Virus

A **virus** is a Submicroscopic Organism that replicates only inside the living cells of an organism. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea. The study of viruses is known as virology.

When infected, a host cell is forced to rapidly produce thousands of identical copies of the original virus. When not inside an infected cell or in the process of infecting a cell, viruses exist in the form of independent particles or virions.

It consists of:

(i) The genetic material, i.e. long molecules of DNA or RNA that encode the structure of the proteins by which the virus acts.

(ii) A protein coat, the capsid, which surrounds and protects the genetic material.

(iii) An outside envelope of lipids. The shapes of these virus particles range from simple helical and icosahedral forms to more complex structures. Most virus species have virions too small to be seen with an optical microscope as they are one hundredth the size of most bacteria.

Microbiology:

Life properties:

They have been described as "organisms at the edge of life", since they resemble organisms in that they possess genes, evolve by natural selection, and reproduce by creating multiple copies of themselves through self-assembly.

Although they have genes, they do not have a cellular structure, which is often seen as the basic unit of life. Viruses do not have their own metabolism, and require a host cell to make new products.

They therefore cannot naturally reproduce outside a host cell although bacterial species such as rickettsia and chlamydia are considered living organisms despite the same limitation.

Accepted forms of life use cell division to reproduce, whereas viruses spontaneously assemble within cells. They differ from autonomous growth of crystals as they inherit genetic mutations while being subject to natural selection.

Structure:

Viruses display a wide diversity of shapes and sizes, called “morphologies”. In general, viruses are much smaller than bacteria. Most viruses that have been studied have a diameter between 20 and 300 nanometers.

A complete virus particle, known as a **virion**, consists of **nucleic acid** surrounded by a protective coat of protein called a **capsid.**

These are formed from identical protein subunits called capsomeres. Viruses can have a lipid "envelope" derived from the host cell membrane.

The capsid is made from proteins encoded by the viral genome and its shape serves as the basis for morphological distinction.

Virally-coded protein subunits will self-assemble to form a capsid, in general requiring the presence of the virus genome. Complex viruses code for proteins that assist in the construction of their capsid.

Proteins associated with nucleic acid are known as nucleoproteins, and the association of viral capsid proteins with viral nucleic acid is called a nucleocapsid.

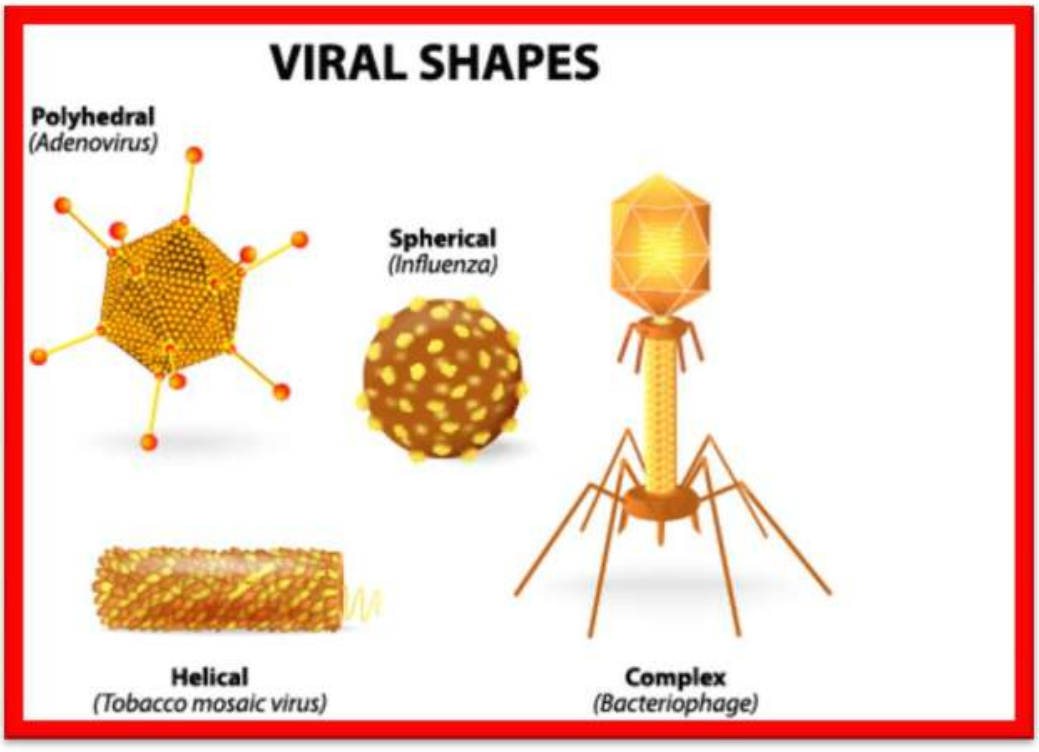

Fig: Viral Shapes

Helical:

These viruses are composed of a single type of capsomere stacked around a central axis to form a helical structure, which may have a central cavity, or tube.

This arrangement results in rod-shaped or filamentous virions which can be short and highly rigid, or long and very flexible. The genetic material (typically single-stranded RNA, but ssDNA in some cases) is bound into the protein helix by interactions between the negatively charged nucleic acid and positive charges on the protein.

Overall, the length of a helical capsid is related to the length of the nucleic acid contained within it, and the diameter is dependent on the size and arrangement of capsomeres. The well-studied tobacco mosaic virus is an example of a helical virus.

Icosahedral

Most animal viruses are icosahedral or near-spherical with chiral icosahedral symmetry. A regular icosahedron is the optimum way of forming a closed shell from identical sub-units.

The minimum number of identical capsomeres required for each triangular face is 3, which gives 60 for the icosahedron. Many viruses, such as rotavirus, have more than 60 capsomers and appear spherical but they retain this symmetry.

To achieve this, the capsomeres at the apices are surrounded by five other capsomeres and are called pentons. Capsomeres on the triangular faces are surrounded by six others and are called hexons. Hexons are in essence flat and pentons, which form the 12 vertices, are curved.

Envelope:

Some species of virus envelop themselves in a modified form of one of the cell membranes, either the outer membrane surrounding an infected host cell or internal membranes such as nuclear membrane or endoplasmic reticulum, thus gaining an outer lipid bilayer known as a viral envelope.

This membrane is studded with proteins coded for by the viral genome and host genome; the lipid membrane itself and any carbohydrates present originate entirely from the host.

The influenza virus and HIV use this strategy. Most enveloped viruses are dependent on the envelope for their infectivity.

Complex:

These viruses possess a capsid that is neither purely helical nor purely icosahedral, and that may possess extra structures such as protein tails or a complex outer wall.

Some bacteriophages, such as Enterobacteria phage T4, have a complex structure consisting of an icosahedral head bound to a helical tail, which may have a hexagonal base plate with protruding protein tail fibres.

This tail structure acts like a molecular syringe, attaching to the bacterial host and then injecting the viral genome into the cell.

The poxviruses are large, complex viruses that have an unusual morphology. The viral genome is associated with proteins within a central disc structure known as a **nucleoid.**

The nucleoid is surrounded by a membrane and two lateral bodies of unknown function. The virus has an outer envelope with a thick layer of protein studded over its surface. The whole virion is slightly pleomorphic, ranging from ovoid to brick-shaped.