9.9A: Negative-Strand RNA Viruses of Animals

Negative-strand RNA viruses are single-stranded viruses that can infect several types of animals.

Learning Objectives

• Explain the mechanism of genome replication in negative-strand RNA viruses

Key Points

• Negative-strand RNA viruses can infect animals, but in several cases they can go from animals into humans, such as the SARS virus of the Ebola Zaire virus.

• The virion RNA is negative sense (complementary to mRNA and cannot encode proteins), which means it must be replicated over to mRNA before protein production can begin. This is carried out by an RNA-dependent RNA-polymerase.

• Negative-strand viruses can be found in many niches of Earth and are responsible for many common and very deleterious diseases of animals.

Key Terms

• **SARS**: The SARS coronavirus, sometimes shortened to SARS-CoV, is the virus that causes severe acute respiratory syndrome (SARS).

• **RNA-dependent RNA-polymerase**: (RdRP, or RNA replicase) An enzyme that catalyzes the replication of RNA from an RNA template. This is in contrast to a typical DNA-dependent RNA polymerase, which catalyzes the transcription of RNA from a DNA template.
The study of animal viruses is important from a veterinary viewpoint, but many animal viruses are also important from a human medical perspective. The emergence of the SARS virus or Ebola Zaire virus in the human population, coming from an animal source, highlights the importance of animals in bearing infectious agents. In addition, research into animal viruses has made an important contribution to our understanding of viruses in general, including their replication, molecular biology, evolution, and interaction with the host. Animal RNA viruses can be classified according to the sense or polarity of their RNA into negative-sense, positive-sense, or ambisense RNA viruses.

Figure: **Rabies**: Note the salivia dripping from the dog's mouth, a typical sign of a rabies infection. The infection of domestic animals with rabies was common until the 1960s; now most instances of rabies-infected animals are found in the wild.

The RNA found in a negative-sense virus is not infectious by itself, as it needs to be transcribed into positive-sense RNA. The complementary plus-sense mRNA must be made before proteins can be translated from the viral genome. This RNA negative-strand to positive-strand copying is carried out by an RNA-dependent RNA-polymerase. Each virion that has one negative-strand copy can be transcribed to several positive-sense RNAs. There are several different types of negative-strand RNA viruses that infect animals; two families will be discussed here in further detail.

Rhabdoviruses are a diverse family of single-stranded, negative-sense RNA viruses that can successfully utilize a myriad of ecological niches, ranging from plants and insects, to fish and mammals. This virus family includes pathogens—the rabies virus, vesicular stomatitis virus, potato yellow dwarf virus, etc.—that are of tremendous public health, veterinary, and agricultural significance. Due to the relative simplicity of their genomes and morphology, in recent years rhabdoviruses have become powerful model systems for studying molecular virology.

Paramyxoviruses are a diverse family of non-segmented negative-strand RNA viruses that include many highly pathogenic viruses affecting humans, animals, and birds. In recent years the advent of reverse genetics has led to a greater understanding of their genomics, molecular biology, and viral pathogenesis. Paramyxoviruses cause a range of diseases in animal species: canine distemper virus (dogs), phocine distemper virus (seals), cetacean morbillivirus (dolphins and porpoises), Newcastle disease virus (birds), and rinderpest virus (cattle). Some paramyxoviruses, such as the henipaviruses, are zoonotic pathogens, occurring naturally in an animal host, but also able to infect humans.