

CHAPTER 12
THE STRUCTURE AND
INFECTION CYCLE OF VIRUSES

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VIRUS STRUCTURE

- ◆ Viruses are obligate intracellular parasites because they cannot live outside a host cell
- ◆ Viruses come in a variety of sizes and shapes
- ◆ Viruses contain either DNA or RNA but never both

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VIRUS STRUCTURE

- ◆ The nucleic acid in a virion is surrounded by a protein coat called a capsid
- ◆ The capsid is made up of repeating protein subunits known as capsomeres
- ◆ Some viruses are surrounded by an envelope composed of viral glycoproteins and oligosaccharides complexed with host cell membranes

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THE INFECTION CYCLE

- ◆ Viruses can go through a cycle in which the host cell makes new virions and releases them
- ◆ Viruses can also exhibit latency, in which they infect host cells but new virions are not produced
- ◆ Viruses can go through a lytic cycle, in which the host cell fills with new virions and bursts

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THE INFECTION CYCLE

- ◆ Host cell receptors used by viruses represent a small fraction of the cell membrane proteins
- ◆ Many different viruses can share the same receptor
- ◆ Virus–receptor interactions facilitate the infection process by enhancing virus entry into host cells

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THE INFECTION CYCLE

- ◆ For enveloped viruses, penetration occurs through a fusion event between the viral envelope and the host cell's plasma membrane
- ◆ Once fusion has occurred, the virus is released into the cytoplasm of the host cell, where various mechanisms allow the uncoating of the virus

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RETROVIRUSES

- ◆ Retroviruses are RNA viruses that contain the enzyme reverse transcriptase
- ◆ Reverse transcriptase converts RNA into DNA, which is then integrated into the host cell's DNA

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DNA VIRUSES - REPLICATION

- ◆ Replication of DNA viral genomes uses the same mechanism as the host cell but also requires several viral components
- ◆ Viral DNA replication occurs at specialized sites, which contributes to the efficiency and productivity of the viral infection

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DNA VIRUSES- REPLICATION

- ◆ Transcription of dsDNA genomes can begin immediately viral DNA enters the nucleus; however, for ssDNA genomes, the single strands must be converted to double strands before transcription can begin
- ◆ Transcription of viral DNA is performed by the host cell's RNA polymerase (except for poxviruses, which bring their own RNA polymerase)
- ◆ Viral genomes are transcribed at a very high rate, to make as many new virions as possible

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RNA VIRUSES- REPLICATION

- ◆ RNA virus replication is more complicated than DNA virus replication
- ◆ RNA viruses have either single-stranded or double-stranded RNA
- ◆ Single strands can be (-) or (+)

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RNA VIRUSES- REPLICATION

- ◆ In all cases, RNA viruses use a template strand of RNA to make new viral genomes
- ◆ Retroviruses are RNA viruses that contain the enzyme reverse transcriptase
- ◆ Reverse transcriptase can convert RNA into DNA, which can then be integrated into the host cell's chromosomes

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VIRUS REPLICATION

- ◆ Virus replication is a complicated process in which the host cell manufactures new viral components from the template provided by viral DNA or RNA
- ◆ Viruses are completely reliant on host cell machinery for translation

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INTRACELLULAR TRAFFICKING

- ◆ Intracellular trafficking is crucial for viral reproduction
- ◆ Intracellular trafficking requirements can be quite complex, with transport of viral macromolecules over long distances in the cell

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VIRAL ASSEMBLY

- ◆ Assembly of different viral components occurs at different sites and requires that all viral proteins be sorted in the Golgi
- ◆ All virions complete a set of assembly reactions
- ◆ Capsomere proteins are assembled first

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VIRAL ASSEMBLY

- ◆ The number of capsomeres produced is always far in excess of the number required for the number of virions to be assembled
- ◆ Some viruses use host cell proteins called chaperones to assemble viral capsids

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VIRAL RELEASE

- ◆ New virions are released through lysis, which kills the host cell, or by budding from the host cell, which allows the host cell to survive for a period
- ◆ Some viruses are released in an immature non-infectious state and must be activated enzymatically before they can infect host cells

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