

BACTERIOPHAGE

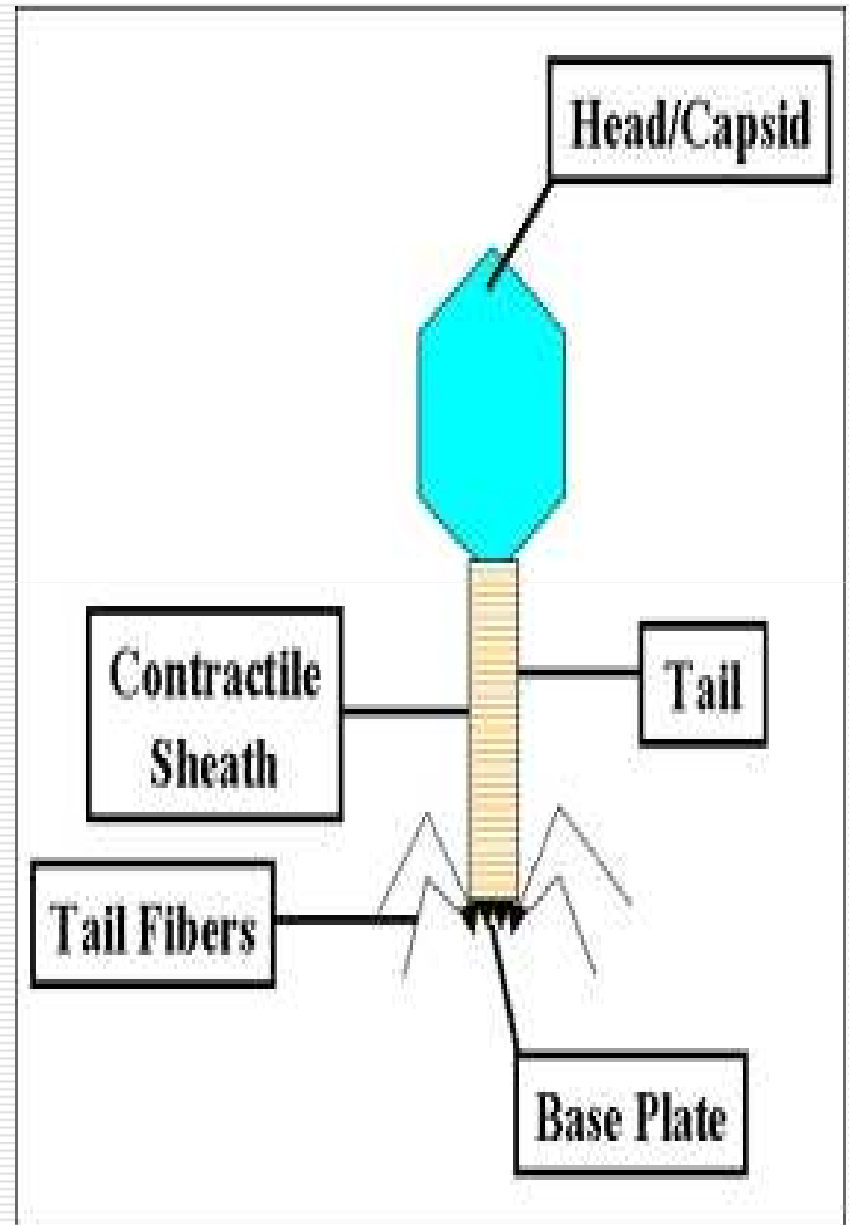
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What is Bacteriophage ?

- ❑ Viruses that infect & parasitize bacteria.
- ❑ Distributed widely in environment – commonly present in sewage, faeces, polluted water, soil & other natural sources of mixed bacterial growth.
- ❑ Control bacterial population in environment.
- ❑ Transmit genetic information between bacteria.

STRUCTURE

- ❑ **Phages affecting E. coli - T-even phages**
- ❑ **Tadpole shaped**
- ❑ **Consist of**
 - 1) Head- hexagonal**
 - **28-100 nm.**
 - **capsid (protein)**
 - **genome (ds DNA)**
 - 2) Tail- cylindrical**
 - **hollow core**
 - surrounded by contractile sheath**
 - **terminal base plate**
 - **prongs**
 - **tail fibres**



Important characteristics

- ❑ High host specificity
- ❑ Filterable through filters, which hold back bacteria
- ❑ Lytic phase cause lysis of bacteria
- ❑ Sensitive to heat – inactivated by heat
- ❑ Their commonest habitat is intestinal bacterial flora of man & animal

Life cycle

- Lytic cycle (virulent cycle)

Intracellular multiplication of phages occurs that results in the lysis of the host bacterium and release of progeny virions.

- Lysogenic cycle (temperate cycle) – there is integration of phage DNA into the bacterial genome that replicates with bacteria without causing any harm to the host cell.

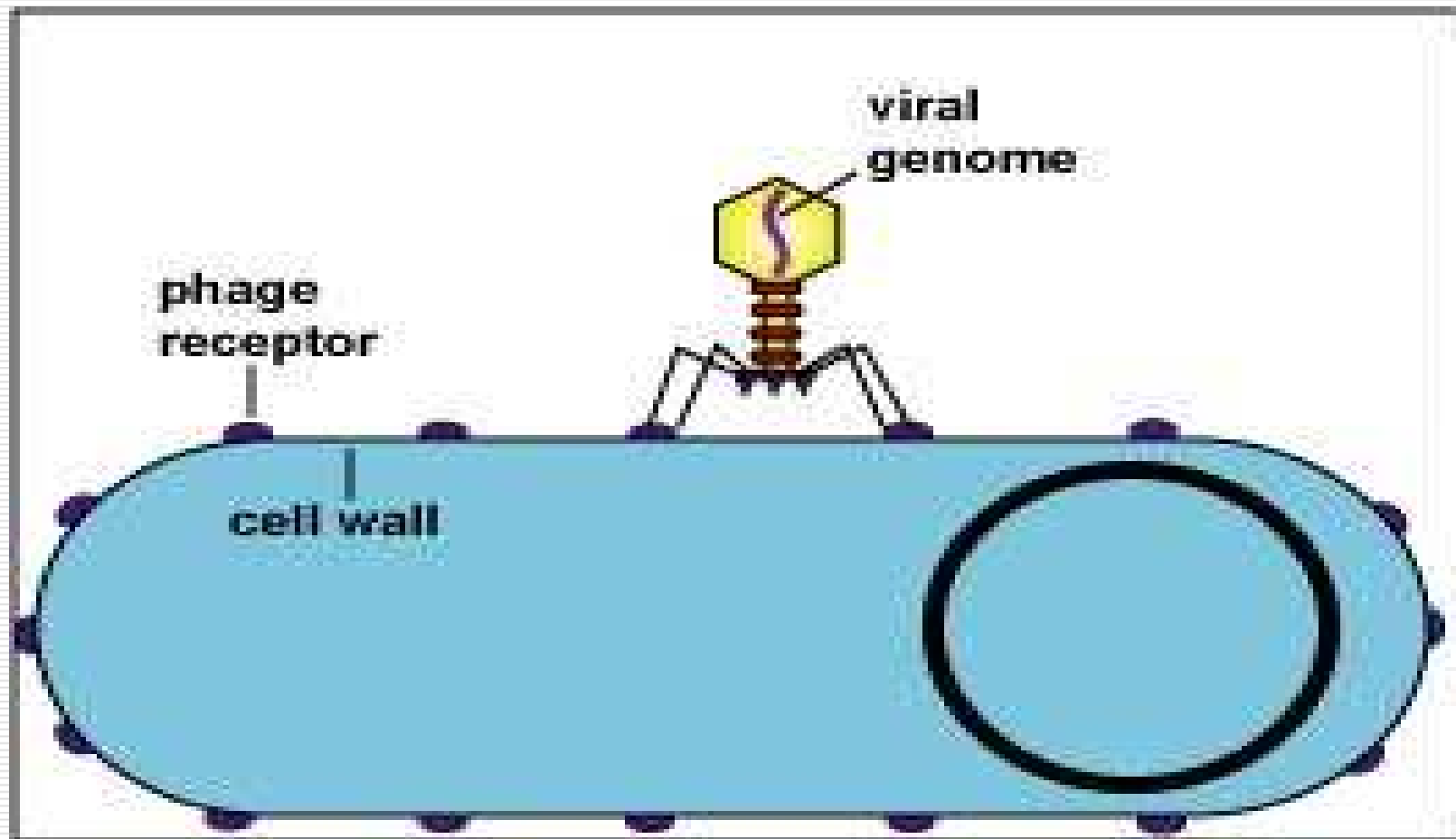
LYTIC CYCLE

- Stages
- 1) Adsorption
 - 2) Penetration
 - 3) Synthesis
 - 4) Assembly
 - 5) Maturation
 - 6) Release

Adsorption

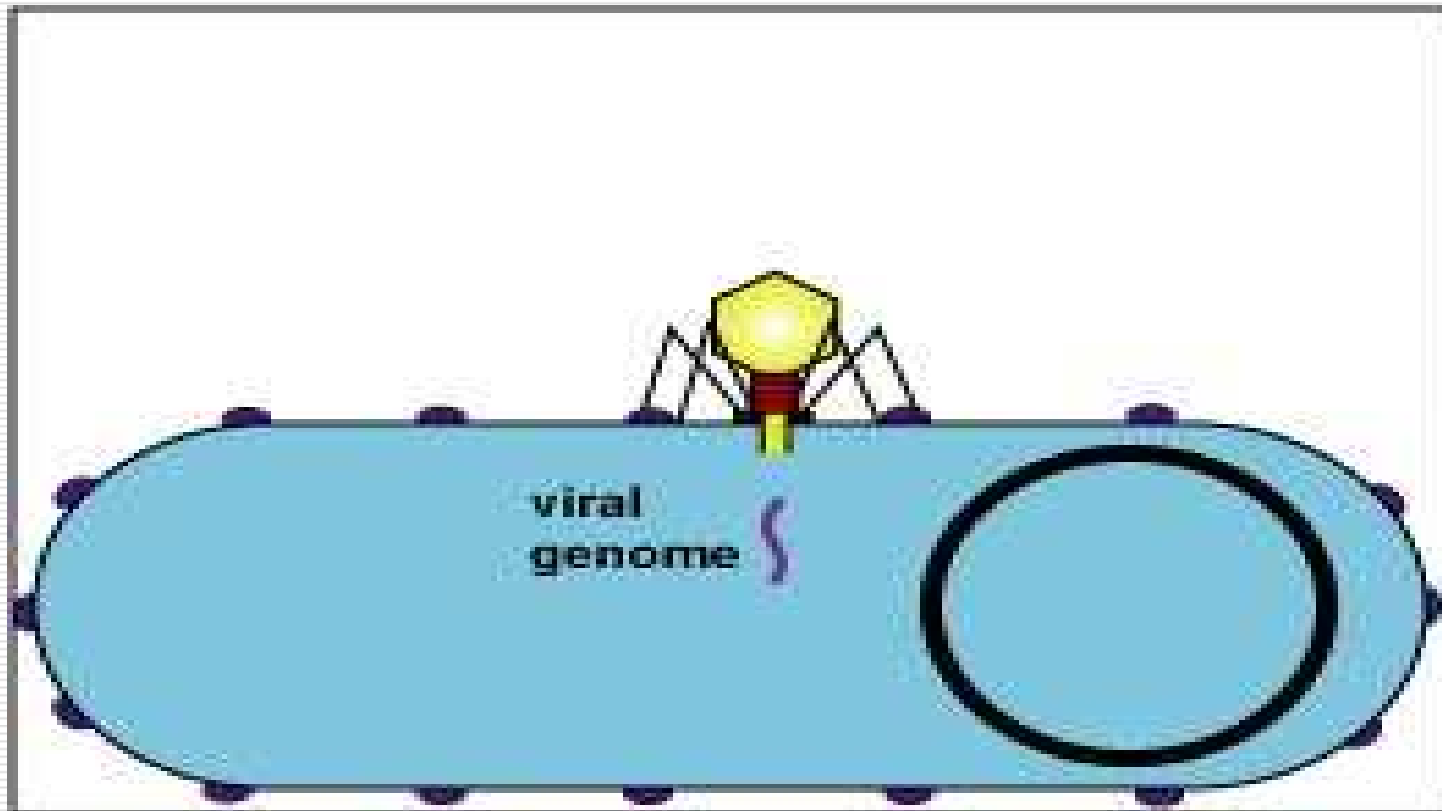
Rapid & Specific process

Host specificity of phages is determined at the level of adsorption.



Penetration

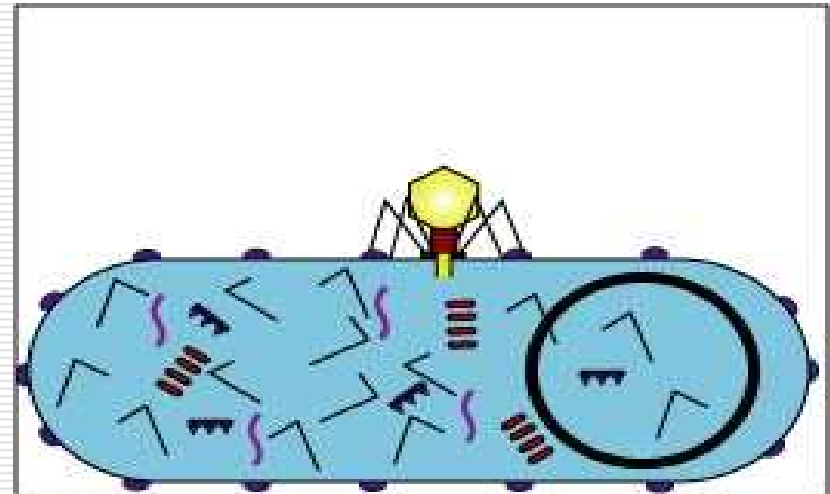
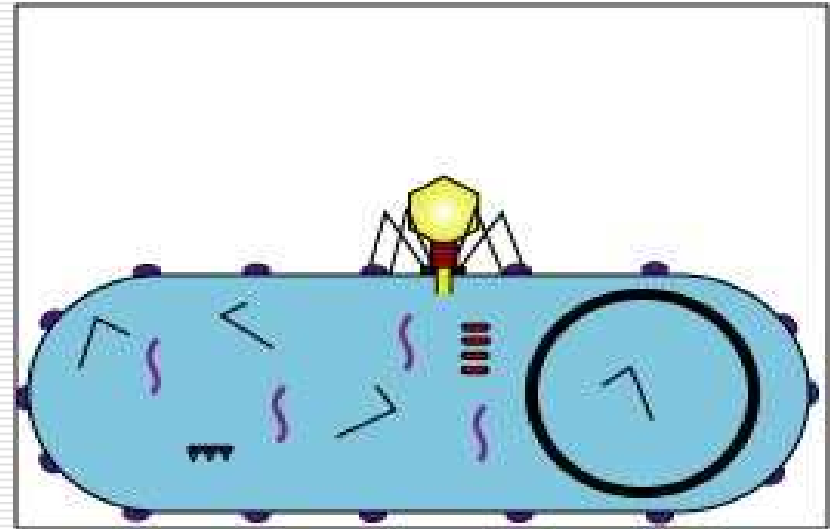
- The process of penetration resembles injection through a syringe that keeps the empty head (capsid) & tail outside the bacterial cell as shell or ghost.



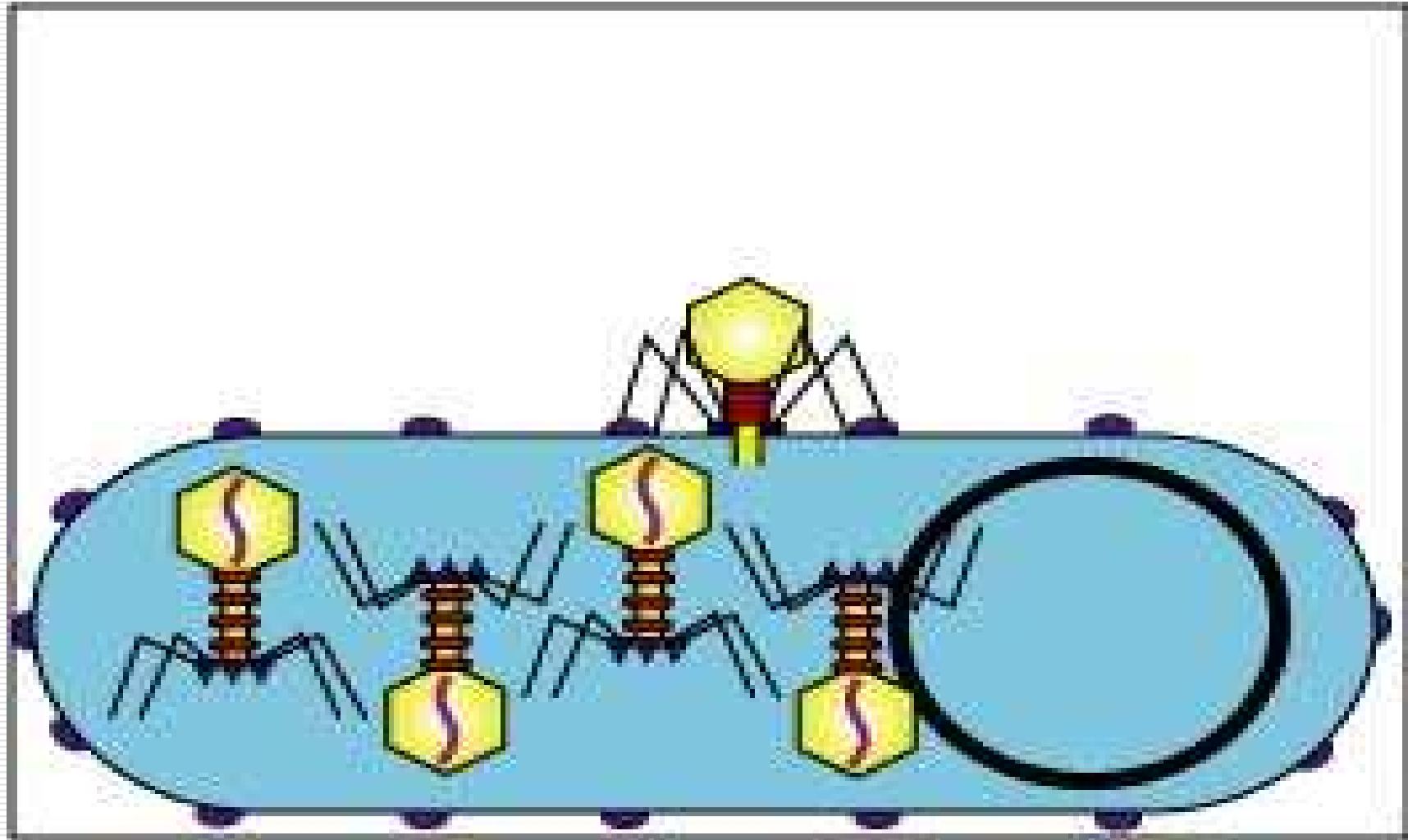
- **When bacterial cell is attacked by large number of phages, multiple holes are produced on the cell wall causing lysis of cell without the viral multiplication. This is known as lysis from without.**

Synthesis of phage components

- specific enzymes
- Late proteins
- Synthesis of bacterial protein, DNA & RNA ceases.

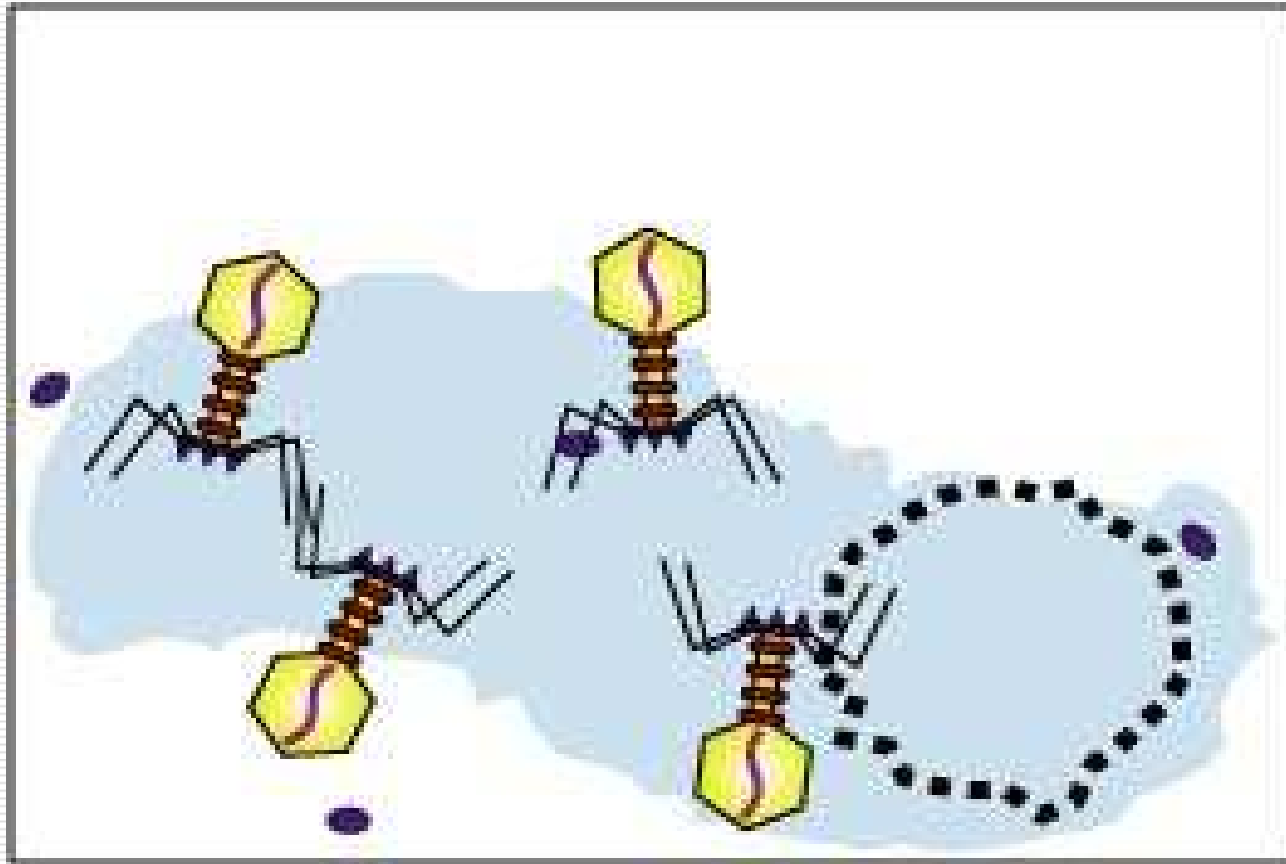


Assembly & maturation



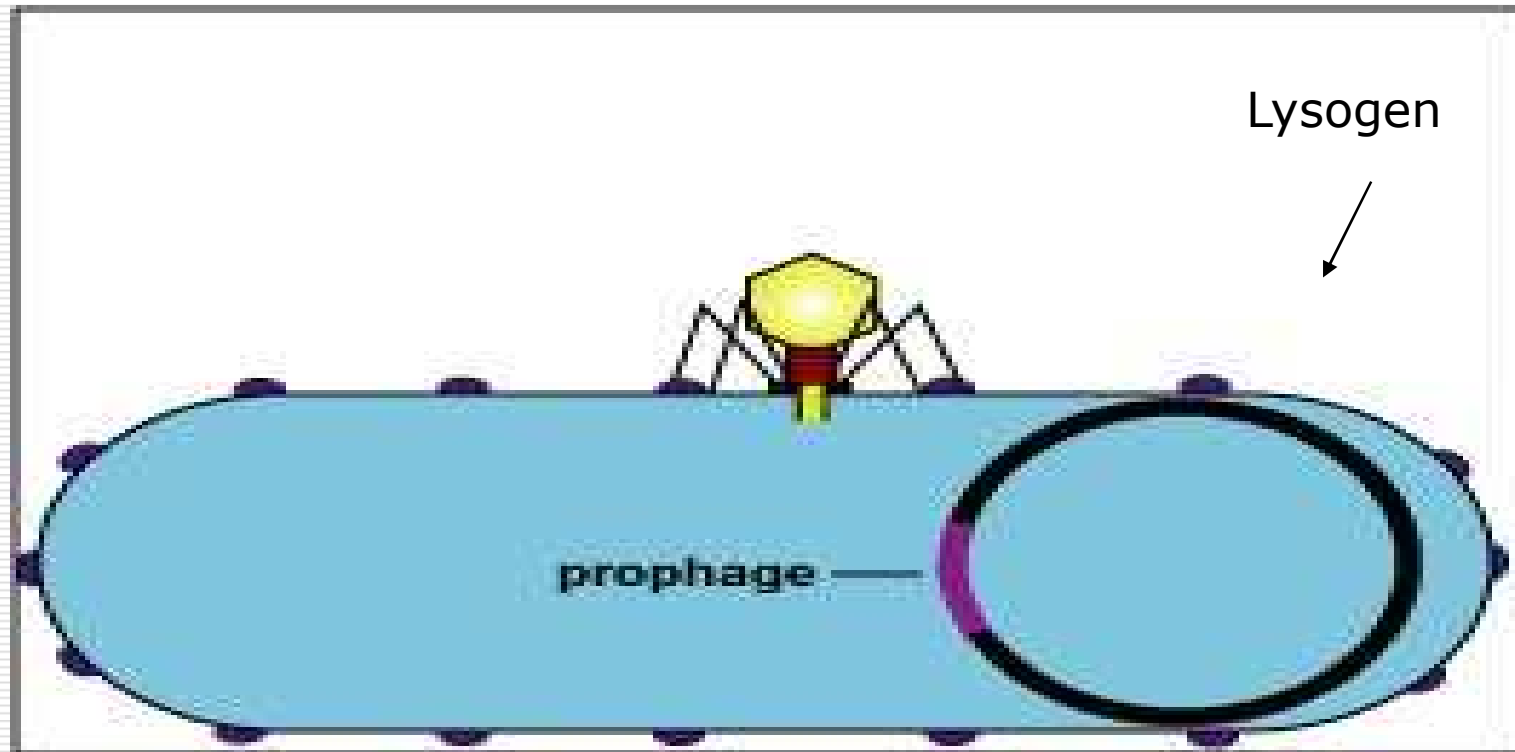
Release

- **Lysis from within**



LYSOGENIC CYCLE

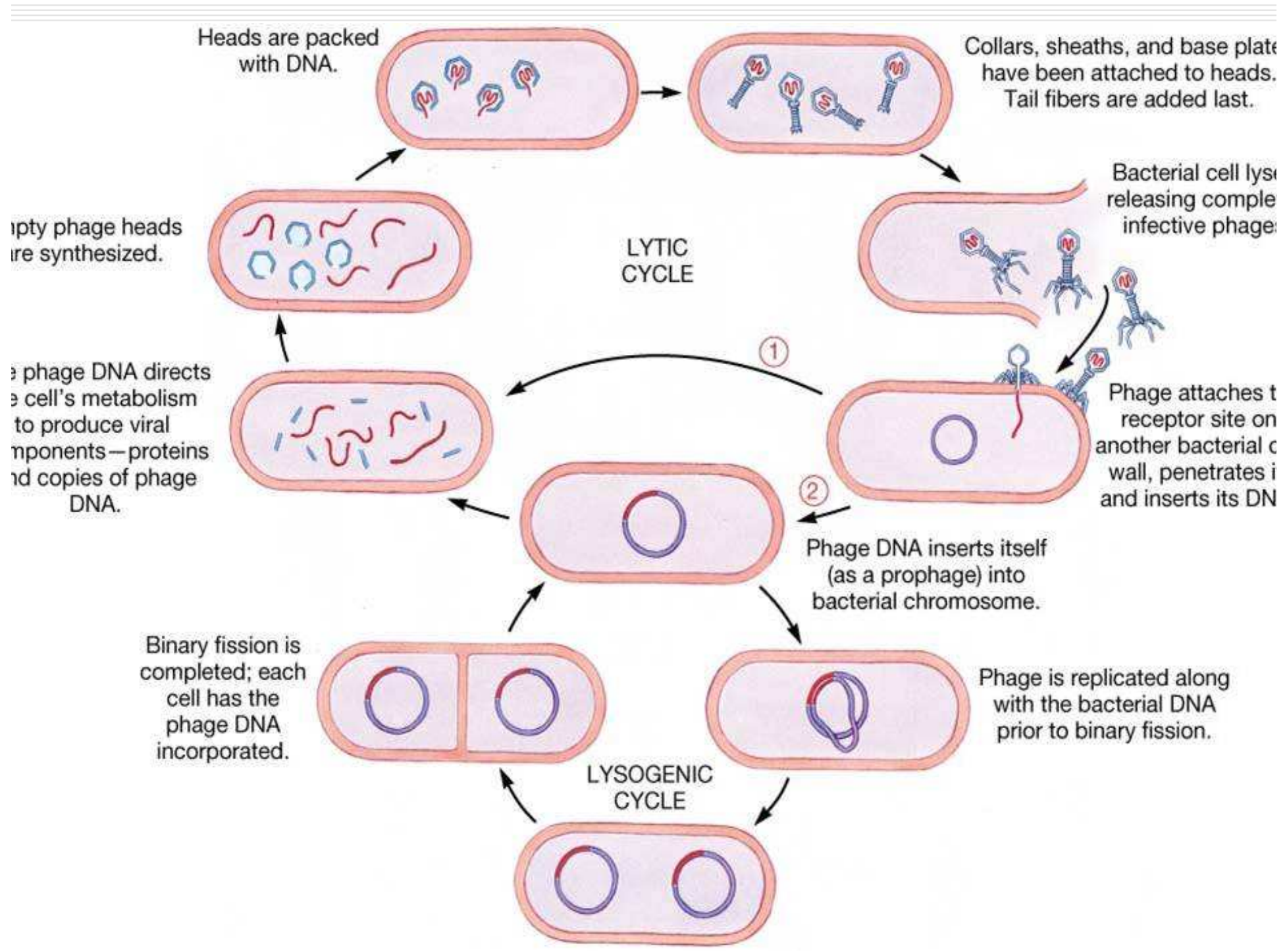
- ❑ Some phages after infection insert their nucleic acid (genome) into the bacterial chromosome – PROPHAGE.
- ❑ confers certain new properties
- ❑ resistant to reinfection by the same or related phages – super infection immunity.



□ **Examples :**

- Phage mediated toxigenicity of *C. diphtheriae*.
- Phage mediated toxicity of *Cl. botulinum*
- Phage mediated conversion (modification) of somatic antigens of *Salmonella*

- Bacteriophage may act as carriers of genes from one bacterium to another – transduction.
- In restricted transduction, only bacterial genes contiguous to the prophage are transmitted - prophage lambda in E. coli K 12 transfers only the gal+ gene which determines fermentation of galactose
- In generalized transduction, any bacterial gene may be transferred.



Heads are packed with DNA.

Collars, sheaths, and base plate have been attached to heads. Tail fibers are added last.

Empty phage heads are synthesized.

LYTIC CYCLE

Bacterial cell lyses releasing complete infective phages.

Phage DNA directs the cell's metabolism to produce viral components—proteins and copies of phage DNA.

1

Phage attaches to receptor site on another bacterial cell wall, penetrates it, and inserts its DNA.

2

Phage DNA inserts itself (as a prophage) into bacterial chromosome.

Binary fission is completed; each cell has the phage DNA incorporated.

Phage is replicated along with the bacterial DNA prior to binary fission.

LYSOGENIC CYCLE

Significance of phages

- ❑ Phage typing - as epidemiological marker
 - to differentiate bacterial species or genus into subtypes
- ❑ Act as carriers of genes from one bacterium to another
- ❑ Confer the property of toxin production.
- ❑ Used to study host-parasite relationships.

Bacteriophage typing

