

Viruses are small obligate intracellular parasites either an RNA or DNA genome surrounded by a protective protein coat.

General properties of viruses

- 1- Viruses are obligate intracellular parasites of bacteria, protozoa, fungi, algae, plants and animals, inactive macromolecules outside the host cell and active only inside host cell.
- 2- Particles composed of DNA or RNA molecules surrounded by a protein coat.
- 3- Nucleic acid can be double stranded DNA, single stranded DNA, double stranded RNA or single stranded RNA
- 4- Lack enzymes for most metabolic processes and lack machinery for synthesizing protein.
- 5- They have a component - a receptor binding protein for attaching to cells.

Viral structure

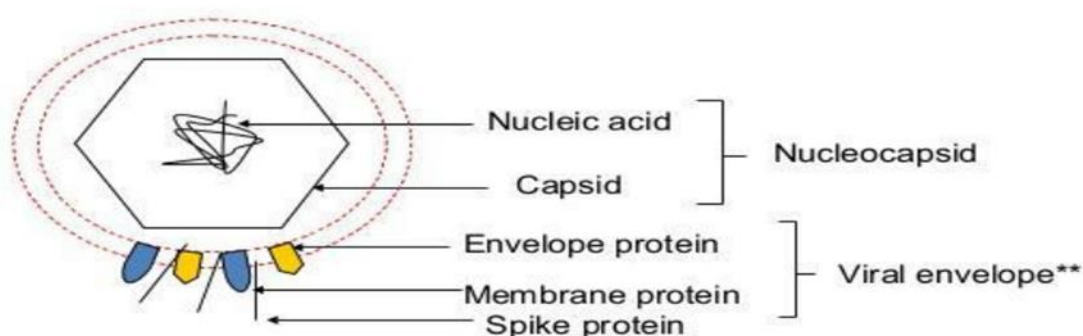
1- Viral nucleic acid

The viral nucleic acid is located internally and can be either single- or double stranded RNA or DNA. The nucleic acid can be either linear or circular. The DNA is always a single molecule, the RNA can exist either as a single molecule or in several pieces (segmented).

Some RNA viruses are positive polarity and others are negative polarity.

2-Capsid

The protein shell, or coat, that encloses the nucleic acid genome and mediates the attachment of the virus to specific receptors on the host cell surface. This



interaction of the viral proteins with the cell receptor is the major determinant of species & organ specificity. The capsid proteins protect the genome from degradation by nucleases.

3-Capsomeres

Morphologic units seen in electron microscope. Each capsomere, consisting of one or several proteins.

Naked viruses are composed of nucleic acid + capsid (**nucleocapsid**).

4- Viral envelope

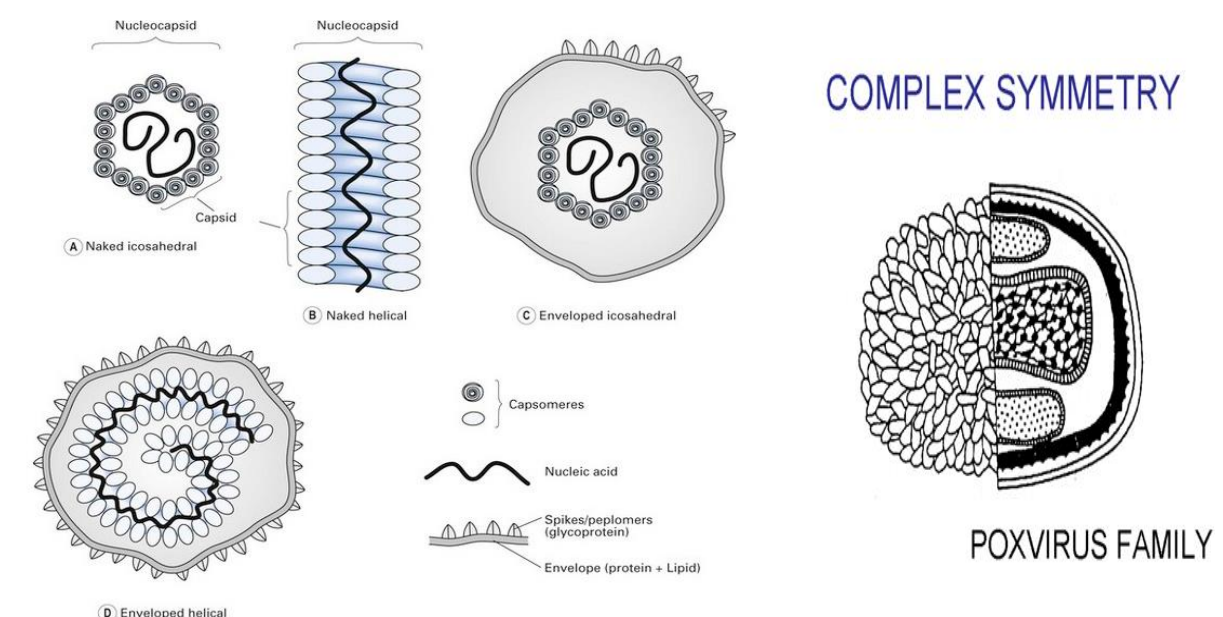
The envelope is a lipoprotein membrane composed of lipid derived from the host cell membrane and protein that is virus- specific. Furthermore, there are frequently glycoproteins in form of spike-like projections on the surface, which attach to host cell receptors. The presence of an envelope confers instability on the virus. **Enveloped viruses** NA + capsid + envelope.

The whole virus particle is called **virion**.

Types of symmetry of virus particle

Symmetry can be icosahedral, helical or complex.

1.Icosahedral symmetry: composed of 12 vertices, has 20 faces (each an equilateral triangle) with the approximate outline of a sphere like Herpesviruses, Adenoviruses.



2. Helical symmetry: In which the capsomeres are arranged in a hollow coil that appears rodshaped. The helix can be either rigid or flexible. The capsomere and nucleic acid are wound together to form helical or spiral tube-like structure.

Most of the helical viruses are enveloped and all are RNA viruses (Influenza viruses).

3. Complex structures: composed of several separate capsomere with separate shape and symmetry. They do not have either icosahedral or helical symmetry due to complexity of their capsid structure. Exp: Pox virus, Bacteriophage.

Reaction to physical and chemical agent

1-Heat and cold: Viral infectivity is generally destroyed by heating at 50-60 °C for 30 min., hours at 20 °C, days at 4 °C. Viruses can be preserved at -90 °C or -196 °C (liquid nitrogens).

2-PH: Viruses can be preserved at physiological PH (7.3).

3- Ether susceptibility: Ether susceptibility can be used to distinguish viruses that possess an envelope from those that do not.

4-Detergents: Nonionic detergents solubilize lipid constituents of viral membranes. The viral proteins in the envelope are released. Anionic detergents also solubilize viral envelopes; in addition, they disrupt capsids into separated polypeptides.

5-Salts: Many viruses can be stabilized by salt in concentrations of 1 mol/L. e.g. MgCl₂, MgSO₄, Na₂SO₄.

6- Radiation: Ultraviolet, X-ray, and high-energy particles inactivate viruses.

7- Formaldehyde: Destroys viral infectivity by reacting with nucleic acid.

8- Antibiotics: Antibacterial antibiotics have no effect on viruses.

Classification of viruses

1. Virion morphology, including size, shape, type of symmetry, presence or absence of peplomers, and presence or absence of membranes.

2. Virus genome properties, including type of nucleic acid (DNA or RNA), size of the genome, stranded (single or double), whether linear or circular, sense (polarity), segments (number, size).

3. Genome organization and replication, including gene order, number and position of open reading frames, strategy of replication (patterns of transcription, translation), and cellular sites (accumulation of proteins, virion assembly, virion release).

4. Virus protein properties, including number, size, amino acid sequence, modifications and functional activities of structural and nonstructural proteins

5. Antigenic properties.

6. Physicochemical properties of the virion, including molecular mass, buoyant density, pH stability, thermal stability, and susceptibility to physical and chemical agents, especially solubilizing agents and detergents.

7. Biologic properties, including natural host range, mode of transmission, vector relationships, pathogenicity, tissue tropisms, and pathology.

Nomenclature of viruses

On the basis of shared properties viruses are grouped at different levels **order, family, subfamily, genus and species**. More than 30,000 different virus isolates are known today and grouped in more than 3,600 species, in 164 genera and 71 families. Viral morphology provides the basis for grouping viruses into families. A virus family may consist of members that replicate only in vertebrates, only in invertebrates, only in plants, or only in bacteria. Certain families contain viruses that replicate in more than one of these hosts.

The use of Latinized names ending in **-viridae** for virus families and ending in **-virus** for viral genera has gained wide acceptance. The names of subfamilies end in **-virinae**. **Vernacular** names continue to be used to describe the viruses within a genus. In this text, Latinized endings for families and subfamilies usually are not used