Chapter 15

Medical Virology

Pharmaceutical Microbiology

Dr. Mohammed Hussien Taleb

General Properties of Viruses

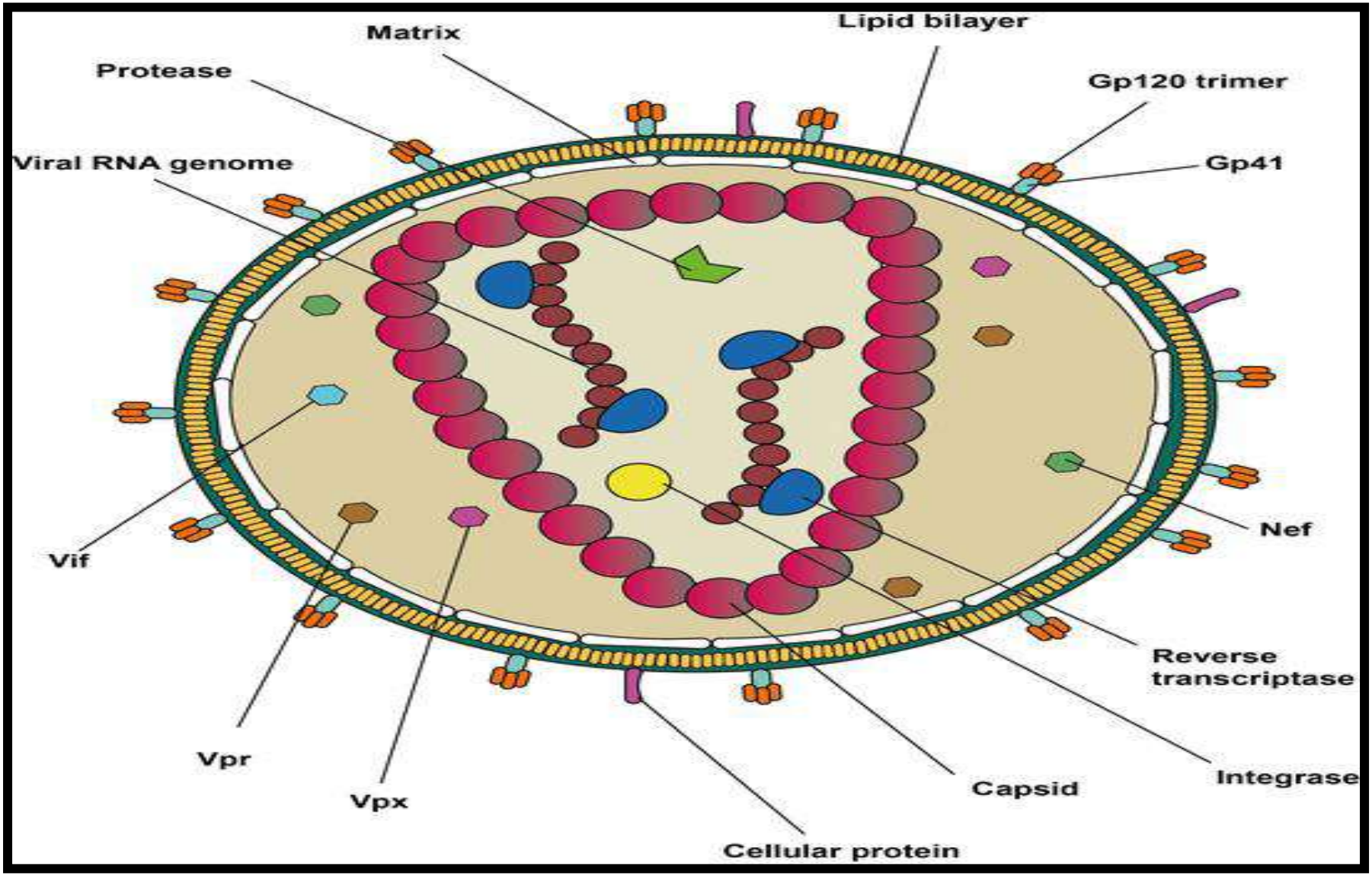
- Viruses are **the smallest infectious agents** (ranging from about **20 nm to 300 nm** in diameter) and contain **only one kind of nucleic acid (RNA or DNA)** **as their genome**.
- The **nucleic acid** is **encased in a protein shell**, which may be **surrounded by a lipid-containing membrane.**

- The entire infectious unit is termed

a virion

- Viruses are inert in the extracellular environment; **they replicate only in living cells**, being parasites at the genetic level.

Scheme of HIV virion



What is a Virion?

- A virion is a complete functional virus that has the capacity to infect living tissue. This means that it includes the genetic material, the capsid, the envelope and the membrane proteins that allow the virus to bind to its host and enter it.
- Structural unit of the virus
- It has two essential structures: DNA or RNA and capsid.
- Sometimes, glycoprotein spicules can be added to these basic structures
- VIRUSES can be found either inside a cell (intracellular) or outside of a cell (extracellular). If it is found extracellular, the virus is called a virion. A virion contains a protein coating called a capsid, which surrounds the core of the virus containing the nucleic acid (either DNA or RNA).

Virus versus Virion

- Virus is a broad general term for any aspect of the infectious agent and includes:
  - the infectious or inactivated virus particle
  - viral nucleic acid and protein in the infected cell

- Virion is the physical particle in the extra-cellular phase which is able to spread to new host cells; complete intact virus particle

Replication of viruses

The viral multiplication cycle can be divided into six sequential phases, though the phases may sometimes be overlapping

1. Adsorption or attachment
2. Penetration
3. Uncoating
4. Biosynthesis
5. Maturation
6. Release

- The viral nucleic acid contains information necessary for programming the infected host cell to synthesize virus-specific macromolecules required for the production of viral progeny.
- During the replicative cycle, numerous copies of viral nucleic acid and coat proteins are produced.

- The virus infection may have little or no effect on the host cell or may result in cell damage or death.
- Viruses vary greatly in structure, genome organization and expression, and strategies of replication and transmission.
- Viruses are known to infect unicellular organisms such as mycoplasmas, bacteria, and algae and all higher plants and animals.

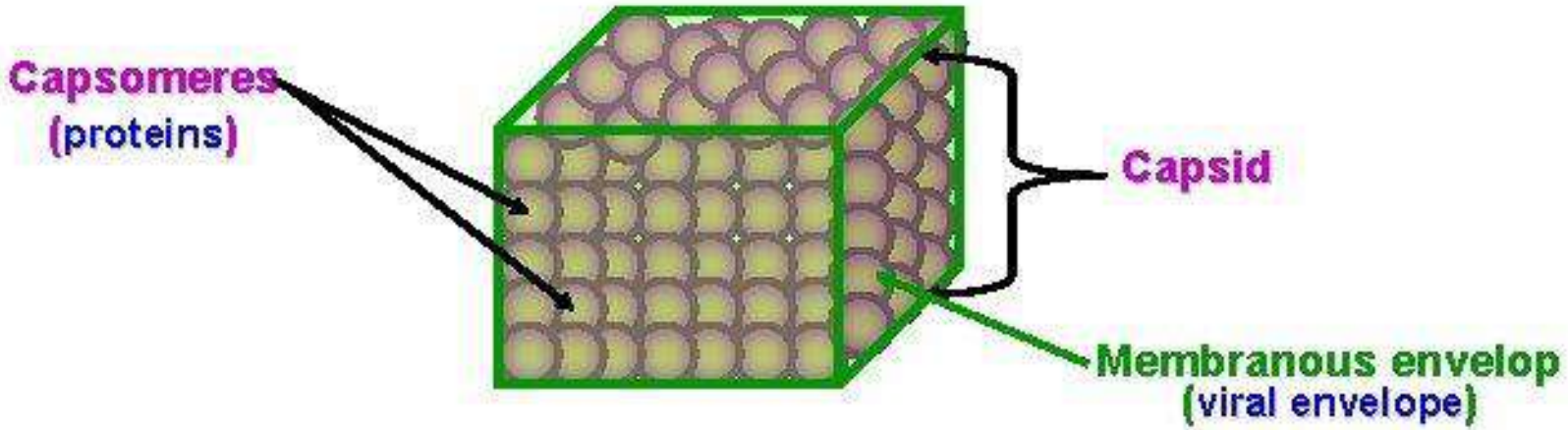
Terms and definitions in virology

- **Capsid:** The protein shell, or coat, that encloses the nucleic acid genome.
- **Capsomeres:** Morphologic units seen in the electron microscope on the surface of icosahedral virus particles.
- **Capsomeres** represent clusters of polypeptides, but the morphologic units do not necessarily correspond to the chemically defined structural units.

Viral Capsid and Envelope

A- Capsid

- A protein shell that encloses the viral genome.
- It is rode-shaped, helical, polyhedral or more complex.
- Capsomeres: Are the protein units that form capsid.



Sometimes further rapped لف in a membranous envelope (Viral envelope), ex. Influenza virus.

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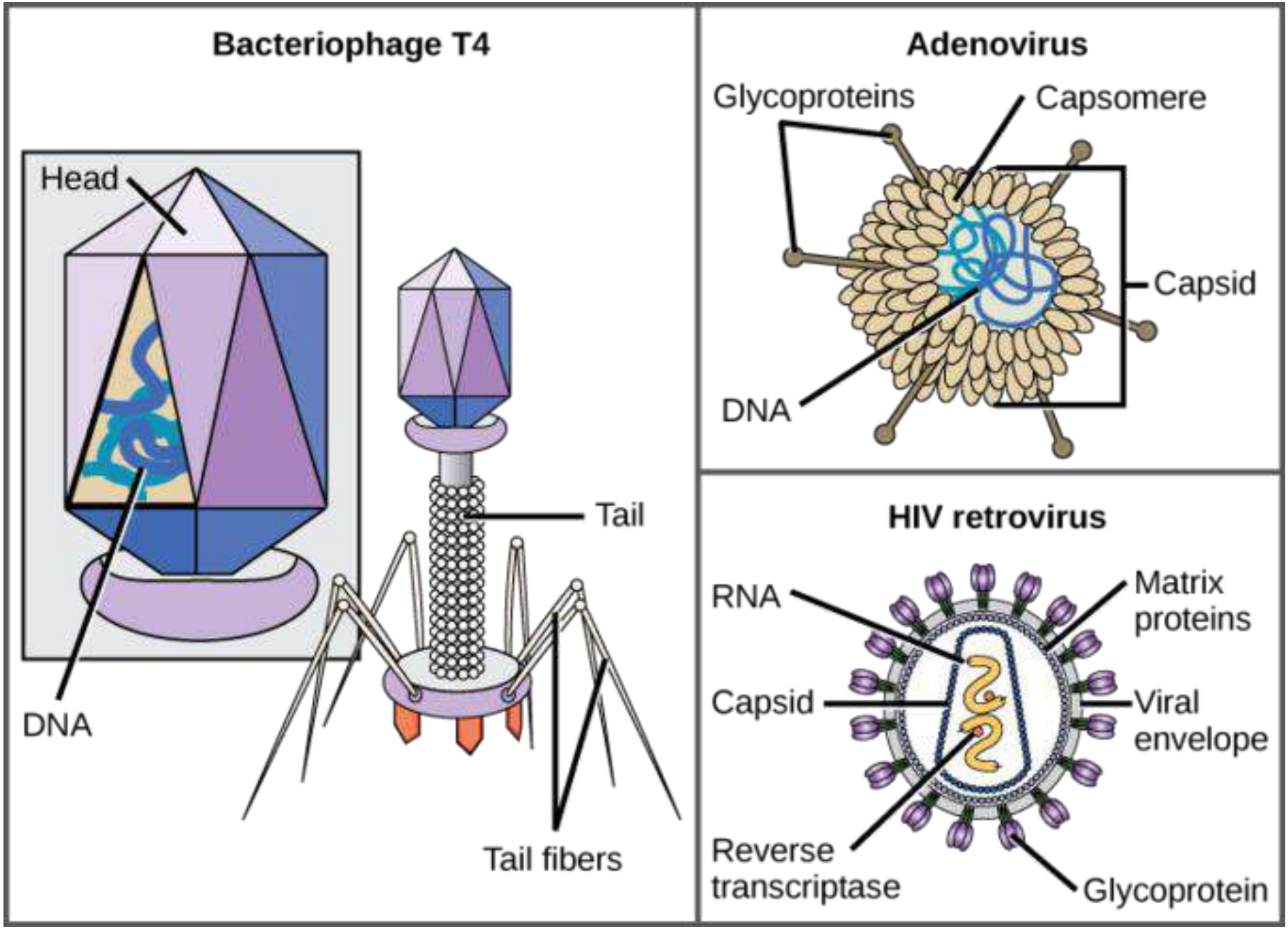
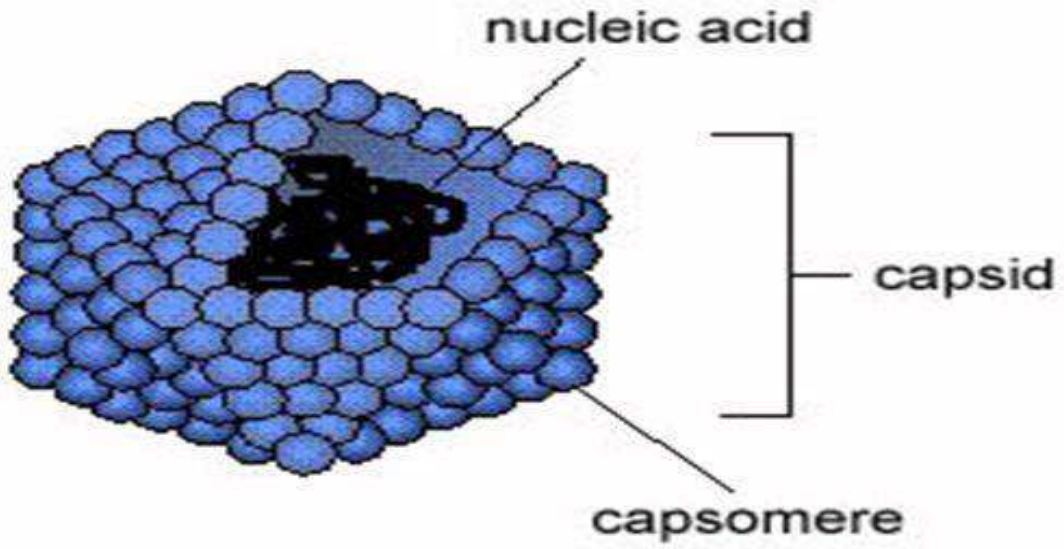

Bacteriophage T4
Head
DNA
Tail
Tail fibers
Adenovirus
Glycoproteins
Capsomere
Capsid
DNA
HIV retrovirus
RNA
Matrix proteins
Capsid
Viral envelope
Reverse transcriptase
Glycoprotein

3-Capsomeres:

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

- Naked viruses are composed of nucleic acid + capsi (nucleocapsid)



- **Defective virus:** A virus particle that is functionally deficient in some aspect of replication.
- **Envelope:** A lipid-containing membrane that surrounds some virus particles.
- It is **acquired during** viral maturation by a budding process through a cellular membrane.
- **Peplomers :** Virus encoded glycoproteins are exposed on the surface of the envelope.

Nucleocapsid:

- protein–nucleic acid complex representing the packaged form of the viral genome.
- The term is commonly used in cases in which the nucleocapsid is a substructure of a more complex virus particle.

Structural units:

- The basic protein building blocks of the coat.
- They are usually a collection of more than one nonidentical protein subunit.
- The structural unit is often referred to as a protomer.
- Subunit : A single folded viral polypeptide chain.

Evolutionary origin of viruses

- The origin of viruses is not known.
- There are **profound differences** among **the DNA viruses**, the **RNA viruses**, **and viruses that use both DNA and RNA** as their **genetic material during different stages of their life cycle.**

- **Viruses** may be derived from DNA or RNA nucleic acid components of host cells that **became able to replicate autonomously and evolve independently.**
- They resemble genes that have acquired the capacity to exist independently of the cell.
- **Some** viral sequences are related to portions of cellular genes encoding protein functional domains.
- It **seems** likely that at least some viruses evolved in this fashion.

- Viruses may be degenerate forms of intracellular parasites.
- There is no evidence that viruses evolved from bacteria, although other obligately intracellular organisms (eg, rickettsiae and chlamydiae) presumably did so.
- However, poxviruses are so large and complex that they might represent evolutionary products of some cellular ancestor.

The end of Chapter &

the end of course

Congratulations