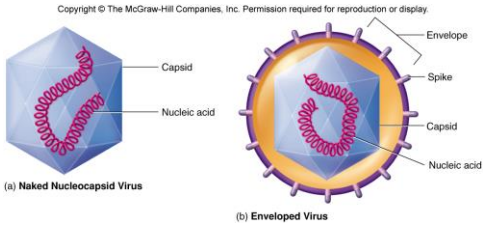
Unit 1 Lecture 3

Introduction to Viruses

Viruses: Position in the Living Spectrum

A virus is a non-cellular entity. Viruses are infectious particles that invade every known type of cell including plant, animal tissue, and even bacteria making them obligate intracellular parasites. Although they are not alive, they can direct the host to reproduce viral particles, which causes death or disease to that cell. They lack metabolism and respiratory enzymes, but do produce enzymes that allow them to enter and infect cells and for synthesizing DNA or RNA or digesting DNA.



Viruses are ultramicroscopic (<0.2µm) in size which necessitates that an electron microscope be used to see them. The virus consists of a viral capsid (a protective outer protein shell), that encases a nucleic acid (DNA or RNA, but not both), and possibly an envelope. The capsid shape is due to capsomere arrangement (helical, icosohedral, complex viruses, or bacteriophages). If envelopes are not present, then the virus is considered to have a naked nucleocapsid. The envelope functions in protection, binds to host cell, and assists with penetration. Some viruses have a tail piece attached. Click here to view various shapes of viruses.

The nucleic acid is DNA or RNA and can either be single or double stranded. Viruses are considered to be genetic parasites because they cannot multiply until their nucleic acid has reached the interior of the host cell. RNA viruses multiply in the cytoplasm of the cells whereas DNA viruses insert themselves into the DNA of the host cell and replicate there. RNA viruses tend to mutate more than DNA viruses. Examples of RNA viruses that readily mutate are HIV and influenza viruses.

How Are Viruses Named?

Viruses are named from their structure, chemical composition, similarities in genetic makeup, type of capsid, nucleic acid strand number, presence and type of envelope, overall viral size, and area of host cell where virus multiplies, for example, pantropic (entire body), neurotropic (neural tissue), pneumotropic (lungs), enterotropic (GI system), and dermotropic (skin), and viscerotropic viruses. Viruses that infect bacteria are called bacteriophages.

Modes of Viral Replication

The first thing a virus has to do is to attach itself to a target cell. A specific site on the virus coat of the virion attaches to a specific cell receptor site on the surface of the host cell. This is called the **Adsorption stage**. The next stage is the **Penetration stage** where injection of the whole virus or just its DNA is shot into the cell. There can be endocytosis and uncoating of RNA viruses. Next is the **Replication stage** when copying of the viral genome at the expense of the host's own cellular functions results in production of various viral components. After all these components are made they are assembled and mature during the **Assembly and maturation stages**. This occurs in the cytoplasm of the host cell. Finally, the virus exits the cell during the **Release Stage**. This may be due to cellular lysis or through the membrane by exocytosis. Click here to view multiplication of bacteriophages or here to view multiplication of animal viruses.

Relationships to Host Cells

A lytic (acute) infection occurs when the virus invades and takes immediate control of cell to reproduce itself. The outcome is host cell death with many virions produced. A persistent infection occurs if the host cell survives and sheds low numbers of virions. When a lysogenic or lysogeny (latent) infection occurs, the virus invades and becomes an integral part of the genome; it remains as a "provirus" and is reproduced within the cell. Proper stimulus activates the provirus to enter the lytic cycle. Good examples of a latent infection are found in the herpes viruses.

An Oncogenic virus is a virus that invades and becomes an integral part of the genome. The virus's nucleic acid transforms the cells which keep growing. The transformed cell undergoes continual reproduction without lysis to form a tumor.

Techniques in Cultivating and Identifying Viruses

The purpose of culturing viruses is to isolate and identify viruses from clinical specimens so that a diagnosis can be made and proper treatment provided. Viruses are also identified to prepare viral vaccines and to do detailed research on viral structure, multiplication cycles, genetics, and the effects on host cells.

Some methods of culturing include using live animals (specially bred strains of mice, rats, guinea pigs), bird embryos and tissue cultures to grow the virus. One would then look for evidence of **cytopathic effect** (CPE), which is virus induced damage to cells that alters its microscopic appearance or plaque formation due to cell death. Other studies could include tumor formation. In observation of tissue cultures, one would also look for the appearance of inclusion bodies (cytoplasmic or intranuclear inclusions to

determine the type of virus that is causing the infection) or giant cell (syncitia) formation from the merger of cells.

Evidence of Viral Infections

Specific laboratory testing can also be performed to determine the viral agent. Some of these tests are the rise of Interferon levels, antibody production, viral neutralization, hemagglutination and hemadsorption, or hemagglutination inhibition and hemadsorption inhibition, compliment fixation, PCR technology, and electron microscopy.

Prion

Prions are **Pr**oteinaceous **in**fectious particle, smaller than viruses, also non-living that are associated with chronic wasting disease, Kuru, and spongiform encephalopathies such as Mad Cow Disease and chronic wasting disease. They are extremely resistant to most methods that are employed to sterilize.