Chapter-8 Viruses

Very Short Answers Questions:

1. What is the shape of T_4 phage? What is its genetic material?

A: Tadpole shape distinguished with head and tail regions joined by collar.

Genetic material is DNA.

2. What are virulent phages? Give an example?

A: Bacteriophages which during their infection of bacteria and multiplication, kill their hosts by undergoing lytic cycle are called virulent phages.

E.g.: T even phages like T_2, T_4, T_6

3. What is lysozyme and what is its function?

A: Lysozyme is a hydrolytic enzyme.

It dissolves plasma membrane of the host cell while releasing the phage particles during lytic cycle.

4. Define 'lysis' and 'burst size' with reference to viruses and their effects on host cells?

A: Lysis is dissolving the plasma membrane by lysozyme and killing the host cell.

During lytic cycle the number of nearly synthesized phage particles released from a single cell is called as 'burst size'.

5. What is a prophage?

A: Prophage is a viral DNA that is inserted and integrated into the host genome .It replicates along with bacterial genetic material.

6. What are temperate phages? Give one example?

A: Temperate phages are phages that do not cause lysis and death of the cells when they multiply. Instead, the phage DNA integrates into the host genome.

E.g.: λ (lambda) phage.

7. Mention the differences between virulent and temperate phages?

A:

Virulent Phages	Temperate Phages
1. They undergo lytic cycle and kill the host cells. 2. Do not incorporate genetic material into the host genome.	1. They undergo lysogenic cycle. They do not kill the host immediately. Under certain environmental conditions they kill the host by lytic cycle. 2. It incorporates DNA into the host genome.

8. What is the shape of TMV? What is its genetic material?

A: TMV is rod shaped virus.

Genetic material is singles stranded RNA (ssRNA)

Short Answer Questions

1. What is ICTV? How are viruses named?

Ans: ICTV stands for **International Committee on Taxonomy of Viruses**. ICTV regulates the norms of classification and nomenclature of viruses. The ICTV scheme has three hierarchial levels –

1. Family (including some sub-families) **2. Genus 3. Species**

The **family** names end with the suffix '**viridae**' while **genus** names with **'virus'** and the **species** names are common English expressions describing their nature.

Viruses are names after the disease they cause e.g. **polio virus**.

Using ICTV system of classification the virus that causes **Acquired Immune Deficiency Syndrome (AIDS)** in human beings is classified as

Family: **Retroviridae**

Genus: **Lentivirus**

Species: **Human Immune Deficiency Virus (HIV)**

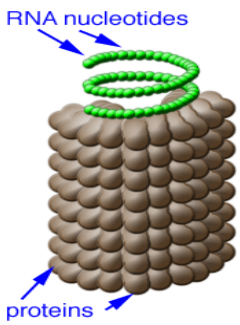
2. Explain the chemical structure of viruses?

Ans: Viruses are chemically nucleic acids and proteins.

All viruses consists of two basic components a **core** and **capsid**.

Core is the **nucleic acid** that forms the **genome** of the virus.

Capsid is the coat surrounding the capsid and made up of **proteins.** Capsid gives shape to the virus and provides protective covering for the genome. It is made up of **protein subunits** called **capsomeres**.



A virus contains its genetic information in either a double stranded DNA **(ds DNA)** or a single stranded DNA **(ss DNA)**.

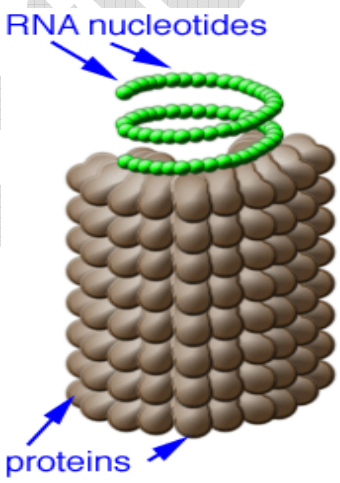
In general, viruses that infect **plants** have **ssRNA** and viruses that infect **animals** have **dsDNA.**

Viral nucleic acid molecules are either **circular** or **linear**. Most virus molecules have single nucleic acid molecule, but few have more than one e.g **HIV** – which have **two identical molecules of RNA**- representing its genomic copies.

Capsids of some viruses are covered by **polysaccharide** or **glycoprotein envelope**.

3. Explain the structure of TMV?

Ans:



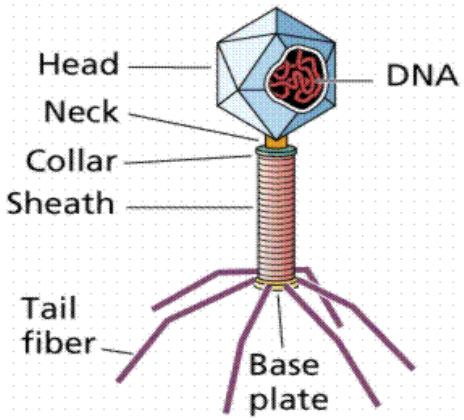
Shape and size: It is rod shaped virus about 300nm long and 18 nm in diameter, with a molecular weight of 39 x 10^6 Daltons. These are **helical viruses**.

Chemical nature: The **capsid** is made of **2,130 protein** subunits of identical size called **capsomeres**. The capsomeres are arranged in helical manner around a central hollow space of 4 **nm**. Each protein subunit is made up of a single polypeptide chain which possesses 158 amino acids.

Inside the protein capsid there is a single stranded **spirally coiled RNA** molecule consisting of **6,500 nucleotides.**

4. Explain the structure of T-even bacteriophages?

Ans:



Shape and size: The body of a typical bacteriophage such as T4 can be distinguished into head and tail regions joined by a collar. It is a **tad pole** shaped virus. They have **'polyhedral symmetry'** in the **'head'** and **'helical symmetry'** in the **'tail sheath'**.

The head is formed of number of capsomeres. It encloses the double stranded DNA which is linear.

The tail region includes a **tail sheath**, a **basal plate**, **pins** and **tail fibres**.

At the tip of the tail there is a basal plate which is hexagonal. At each corner of the basal plate spike like structures arise called pins. From the corners of the basal plate six tail fibres arise. Tail fibres help the bacteriophage attach to the host cell. Tail is covered by a compressible sheath. The tail sheath aids in **injecting viral DNA** into the host cell.

5. Explain the lytic cycle with reference to certain viruses?

Ans: The lytic cycle is a five step process

1. Attachment

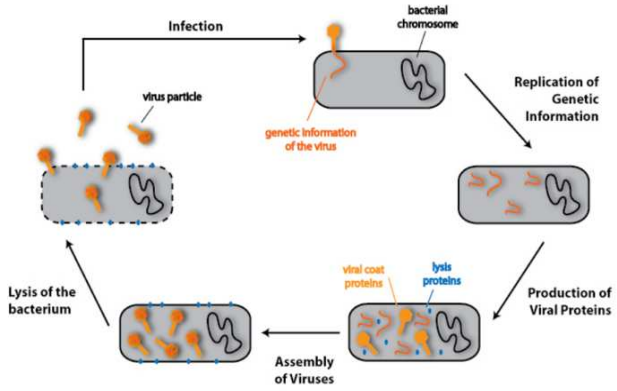
2. Penetration

3. Biosynthesis

4. Maturation

5. Release

1. Attachment: After a chance contact between phage partcles and bacteria **attachment** or adsorption occurs. The phages uses the tail fibres for attachment to the compatible bacterial cell wall.



2. Penetration: Attachment is followed by penetration. Due to the contraction of the tail sheath of the phage the DNA is injected into the bacterial cell by the piercing of the tube, acting like a hypodermic syringe. The capsid remains outside the bacterial cell and is referred as **ghost**.

3. Biosynthesis: Inside the bacterium, the phage DNA degenerates the bacterial genome and takes control of the bacterial cytoplasm. The phage DNA starts synthesis of its own DNA copies and proteins. The phage components are synthesized separately.

4. Maturation: During this phase the protein components starts assembling into complete **virions.** The period of time between infection and appearance of mature viruses is called as **eclipse period**.

5. Release: It is **lytic** phase. The phage DNA codes for **lysozyme** in the bacterium which dissolves the plasma membrane and host cell gets disrupted. This is called as lysis.

The number of newly synthesized phages released from a single cell is referred as **'burst size'**.

Long Answer Questions

1. Write about the discovery and structural organization of viruses?

Ans: **Discovery:** Viruses have been victimizing the mankind from ancient times, causing many diseases in humans and also in economically useful plants and animals. The agent responsible for these diseases was not known even after the proposition of **germ theory of diseases**.

In 1892 for the first time, the Russian pathologist **Dmitri Iwanowski**, while studying tobacco mosaic disease, filtered the **sap from the diseased tobacco leaves** with filters that can retain bacteria. The infectious agents passed through the filters. The filtered sap when injected into healthy plants symptoms of mosaic disease developed in it.

Unable see any microorganism in the sap Iwanowski reported that filterable agent was responsible for the disease.

Martinus Beijerinck repeated Iwanowski's experiments and concluded that the disease causing agent was a '**contagium vivum fluidum** (contagious living fluid).

W.M. Stanley in 1935 purified the sap and announced that the virus causing mosaic disease can be crystallized. It was named Tobacco Mosaic Virus (TMV).

Frankel Conrat in 1956 confirmed that the genetic material of the **TMV** is **ssRNA**.

Structure of the Viruses:

Viruses range from 300 nm as in TMV to 20 nm as in **parvoviruses**. The largest virus is of the size equal to that of the smallest bacterium such as mycoplasma. Smallest virus is similar in size of a ribosome.

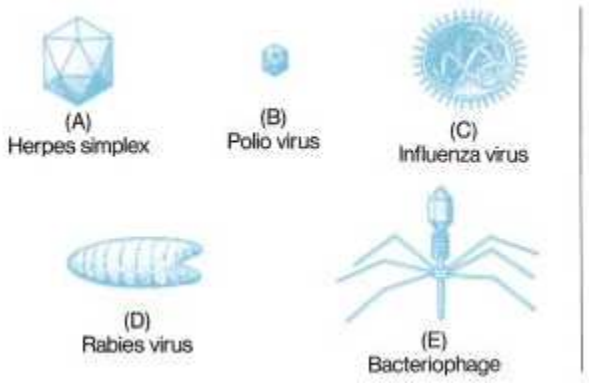
Viruses may be classified into several different morphological types.

Helical viruses are long **rod shaped** that may be rigid or flexible **E.G**. **Rabies virus** and **Tobacco Mosaic Virus**.

Polyhedral viruses are many sided. Each side is a equilateral triangle.

Bacteriophages that infect bacteria are **complex viruses** with complicated structures. They have '**polyhedral symmetry'** in the 'head' and '**helical symmetry'** in tail sheath. In some

viruses are capsids are covered by **envelope**. In **measles virus** the envelope contain **glycoprotein** projections called **spikes**. The spikes function in attaching the virus to the susceptible hosts.



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Viral nucleic acid molecules are either **circular** or **linear**. Most virus molecules have single nucleic acid molecule, but few have more than one e.g **HIV** – which have **two identical molecules of RNA**- representing its genomic copies.

2. Describe the process of multiplication of viruses?

Ans: Multiplication or reproduction of the viruses takes place inside the host cells. Viruses are obligate intracellular parasites. It takes over the host metabolic machinery and synthesizes its

own body components. The viral multiplication cycles are similar in all viruses. A typical bacteriophage can multiply by two different mechanisms.

1. Lytic cycle **2. Lysogenic cycle**.

1. Lytic cycle: The lytic cycle is a five step process

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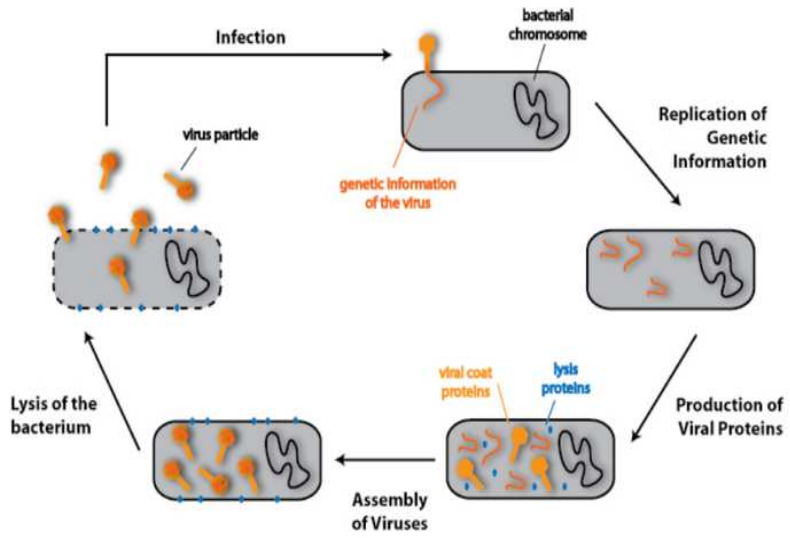

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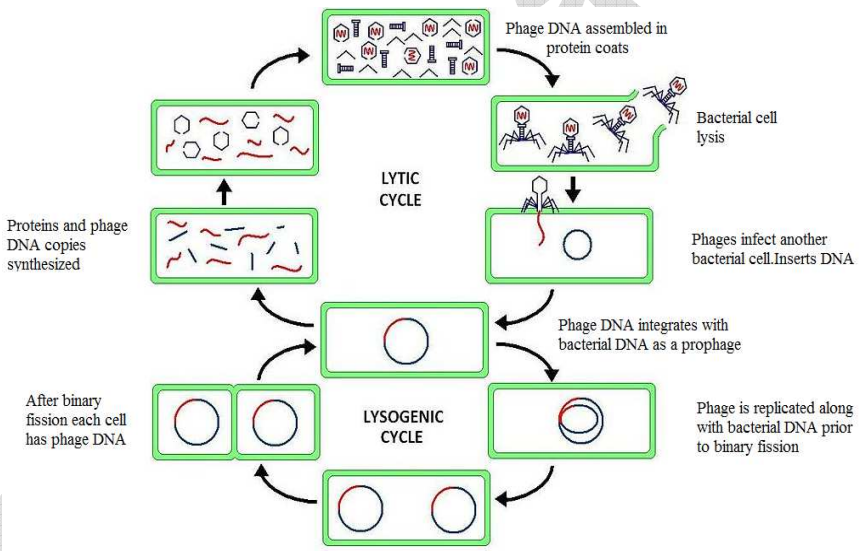
2. Lysogenic cycle: Some bacteriophages such as λ **(Lambda)** phages do not cause lysis and death of the host cell when they multiply. Instead, the phage DNA after penetration into an ***E.coli*** cell gets integrated in to the circular bacterial DNA. It becomes a part of it and remains **latent**

(Inactive). Such phages are called **temperate phages**. The inserted DNA is called **prophage**.



Every time the bacterial genetic material replicates, the **prophage** also undergoes replication. The prophage remains latent within the progeny cells. However, in some rare spontaneous events or when host cells are exposed to UV light or some chemicals, the phage DNA separates from the bacterial genetic material leading to the initiation of the lytic cycle and death of the host cell.