VIRUSES

1. Write a short note on Virus Discovery.

The name **virus** came from a Latin word *virus* which means venom or poisonous fluid. Based on the nature of host, viruses cannot be categorised either in the animal or in the plant kingdom. The branch that deals with the viruses is known as virology and the scientists who work in this branch are called virologists. Although plant diseases like leaf roll of potato and human diseases like yellow fever, small pox etc., were known for long time but the nature of causative agent was known to us quite later.

Adolph Meyer (1886), an agriculture chemist of Holland, observed a diseased tobacco plant showing mottling of leaf and named it mosaic. He unraveled the infectious nature of the sap of infected plant by grinding, filtering, through double filter paper and then applying the fluid to the healthy plants. The infective capacity of the plant sap was lost by heating at 80°C and he concluded that certain microbes are the causative agent of tobacco mosaic.

D. lwanowski (1892), a Russian scientist, was the first to demonstrate the transmission of tobacco mosaic virus disease from infected to healthy plant through sap, even the sap was filtered through Chamberland filter candle, which is sufficient to remove bacteria.

W.M. Beijerinck (1898), a bacteriologist of Holland, was able to explain that the invisible, filterable and non-cultivable infectious fluid could diffuse through an agar gel.The bacteria and other organism cannot do so. Beijerinck believed that the fluid itself was alive and he called it as "infectious living fluid".

Loeffler and Frosch (1898) observed that the agent of mouth and foot disease of cattle could pass through bacteriofilter. The agent could not be grown in artificial culture medium and was not visible under microscope.

Walter Reed and his associates (1900) discovered the causative agent of yellow fever, which is the first discovered viral disease of man. Till date many viral diseases of vertebrates are known.

F.W. Twort (1915), a British scientist, described some viruses that attack bacteria. Two years later, **Felix d'Herelle (1917),** a French scientist, independently observed and studied in detail about the virus attacking bacteria and named the virus bacteriophage, commonly called bacteriophage.

Schlessinger (1933) was the first to purify virus by using differential centrifugation. Later, **Wendell M. Stanley (1935),** an organic chemist, observed that the virus could be crystallized and consisted largely of proteins. He also explain that virus contains a small amount of RNA or DNA in addition to protein. Therefore, virus is an organism of nucleoprotein and the nucleic acid is the infective agent rather than protein. A few years later, **W.M. Stanley (1946)** was awarded the Nobel Prize for the above discovery.

2. **Write about the general structure of viruses.**

The viruses are non cellular, self-replicating obligate, intracellular parasitic agents – essentially composed of a protein that covers a central nucleic acid molecule, either RNA or DNA.

The virus contain two parts – i) centrally placed nucleic acid and ii) Protein Coat. Sometimes it consists of additional envelope.

i) Nucleic Acid: Viruses contain only one type of nucleic acid i.e. either DNA or RNA. The DNA containing viruses are known as Deoxyviruses and RNA containing viruses are known as Riboviruses. Viruses are varied in their structure of nucleic acid. Most of the plant viruses have either single stranded RNA (TMV) or double stranded RNA (Rice ragged stunt viruses), except a few have DNA either single (Gemini viruses) or double stranded (Dahlia mosaic viruses). Animal viruses have mostly double stranded DNA or either single (Polio virus) or double stranded RNA (Reo virus) and bacteriophages contain mostly double stranded DNA but they also have single stranded RNA (f_2, R_{17}, fr) or single stranded DNA (f_1, fd, M_{13}). The amount of nucleic acid, called genome of a virion usually depends on their size, ranges from 4-8 for small viruses and 100-200 for the large viruses.

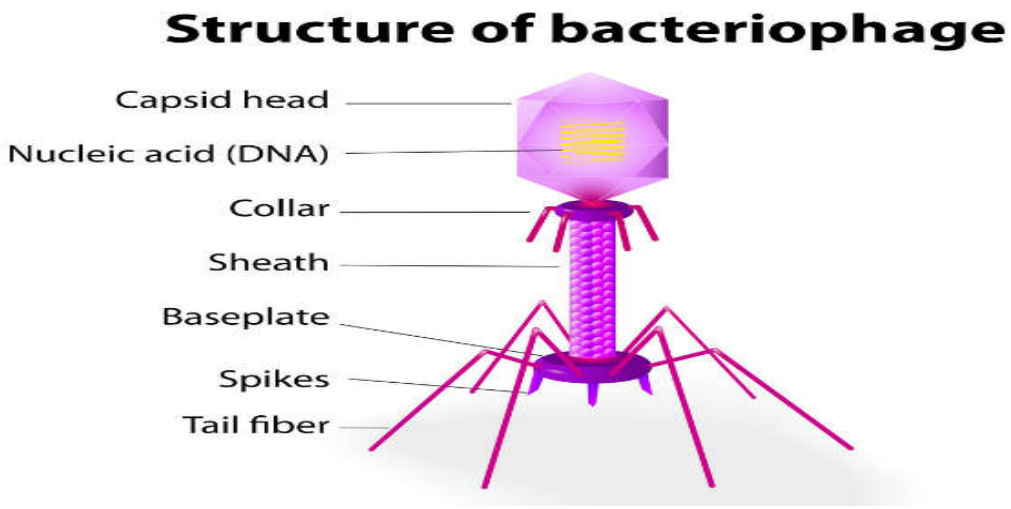
ii) Protein Coat: The protein coat surrounding the genome is known as capsid and the capsid together with nucleic acid is known as nucleocapsid. The capsid is made up of protein subunits called capsomeres. Capsid function as a shell to protect the genome from nucleases and it helps to attach virions on host receptor site during infection. Many mammalian viruses have envelope made up of a bilayered lipoprotein, which surrounds the nucleocapsid. The envelope is usually derived from modified host cell membrane. It can be considered as an additional protective coat.

3. **Write a short note on ultrastructure of Bacteriophage.**

The bacteriophage consists of a polyhedral head, a short collar and a helical tail.

- **Head-** The head consists of 2000 capsomeres enclosing a single double-stranded DNA thread of about 50 nm. Molecular weight of the DNA is 2,500,000 and the amount of nucleic acid is approximately 6×10^3 micrograms.

- **Tail-** The tail consists of an inner hollow tube (through which DNA passes to the host cell during infection) which is surrounded by a contractile sheath with 24 annular rings. The distal end consists of a basal plate with tail fibres at each corner. Basal plate has a pin at every corner which is attached with the distal end of the sheath. The bacteriophage attaches to the cell wall of bacteria with the help of these tail fibres.



4. Briefly describe the stages of Lytic Cycle with a diagram.

In the Lytic Cycle, a bacteriophage infects bacteria and kills it to release progeny virus. This cycle takes place in the following steps:

Adsorption

The bacteriophage attaches itself on the surface of bacteria. This process is known as adsorption. The tips of the tail fibres attach to specific receptors on the surface of the bacterial cell. Tail fiber then bends and allows the tail pins to attach on the host surface that makes an irreversible attachment.

Penetration

The tail sheath of the phage contracts after adsorption. The base plate and the tail fibres are attached firmly to the bacterial cell. The phage weakens a part of the cell wall and the hollow core is pushed downwards through it. The DNA is injected inside the bacterial cell.

Synthesis of Phage Components

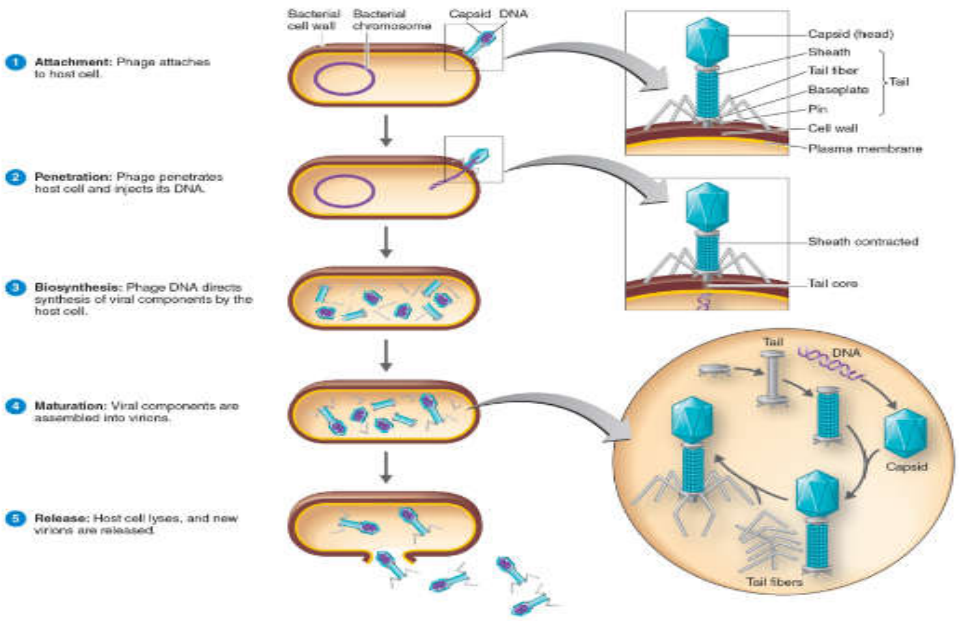
Once the phage nucleic acid takes the entry into the bacterial cell it suppresses the synthesis of bacterial protein and directs to synthesis protein of phage particle. Majority of the phage DNA acts as a template for its own synthesis and the rest is used as template for the synthesis of viral specific m-RNA by utilizing the RNA polymerase of the host to synthesise the proteins which are used to build up the protein coat of the phage particle.

Maturation and Assembly

On maturation, the head and tail protein of phage DNA assemble and each component of phage DNA is surrounded by a protein coat. Initially the core tube is attached with the basal plate and then sheath becomes assembled around the core tube. Ultimately, the tail structures become attached to the base of the head taking a collar between. At last, the tail fibers are attached to the basal plate.

Release

The infected bacterial cell is lysed releasing the progeny phages. In the host cell, the phage DNA secrets lysozyme causes the lysis of host cell wall. In a cycle of phage development 200 phages are formed which take about 30-90 minutes.



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