Course Title – Virology

Course Code – L.Sc. – 307 **Marks: 75**

S. No.	Topic
1.	Origins of virology, viruses as a living system etc
2.	Classification of viruses
3.	Organization of viruses Protein structure and assembly, nucleic acid packaging, geometrical aspects, icosahedral and helical symmetry
4.	Virus attachment and entry in to host cells
5	Cellular and molecular biology of Host virus interaction
6.	Genome replication and mRNA production by RNA viruses
7	Reverse transcription and integration in to the host genome (retroviruses)
8.	DNA virus replication strategies
9	Unique features of viral gene expression
10.	Translational control of viral gene expression
11	Viral pathogenesis and cell transformation by viruses
12.	Viral Genetics, Viral vaccines, Antiviral chemotherapy, Persistence of viruses
13	Hepadnaviruses, HIV, Polyomaviruses (SV40), Baculovirus, Topsoviruses, Potyviruses
14	Virus evolution
15.	Viral vectors and gene therapy

SPREAD OF THE VIRUS IN THE BODY

- Entry – through an epithelial surface
- Migration – to regional lymph nodes
- Primary viremia – virions enter blood stream
- Secondary viremia – blood to RE system, multiply then come back to blood
- Target organ – through blood. Produce lesion in the target organ.

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SIGNIFICANCE OF INCUBATION PERIOD

- Short – less than a week. Eg arboviruses
- Medium – 7 to 21 days
- Long – weeks to months. Eg 2-6 weeks for hepatitis A, 6-20 weeks for hepatitis B.
- Very long – years. Eg slow viruses. Prions

HOST RESPONSE TO VIRUS INFECTIONS

- **Immunological response**

- Antibody mediated immunity
  - IgA, IgM, IgG.
  - Virus neutralization in different ways –
    - prevent adsorption,
    - enhanced degradation,
    - prevent release of progeny,
    - complement mediated damage,
    - cytolysis of virus infected cells

- Nonimmunological response
  - Phagocytosis – macrophages
  - Fever – natural defense. Most viruses inhibited at temperatures above 39”C.
  - Hormones – steroids worsen, pregnancy – severe
  - Malnutrition – worsening
  - Age – extremes of age
  - Interferons – host coded proteins that protect uninfected cells.

REPLICATION/ REPRODCTION/ MUTLIPLICATION/ VIRUS-HOST INTERACTION

- Genetic information for viral replication is contained in viral nucleic acid, **but lacking biosynthetic enzymes**
- Virus depends on **the machinery of the host cell** for replication
- There are two life cycle for virus/bacteriophage for their replication

1. **Lytic (virulent) cycle:**
2. **Temperate (avirulent) cycle:**

REPLICATION/ REPRODCTION/ MUTLIPLICATION/ VIRUS-HOST INTERACTION

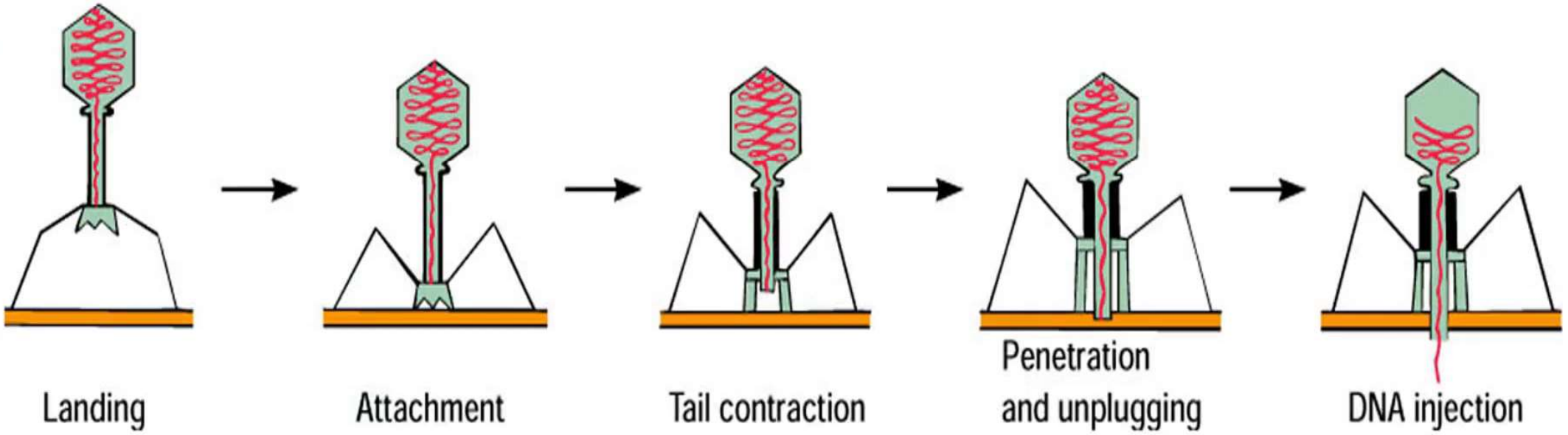
1. **LYTIC (VIRULENT) CYCLE:** The **host cell will *BURST OR GET LYSED*** at the end of the phage division and releasing new progeny phages to infect other host cells

2. **TEMPERATE (AVIRULENT) CYCLE:** They ***DO NOT DESTROY* the host cells.** The **viral nucleic acid is integrated with the host cell genome** and replicated from one generation to another **without any cell lysis.** This is called **lysogeny. LYSOGENY is carried out only by phages with ds DNA** Most of the gene products of the lysogenic phage remains dormant until it is induced to enter the lytic cycle

THE LYSOGENIC LIFE CYCLE: TEMPERATE CYCLE

- Phages with **ds DNA** usually **will not destroy the bacterial cell.**
- In this the **viral nucleic acid is integrated with the host cell genome** and replicated from one generation to another without any cell lysis
- E.g. **The association of lamda phage with E.coli**
- Most of the gene products of the lysogenic phage remains dormant until it is induced to enter the lytic cycle

1. ADSORPTION (ATTACHMENT)



2. PENETRATION

- The virus/phage **injects its DNA into the bacterial cell**.
- The capsid remains on the outer surface of the cell.
- The **DNA passes** through the **tube** to the bacterial cytoplasm
- The **phage sheath contracts** forcing the tail core tube **to transfer genetic material** to the bacterial cell
- **Non enveloped virus** enter **by engulfment** by invagination of plasma membrane with accumulation of virus cytoplasmic vesicles called **phagosomes**
- **Enveloped virus** may **fuse** with plasma membrane of host cell releasing the **nucleocapsid** into the cytoplasm

3. UNCOATING

- It is the **physical separation** of **nucleic acid** from its **outer structural components** and **capsid** so that the **nucleic** acid is **released** into **cell**
- **Host component** and **proteolytic enzymes** within the **lysosomes** cause coating.

4. MULTIPLICATION (biosynthesis)

- Synthesis of viral components inside the host cell can be divided in to
  - **Early functions**
    - Take over of host cell
    - Synthesis of early **viral mRNA**
    - Synthesis of Early proteins and enzymes: nucleases, DNA dependent RNA polymerases
  - **Late functions**
    - Synthesis of structural and enzymatic proteins
    - Assembly of nucleocapsid
    - Late proteins: phage head, tail, tail fibers, endolysin

4. MULTIPLICATION (biosynthesis)

- **Conversion** of host cell to phage producing cell
- Once the bacteriophage enters the host cell **it stops the replication** and **transcription** of bacterial DNA and RNA
- **Virus/ Phage mRNA codes** for **nucleases degrade** the **host DNA in to small fragments.** This makes the nucleotide of the host DNA available for phage DNA synthesis
- The **transcription of phage mRNA is initiated by host cell RNA polymerase**
- Viral genome expressed ➔ directs the biosynthetic machinery of the host cell to **shut down the normal cellular metabolism** and to start **production (biosynthesis) of viral components** (head, tail etc).

5. ASSEMBLY

- The viral pieces are **assembled to produce complete viral particles (virions)**

- Two kinds of proteins are required for phage assembly
  - **Structural proteins** of phage particles
  - **Enzymes that catalyze** the assembly process (These enzymes do not become a part of bacteriophage)

5. ASSEMBLY

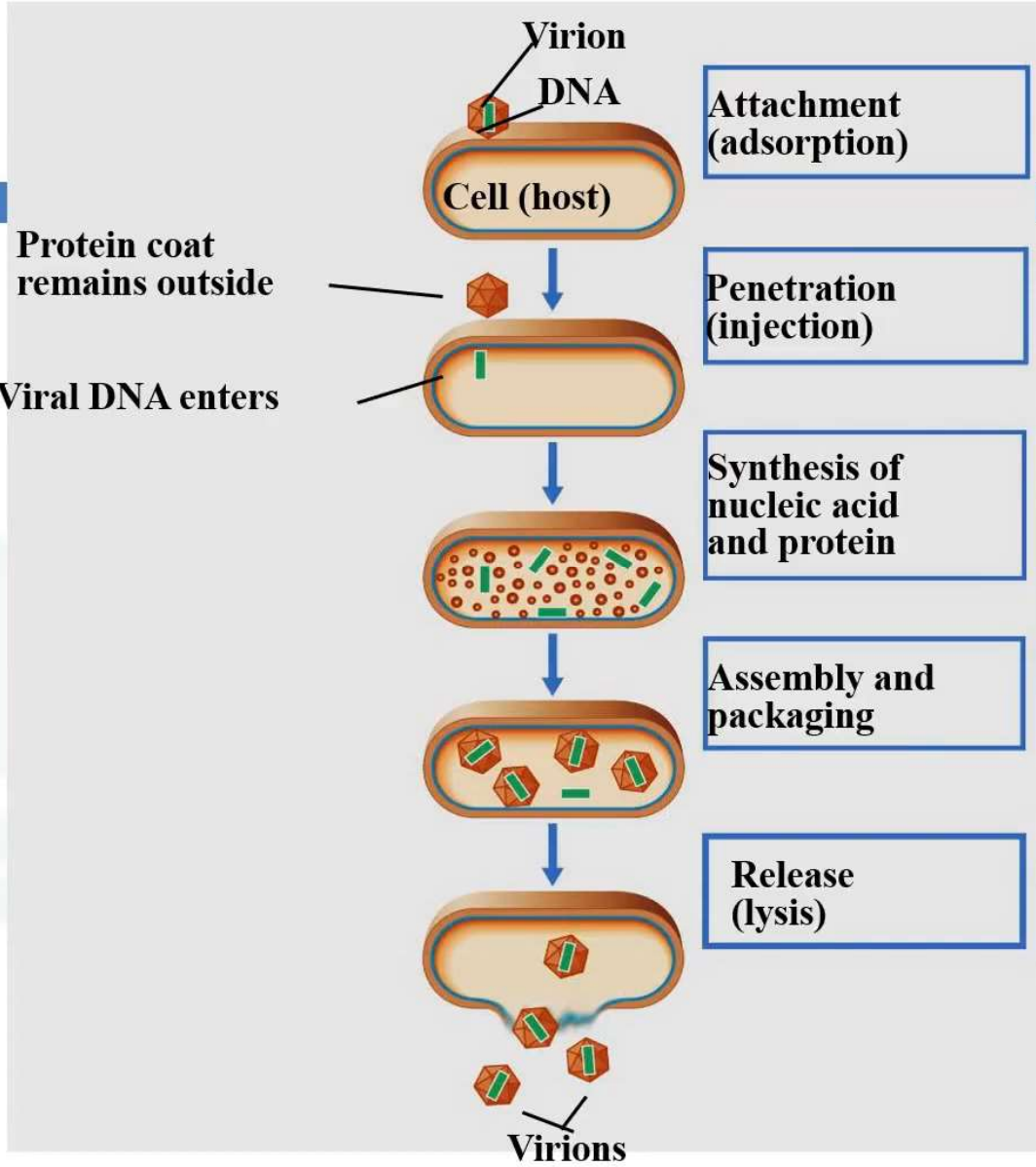
Assembly of icosahedral phages take place in several steps

- Aggregation of phage structural proteins to form a **head and tail**.
- Condensation of the nucleic acid and entry in to a preformed head
- Attachment of a tail to a packed head
- About **25 minutes** after infection **50 to 1000** phage particles will be assembled

6. RELEASE

- **Final event - Host cell bursts** and **all of the new virions escape** from the bacterial cell.
- An enzyme called **ENDOLYSIN** is produced towards the end of the lytic cycle **which lyses the bacterial wall** and **releases** the **mature phages**

- When the bacterial cells are **infected** with **filamentous phages** the **release** is by means of **extrusion,** without damaging the bacterial cell wall **(Reverse phagocytosis).** In this case as the viral DNA extrudes through the membrane it picks up protein molecules


Virion
DNA
Attachment (adsorption)
Cell (host)
Protein coat remains outside
Penetration (injection)
Viral DNA enters
Synthesis of nucleic acid and protein
Assembly and packaging
Release (lysis)
Virions