BHARATHIDASAN UNIVERSITY

Tiruchirappalli-620024

Tamil Nadu, India.

Programme: M.Sc., Biomedical Science

Course Title : Medical Virology

Course Code : BM59C19MV

Unit-II

M13 Phage

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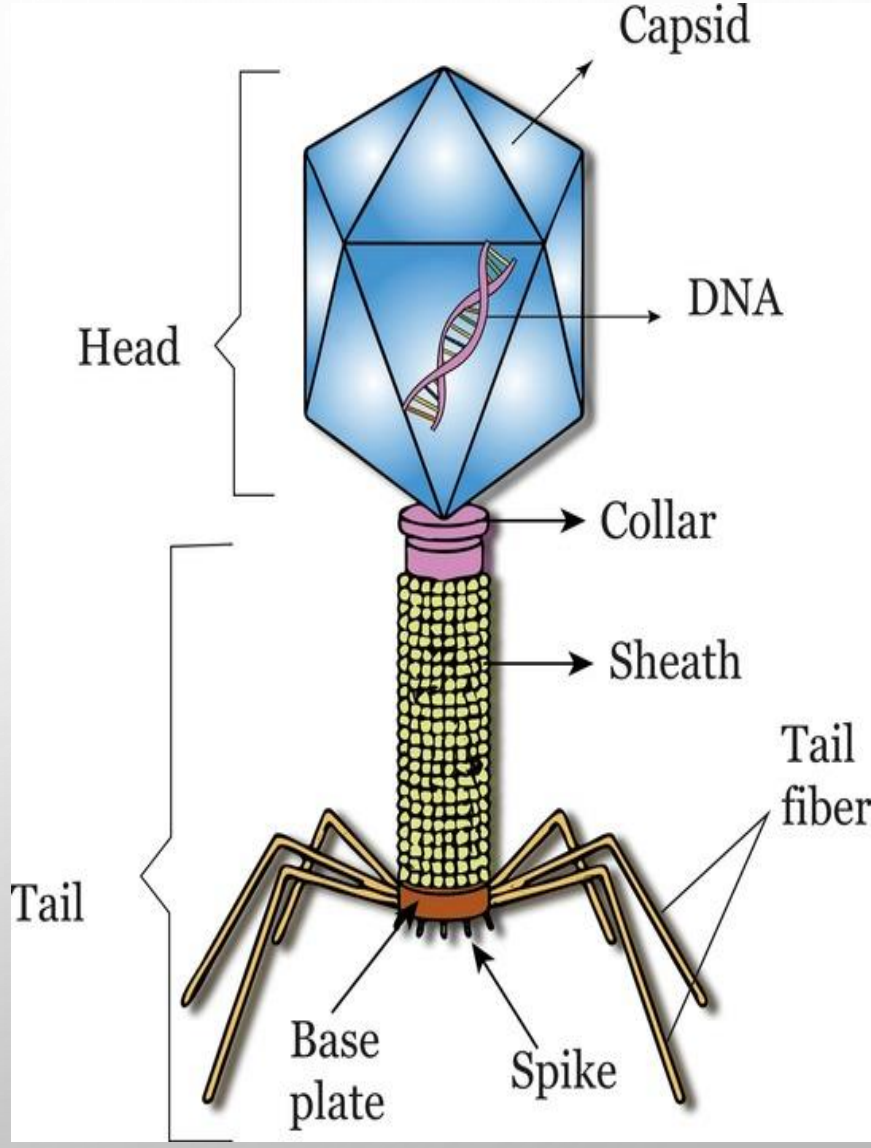
Bacterial virus:

M13

BACTERIOPHAGE

- Type of virus that infects bacteria (phage-to eat).
- Replicate only in bacterial cells.
- Ubiquitous.
- With the help of electron microscopy, scientists studied the detailed visualisation of hundreds of phage types , some of which appears to have head,legs and tails.
- Phages are non-motile and depend upon Brownian motion to reach their targets.



DISCOVERY OF BACTERIOPHAGE

Fredrick Twort **1915**

Discovered an agent that kill bacteria. Research has been cut short-world war 2.

Félix d'Hérelle **1917**

An invisible, antagonist microbe of the dysentery& named the term.

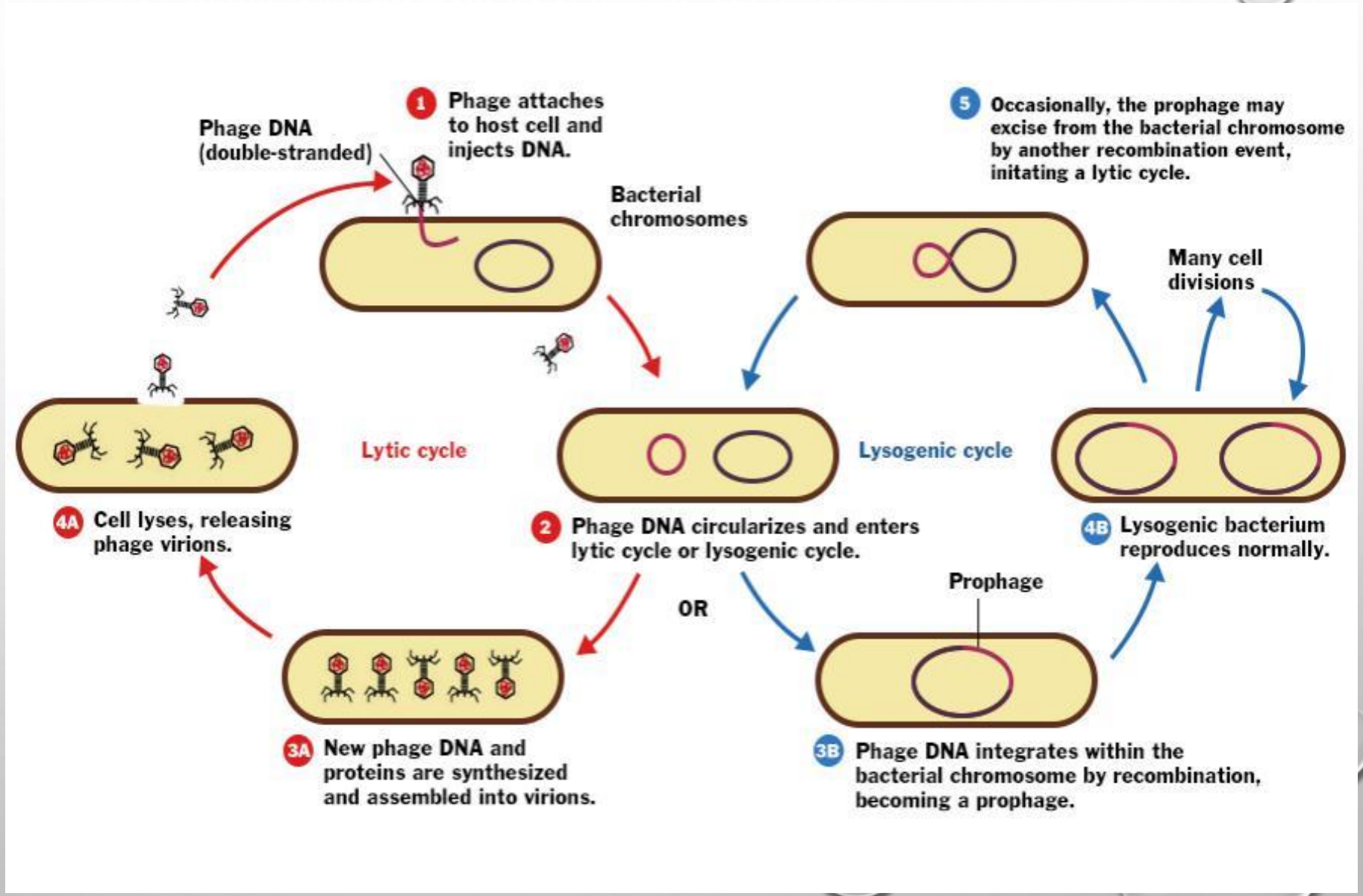
Ernest Hanbury Hankin **1896**

Report on Ganges and yamuna river- seemed to have some sort of antibacterial property against Cholera.

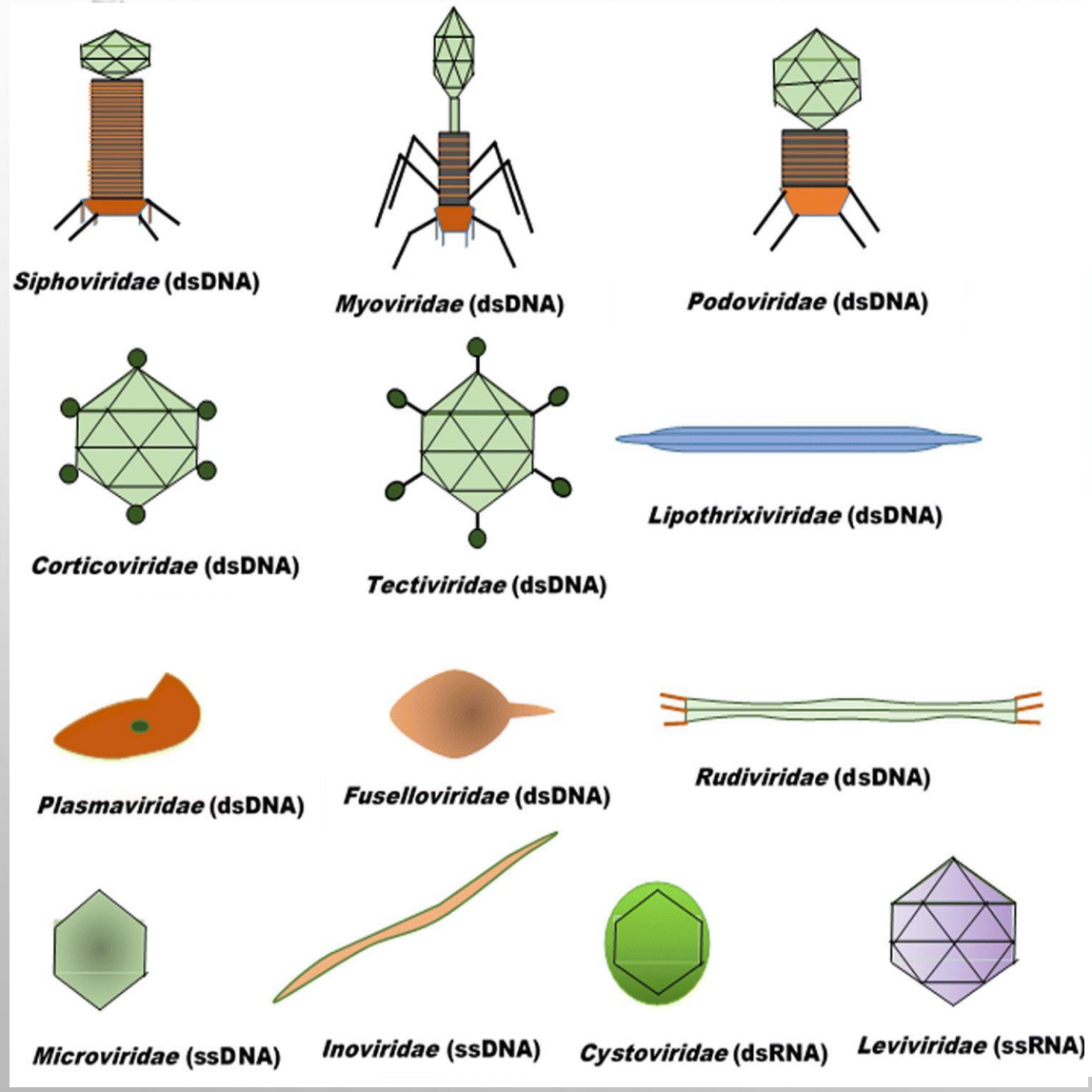
TYPES OF BACTERIOPHAGE

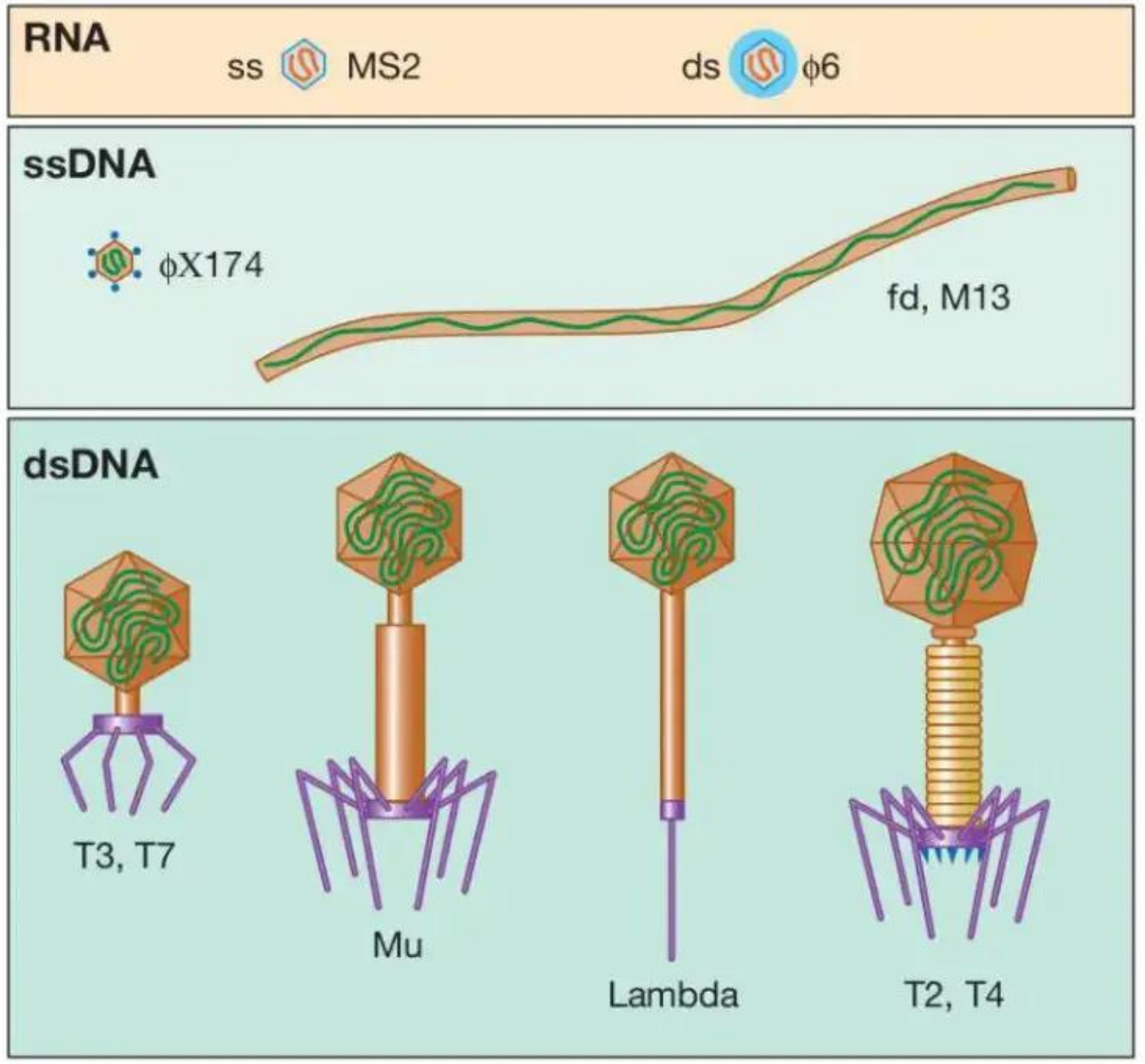
1.Virulent phages- **lytic cycle**

2.Temperate phages- **lysogenic cycle**



STRUCTURE OF BACTERIOPHAGE





PHAGE THERAPY

M13 PHAGE

- Filamentous ssDNA Phages are in the family inoviridae.
- Plus strand phages and are male-specific or F-specific filamentous (Ff) Phages infecting gram-negative bacteria*(E.coli)*.

Discovery of bacteriophage:

- The M13 phage was discovered in 1966 by researchers H.S. Smith and Richard.W. A. H. Smith, and it became a significant tool in molecular biology.

TAXONOMICAL CLASSIFICATION

Realm:monodnaviria

Kingdom:Loebvirae

Phylum:Hofniviricota

Class:Feserviricetus

Order:Tubulavirales

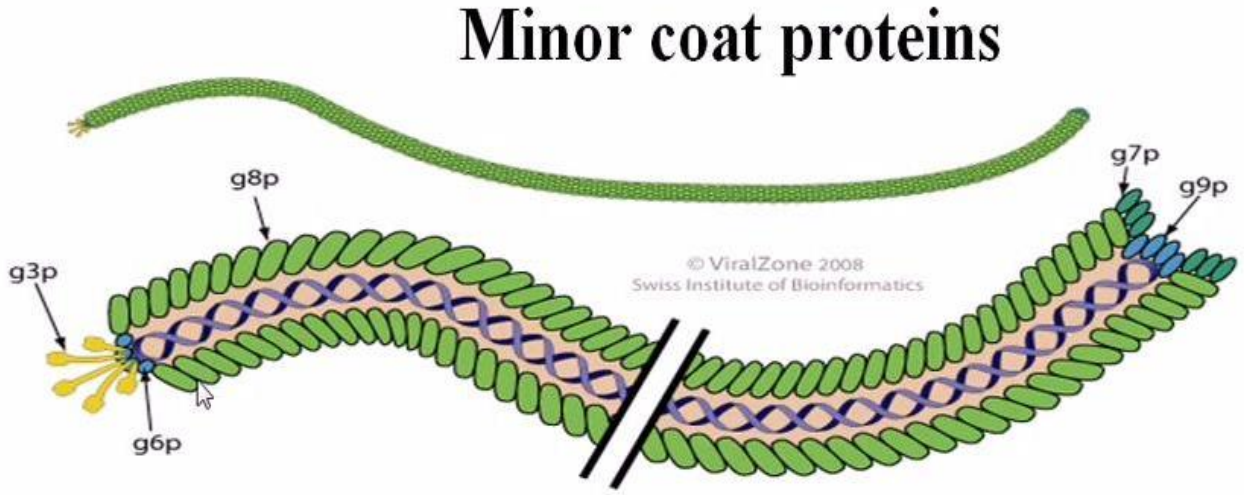
Family:*inoviridae*

Genus: inovirus

Species: Escherichia virus M13

MORPHOLOGY

- **Shape**:long, thin, and **filamentous** shape.
- **Size**:approx. **900 nanometers** in length and about **6-8** nanometers in diameter.
- **Capsid**: The phage is surrounded by a helical protein coat composed of around **2,700 copies o**f the major coat protein (***pVIII***), forming the helical structure.
- **Genome**:Circular single-stranded DNA molecule, approximately **6,407 base pairs** in length.



The minor coat proteins are present at the ends of the filament.

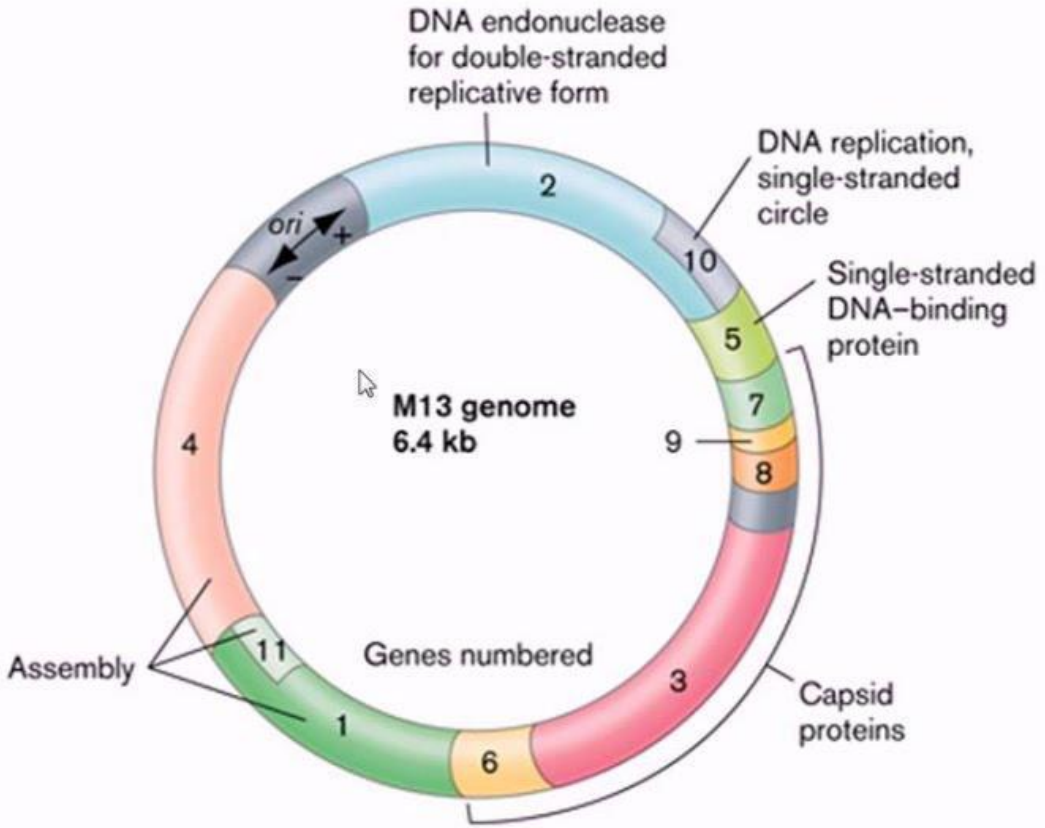
a) gp3 (42kD) and gp6 *(12 kD)*, together form an adsorption complex **for recognition of the sex pilus**.

b) ***gp7 (3.5kD) and*** **gp9** (3.5kD), assembly initiates from this end.

GENOME ORGANIZATION OF M13

Overall, the M13 phage genome is compact, and its organization reflects its efficient strategy for replication and infection. The phage's simplicity makes it a valuable tool in molecular biology and genetic engineering.

Genome of M13



The genome encodes 11 proteins. Genes are grouped by function:

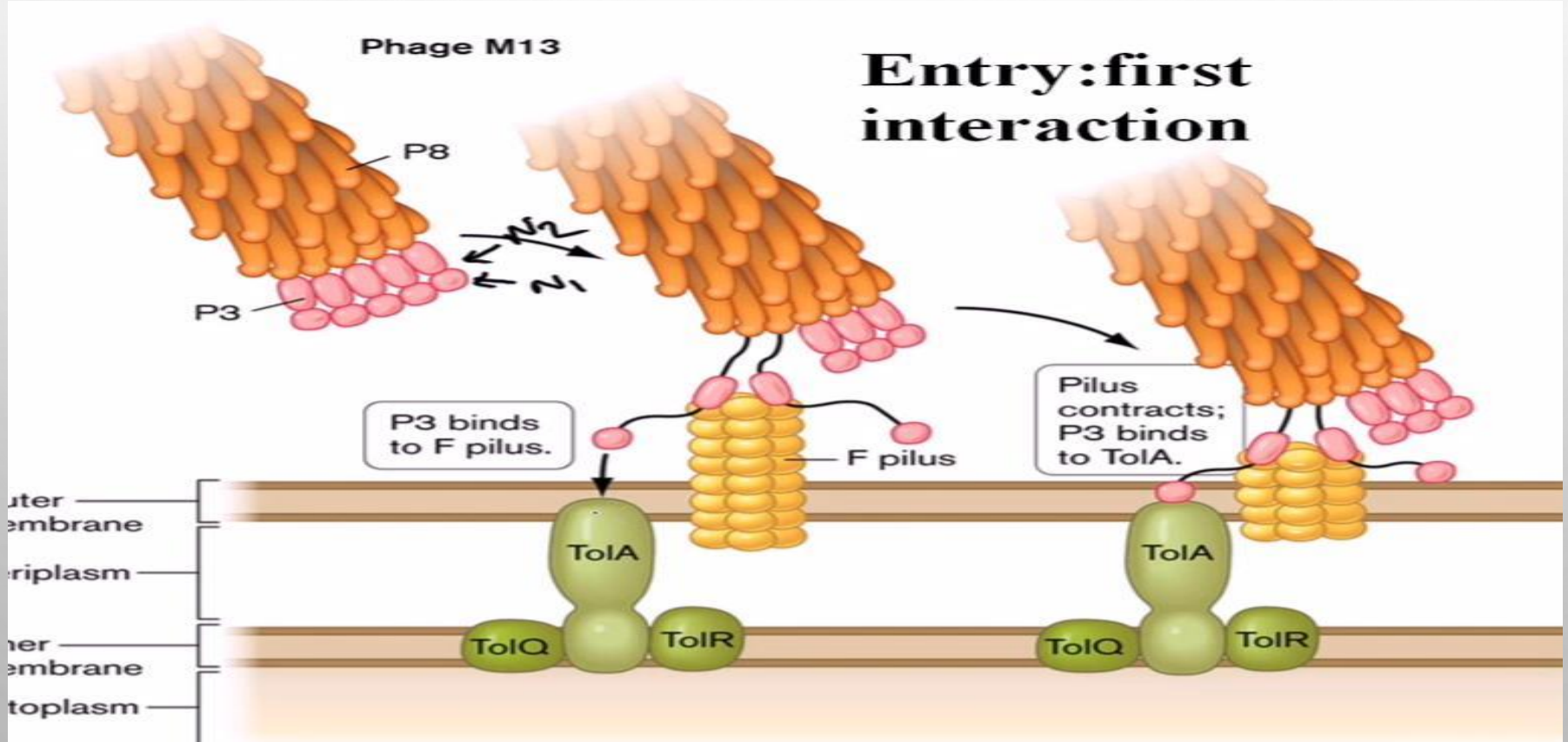
1. *phage DNA* **synthesis -genes** *II, V and X*
2. *capsid* **structure- genes** *III, VI, VII, VIII and IX* **and**
3. *assembly* **-genes** *I , IV and XI*

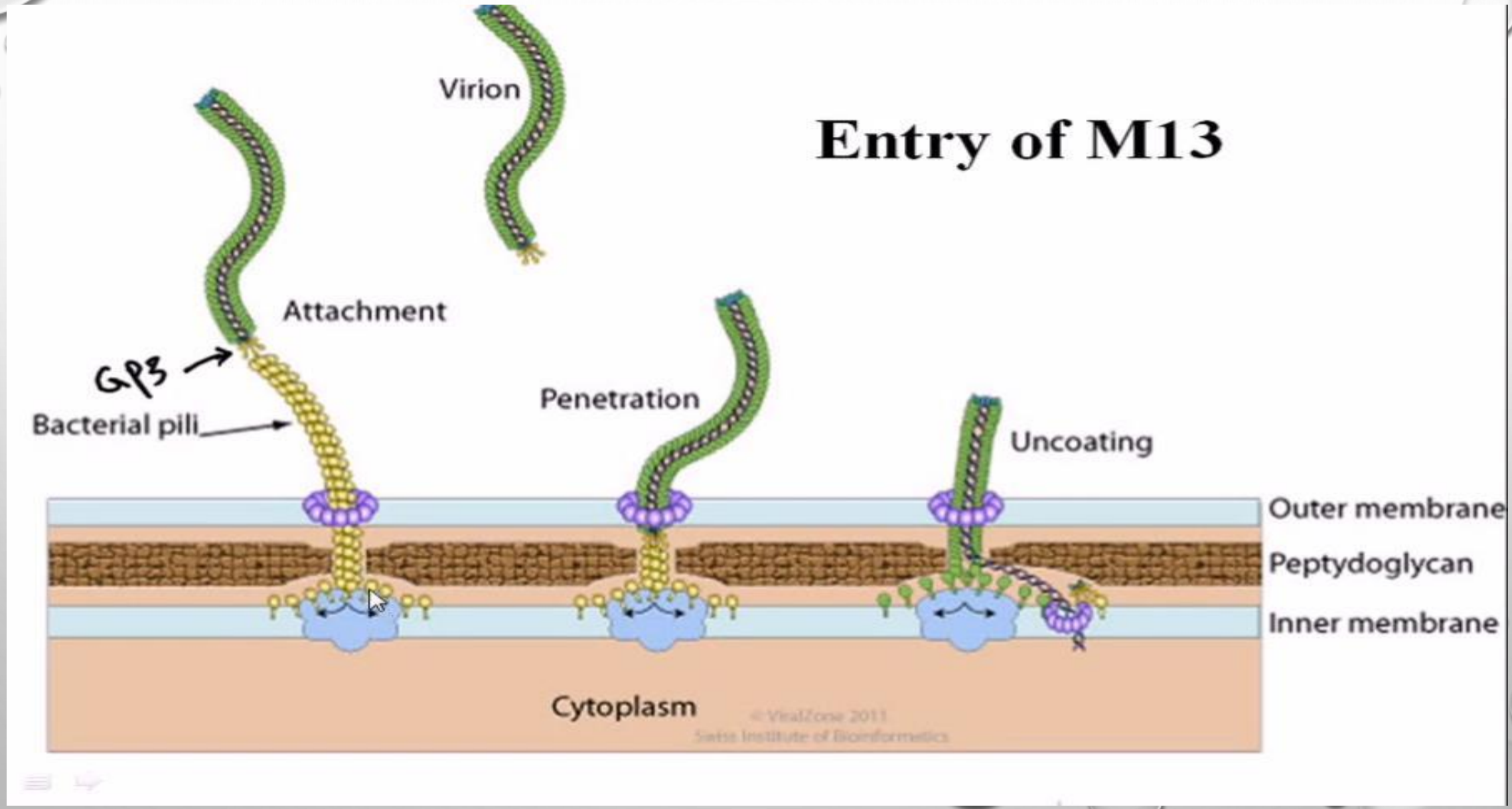
M13 gene name and size	Protein name	Protein function
I(1040)	g1p	Assembly/morphogenesis/inner membrane
II(1200)	g2p	Endonuclease,nickase,RF-replication, cytoplasm
III(1300)	g3p	Minor capsid protein (5) 'Proximal' tip
IV(1270)	g4p	Channel formation, assembly
V(270)	g5p	ss binding protein, replication, cytoplasm
VI(340)	g6p	Minor capsid protein (5) 'Proximal' tip
VII(101)	g7p	Minor capsid protein (5) 'Distal' tip of virus
VIII(220)	g8p	Major capsid protein 5 KD
IX(98)	g9p	Minor capsid protein (5) 'distal' tip of the virus
X(250)	g10p	Replication

LIFE CYCLE OF M13 PHAGE

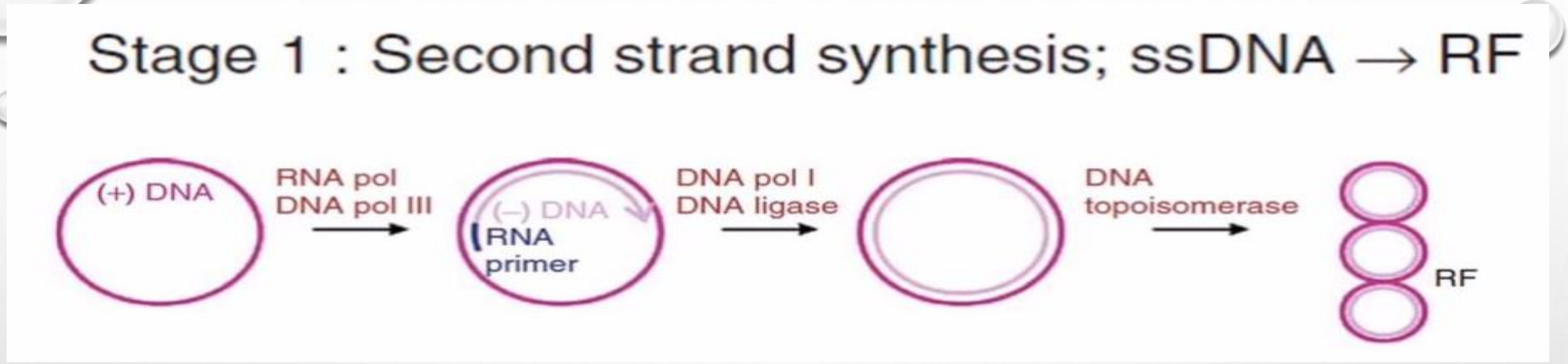
1.Attachment and entry
2. Replication
3. Assembly of Phage
4.Release of phage

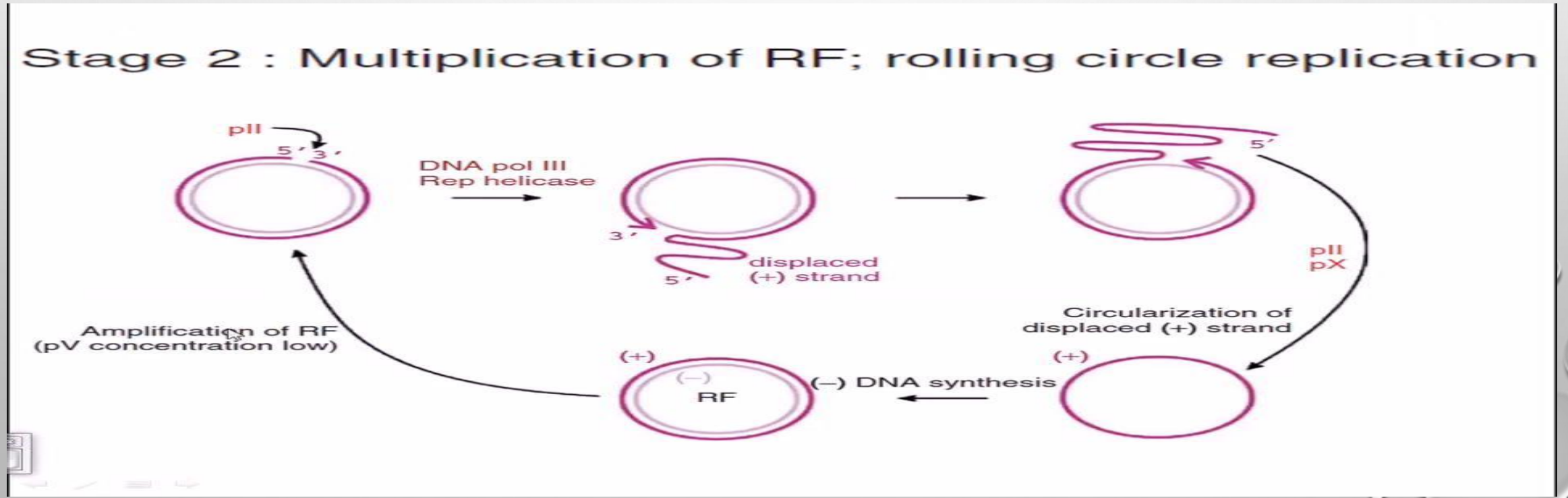
1.Attachment




Entry of M13
Virion
Attachment
GP3
Bacterial pili
Penetration
Uncoating
Outer membrane
Peptydoglycan
Inner membrane
Cytoplasm
© ViralZone 2011
Swiss Institute of Bioinformatics

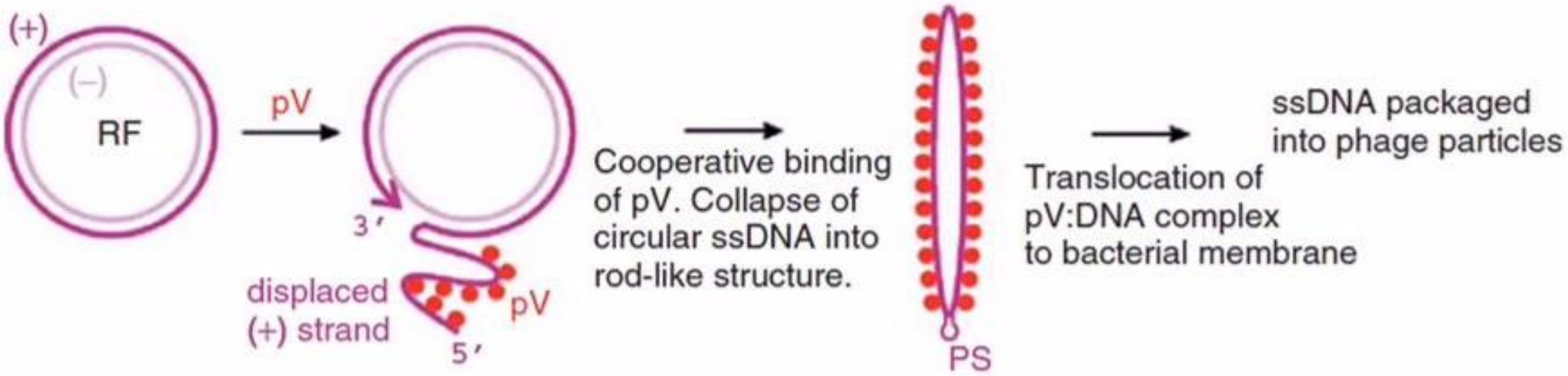
2.Replication



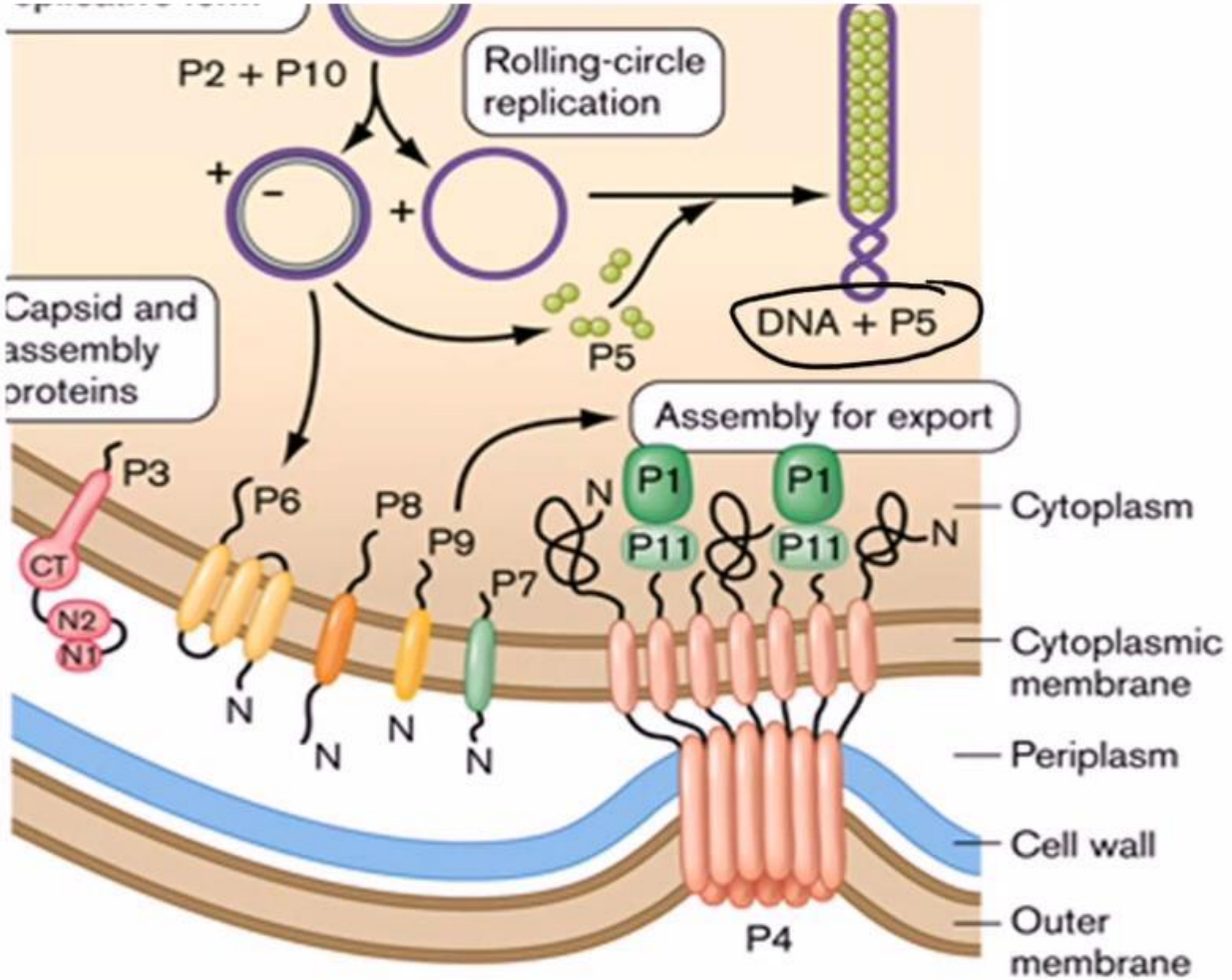


Stage 3 : Amplification of ssDNA; RF → ssDNA (+)

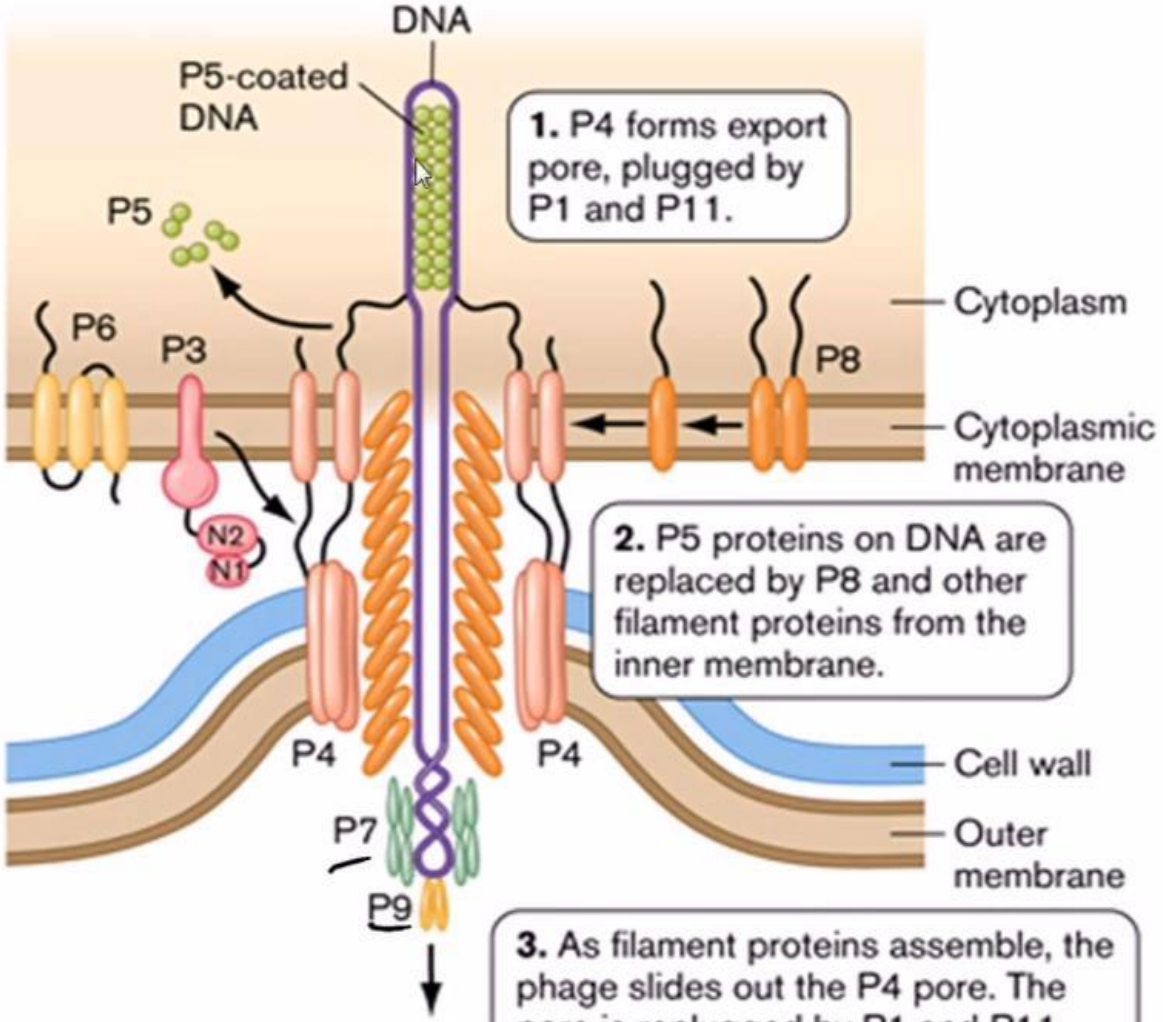
(pV concentration high)



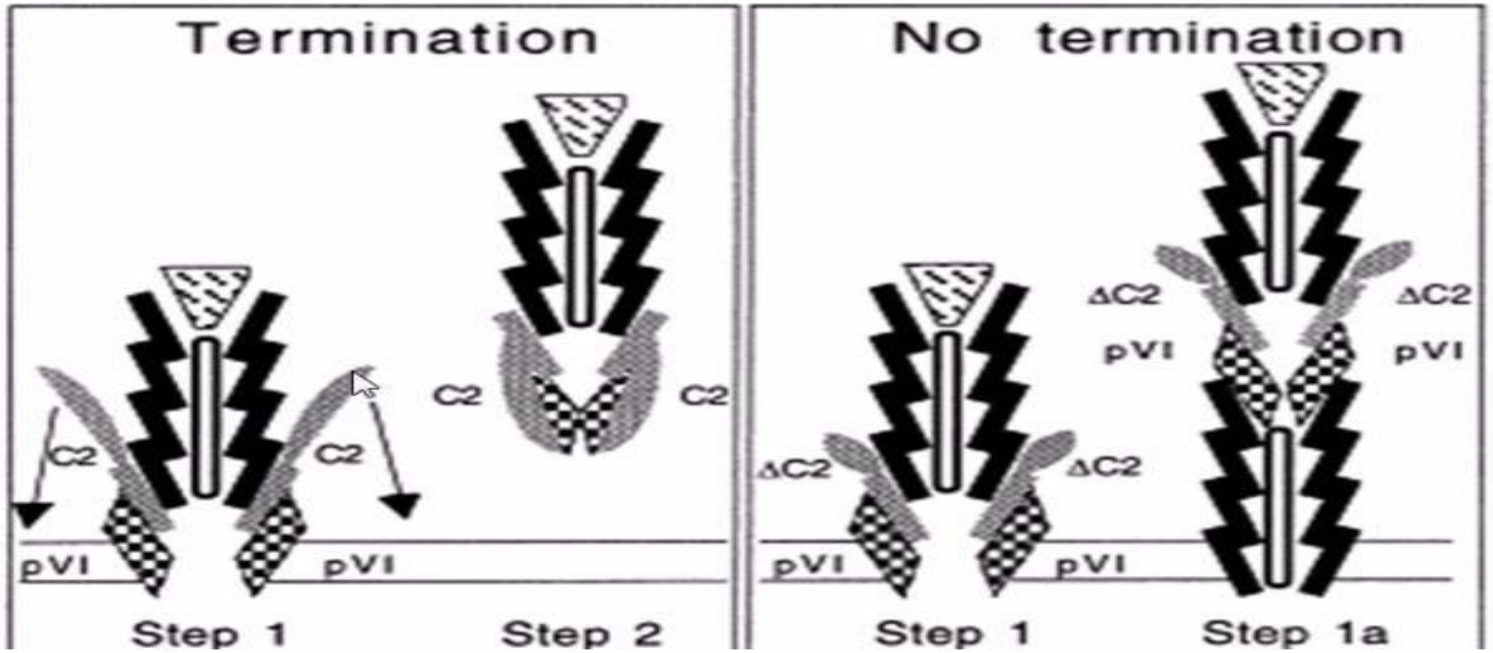
Assembly of M13 bacteriophage



Release of M13 bacteriophage



Formation of polyphage



In the absence of gp3, elongation would continue with gp8 encapsidating another viral DNA to generate a polyphage.

APPLICATIONS

- ***Phage Display:*** widely used in phage display technology to study protein interactions and identify peptide ligands.
- ***Vaccine Development:*** used to develop vaccines by displaying antigens on its surface.It enables the generation of immunogenic proteins that can stimulate an immune response, leading to the development of new vaccines.
- ***Genetic Engineering:*** Tool for cloning and sequencing. Its ability to produce single-stranded DNA allows researchers to easily manipulate and sequence DNA inserts.
- ***Biosensors:*** M13 phage can be engineered to detect specific substances or environmental conditions.

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THANK YOU !