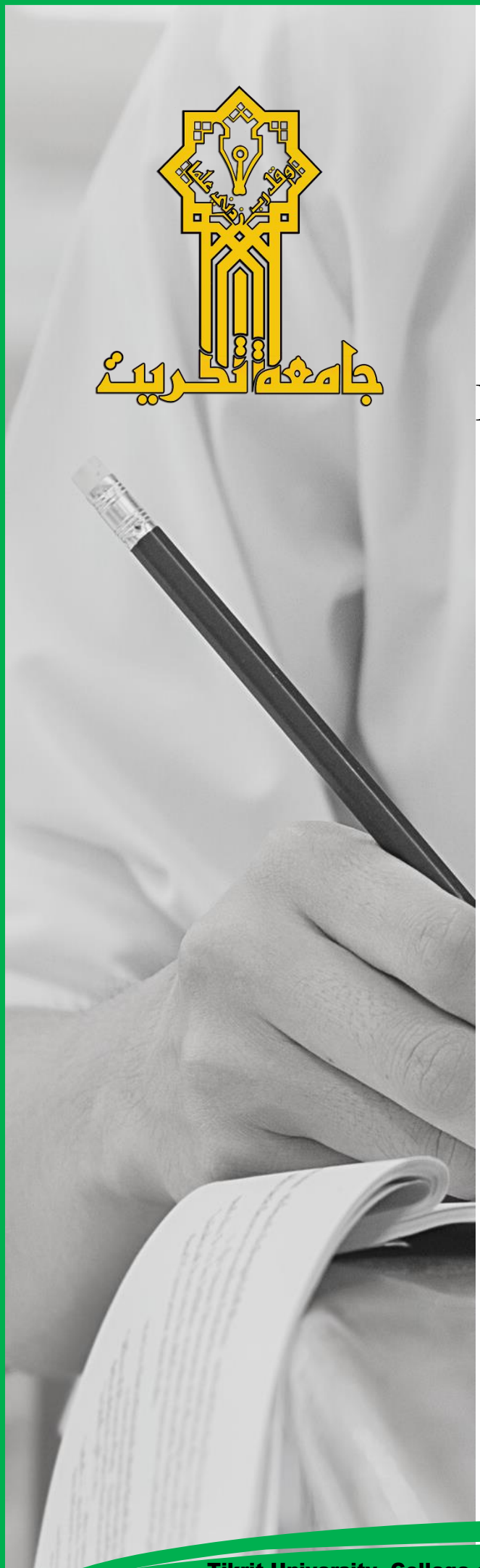

Tikrit University
College of Veterinary Medicine

Lect. 1-Virology

Subject name:Virus Introduction and Classification
Subject year:2024-2023
Lecturer name: Prof. Dr. Nihad Abdul-Hussain Jafar and Assist.Prof.Dr. Agharid Ali Hussein
Academic Email:
agharidalrasheed@tu.edu.iq
nihadabid73@tu.edu.iq

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Lecturers link

Viruses

Viruses are acellular, ultramicroscopic particles containing either RNA or DNA covered by protein coat which reproduce inside living cells, pass through filters that retain bacteria.

The general properties of viruses are:

1- Do not possess cellular organization.
2- Contain one type of nucleic acid, either RNA or DNA but never both.
3- Lack enzymes necessary for protein and nucleic acid synthesis and so depend upon synthetic machinery of host cells.
4- They multiply by complex process and not bi binary fission.
5- They are unaffected by antibiotics.
6- They are sensitive to interferon.
7- Do not grow on culture media and can grow only on living cells and they are obligate parasites.
8- They are very small and can be seen only by electron-microscope and pass through filters which retain bacteria.

Morphology: Some viruses have characteristic shape e.g. rabies virus has bullet shape, pox viruses are brick shaped, bacteriophage has head and tail..etc.

Structure: The complete viral particles known as virion which is composed of the followings:

1- Genetic material: RNA or DNA, double stranded or single stranded, linear or circular, and some time segmented.
2- Capsid: is the protein coat which cover the genetic material.
3- Envelope: which cover the capsid in some viruses and are derived from host cell membrane.

Genome: Viruses have RNA or DNA therefore classified to tow types: RNA groups and DNA groups

DNA groups may be single stranded or double stranded (usually double) and are linear or circular according to the family of the virus.

RNA viruses also may be single stranded or double stranded and may be segmented.

ssRNA viruses divided to tow groups:

1- Plus-strand or positive-strand or sense and act directly as mRNA
2- Minus-strand or negative-strand or anti-sense.

Capsid: It is the shell that cover the genetic material and is composed of proteins which combined with the genetic material. They are together known as nucleucapsid. The capsid in turns composed of secondary elements known as capsomere. Number of capsomeres differ according to the types of viruses and its functions is to protect the genetic material and also for attachment to the host cell (adsorption).

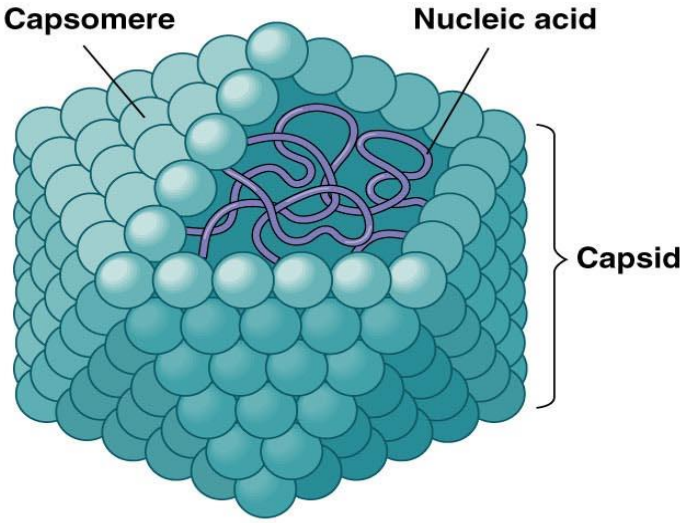
Envelope: It covers the capsid in many viral families and it origin is from the nuclear or cytoplasmic membrane of the host cell. The enveloped virus attached to host cell by envelope and not by capsid.

Other components of the viral particles:

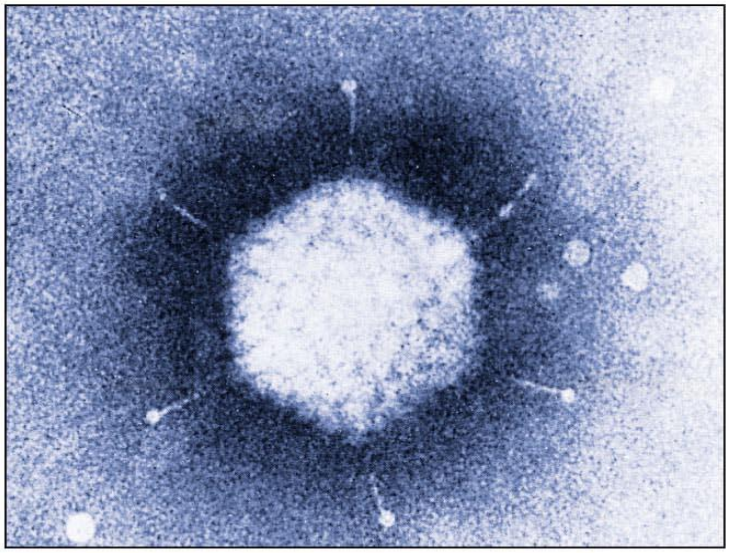
1- Enzymes: some viruses have enzymes according to the type of genetic material and mode of infection:
a- Myxoviruses have neuraminidase which is used for invasion and for release.
b- Negative stranded RNA viruses contain RNA-dependent RNA polymerase
2- Hemagglutinin: Myxoviruses and paramyxoviruses have the ability to agglutinate human and animal RBCs because they have surface proteins (Hemagglutinin) in the envelope which cause agglutination of the RBCs.

Symmetry: Divided to three groups:

1- Cubic (rotational) symmetry: also known as icosahedron, contain 20 face each one is a triangle, and have 12 corners.

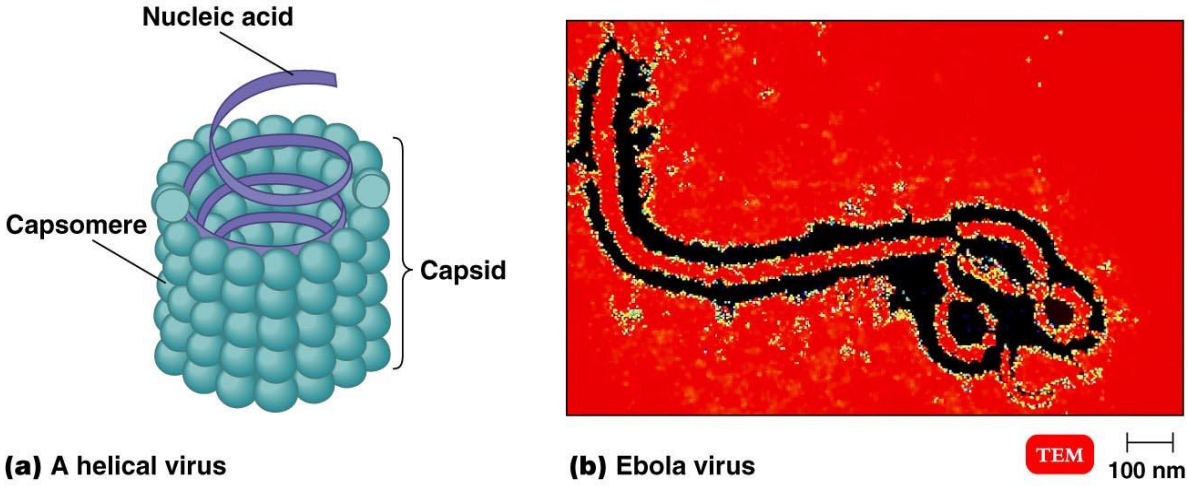


(a) A polyhedral virus

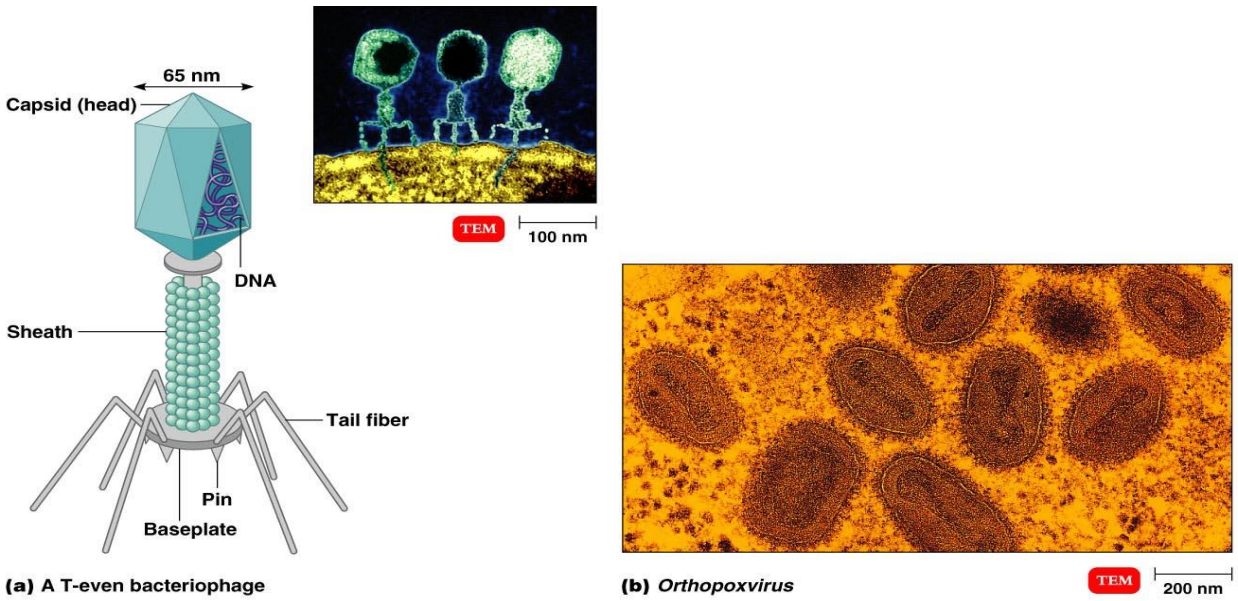


(b) *Mastadenovirus*

2- Helical symmetry: one axis is longer than the other. It have a rod like shape when viewed under electron microscope, and this is due to the helical arrangement of capsomers, resulting in tube or cylinder, with room in the center for the nucleic acid elements.



3- Complex symmetry: found in bacteriophage and smallpox viruses. Composed of head which is icosahedron (contain DNA) and tail like tube by which the DNA is injected to the host cell.



Virus size: viral size ranged between 20 nm as in Foot and mouth disease virus to 300 nm as in Pox viruses.

Classification of viruses

The most important characteristics used in the diagnosis of viruses are:

1- Type of the genome (DNA or RNA).
2- Capsid symmetry (cubic or helical).
3- Presence or absence of the envelope.
4- Site of the nucleic acid replication (cytoplasm or the nucleus).
5- Site of assembly and maturation of the nucleucapsid.
6- Sensitivity to ether and chloroform.
7- Number of capsomeres on the virion.
8- Diameter of the virion.
9- Molecular weight of the nucleic acid.

Viral replication: Viruses replicate by a complex method. The important events in viral replication are:

1- ***Adsorption (attachment)***

Viruses have reactive sites on their surface which interact with specific receptors on suitable host cells. This is usually a passive reaction (not requiring energy) and the specificity of the reaction between viral protein and host receptor defines and limits the host species as well as the type of cell that is infected. Damage to these binding sites (e.g. by disinfectants or heat), or blocking by specific antibodies (neutralizing antibodies) can render virions non-infectious.

2. Uptake

After adsorption, the coat of enveloped viruses may fuse with the host cell membrane and release the virus nucleocapsid into the host cytoplasm. Other viruses may enter the cell by a process of "endocytosis" which involves invagination of the cell membrane to form vesicles in the cell cytoplasm.

3. Uncoating

Refers to the release of the viral genome from its protective capsid to enable the nucleic acid to be transported within the cell and transcribed to form new progeny virions.

4. Genomic activation

Messenger RNA (m-RNA) is transcribed from viral DNA (or formed directly from some RNA viruses) and codes for viral proteins that are translated by the host cell. " Early" proteins are usually non-structural (eg. DNA or RNA polymerases) and later proteins are structural, eg. capsid proteins, ie. building blocks of the virion. Nucleic acid replication produces new viral genomes for incorporation into progeny virions.

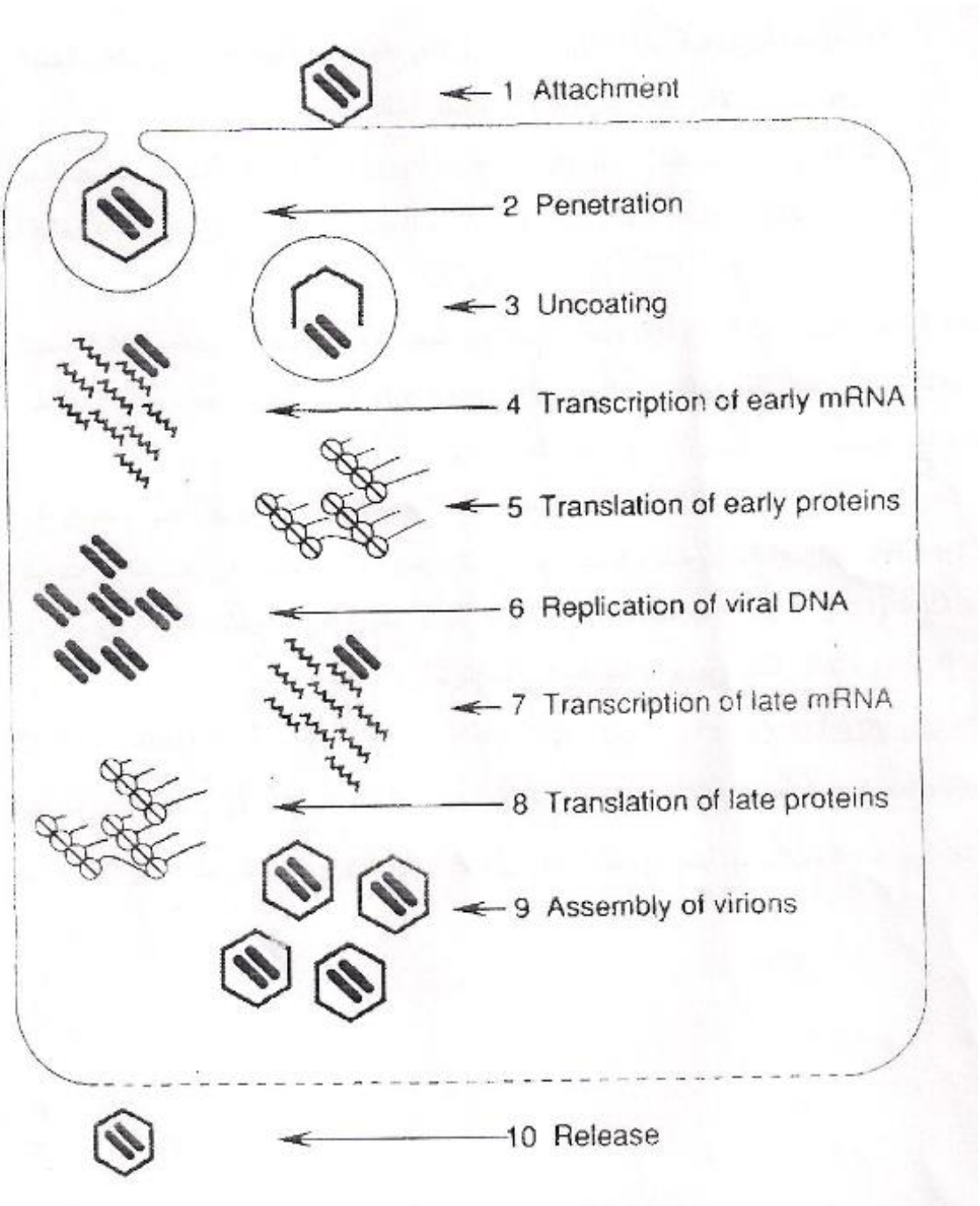
In general, DNA viruses replicate mainly in the nucleus and RNA viruses mainly in the cytoplasm, but there are exceptions, eg. Pox viruses contain DNA but replicate in the cytoplasm of the host cell.

5. Assembly

Assembly of viral nucleocapsids may take place in the nucleus (e.g. herpes virus, adenovirus); in the cytoplasm (e.g. polio virus); or at the cell surface, eg. "budding" viruses such as influenza. Accumulation of virions at sites of assembly may form "inclusions" that are visible in stained cells with the light microscope.

6. Release

Release of new infectious virions is the final stage of replication. This may occur by budding from the cell surface, as occurs with many enveloped viruses. In this case capsid proteins and nucleic acid condense directly adjacent to the cell membrane and viral-coded envelope proteins, introduced into the cell membrane, concentrate in the vicinity of capsid aggregates. The membrane surrounding the nucleocapsid then bulges out and becomes "nipped off" to form the new enveloped virion.



Viral replication cycle