

Viruses

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What is Virus:- Virus is a group of ultramicroscopic, non-cellular, highly infectious agents that multiply only intracellularly inside the living host cells.

Outside the host cells, they are inert particles.

According to Bawden, "Viruses are obligate parasites, too small to be seen."

General Characters of Viruses:-

1. Viruses are non-cellular, ultra-microscopic, infectious particles.
2. They are perfect obligate parasites (parasitic at the gene level) and cannot be grown on artificial culture medium. They are inert outside the host cell.
3. Size:- (i) Smallest animal virus causing "Foot and Mouth Disease" of cattle is 10 nm
(ii) Smallest plant virus, Alfalfa mosaic virus is 17 nm
(iii) Tobacco Mosaic Virus is 300 x 15 nm

4. Shape:- Viruses can be of various shapes. They are:-
- (i) Spherical (Alfalfa Mosaic Virus)
 - (ii) Cubical (Vaccinia)
 - (iii) Elongated Rod shaped (TMV)
 - (iv) Polyhedral (Polio)
 - (v) Tadpole like (Bacterial Virus - T₂)

5. They are highly pathogenic and cause infectious diseases in animals and plants. They cause infection in the host cells by means of nucleic acids.

6. They are very easily transmitted from one organism to another by means of a vector.

7. They lack irritability, energy storing or using, motility & protoplasm.

8. All viruses are nucleoproteins. The nucleic acid is protected by protein coat against attack by nuclear enzyme.

9. They possess only one type of nucleic acid: either DNA or RNA.

10. They take charge of host genetic material.

and make use of host ribosomes for synthesizing their own proteins.



Tobacco
Mosaic Virus
(TMV)

Lettuce
necrotic yellow
virus
(LNyV)

Potato
Virus
X
(PVX)

Turnip yellow
mosaic virus
(TYMV)

Sugarbeet
Yellow virus
(SBYV)

→ Different shapes and sizes of
Viruses

- 11. They are very easily transmitted from one organism to another organism.
- 12. They are not affected to antibiotics.

=> Viruses are living or Non-living :-

Viruses are regarded as intermediate between non-living entities and living organisms. The two views are listed below ↓

1. Viruses are non-living :-

- (i) Viruses have no complete cellular structure. They are not surrounded by cell membrane or cell wall.
- (ii) They do not show cellular metabolism and lack respiration.
- (iii) They possess ~~a~~ activity only when they are inside the living host cells. Outside the host, they are as good as chemical substances. Thus, they do not have their independent existence.
- (iv) The viruses can be precipitated just like

chemical substances.

2. Viruses are Non-living: -

- (i) They have defined shape and morphology like that of a living organism.
- (ii) They possess genetic material (DNA or RNA) which determine their structure and development.
- (iii) They show property of mutation.
- (iv) They can grow inside the host and multiply enormously showing one of the most important property of living organisms.

⇒ General Structure of Viruses: -

In general viruses are made up of envelope, capsid, nucleoid and occasionally one or two enzymes.

- a) Envelope: - Some viruses possess an outer thin loose covering, called envelope. It is composed of proteins, lipids and carbohydrates (both from host).
- b) Capsid: - It is the protein coat that surrounds the central portion of nucleoid and enzymes.

The capsid consists of a specific number and arrangement of small sub-units called capsomers. These subunits possess antigenic properties.

c) Nucleoid :- The nucleic acid present in the virus is called nucleoid. It is the infective part of virus which utilizes the metabolic machinery of the host cell for synthesis and assembly of viral components.

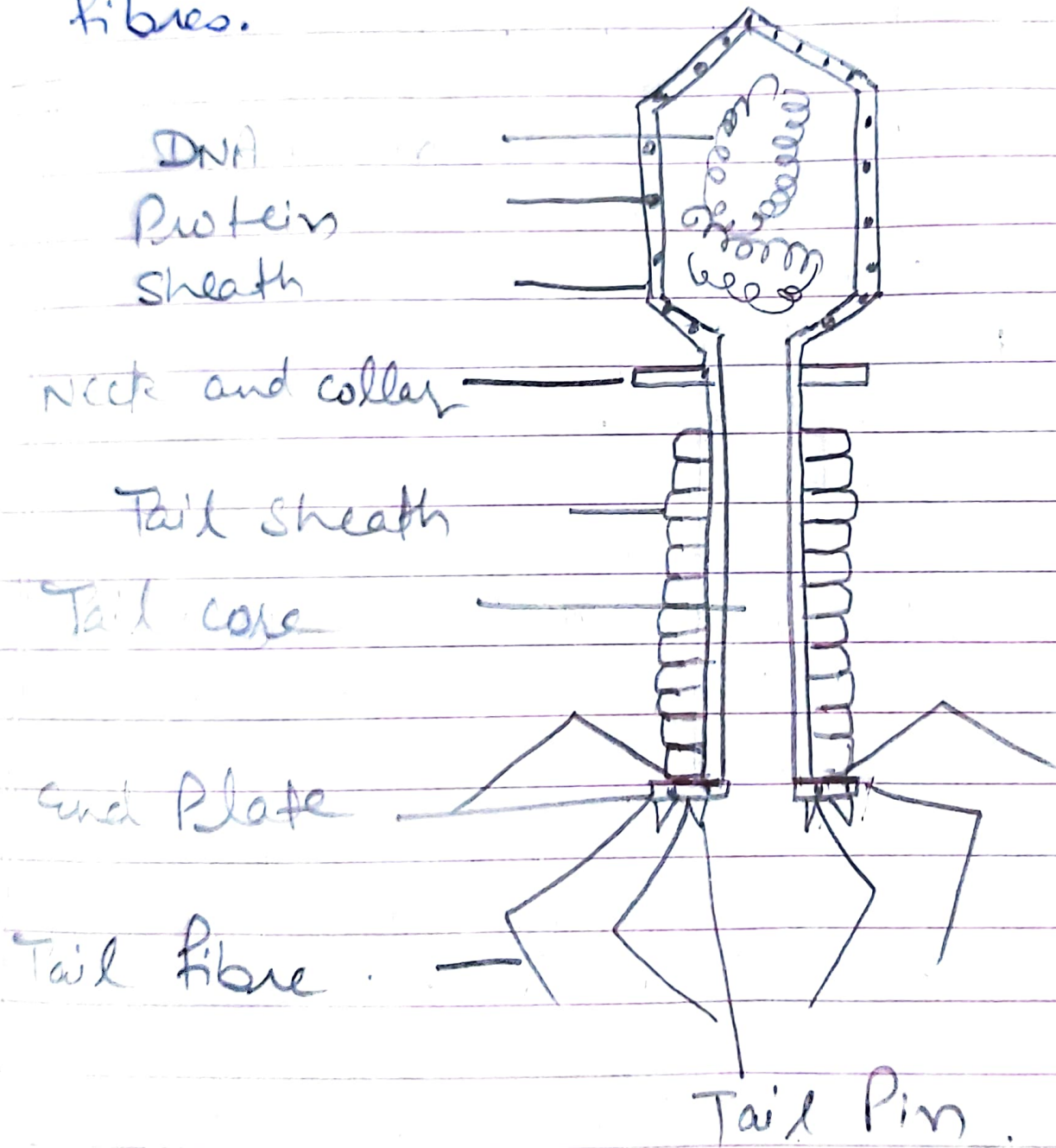
The genetic material of viruses are of 4 types-

- (i) Double Stranded DNA (dsDNA) e.g. Pox Virus
- (ii) Single Stranded DNA (ssDNA) e.g. Coliphage ϕ d
- (iii) Double Stranded RNA (dsRNA) e.g. Reo Virus.
- (iv) Single Stranded RNA (ssRNA) :- TMV.

⇒ Structure of Bacterial Virus (Bacteriophage)

- It is commonly called 'Coli phage'.
- It is a tadpole like virus consisting of a head and a tail.
- Head is polyhedral.
- It has an outer coat of proteins enclosing a single molecule of DNA.
- The DNA molecule is double helix, coiled and long consisting of polynucleotide.

- Tail is narrower and hexagonal in cross section with hollow central core.
- It is made up of 4 different kinds of proteins.
- The distal end of the tail bears 6 spikes to which are attached 6 tail fibres.



Structure of a Bacteriophage

⇒ Reproduction of Bacteriophage :-

The lytic cycle, which is also referred to as "reproductive cycle" of the bacteriophage, is a six-stage cycle.

1. Attachment :-

The phage attaches itself to the surface of the host cell in order to inject its DNA into the cell.

2. Penetration :- The phage injects its DNA into the host cell by penetrating through the cell membrane.

3. Transcription :-

The host cell's DNA is degraded and the cell's metabolism is directed to initiate phage biosynthesis.

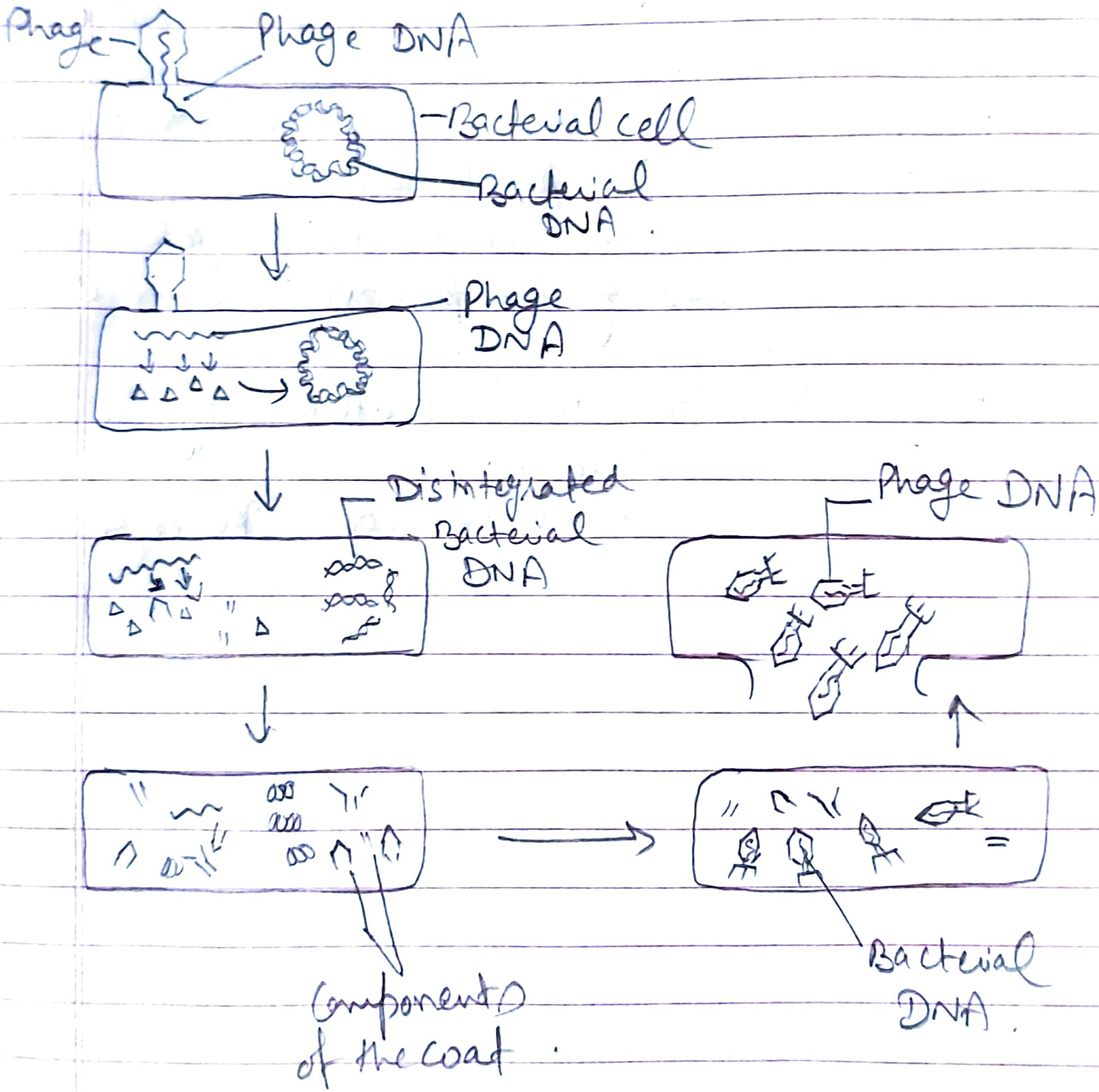
4. Biosynthesis :-

The phage DNA replicates inside the cell, synthesizing new phage DNA and proteins.

5. Maturation :-

The replicated material assembles into fully formed viral phages (with head & tail).

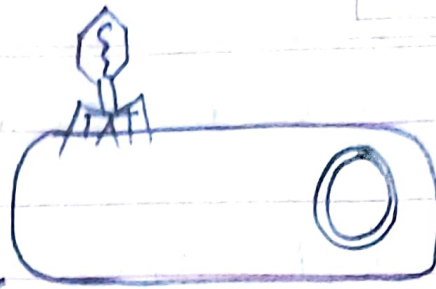
6. Lysis :- the newly formed phages are released from the infected cells to seek out new host cells to infect.



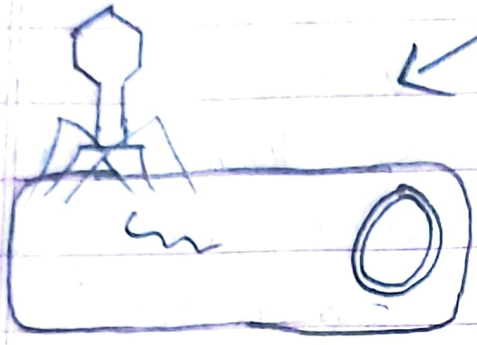
Stages of Lytic cycle

→ Lysogenic Life cycle:-

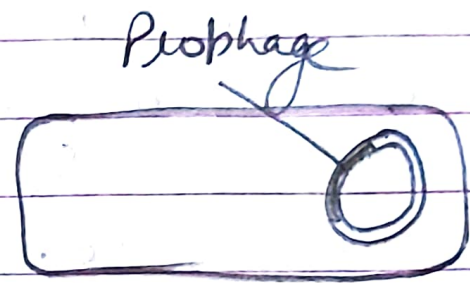
1. Soon After infection, the viral DNA gets attached to the bacterial chromosome as prophage.
2. The bacterial chromosome keep on dividing along with the prophage.
3. A large number of new bacterial cells are formed by the process of fission or budding.
4. Thus prophage is transmitted along with bacterial progeny.
5. Prophage (The viral DNA) act like a gene.



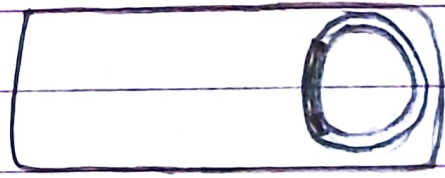
1. Phage attaches to the cell surface of bacterium



2. Phage DNA enters the bacterial cell.



3. Phage DNA integrates into bacterial DNA.



4. Integrated prophage replicates when bacterial DNA replicates.

Stages of Lysogenic life cycle

→ Economic Importance of Viruses:-

→ Useful Activities:-

1. Certain viruses (cow pox virus) are used in vaccinations against small pox diseases.
2. Certain viruses are used in war-fields as biological warfare agents. They cause disease and so demoralize the enemy force.
3. Some viruses act as scavengers by feeding and destroying pathogenic bacteria, which pollute drinking water.

→ Harmful Activities:- Viruses cause serious diseases in plants and animals. Some important viral diseases of plants are listed below.

- Tobacco Mosaic
- Sugarcane Mosaic.
- Leaf curl of of potato.
- leaf curl of papaya.
- Yellow vein mosaic of lady's finger.

