheriae* $\rightarrow$ diphtheria toxin
- *C. botulinum* $\rightarrow$ botulism toxin
- *V. cholerae* $\rightarrow$ cholera toxin

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Specialized Transduction

- bacteriophage (lysogenic→lytic) mediated transfer of genes between bacteria

Viroids

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- plant pathogens (so far)
- naked RNA - infectious
- 300 - 400 bps
- single strand - folded and base paired with itself
- cause serious crop damage ; potato spindle tuber disease

Prions

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- Inherited and transmissible by ingestion, transplant, & surgical instruments
- Spongiform encephalopathies: Sheep scrapie, Creutzfeldt-Jakob disease, Gerstmann-Sträussler-Scheinker syndrome, fatal familial insomnia, mad cow disease
- PrPC, normal cellular prion protein, on cell surface
- PrPSc, scrapie protein, accumulate in brain cells forming plaques

Think about it!

- What kinds of “things” can be infectious?

Study Objectives

1. Compare and contrast viruses with bacteria.

2. Describe the typical structural components of viruses including types of nucleic acids (especially T-even bacteriophages).

3. Describe how bacteriophages are cultivated.

4. Describe the 5 stages of T-even bacteriophage infection during the lytic cycle and contrast this with lambda phage lytic and lysogenic cycles.

5. Describe the consequences of lysogeny.

6. What are viroids?

7. Describe prions and the types of diseases they cause.

8. What kinds of “things” can be infectious?