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Topic: Bacteriophage

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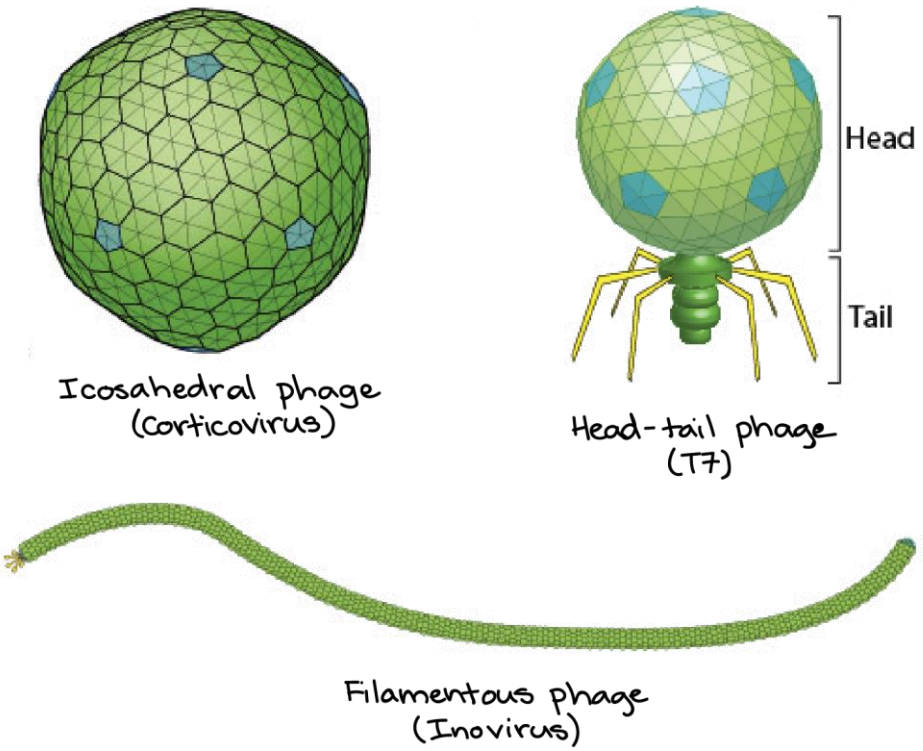
Bacteriophage:

A **bacteriophage**, or **phage** for short, is a virus that infects bacteria. Like other types of viruses, bacteriophages vary a lot in their shape and genetic material. Phage genomes can consist of either DNA or RNA, and can contain as few as four genes or as many as several hundred.



(Fig.- Structure of Bacteriophage)

Bacteriophage infections:

Bacteriophages, just like other viruses, must infect a host cell in order to reproduce. The steps that make up the infection process are collectively called the **lifecycle** of the phage.

Some phages can only reproduce via a lytic lifecycle, in which they burst and kill their host cells. Other phages can alternate between a lytic lifecycle and a lysogenic lifecycle, in which they don't kill the host cell (and are instead copied along with the host DNA each time the cell divides).

Let's take closer look at these two cycles. As an example, we'll use a phage called lambda (λ), which infects *E. coli* bacteria and can switch between the lytic and lysogenic cycles.

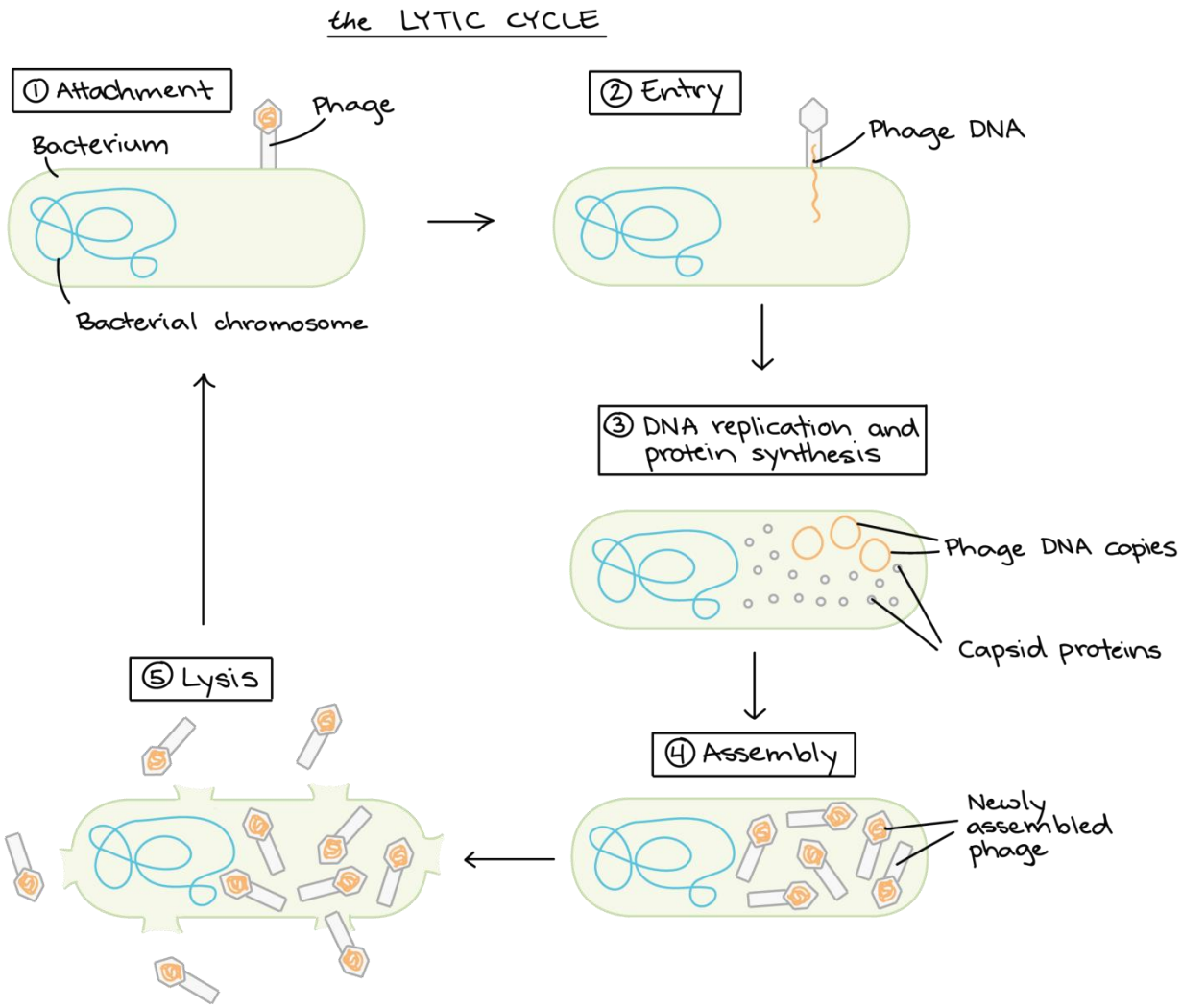
Lytic cycle:

In the **lytic cycle**, a phage acts like a typical virus: it hijacks its host cell and uses the cell's resources to make lots of new phages, causing the cell to **lyse** (burst) and die in the process.

The stages of the lytic cycle are:

1. **Attachment**: Proteins in the "tail" of the phage bind to a specific receptor (in this case, a sugar transporter) on the surface of the bacterial cell.
2. **Entry**: The phage injects its double-stranded DNA genome into the cytoplasm of the bacterium.
3. **DNA copying and protein synthesis**: Phage DNA is copied, and phage genes are expressed to make proteins, such as capsid proteins.
4. **Assembly of new phage**: Capsids assemble from the capsid proteins and are stuffed with DNA to make lots of new phage particles.

5. **Lysis**: Late in the lytic cycle, the phage expresses genes for proteins that poke holes in the plasma membrane and cell wall. The holes let water flow in, making the cell expand and burst like an overfilled water balloon.



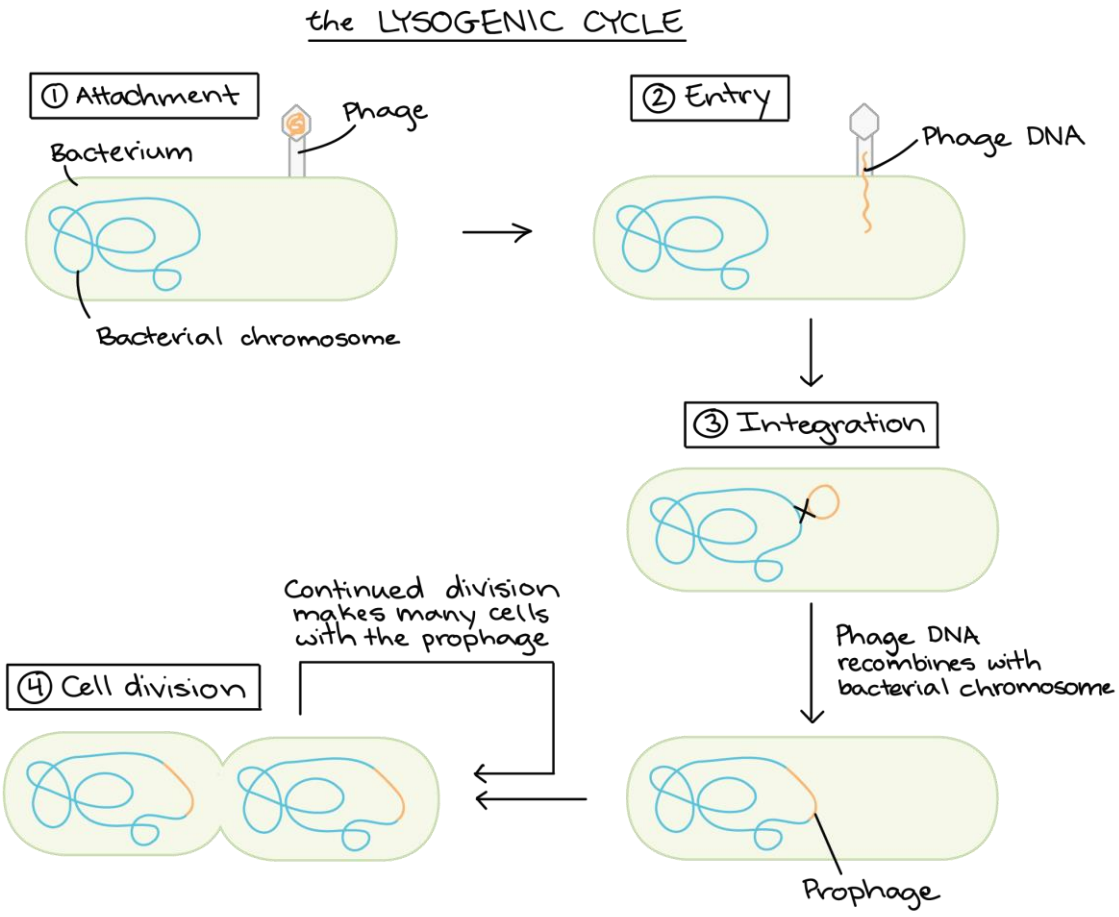
(Fig.- Lytic life-cycle of Bacteriophage)

Cell bursting, or **lysis**, releases hundreds of new phages, which can find and infect other host cells nearby. In this way, a few cycles of lytic infection can let the phage spread like wildfire through a bacterial population.

Lysogenic cycle:

The **lysogenic cycle** allows a phage to reproduce without killing its host. Some phages can only use the lytic cycle, but the phage we are following, lambda (\lambdaλlambda), can switch between the two cycles.

In the lysogenic cycle, the first two steps (attachment and DNA injection) occur just as they do for the lytic cycle. However, once the phage DNA is inside the cell, it is not immediately copied or expressed to make proteins. Instead, it recombines with a particular region of the bacterial chromosome. This causes the phage DNA to be integrated into the chromosome.

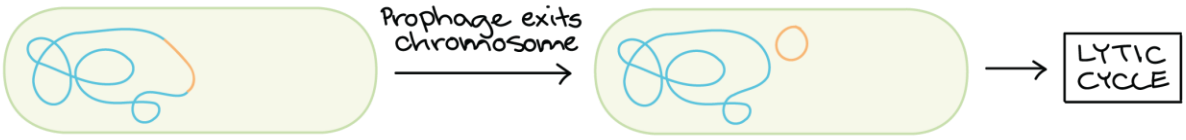


(Fig.- Lysogenic life-cycle of Bacteriophage)

The integrated phage DNA, called a **prophage**, is not active: its genes aren't expressed, and it doesn't drive production of new phages. However, each time a

host cell divides, the prophage is copied along with the host DNA, getting a free ride. The lysogenic cycle is less flashy (and less gory) than the lytic cycle, but at the end of the day, it's just another way for the phage to reproduce.

Under the right conditions, the prophage can become active and come back out of the bacterial chromosome, triggering the remaining steps of the lytic cycle (DNA copying and protein synthesis, phage assembly, and lysis).



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