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<u>**Notes**</u>

- **VIRAL STRUCTURE**
- A complete virus particle, known as a virion, consists of nucleic acid surrounded by a protective coat of protein called a capsid.
- The nucleic acid core surrounded by the protein coat is termed as nucleocapsid.
- Capsid consists of identical protein subunits called capsomeres.
- Some 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.

- **CAPSID:**
- is a protective protein coat that encloses and protects the nucleic acid of a virus.
- accounts for most of the viral mass.
- composed of single or multiple proteins .
- Each protein subunit is termed as a capsomere.
- Capsid determines the shape of the virus.

- Viruses occur in three main shapes,
- i) Spherical (polyhedral)
- ii) Helical (cylindrical or rod like)
- iii) Complex.
- **CAPSID SYMMETRY**
- HELICAL SYMMETRY
- Helical viruses have the nucleic acid inside a hollow cylindrical capsid with a helical structure eg. Rabies virus, Ebola virus, Tobacco Mosaic Virus.
- 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/POLYHEDRAL SYMMETRY**

- 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. The same protein may act as the subunit of both the pentamers and hexamers or they may be composed of different proteins.
- Some icosahedral viruses have a structure such as a knob, projection or fibre at each of the 12 vertices of the capsid. For example, the virions of some phages have projections, while the adenovirus virion has a fibre, with a knob attached, at each of the 12 pentons .
- These structures at the capsid vertices are composed of distinct proteins that are involved in attachment of the virion to its host cell and in delivery of the virus genome into the cell.
- PROLATE SYMMETRY
- An elongated icosahedron is a common shape for the heads of bacteriophages. Such a structure is composed of a cylinder with a cap at either end. The cylinder is composed of 10 elongated triangular faces.
- The Q number (or Tmid), which can be any positive integer specifies the number of triangles, composed of asymmetric subunits, that make up the 10 triangles of the cylinder. The caps are classified by the T (or Tend) number.
- The bacterium E. coli is the host for bacteriophage T4 that has a prolate head structure.
- The functions of the capsid are to:
- protect the genome,

- deliver the genome, and
- interact with the host.

Functions of Capsid:

- Virus genomes removed from their capsids are more susceptible to inactivation, so a major function of the capsid is undoubtedly the protection of the genome.
- A second major function of many capsids is to recognize and attach to a host cell in which the virus can be replicated.
- Although the capsid must be stable enough to survive in the extracellular environment, it must also have the ability to alter its conformation so that, at the appropriate time, it can release its genome into the host cell.
- For many viruses the capsid and the genome that it encloses constitute the virion. For other viruses a lipid envelope and sometimes another layer of protein, surrounds this structure, which is referred to as a nucleocapsid.
- **Double Shell Particle: A capsid within a capsid**
- A different and very complex structural arrangement is found in another class of isometric viruses, the reoviruses, which are composed of a capsid within a capsid.
- The diameter of the inner and the outer capsid being 51 nm and 73 nm respectively. Reovirus synthesizes 11 polypeptides.
- Of these eight are located in the virion, three forming the outer capsid and five forming the inner capsid .
- Both capsids have icosahedral symmetry.
- HIV-1 and Baculoviruses have capsids that are conical and rod shaped, respectively .
- Inside each capsid is a copy of the virus genome coated in a highly basic protein. Both of these viruses have enveloped virions.