

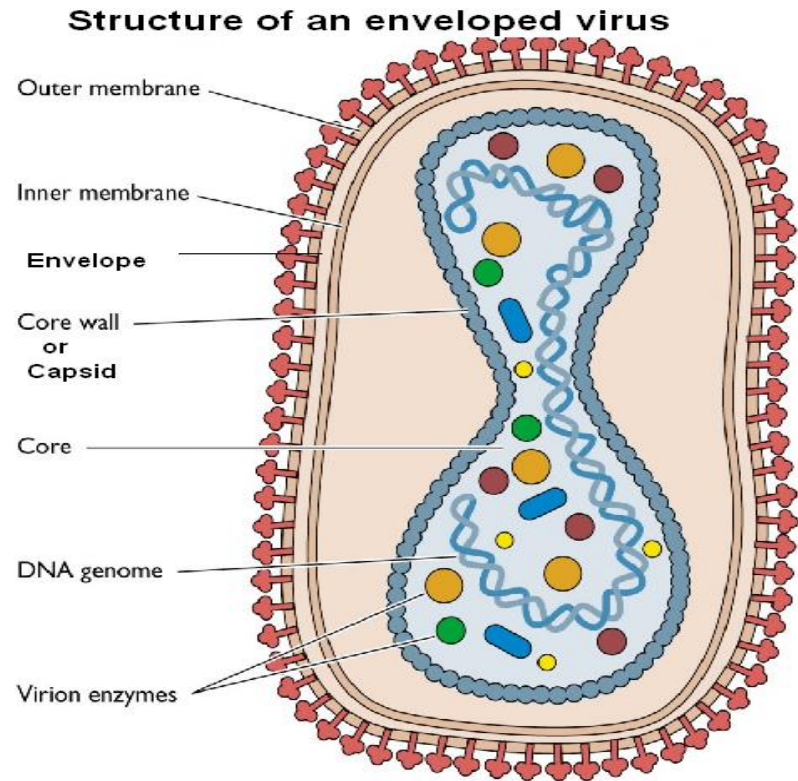
# **General characteristics of viruses**

- Viruses may be regarded as exceptionally complex aggregations of nonliving chemicals or exceptionally simple living microbes
- Viruses contain a single type of nucleic acid a protein coat, sometimes enclosed by an envelope
- Viruses are obligatory intracellular parasites

- **Host range**
- host specific
- Host range is determined by the specific attachment site on the host cells' surface
- **Size**
- Viral size is measured by electron microscopy
- range from 20 nm to 300 nm in length

# Viral Structure

- **Nucleic acid**
- either DNA or RNA
- can be single stranded or double stranded
- nucleic acid can be linear or circular
- **Capsid and Envelope**



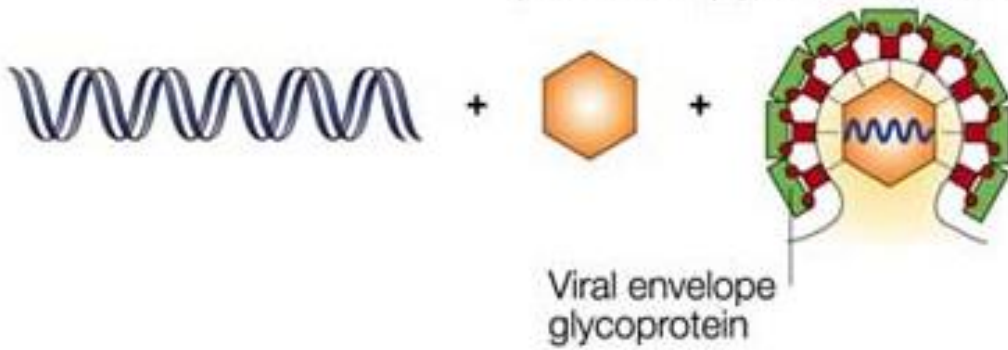
# Morphology

- On the basis of their capsid architecture
- Helical viruses - Tobacco mosaic virus
- capsids are hollow cylinders surrounding the nucleic acid
- Polyhedral viruses – eg. Adenoviruses
- usually the capsid is an icosahedron
- Enveloped viruses - an envelope - roughly spherical but highly pleomorphic
- Complex viruses
- bacteriophages have a polyhedral capsid with a helical tail

Genome DNA or RNA

Capsid proteins

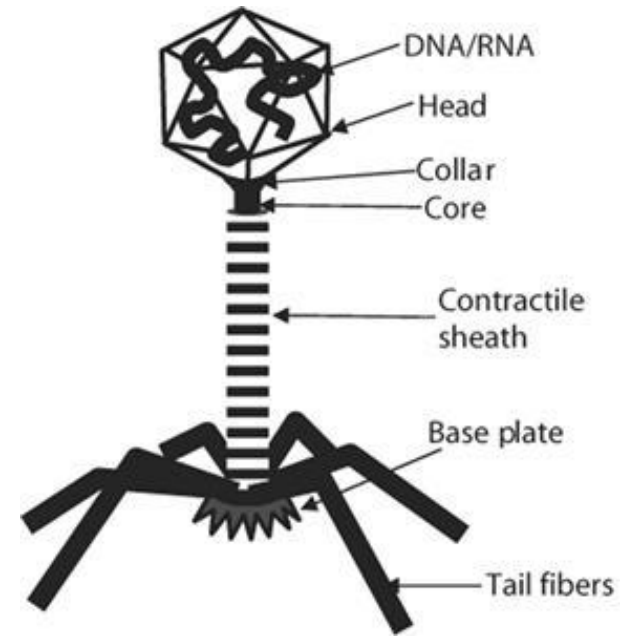
Membrane (lipids and proteins)



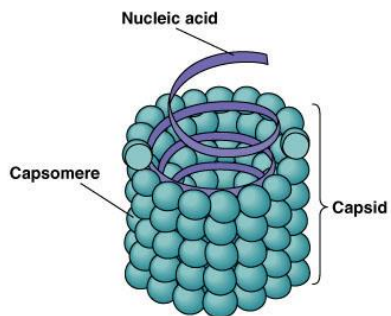
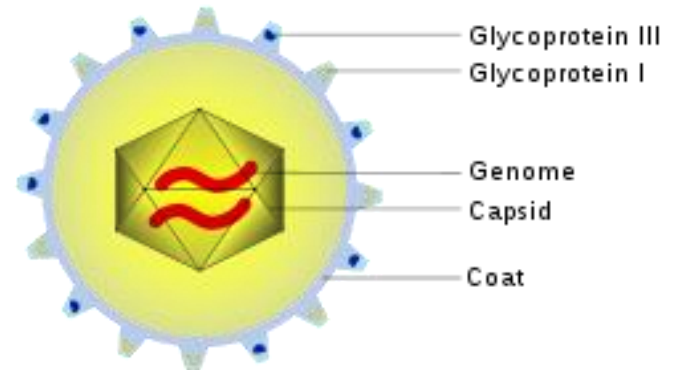
**Naked virus**  
(nucleic acids + proteins)



**Enveloped virus**  
(nucleic acids + proteins + membrane)



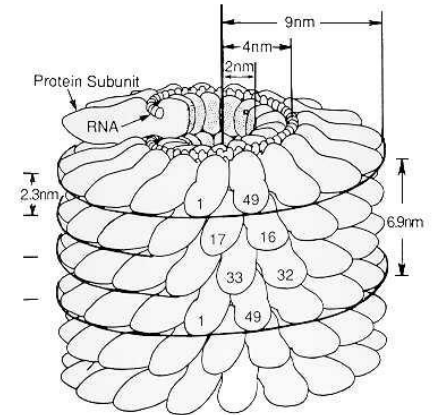
**Scheme of a CMV virus**



**(a) A helical virus**

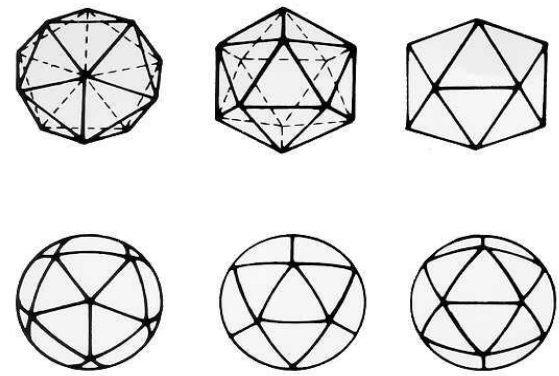
**(b) Ebola virus**

# Symmetry



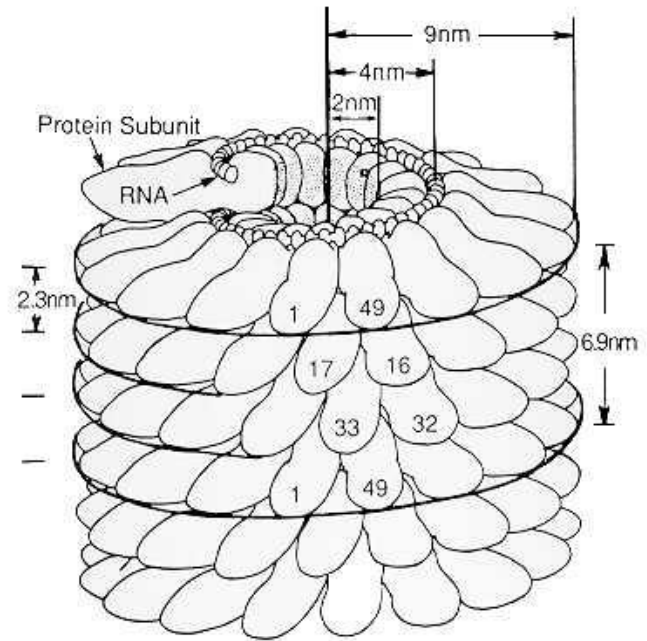
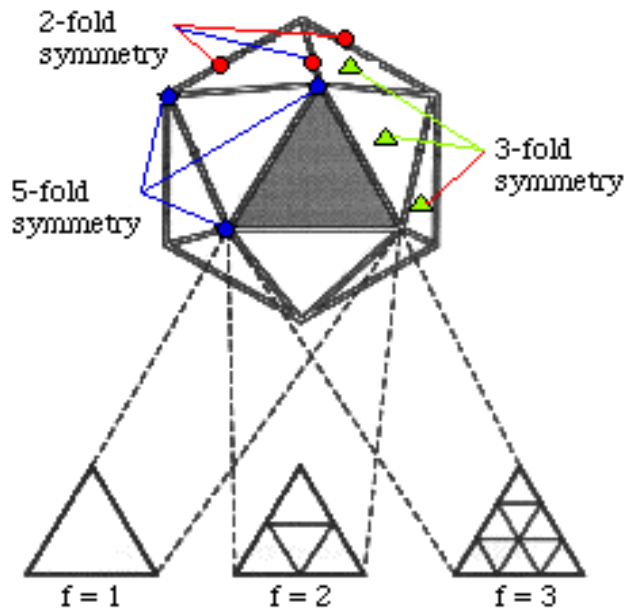
- **Helical Symmetry**
- In the replication of viruses with helical symmetry, identical protein subunits (protomers) self-assemble into a helical array surrounding the nucleic acid, which follows a similar spiral path.
- Such nucleocapsids form rigid, highly elongated rods or flexible filaments.
- In addition to classification as flexible or rigid and as naked or enveloped, helical nucleocapsids are characterized by length, width, pitch of the helix, and number of protomers per helical turn.
- The most extensively studied helical virus is tobacco mosaic

# Icosahedral Symmetry



- An icosahedron is a polyhedron having 20 equilateral triangular faces and 12 vertices .
- Lines through opposite vertices define axes of fivefold rotational symmetry: all structural features of the polyhedron repeat five times within each  $360^\circ$  of rotation about any of the fivefold axes.
- Lines through the centers of opposite triangular faces form axes of threefold rotational symmetry; twofold rotational symmetry axes are formed by lines through midpoints of opposite edges.
- An icosahedron (polyhedral or spherical) with fivefold, threefold, and twofold axes of rotational symmetry is defined as having 532 symmetry (read as 5,3,2).

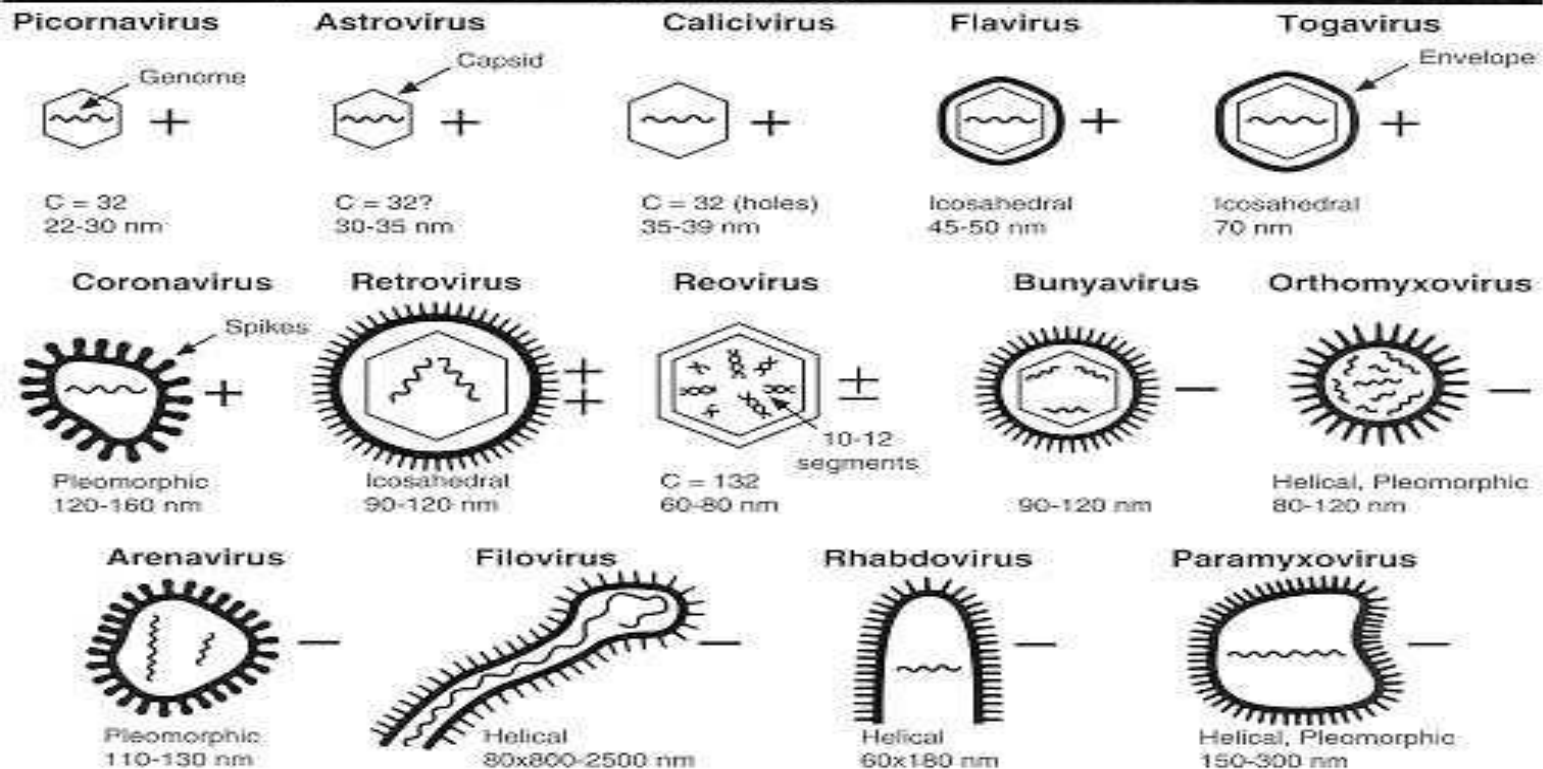




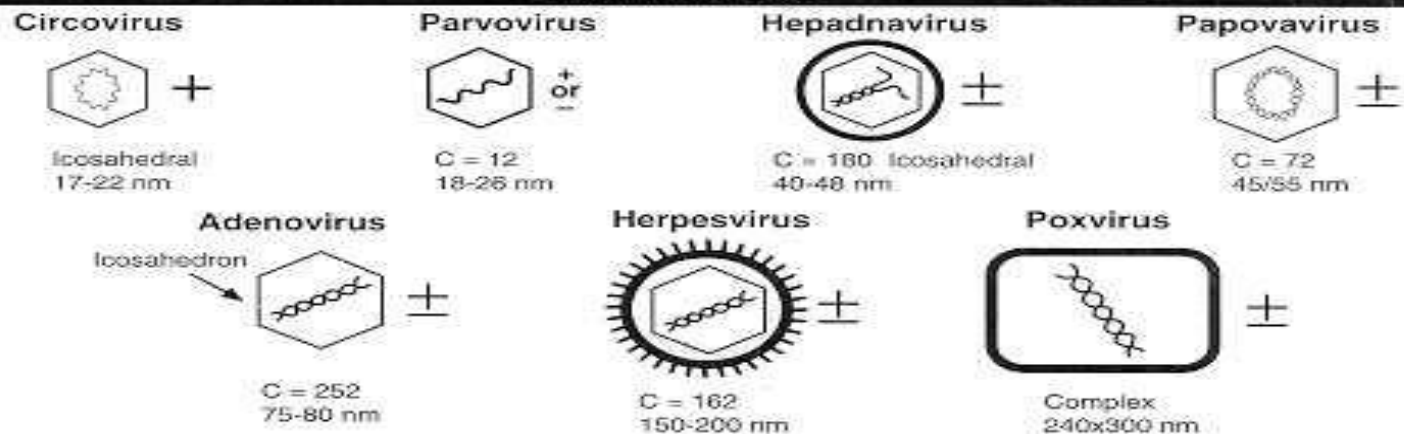
# Taxonomy of Viruses

- Viruses are classified on the basis of type of nucleic acid, morphological class and presence or, absence of an envelope
- Virus family names end in ----- viridae and genus names end in ----- virus

## RNA Viruses

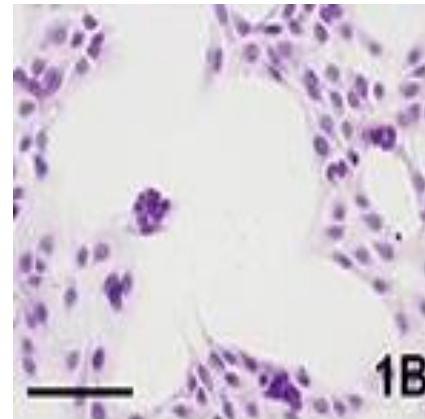
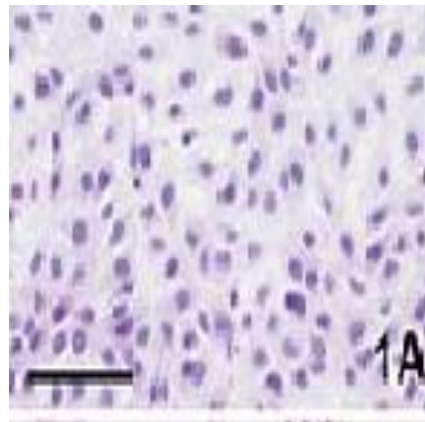
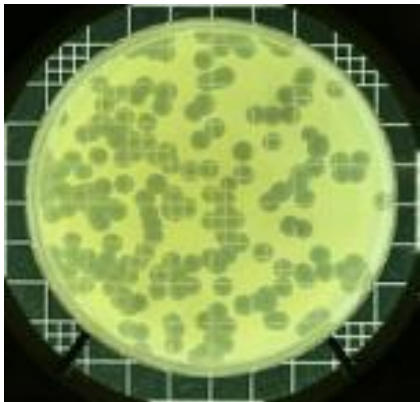


## DNA Viruses



# Growth of viruses in the laboratory

- Bacteriophages can be cultivated by plaque assay
- Cultivation of some animal viruses requires whole animals
- cultivated in embryonated eggs
- cell cultures



# Viral identification

- Serological tests
- (PCR) methods
- Serology forms the mainstay of viral diagnosis. This is what happens in a primary humoral immune response to antigen. Following exposure, the first antibody to appear is IgM, which is followed by a much higher titre of IgG. In cases of reinfection, the level of IgG shoots up rapidly and far more earlier than in a primary infection. Many different types of serological tests are available. With some assays such as EIA and RIA, one can look specifically for IgM or IgG. EIAs and radioimmunoassays are the most sensitive tests available.

# Serological or immunological tests

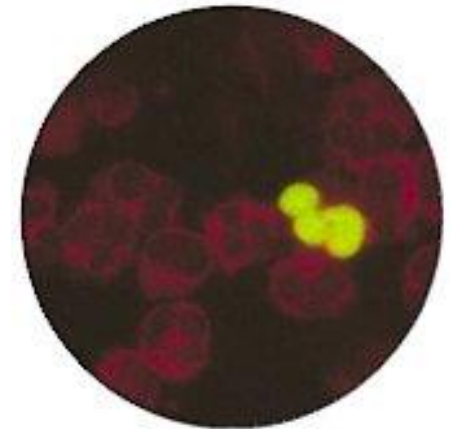


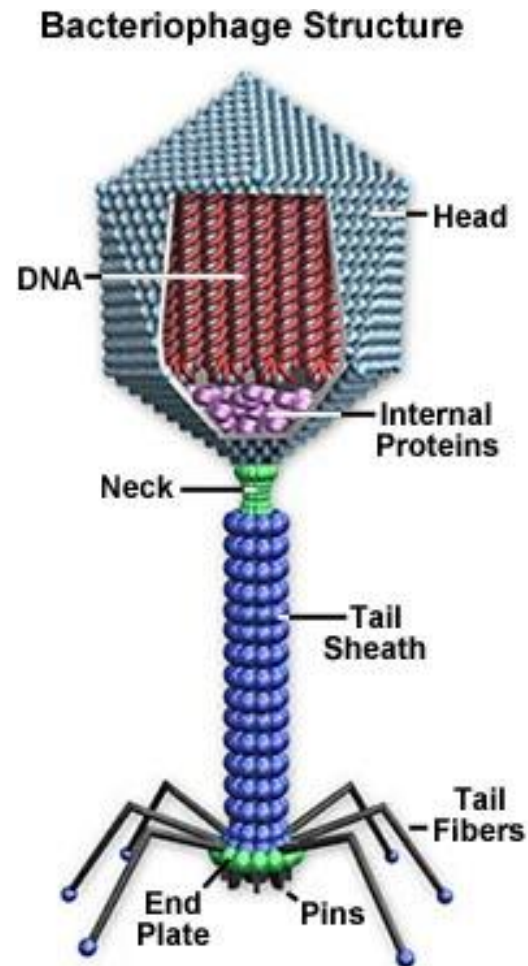
Figure 4 CMV pp65 antigens detected in nuclei of peripheral blood neutrophils

# Multiplication of viruses

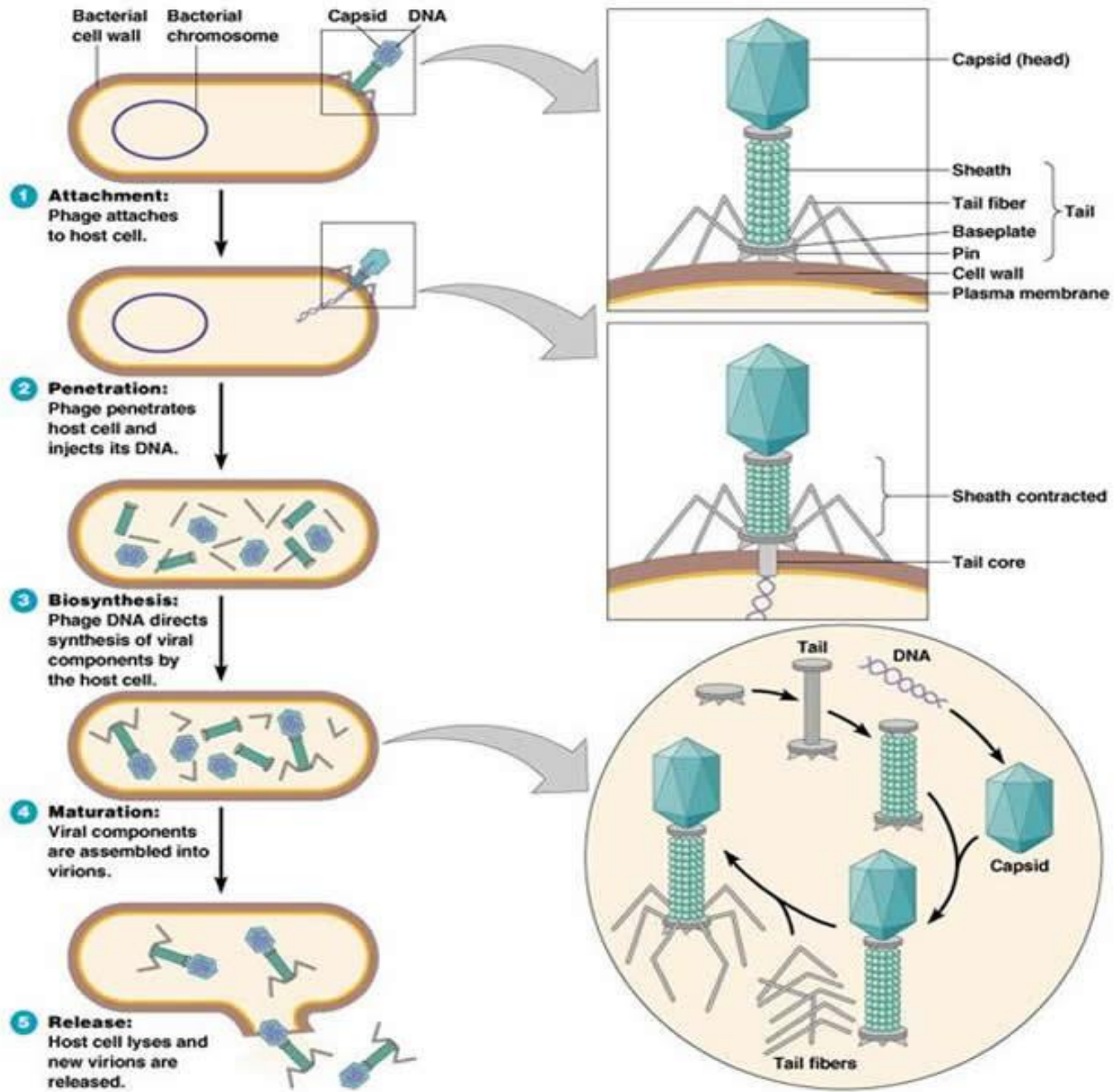
- Multiplication cycle of viruses can be divided into five distinct stages
- Attachment, Penetration, Biosynthesis, Maturation and Release
- Phages can multiply, the lytic cycle, the lysogenic cycle

# Lytic cycle of T – even bacteriophage

- Attachment
- Penetration
- Biosynthesis
- Maturation
- Release

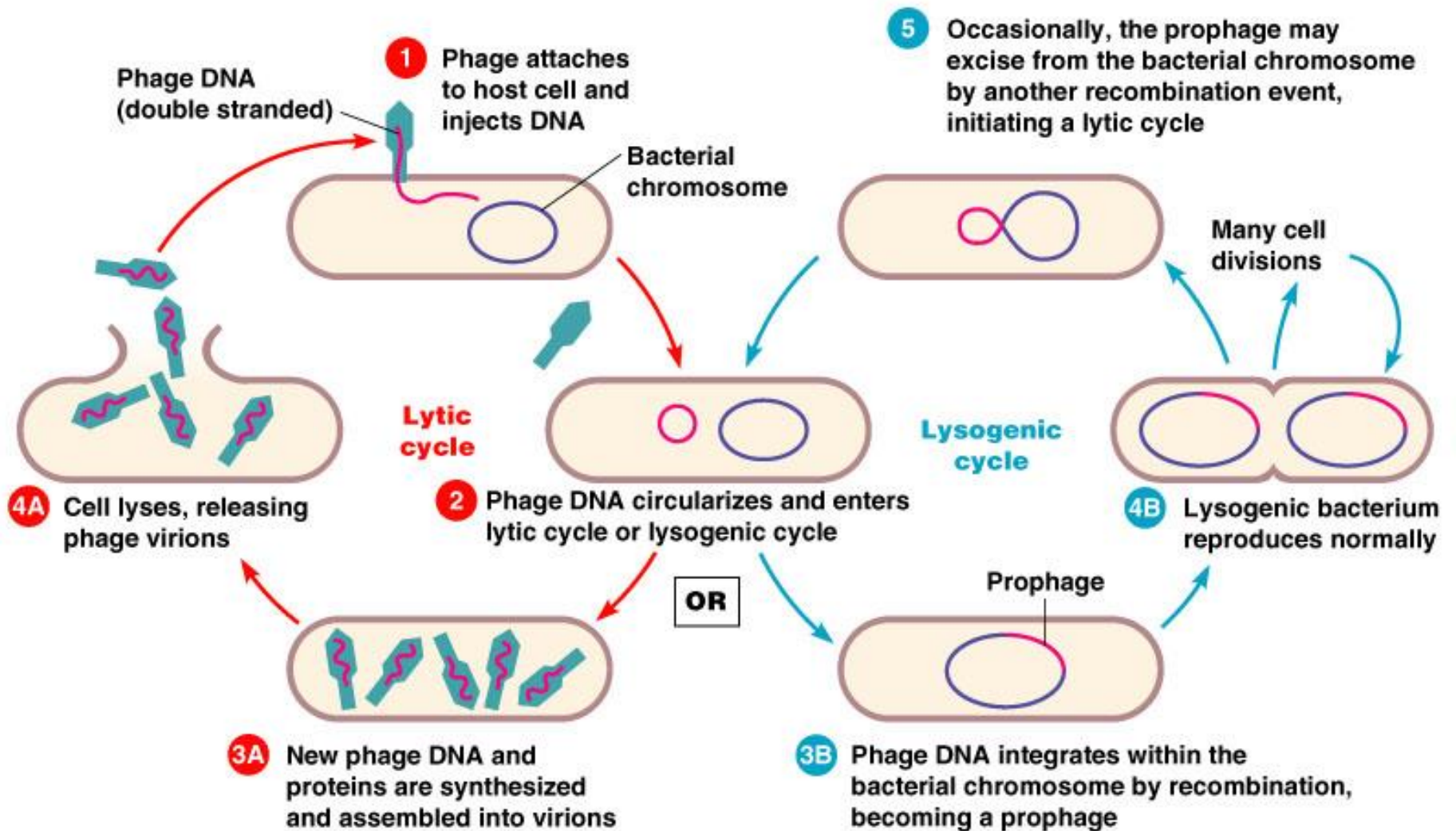






# Lysogenic cycle of Bacteriophage

- phages begin a lysogenic cycle by incorporating their DNA into the host cell's DNA
- this state, called **lysogeny**, is latent
- the linear phage DNA becomes a circle
- inserted phage DNA is called a **prophage**
- prophage DNA also gets replicated
- prophage remains latent
- Under some circumstances, to the action of UV light, chemicals excision of phage DNA occurs which initiates the lytic cycle



# Multiplication of Animal viruses

- Animal viruses attach to the plasma membrane of the host cell and penetration occurs by endocytosis
- uncoated by either viral or host cell enzymes
- DNA is released into the cell and copies of DNA are synthesised
- Capsid protein is synthesised
- After maturation, viruses are released
- Budding, Naked viruses are released through ruptures in the host cell membrane

