

Lecture 9

Viral Replication

Viral replication is the formation of biological viruses during the infection process in the target host cells. Viruses must first get into the cell before viral replication can occur. From the perspective of the virus, the purpose of viral replication is to allow production and survival of its kind. By generating abundant copies of its genome and packaging these copies into viruses, the virus is able to continue infecting new hosts. Replication between viruses is greatly varied and depends on the type of genes involved in them. Most DNA viruses assemble in the nucleus while most RNA viruses develop solely in cytoplasm.

Lytic cycle

The lytic cycle involves the reproduction of viruses using a host cell to manufacture more viruses; the viruses then burst out of the cell. The normal process of viral reproduction involving penetration of the cell membrane, nucleic acid synthesis, and lysis of the host cell. Lytic cycle is one of the two alternative life cycles of a virus inside a host cell, whereby the virus that has entered a cell takes over the cell's replication mechanism, makes viral DNA and viral proteins, and then lyses (breaks open) the cell, allowing the newly produced viruses to leave the now disintegrated host cell to infect other cells.

Process

Viruses of the lytic cycle are called virulent viruses. The lytic cycle is a five-stage cycle.

1) Attachment

The virus first attaches itself to a specific host cell. In the case of the T4 phage, a commonly studied bacteriophage that infects the bacterium *Escherichia coli*, this attachment is done by the tail fibers of the virus having proteins that have an affinity with the host cell wall.

2) Penetration

To infect a cell, a virus must first enter the cell through the plasma membrane and (if present) the cell wall. It then releases its genetic material (either single- or double-stranded RNA or DNA) into the cell. In the case of the T4 phage, after attachment to the host cell, the virus first releases an enzyme that weakens a spot in the cell wall of the host.

3) Replication

The virus' nucleic acid uses the host cell's machinery to make large amounts of viral components, both the viral genetic material (DNA or RNA) and the viral proteins that comprise the structural parts of the virus. In the case of DNA viruses, the DNA transcribes itself into

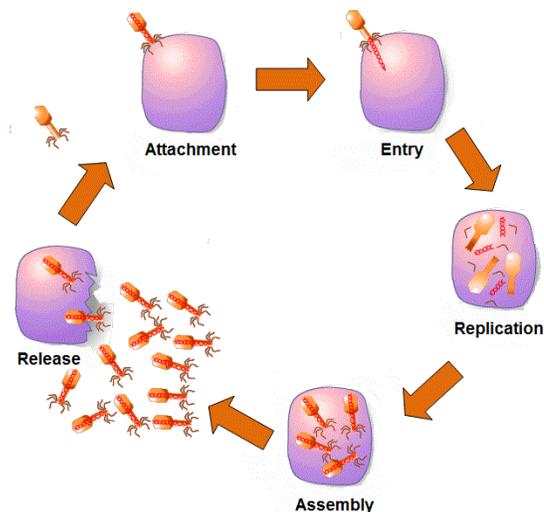
messenger RNA (mRNA) molecules that are then used to direct the cell's ribosomes. One of the first polypeptides to be translated is one that destroys the hosts' DNA.

4) Assembly

After many copies of viral components are made, they are assembled into complete viruses. In the case of the T4 phage, proteins coded for by the phage DNA act as enzymes for construction of the new phages (Towle 1989). The entire host metabolism is directed toward this assembly, resulting in a cell filled with new viruses.

5) Lysis

After assembly of the new virus particles, an enzyme is produced that breaks down the bacteria cell wall from within and allows fluid to enter. The cell eventually becomes filled with viruses (typically 100-200) and liquid, and bursts, or lyses thus giving the lytic cycle its name. The new viruses are then free to infect other cells and start the process again.



Steps of lytic cycle

Latent Phase in Viruses

- Some viruses are capable to dormant inside the host cell are called latent viruses.
- They might be inactive for long time (years).
- They may re-activate to lytic phase in response to some external signal.
- HIV and Herpes viruses are such examples.

Lysogenic Cycle

The lysogenic cycle involves the incorporation of the viral into genome the host cell genome, infecting it from within. A form of viral reproduction involving the fusion of the nucleic acid of a bacteriophage with that of a host, followed by proliferation of the resulting prophage.

Following steps involves in the lysogenic cycle.

1) Adsorption

Attachment of adsorption of tail fibers of the phage on to a specific receptor site on the bacterial cell wall.

2) Injection

Injection of viral genome into the host through the hollow tubes of the tail.

3) Integration of viral genome to the host genome

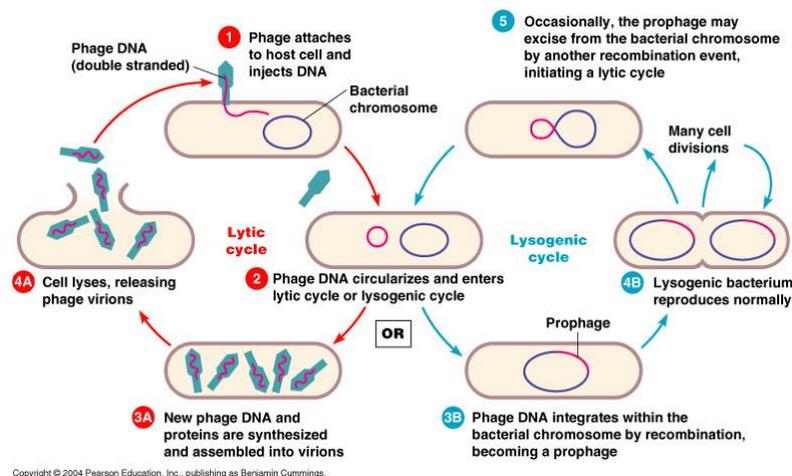
After the entry of viral genome, it gets integrated into the bacterial genome of the host. The viral genome integrated to the bacterial genome is termed prophage

4) Viral genome synthesis

Viral genome replicates along with the bacterial genome replication and Pass on to the daughter cells.

5) Induction of lytic cycle

Occasionally, integrated viral genome detaches and released into the bacterial cytoplasm. This dissociation is called induction and lytic cycle is followed releasing mature lysogenic phages. Induction can be induced artificially using ultraviolet rays or heat treatment.



Lysogenic cycle

Herpes Viruses

Herpes simplex virus is a common viral infection that presents with localized blistering. It affects most people on one or more occasions during their lives. Herpes simplex is commonly referred to as cold sores or fever blisters, as recurrences are often triggered by a febrile illness, such as a cold. • They can also become latent in the nervous system. A herpes infection persists for a person's lifetime.

Examples of herpes virus

- Genital herpes (Herpes Simplex 2)
- Cold sores or fever blisters (Herpes Simplex1)

Vaccination

Vaccination is the administration of antigenic material (a vaccine) to stimulate an individual's immune system to develop adaptive immunity to a pathogen. Vaccines can prevent or ameliorate morbidity from infection. An attenuated virus is a less vigorous and weakened virus. Attenuate" refers to experimental mechanism by which one weakens an agent of disease (heating). A vaccine against a viral disease can be made from less virulent strain of the virus. Attenuated by heating a virus is capable of stimulating an immune response and creating immunity, but not causing illness.

Other Viral Treatments

Interferon is naturally occurring proteins synthesized by cell itself to fight against viruses. Following drugs are used for the treatment of virus

- Genetic altering of viruses
(Attenuated viruses)
- Antiviral drugs (AZT)
- Protease inhibitors

Reference:

https://en.wikipedia.org/wiki/Viral_replication

http://www.newworldencyclopedia.org/entry/Lytic_cycle

<://www.boundless.com/biology/textbooks/boundless-biology-textbook/viruses-21/virus-infections-and>

<http://www.dermnetnz.org/viral/herpes-simplex.html>

<https://en.wikipedia.org/wiki/Vaccination>