4.10.1: Double-Stranded RNA Viruses - Retroviruses

Retroviruses are viruses that are able to reverse transcribe their RNA genome into DNA, which is then integrated into a host genome.

Learning Objectives

- Identify the unique features of retroviruses

Key Points

- In a double stranded RNA form, retroviruses infect a host cell with their genome, and then are reverse transcribed into double stranded DNA, with the DNA then integrated into the home cell genome.
- When integrated into a host genome, a retrovirus is hard to detect and can lay dormant for prolonged periods, having no discernible effect on the host.
- Retroviruses can be human pathogens, and cause many diseases, but have also proven to be invaluable tools when used by molecular biologists.

Key Terms

- **reverse transcriptase**: An enzyme that catalyzes the formation of DNA from RNA; found in retroviruses.
- **transposon**: A segment of DNA that can move to a different position within a genome.
- **integrase**: Any enzyme that integrates viral DNA into that of an infected cell.

A retrovirus is an RNA virus that is duplicated in a host cell using the reverse transcriptase enzyme to produce DNA.
from its RNA genome. The DNA is then incorporated into the host’s genome by an integrase enzyme. The virus thereafter replicates as part of the host cell’s DNA. Retroviruses are enveloped viruses that belong to the viral family Retroviridae. A special variant of retroviruses are endogenous retroviruses, which are integrated into the genome of the host and inherited across generations. Endogenous retroviruses are a type of transposon.

The virus itself stores its nucleic acid in the form of an mRNA genome and serves as a means of delivering that genome into cells it targets as an obligate parasite (a parasite that cannot live without its host). That process of delivering the genome into cells constitutes the infection. Once in the host’s cell, the RNA strands undergo reverse transcription in the cytoplasm and are integrated into the host’s genome, at which point the retroviral DNA is referred to as a provirus. It is difficult to detect the virus until it has infected the host, where the provirus can stay for months, even years, before becoming active and making new infectious viral particles.

In most viruses, DNA is transcribed into RNA, and then RNA is translated into protein. Retroviruses, however, function differently. Their RNA is reverse-transcribed into DNA, which is integrated into the host cell’s genome (when it becomes a provirus), and then undergoes the usual transcription and translation processes to express the genes carried by the virus. So, the information contained in a retroviral gene is used to generate the corresponding protein via the sequence: RNA → DNA → RNA → protein. Retroviruses can be pathogens of many different hosts, including humans. A notable retrovirus is Human immunodeficiency virus (HIV), the virus responsible for acquired immunodeficiency syndrome (AIDS). As well as infecting a host, some retroviruses can cause cancer.
Figure: **HIV viral life cycle**: This diagram depicts the viral life cycle of HIV, from infection, integration into a host genome, reconstruction, and formation of new viral particles. The inset on the left depicts an individual HIV particle.

Finally, retroviruses are proving to be valuable research tools in molecular biology and have been successfully used in gene delivery systems.