

Chapter 13 Viruses of Bacteria

Summary Outline

13.1 General characteristics

- A. **Viruses** are **non-living agents** associated with all forms of life. Each **virion** consists of **nucleic acid** surrounded by a **protein coat**. They are approximately 100 to 1000 fold smaller than the cells they infect.
- B. Virus architecture
 1. Shapes: **Isometric, helical** or **complex**
 2. The shape is determined by the **protein coat (capsid)** that surrounds the **nucleic acid**. These comprise the **nucleocapsid**. Each **capsid** is composed of **capsomeres**; **attachment proteins** or **spikes** project from the capsid.
 3. **Enveloped viruses** have a lipid bilayer surrounding the coat.
 4. **Naked viruses** do not have an envelope are naked.
- C. **Viral genome**: Viruses contain either **RNA or DNA**, which may be **single-stranded or double-stranded**.
- D. **Replication cycle**: Viruses only **multiply within living cells** using the host cell machinery. Some viruses live in harmony with their hosts and others kill the hosts.

13.2 Virus interactions with host cells

- A. **Productive infections** occur when phage multiply inside bacteria and lyse the cells (virulent and lytic)
- B. Other phage multiply but are extruded from the cell and do not kill it.
- C. **Temperate phage** integrate their DNA into the host cell where it multiplies either as a **plasmid** or integrated into the host chromosome as a **prophage** which may confer new properties on the cell.
- D. A **latent infection** may show no signs that cells are infected.
- E. **Lytic phage replication by double-stranded DNA phages**
 1. Productive infection.
 2. Steps:
 - a) **Attachment**—attachment proteins adsorb to specific receptors on the cell wall.
 - b) **Penetration**—the DNA is injected into the cell.
 - c) **Transcription**—the phage DNA is transcribed.
 - d) **Replication of phage DNA and proteins**
 - e) **Assembly (maturation)**—The assembly of the phage components into a complete virion.
 - f) **Release**—a phage-induced lysozyme lyses the cells releasing the phage.
 3. **Lytic phage replication by single-stranded RNA phages**
 - a) **Phages attach** to the sex pilus.
 - b) **Replication: Viral RNA** that enters the cell acts as a **template** and synthesizes a **complementary strand**, which then serves as a **template** for the synthesis of **single-stranded RNA**.
 4. **Phage replication in a latent state-phage lambda**
 - a) The temperate phage λ can either go through a **lytic cycle** similar to T4 or **integrate** its DNA into a specific site in the bacterial chromosome as a prophage.
 - b) **Prophage** often code for proteins, which confer unique properties on the bacteria, **lysogenic conversion**.

5. **Extrusion following phage replication: Filamentous phage** do not take over the metabolism but multiply productively as the host multiplies and are released by extrusion through the cell wall.
 6. **Lytic infection by single-stranded DNA phage:** Single stranded DNA phages exist that can lyse cells.
- 13.3 **Transduction:** there are two types of transduction: **generalized** and **specialized**.
- A. **Generalized transduction**, which can be carried out by virulent and temperate phage, involves the transfer of any piece of the bacterial chromosome from one cell to another cell of the same species.
 - B. **Specialized transduction** involves the transfer of specific genes.
- 13.4 **Host range** of phage: Factors that determine the host range of phage include **specificity of receptors** on the bacterial surfaces and the **restriction-modification system**.