

# **Bacteriophage Reproduction**

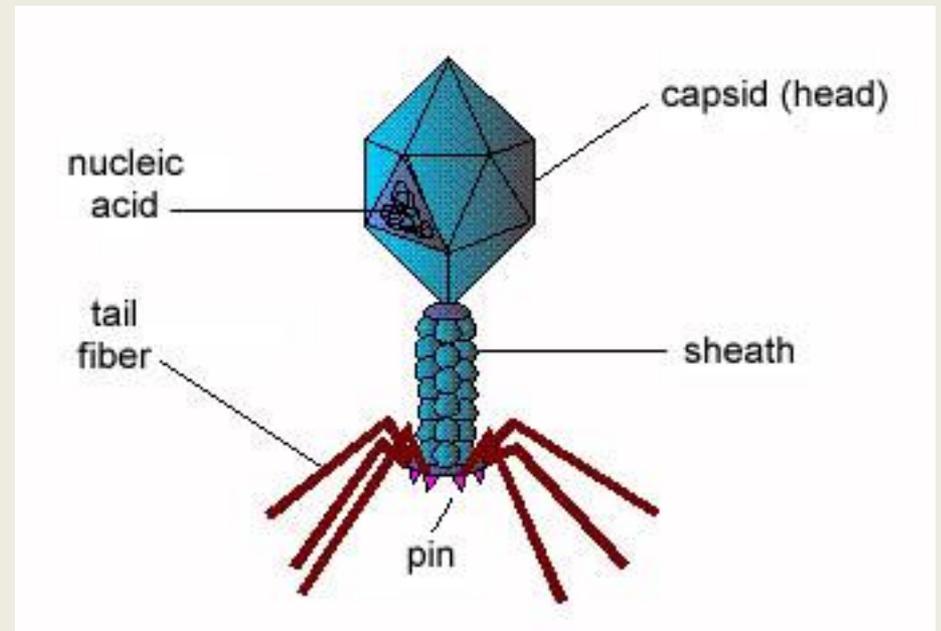
## Lytic and Lysogenic Cycles

The following information is taken from:

<http://student.ccbcmd.edu/courses/bio141/lecguide/unit3/index.html#charvir>

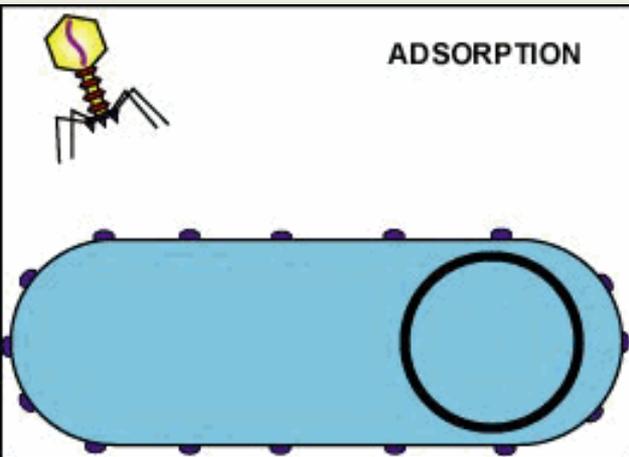
# Bacteriophage Structure

- More complex compared to other types of viruses
- Head = naked icosahedral capsid
- Tail = sheath with fibers at the end

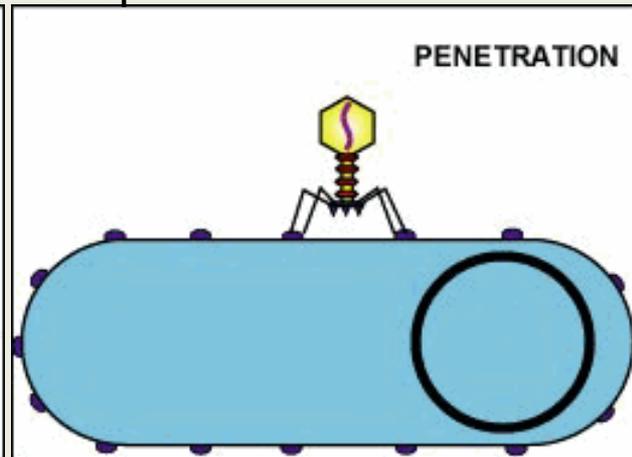


# Bacteriophage Life Cycle Overview

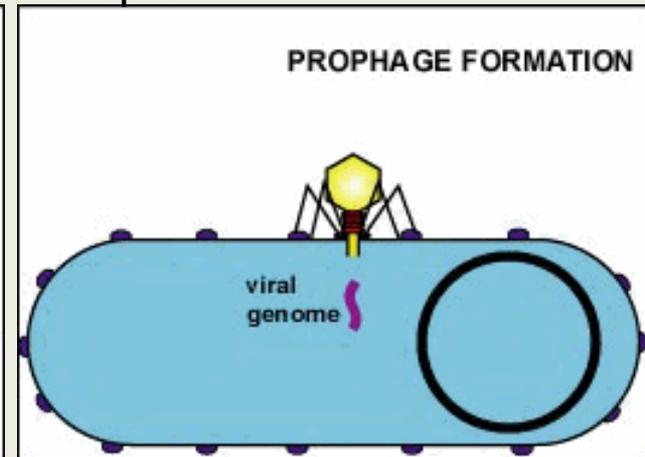
Step 1



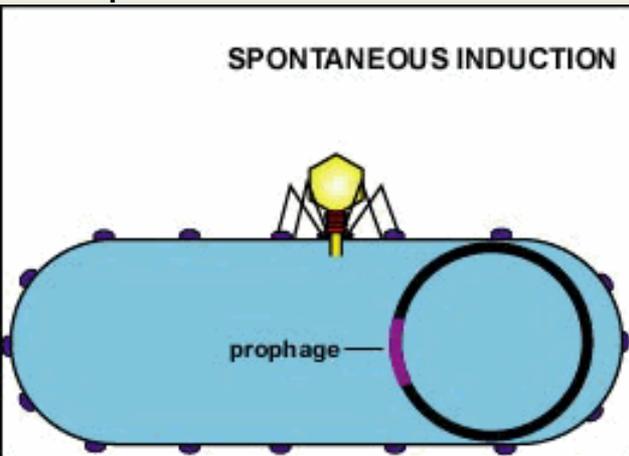
Step 2



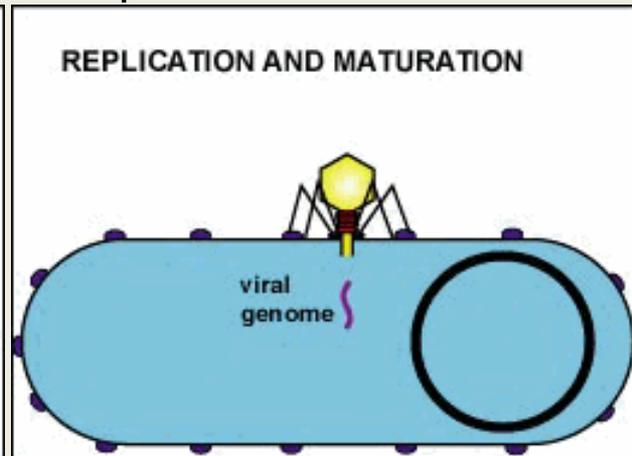
Step 3



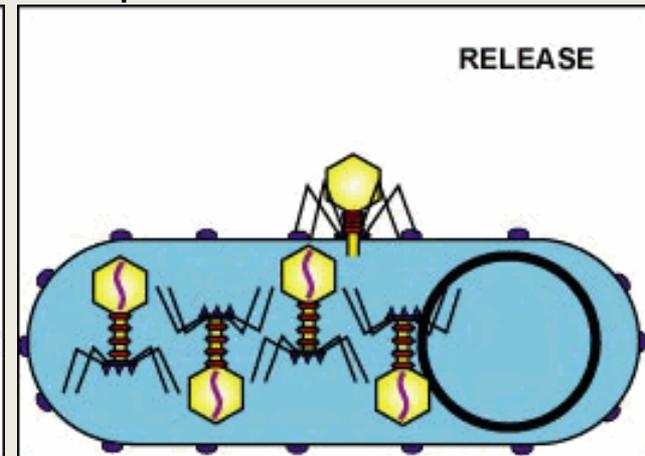
Step 4



Step 5



Step 6



Lytic = steps 1, 2, 5, 6

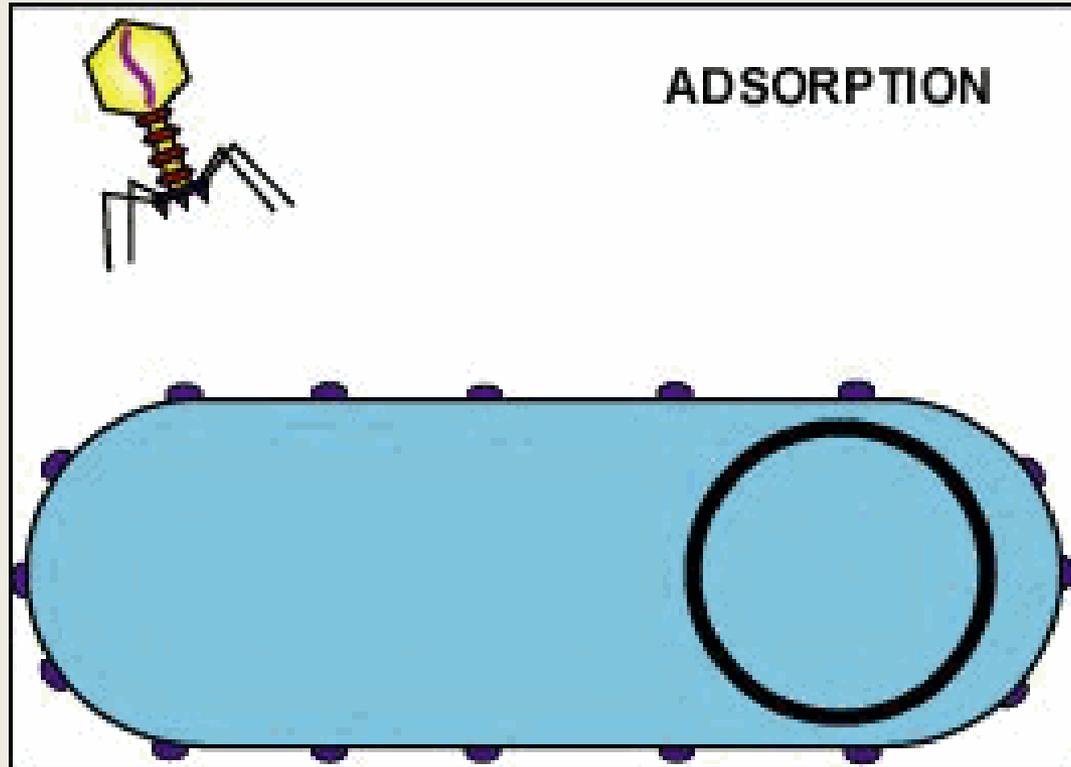
Lysogenic = steps 1, 2, 3, 4 (5 & 6 occur later)

# The Lytic Cycle

The following information is taken from:

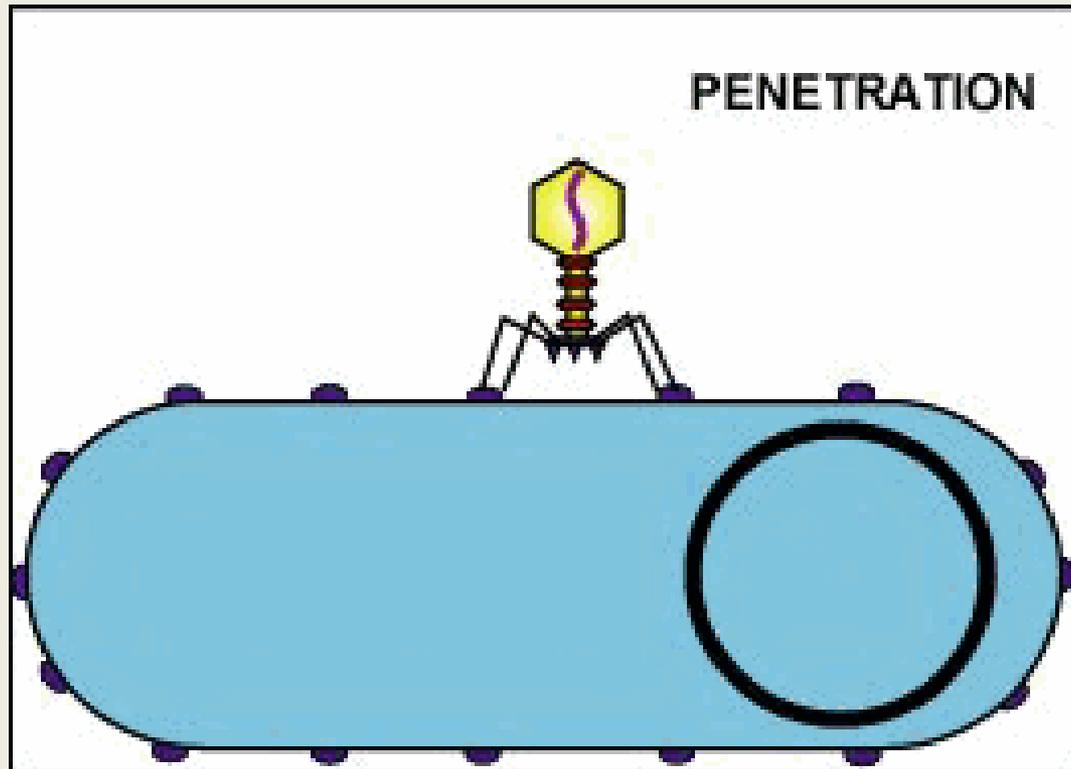
<http://student.ccbcmd.edu/courses/bio141/lecguides/unit3/index.html#charvir>

## Adsorption of a Bacteriophage to the Cell Wall of the Bacterium



Protein on viral surface attaches to a specific receptor on the host cell surface.

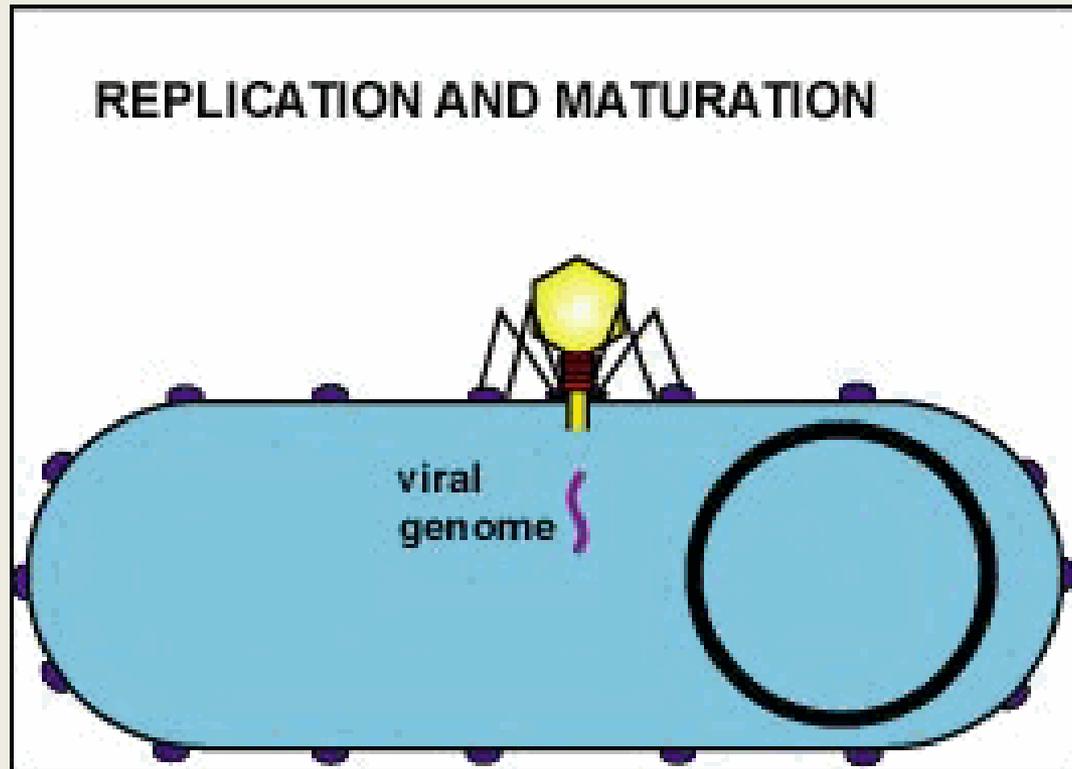
## Penetration of the Viral Genome into the Cytoplasm of the Bacterium



This step is also known as 'Entry'.

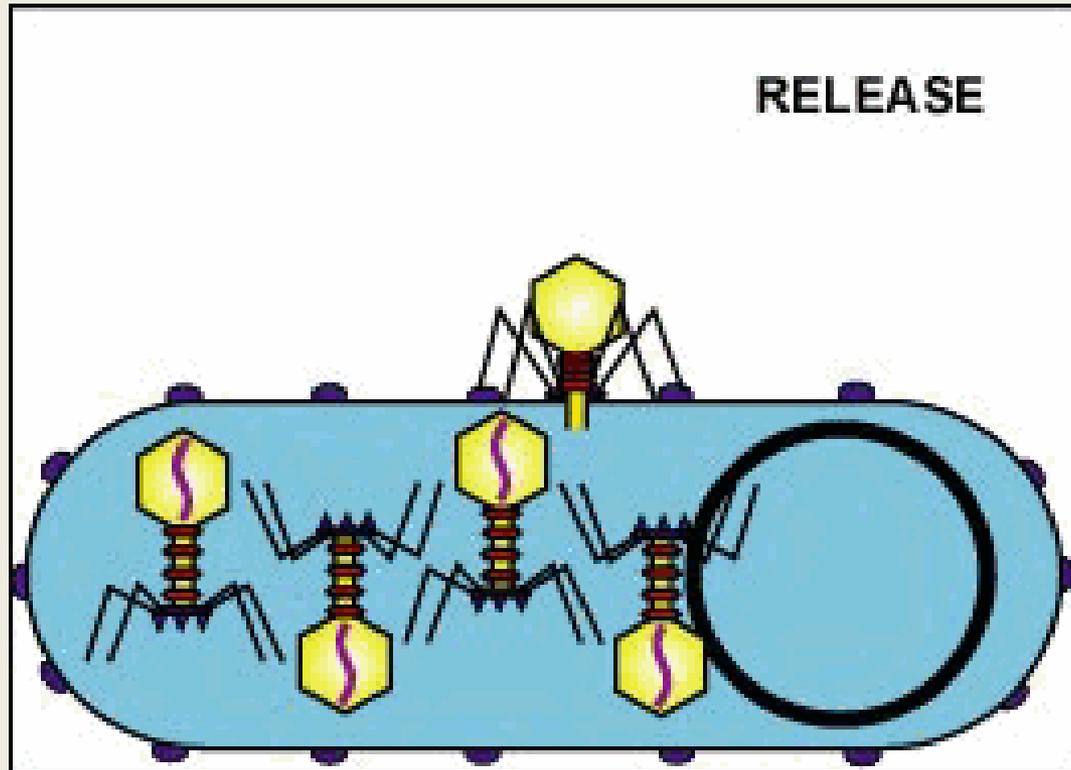
The viral genome (DNA or RNA) enters the host cell.

## Viral Replication and Maturation



Viral DNA is transcribed and then translated by the host cell. The protein parts produced are then assembled together while still inside the host cell.

## Release of the Bacteriophages by Lysis of the Bacterium



The fully formed viruses burst from the host cell by lysing it.

# Lytic Cycle Summary

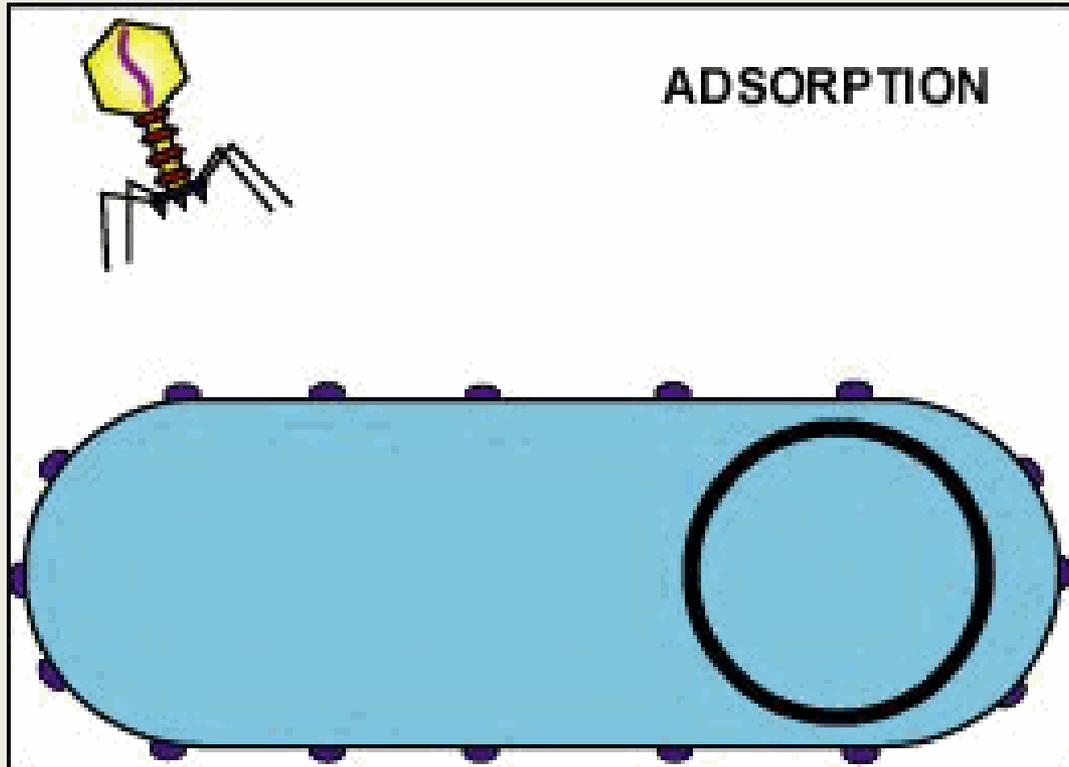
1. Adsorption: Attachment of virus to host cell surface
2. Entry: Penetration of virus into the host cell
3. Replication: using viral genome to make viral RNA and proteins
4. Assembly of new virus components
5. Lysis of host cell & Release of virions

# The Lysogenic Cycle

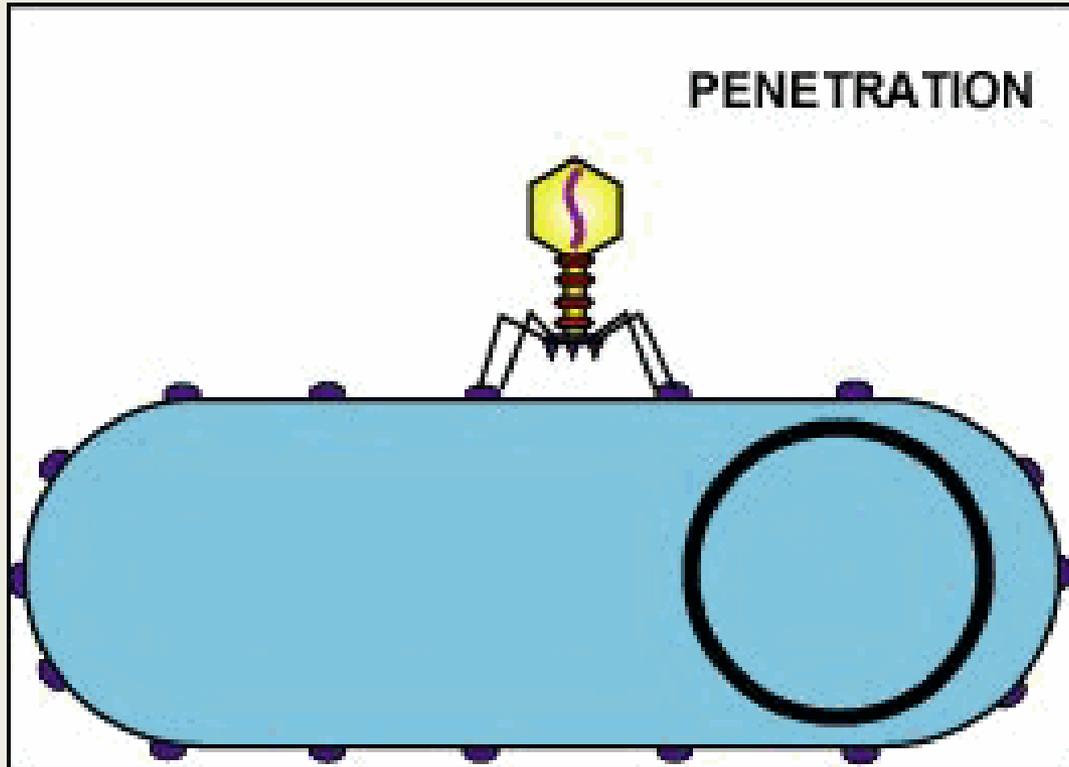
The following information is taken from:

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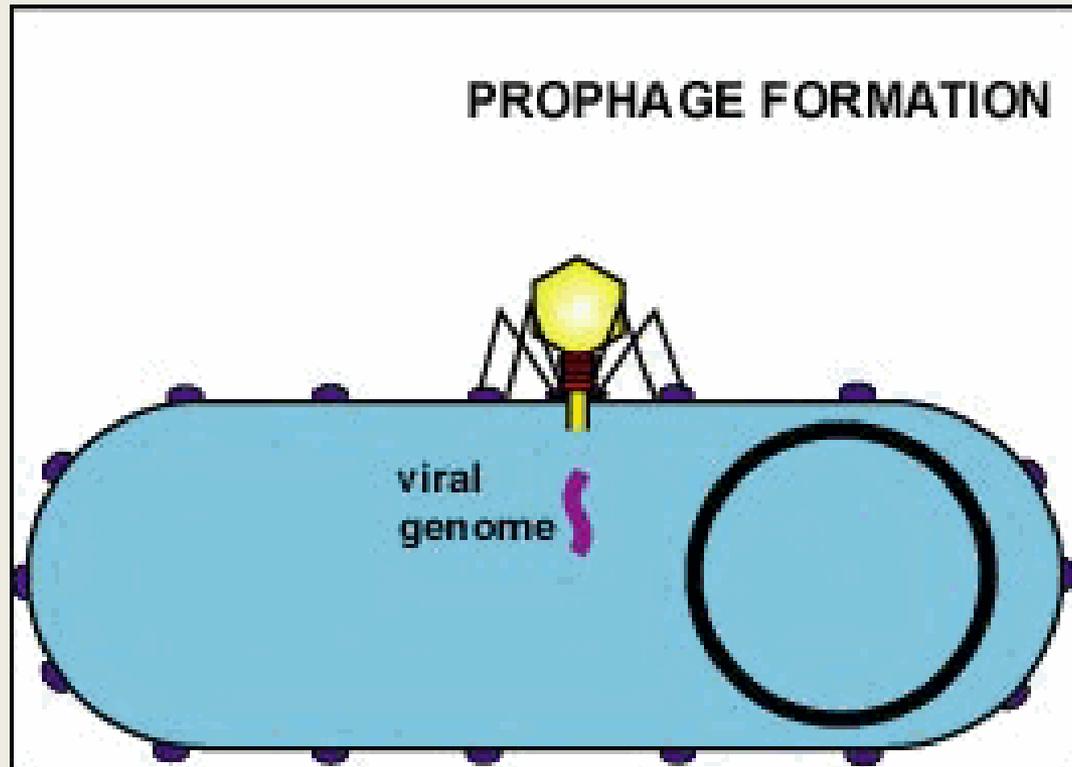
# Adsorption of a Bacteriophage to the Cell Wall of the Bacterium



# Penetration of the Viral Genome into the Cytoplasm of the Bacterium



## Formation of a Prophage

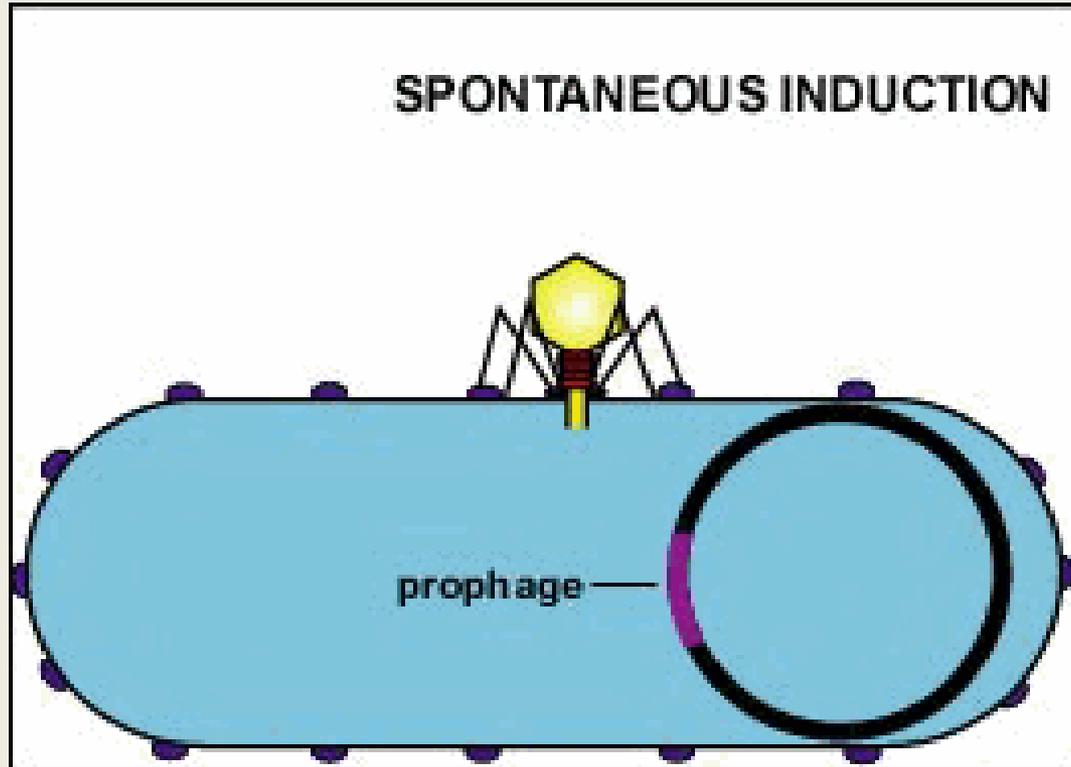


Provirus = viral DNA integrated into host DNA

Prophage = bacteriophage viral DNA integrated into host DNA

The viral DNA is inserted into the host cell's chromosome. As the host cell replicates its own DNA and divides itself during mitosis, the provirus/prophage is replicated along with it. The provirus/prophage lives dormant inside the host cell until...

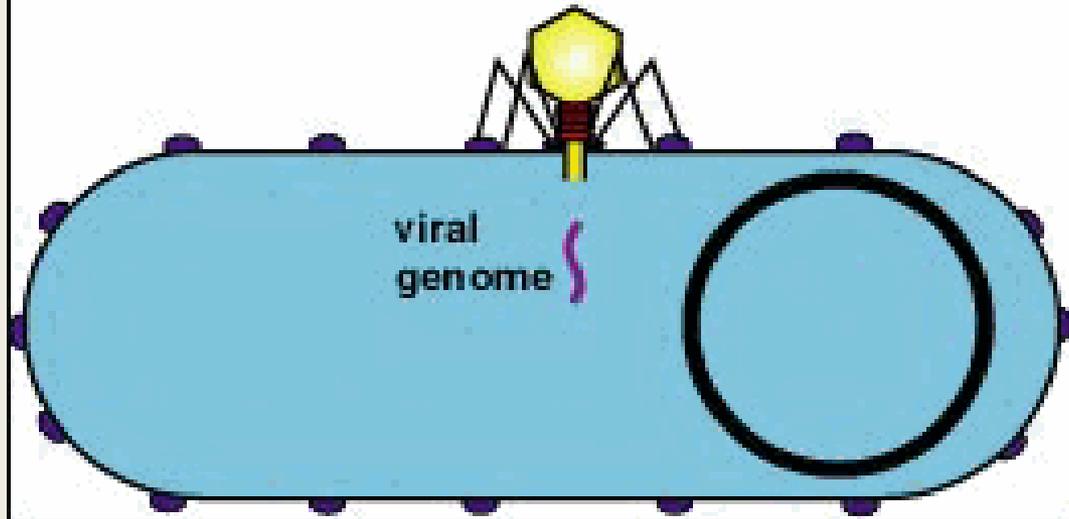
## Spontaneous Induction



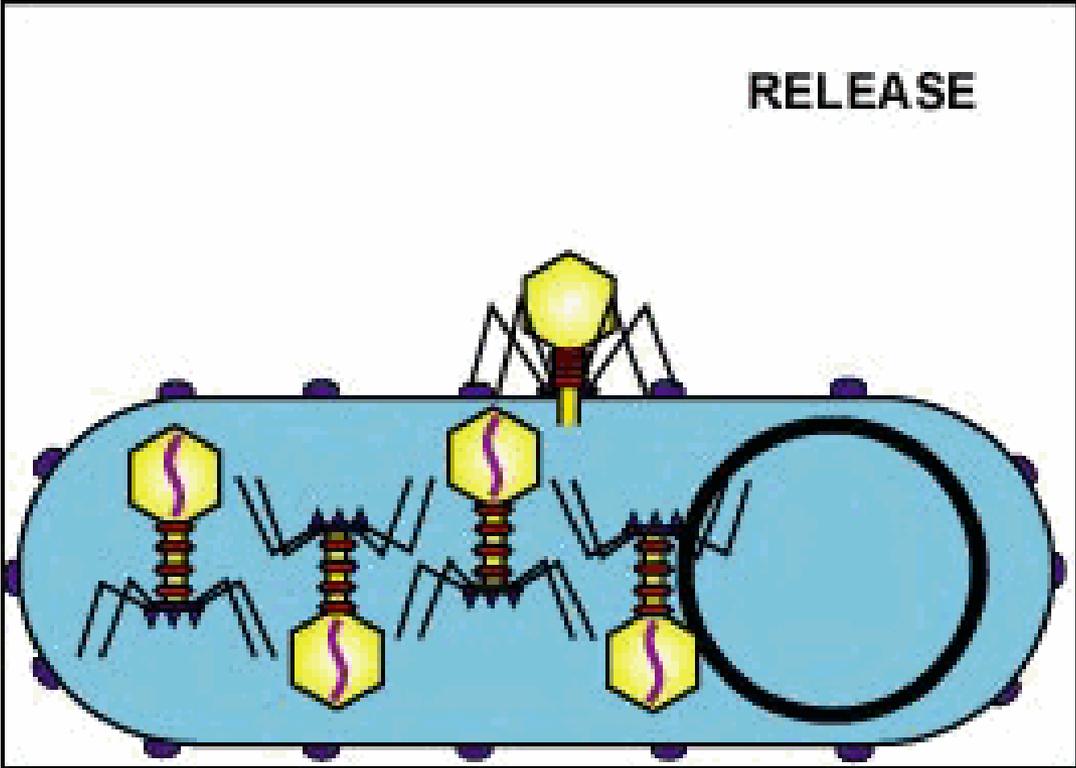
The separation of the provirus from the host chromosome. At this point the virus will complete the steps of the lytic cycle.

# Viral Replication and Maturation

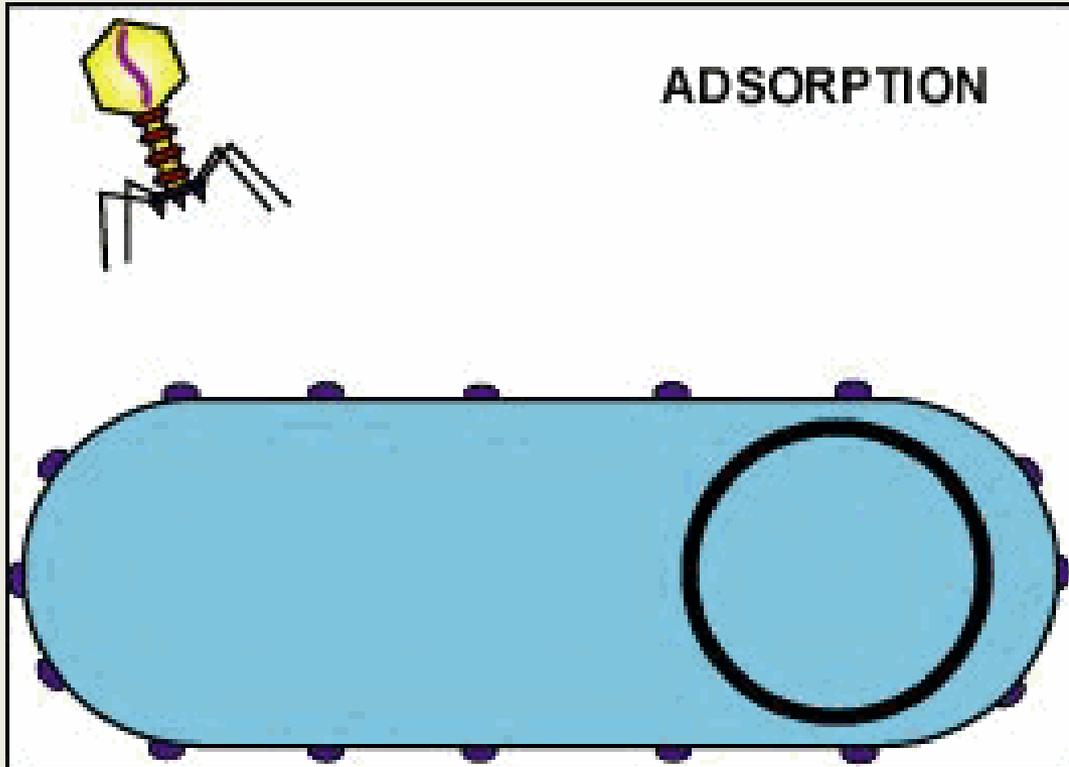
## REPLICATION AND MATURATION



# Release of the Bacteriophages by Lysis of the Bacterium



## Summary of the Entire Lysogenic Cycle

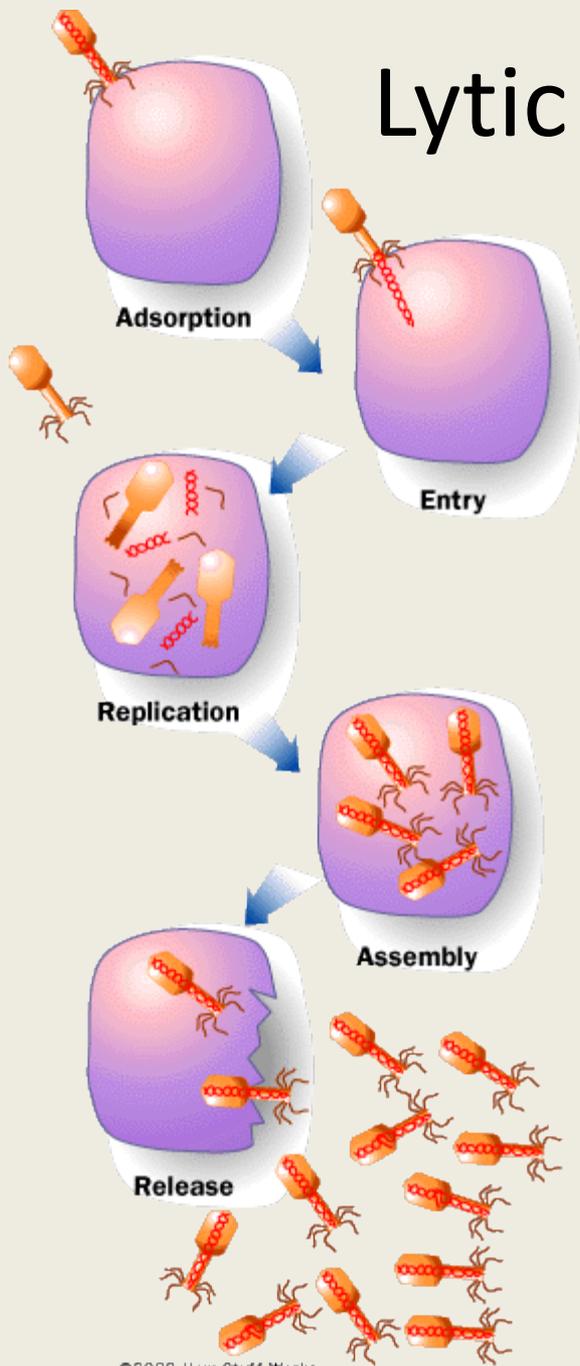


1. Adsorption
2. Entry
3. Integration: formation of provirus or prophage by inserting viral DNA into host genome
4. Spontaneous induction: release of viral DNA from host genome
5. Replication
6. Assembly
7. Lysis & Release

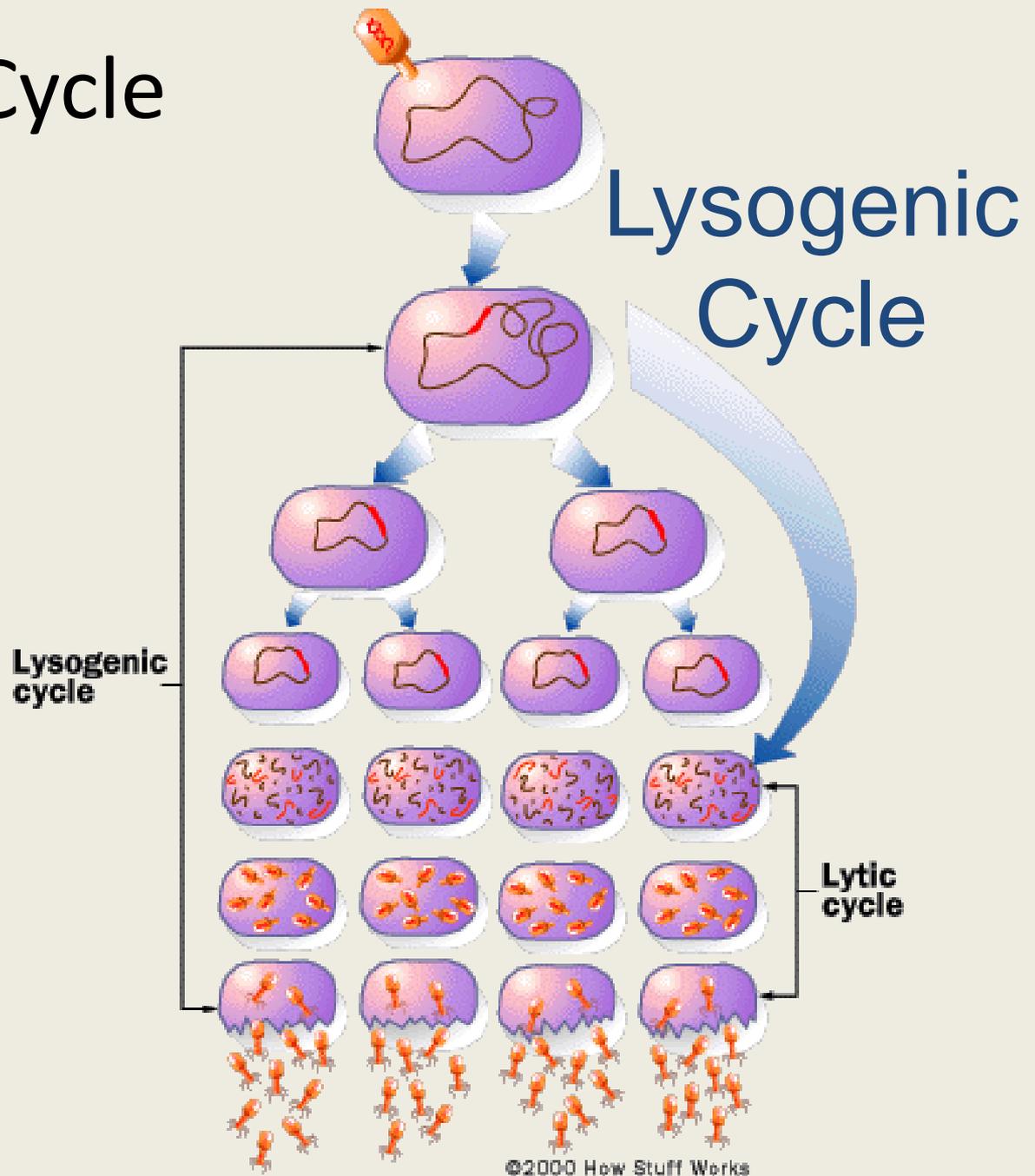
# **Comparing the two Reproductive Strategies**

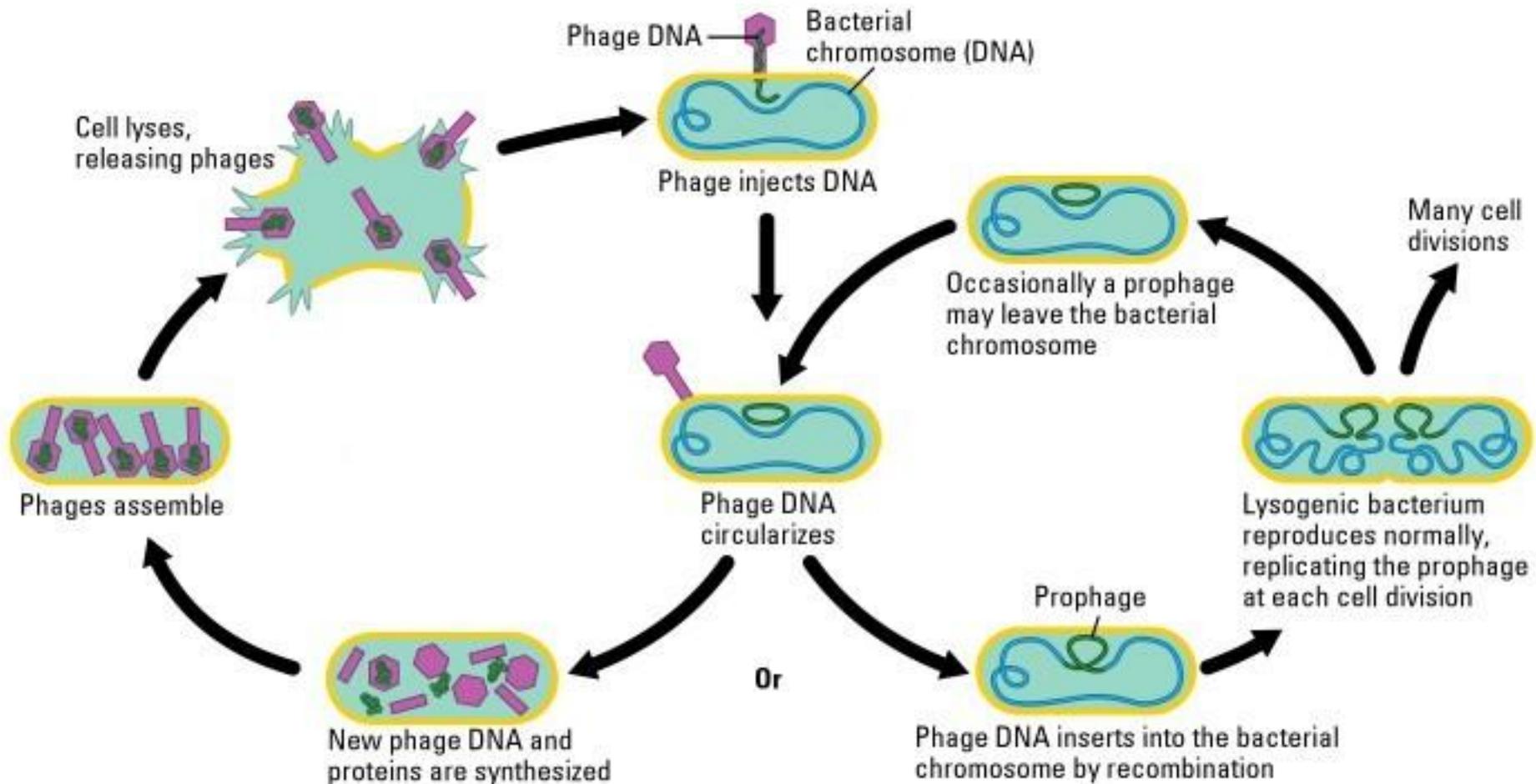
Lytic versus Lysogenic

# Lytic Cycle



# Lysogenic Cycle





# Advantages and Limits

## Lytic cycle

- Replication of new viruses is fast
- However, the host is also immediately killed preventing the viral genome from passing onto the next generation of host cells

## Lysogenic cycle

- Many more viruses can be made because the viral genome is passed onto future generation of host cells
- However, replication is takes longer because it is dependent on the host cell's replication
- Killing host means the virus dies too

# Central Dogma

## DNA → RNA → Protein

- DNA = genetic information (original instructions)
- RNA = a copy of the genetic information (message)
- Protein = building blocks of life (workers)
- Transcription: DNA → RNA
- Translation: RNA → proteins

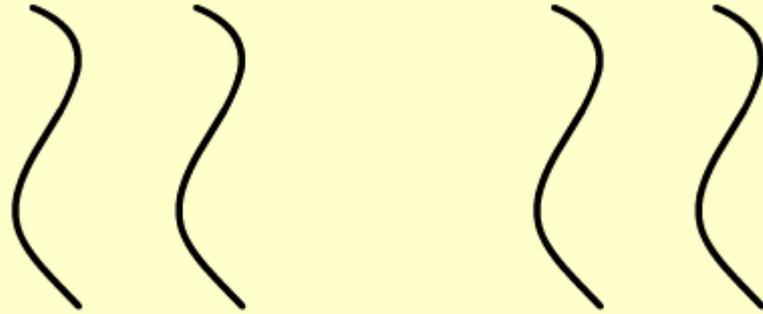
<http://www.youtube.com/watch?v=ztPkv7wc3yU&feature=related> (transcription)

[http://www.youtube.com/watch?v=OtYz\\_3rkvPk&feature=related](http://www.youtube.com/watch?v=OtYz_3rkvPk&feature=related)

<http://www.youtube.com/watch?v=0248WyghCjc&feature=related> (translation)

The viral genome directs the host cell's metabolic machinery (ribosomes, tRNA, nutrients, energy, enzymes, etc.) to synthesize viral enzymes and viral parts.

## REPLICATION



**The viral genome replicates by complementary base pairing.**

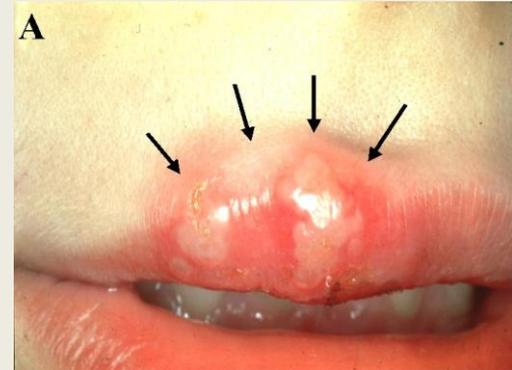
# DNA viruses

Viral DNA can be integrated into the host cell genome so that it can then be transcribed and translated using the host cell's machinery

Steps:

1. Viral DNA integrate into host DNA
2. During transcription of host cell's DNA, the viral DNA is transcribed along with it
3. Viral RNA is then translated into viral proteins which are the components that assemble to form the virion (new virus)
4. Example: Herpes, Epstein-Barr, Mononucleosis, Rabies

# Herpes



Herpes Simplex 1 and herpes simplex 2.

**The sores are sometimes accompanied by other symptoms such as:**

headache, fever, and other flu-like symptoms  
pain, itching, tingling, or tenderness around the genitals  
painful urination, swollen tender points in the groin and lower abdomen

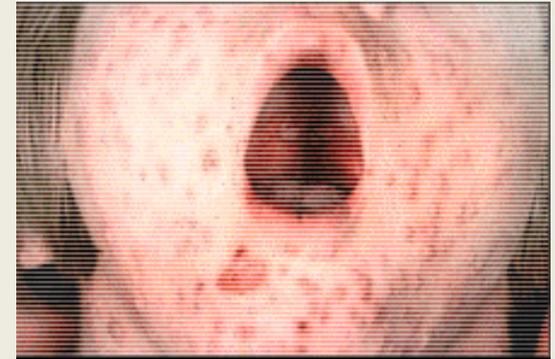
# Chicken Pox

varicella-zoster virus  
(VZV)



Disseminated chicken pox lesions on the back

ASM MicrobeLibrary.org © Tomalty



# RNA viruses

Viral RNA can be immediately translated with host cell's machinery, skipping transcription. This occurs in the cell's cytoplasm.

Steps:

1. Ribosomes bind to all types of RNA, both host cell's and viral RNA
2. Ribosomes translate RNA into protein
3. The viral proteins produced are the components that will be assembled to form the virion (new virus)
4. Example: HIV, Influenza, Tobacco Mosaic Virus

# Retroviruses (RNA Virus)

Retroviruses have an enzyme that is capable of reverse transcribing their RNA into DNA. This viral DNA can then be integrated into the host cell's genome.

Retroviruses replicate with a high mutation rate. This increases its ability to evolve and survive.

Steps:

1. Viral RNA enters the host cell along with the enzyme reverse transcriptase
2. Reverse transcriptase copies the viral RNA into DNA
3. The reverse transcribed viral DNA is integrated into the host cell's genome

Example: HIV, Hepatitis

# Retroviruses (RNA Virus)

