Lecture 6

Structure of Viruses

Viruses

A virus is a small infectious agent that replicates only inside the living cells of other organisms. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea.

Virology

Virology is the study of viruses – submicroscopic, parasitic particles of genetic material contained in a protein coat.

Virologists

Virologists study viruses that affect humans, animals, insects, bacteria, fungi, and plants in community, clinical, agricultural, and natural environments.

Viruses as Living

Living characteristics of viruses

1) Viruses have genetic material (DNA or RNA).

2) They can be mutated.

3) They can be transmitted from one host to another.

4) They are capable of multiplication within a host.

5) They are able to infect and cause disease to living beings.

6) The DNA and proteins of viruses are similar in composition and structure to those of higher organisms.

Viruses as Non-living

Nonliving characteristics of viruses

1) Viruses can replicate and multiply inside the host but cannot grow.
2) Viral replication is different from reproduction of other living organisms.

3) There is no cell wall, membrane or cytoplasm.

4) There are no cell organelles and there is no metabolism.

5) They use the host cell's metabolic machinery.

General Features of viruses

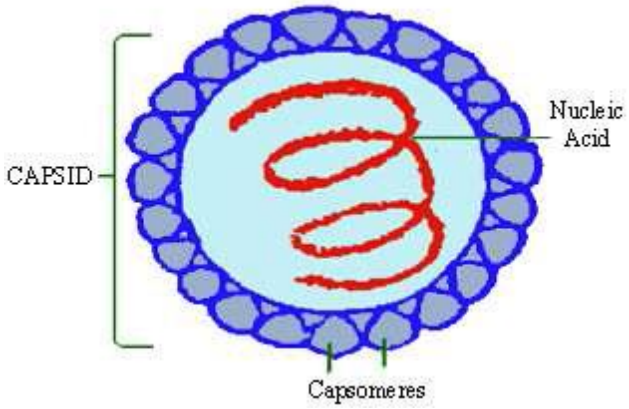
1) Obligate intracellular parasite.

2) Contain either DNA or RNA never both.

3) Can affect humans, animals, insects, bacteria and plants.

4) They do not respond to antibiotic.

5) Some viruses also surrounded by a membrane-like envelope



Structure of Viruses

Viruses come in an amazing variety of shapes and sizes. They are very small and are measured in nanometers, which is one-billionth of a meter. Viruses can range in the size between 20to750nm, which is 45,000times smaller than the width of a human hair. The majority of viruses cannot be seen with a light microscope because the resolution of a light microscope is limited to about 200nm, so a scanning electron microscope is required to view most viruses.

The three major viral components are

1. Nucleic acid **2.Capsid** **3.Viral Envelope**

1. Nucleic acid

The viral nucleic acid carries the genetic information in either DNA or RNA which is considered as the finger prints of the virus.

2. **Capsid (Protein coat)**

Capsid is the protein shells which enclose the nucleic acid. It is formed of small unis called capsomeres. Capsomeres are arranged in a precise and highly repetitive pattern around the nucleic acid. A single type of capsomeres or several chemically distinct types may make up the capsid. The combination of genome and capsid is called the viral nucleocapsid**.**

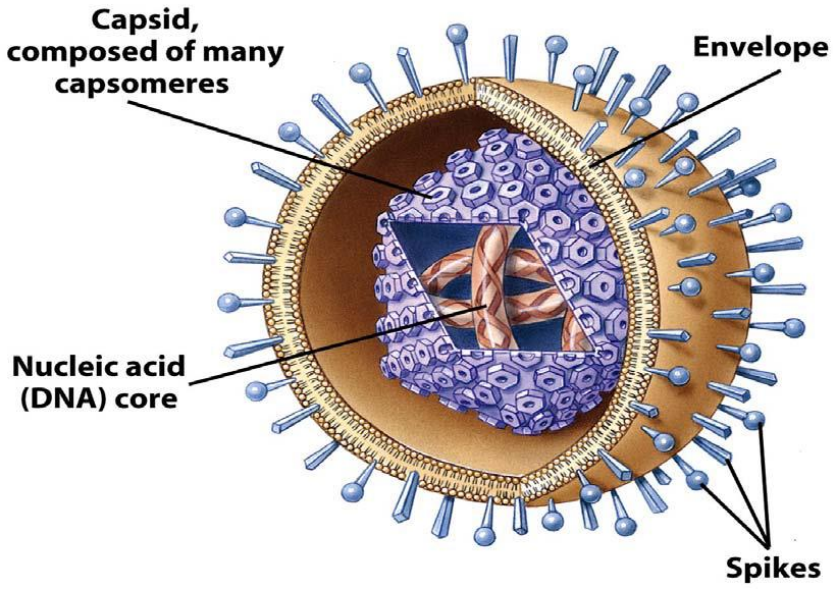
Functions of the capsid

1) Protects the viral genome against extracellular environments.

2) It carries he viral attachment proteins (VAP) which are glycoproteins that attach the virus to a specific receptor on the target cell.

3) Determine the antigenic characters of the virus.

4) It is responsible for the symmetry of the virus



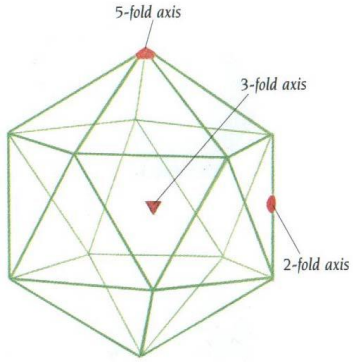
3. Viral Envelopes

A number of kinds of viruses contain envelopes. An envelope is a membrane like structure that encloses the nucleocapsid and is obtained from a host cell during the replication

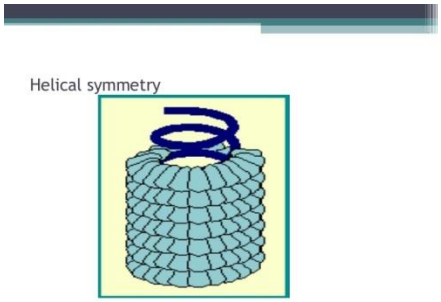
process. The envelope contains viral-specified proteins that make it unique. Among the envelope viruses are those of herpes simplex, chickenpox, and infectious mononucleosis.

The nucleocapsids of viruses are constructed according to certain symmetrical patterns. The virus that causes tobacco mosaic disease, for example, has helical symmetry**.** In this case, the nucleocapsid is wound like a tightly coiled spiral. The rabies virus also has helical symmetry. Other viruses take the shape of an icosahedron, and they are said to have icosahedral symmetry**.**

In an icosahedron, the capsid is composed of 20 faces, each shaped as an equilateral triangle 12 vertices, 5-3-2 symmetry axes, 60 identical subunits in identical environments can form icosahedral shell.



Icosahedral symmetry



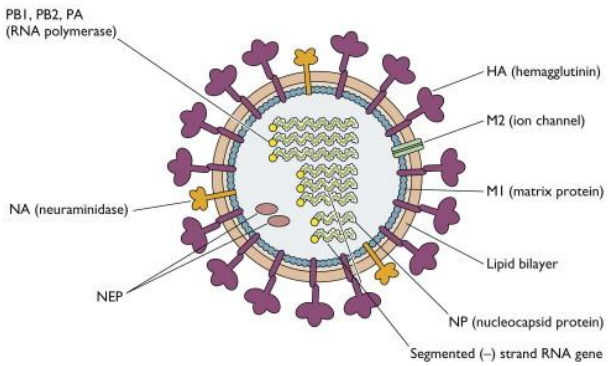
helical symmetry

Envelope Glycoproteins

Found in the envelope bilayer. This is aided by domains of host membrane proteins called *spanners.* They can generate spikes or other structures on the outside of the virion to anchor a host cell.

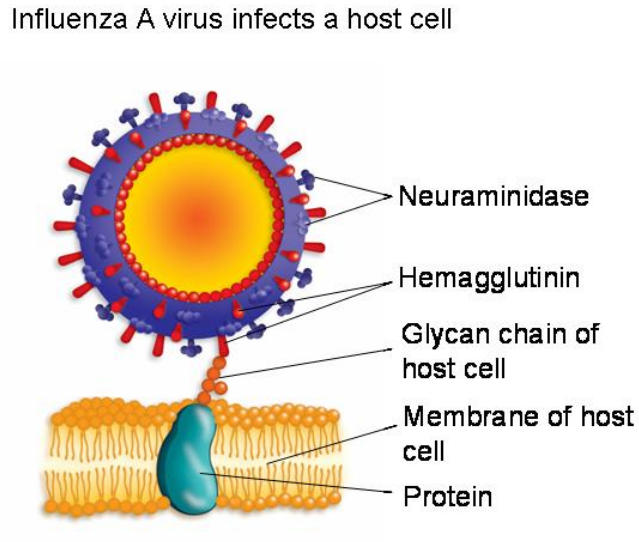
4. Influenza virus

The influenza virion (as the infectious particle is called) is roughly spherical. It is an enveloped virus – that is, the outer layer is a lipid membrane which is taken from the host cell in which the virus multiplies. Inserted into the lipid membrane are ‘spikes’, which are proteins – actually glycoproteins, because they consist of protein linked to sugars – known as HA (hemagglutinin) and NA (neuraminidase). These are the proteins that determine the subtype of influenza virus.



Influenza Hemagglutinin

Hemagglutinin (BE) is an antigenic glycoprotein found on the surface of the influenza viruses. It is responsible for binding the virus to the cell that is being infected. The name "hemagglutinin" comes from the protein's ability to cause red blood cells (erythrocytes) to clump together ("agglutinate") in vitro. The process is like this: Hemagglutinin (HA) binds to the monosaccharide sialic acid which is present on the surface of its target host cells. The cell membrane then engulfs the virus through endocytosis and forms endosome. The cell then attempts to begin digesting the contents of the endosome by acidifying its interior and transforming it into a lysosome. The HA spikes extend like a spring during infection.



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