Not all infections leads to new progeny virus.

↳ not all infectious viruses are virulent
↳ not all viruses replicate inside infectious cell.

- **Productive infection:** permissive cells → production of infectious virus.
  ↳ cells that permit viruses to use their machinary & produce new viruses
  ✓ Progeny
- **Abortive infection:** fails to produce infectious progeny, may be non-permissive cells or the infecting virus may be defective.
  X Progeny
  virus can't replicate without a helper virus which provides the missing function
- **A latent infection:** persistence of viral genomes, the expression of no or a few viral genes, and the survival of the infected cell.
  X Progeny
  (virus just lives inside cell without replicating)

* gene expression just to survive
* examples: Herpes, remains inside cell ⟶ stress or problem in immunity → elicit replication

The unique feature of viral replication is that soon after interaction with the host cell , the infecting virion is disrupted and its measurable infectivity is lost (eclipse period) ; its duration varies depending on both the virus and the host cell, and it is followed by an interval of rapid accumulation of infectious progeny virus particles. The latent period, in contrast, is defined as the time from the onset of infection to the appearance of virus extracellularly.

virus = capsid + nucleic acid

here ↗ seperate so no virus (uncoating)

اختفاء

Penetration → nucleic acid + Protein synthesis

eclipse

Assembly → virus extracellulary

latent period

* Before Assembly (complete virus particle)

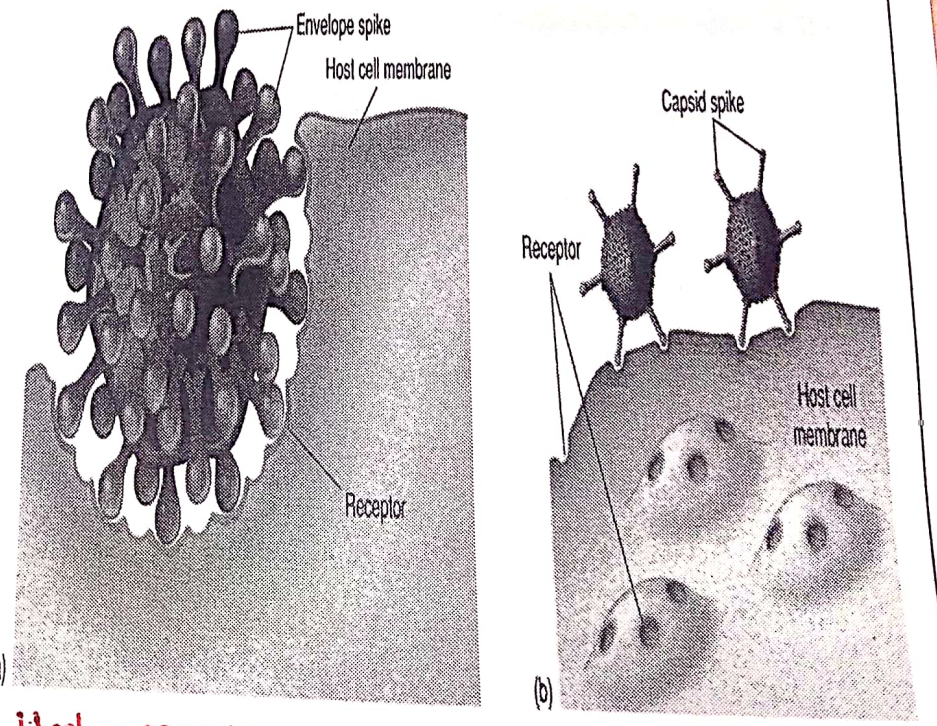
There are 6 major steps in the replication cycle of all viruses:

- **Adsorption.** (Attachment)
- **Penetration.**
- **Uncoating.**
- **Nucleic acid and protein synthesis.**
- **Assembly of virions.**
- **Release.**

(1) **Early events** (**attachment**, **penetration**, and **uncoating**);
(2) **Middle events** (**gene expression** and **genome replication**);
(3) **Late events** (**assembly** and **release**).

Adsorption (Attachment)

Specific viral outer proteins (or glycoproteins on envelope viruses) bind to receptors on cell membrane. This specificity determines the host range and tissue tropism e.g. herpes simplex virus type 1 attaches to the fibroblast growth factor receptor, rabies virus to the acetylcholine receptor, and human immunodeficiency virus (HIV) to the CD4 protein on helper T lymphocytes.



* Host range : the virus infects which kingdom
  ↳ human, mammals, birds
  ↳ remember : influenza A has a broad host range, it can infect human, horse, birds (not only 1 type)
* tissue tropism : which tissue ??
  ↳ brain
  ↳ liver

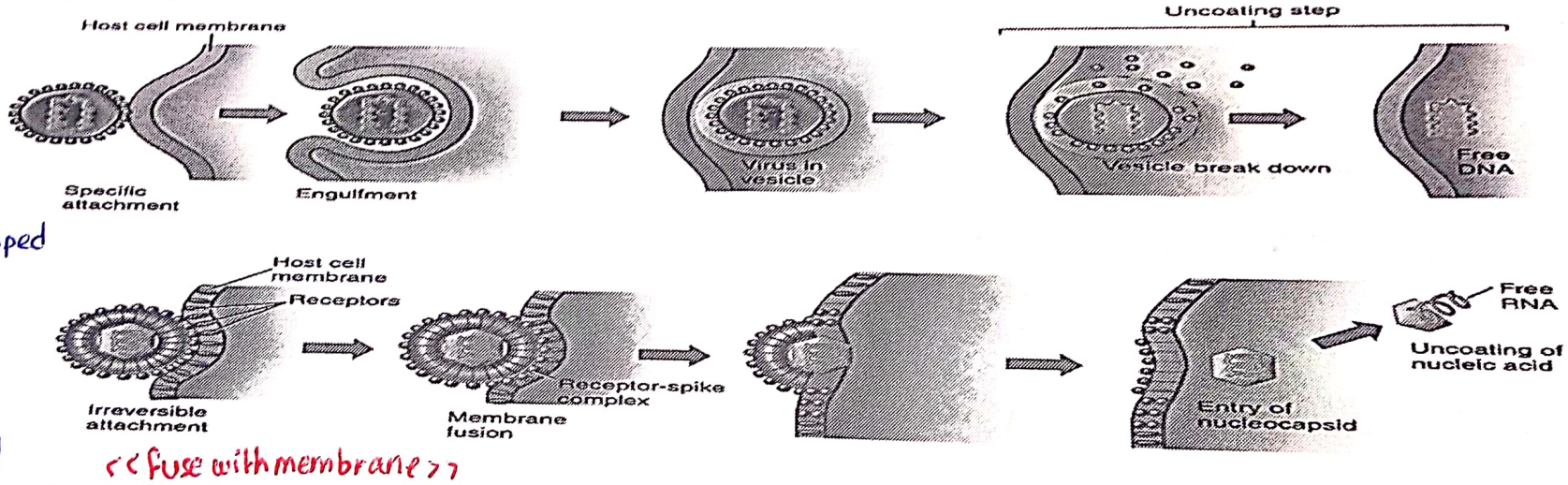
Penetration

Virus uptake by **pinocytosis (viropexis)** or by **fusion** of the viral envelope with the cytoplasmic membrane.

↳ not enveloped

Uncoating

Nucleic acid released.



not enveloped

enveloped

<< fuse with membrane >>

differ in the way of entering & exiting & uncoating

L enveloped
differ in the way of entering & exiting & uncoating

<<fuse with membrane>>

* middle events &-

Nucleic acid and protein synthesis

- *Replication involves synthesis of viral messenger RNA (mRNA) (Transcription) for viruses except positive sense RNA viruses, and viral protein synthesis (Translation).*

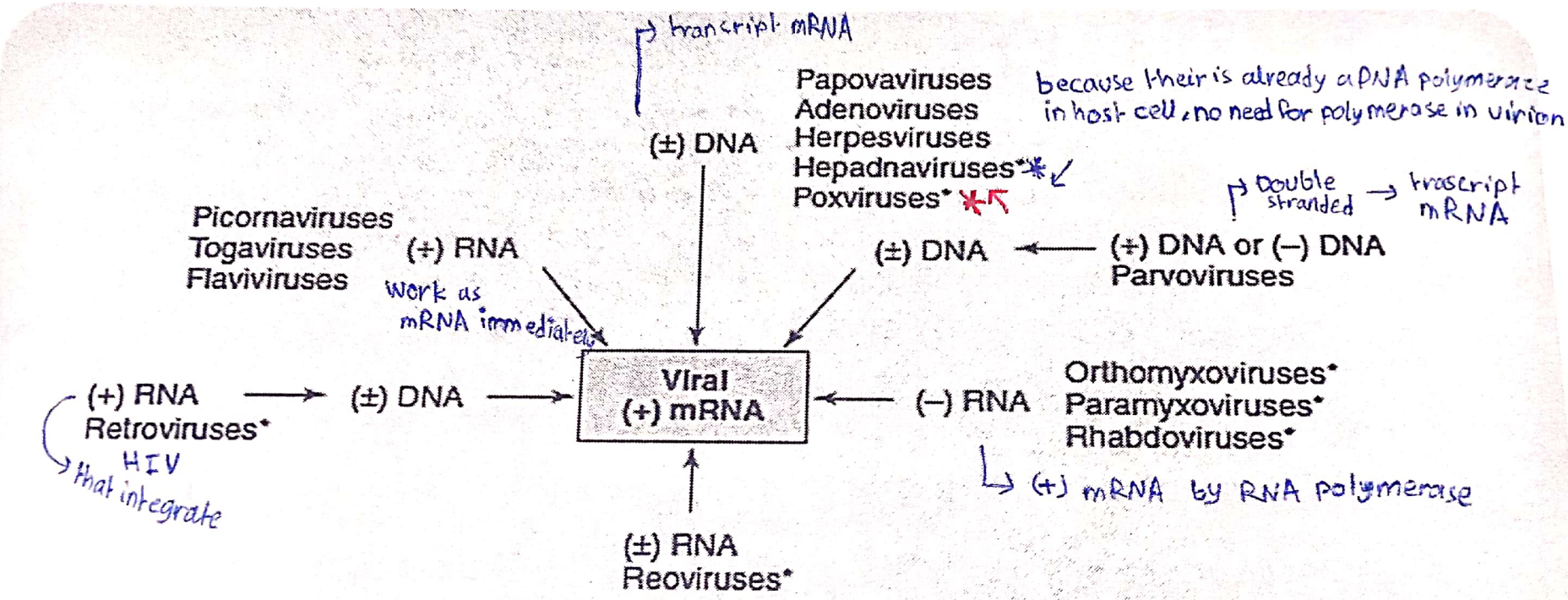
- *Early mRNA and proteins are synthesized; the early proteins are* enzymes *used to replicate the viral genome. Late mRNA and proteins are then synthesized. These late proteins are the* structural, capsid proteins.

(-) mRNA but (+) mRNA doesn't need an enzyme

by using enzymes synthesized by early mRNA

* All DNA viruses replicate in nucleas except poxviruses which replicates in cytoplasm which means that it needs its own polymerase ↳ to use DNA polymerase

* All RNA viruses replicate in cytoplasm except orthomyxoviruses (as influenza ↳ cuz it needs material from nucleus for capping), HIV, Hepatitis B (DNA) ↱ cus its integrated in host cell genome



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* Hepadnaviruses → double stranded with regions of single strandedness thats why it needs it's own polymerase (RT) (HBV)

يقوم العملين ، كما يستخدم تاع الخلية

في Reverse transcriptase

DNA viruses:

The genome replication of most DNA viruses takes place in the cell's nucleus.

Most DNA viruses are entirely dependent on the host cell's DNA and RNA synthesizing machinery, and RNA processing machinery. The viral genome must cross the cell's nuclear membrane to access this machinery.

RNA viruses:

RNA viruses are unique because their genetic information is encoded in RNA. Replication usually takes place in the cytoplasm. The polarity of the RNA largely determines the replicative mechanism, also whether the genetic material is single-stranded or double-stranded. RNA viruses use their own RNA replicase enzymes to create copies of their genomes.

Reverse transcribing viruses:

Reverse transcribing viruses replicate using reverse transcription "reverse transcriptase enzyme", which is the formation of DNA from an RNA template. Reverse transcribing viruses containing RNA genomes use a DNA intermediate to replicate such as retroviruses that often integrate the DNA produced by reverse transcription into the host genome.

↳ HIV, Hepatitis B

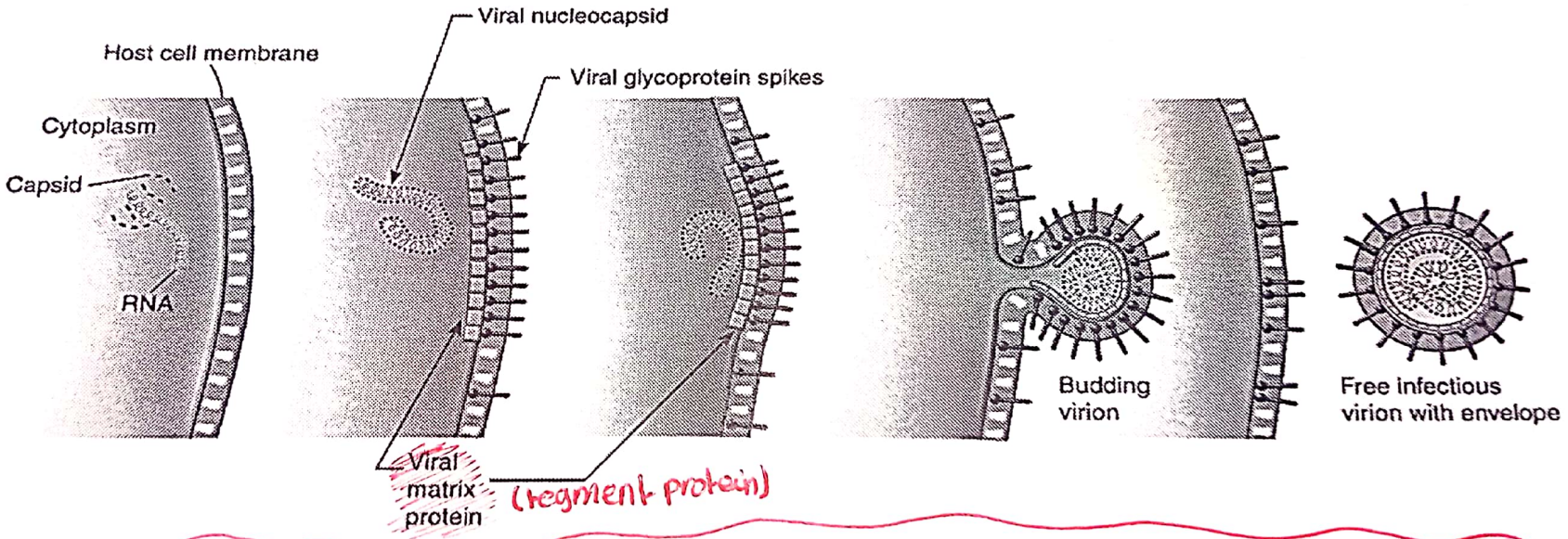
Assembly

The progeny particles are assembled by packaging the viral nucleic acid within the capsid proteins. Following the assembly of the virus particles post-translational modification of the viral proteins often occurs. In viruses such as HIV, this modification, (sometimes called maturation), occurs after the virus has been released from the host cell.

Release

Viruses are released from the host cell by lysis, a process that kills the cell by bursting its membrane. Enveloped viruses (e.g., HIV) typically are released from the host cell by budding. During this process, the virus acquires its envelope which is derived form the host's cell membrane.

non enveloped



* remember:
the envelope only contains virus proteins not from cellmembrane proteins

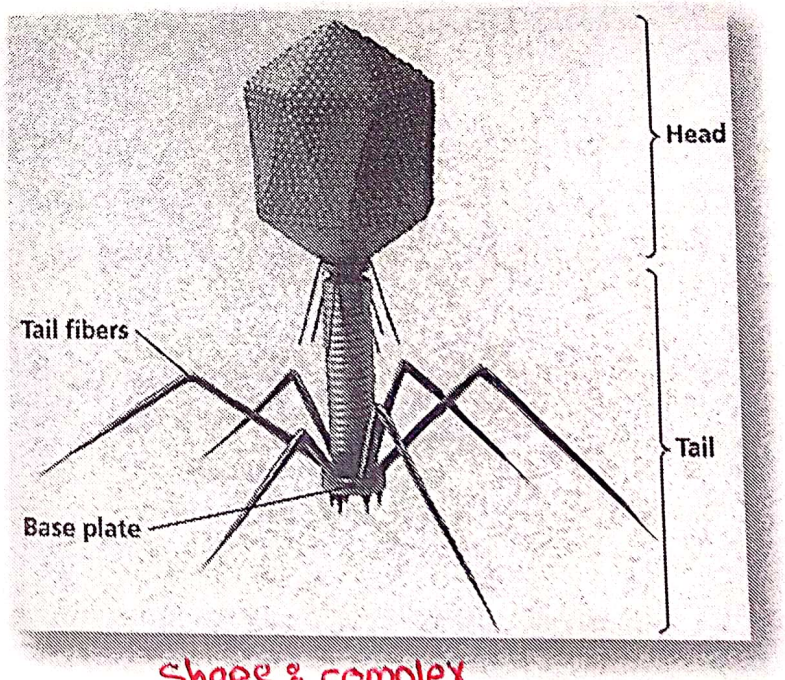
The Bacteriophages

↳ Atypical
↳ pseudovirions

- Viruses that Infect Bacteria.
- Most contain dsDNA.
- Bacteria → more pathogenic for humans.
- Lytic infections and Lysogenic (temperate) infections.

phage

↳ latent infection
↳ integrated in genome

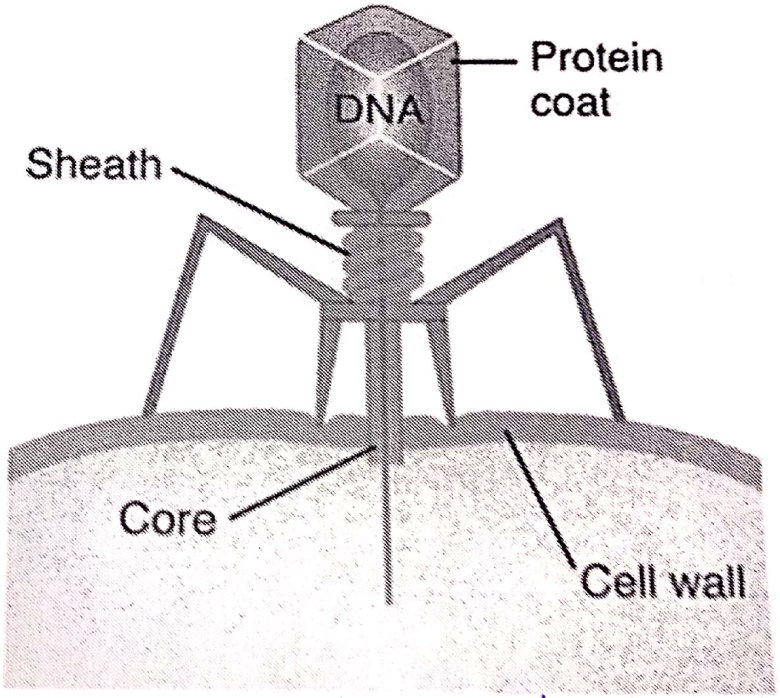


Shape & complex

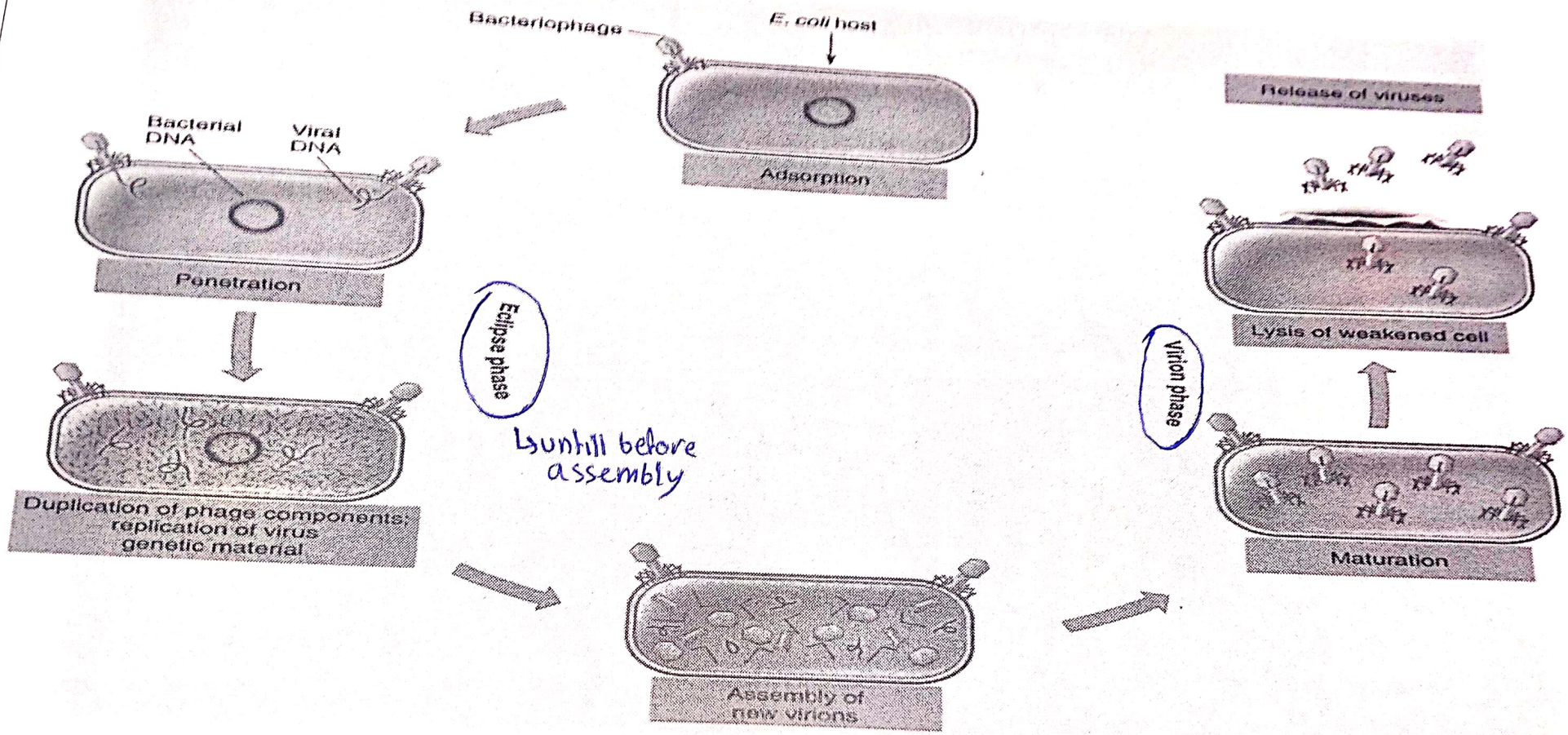
Lytic Infections

Similar stages as animal viruses:

- Adsorb to host bacteria
- The nucleic acid penetrates the host after being injected through a rigid tube inserted through the bacterial membrane and wall.
- The host cell machinery is then used for viral replication and synthesis of viral proteins
- As the host cell produces new parts, they spontaneously assemble and released



* only genome inside cell not as typical viruses



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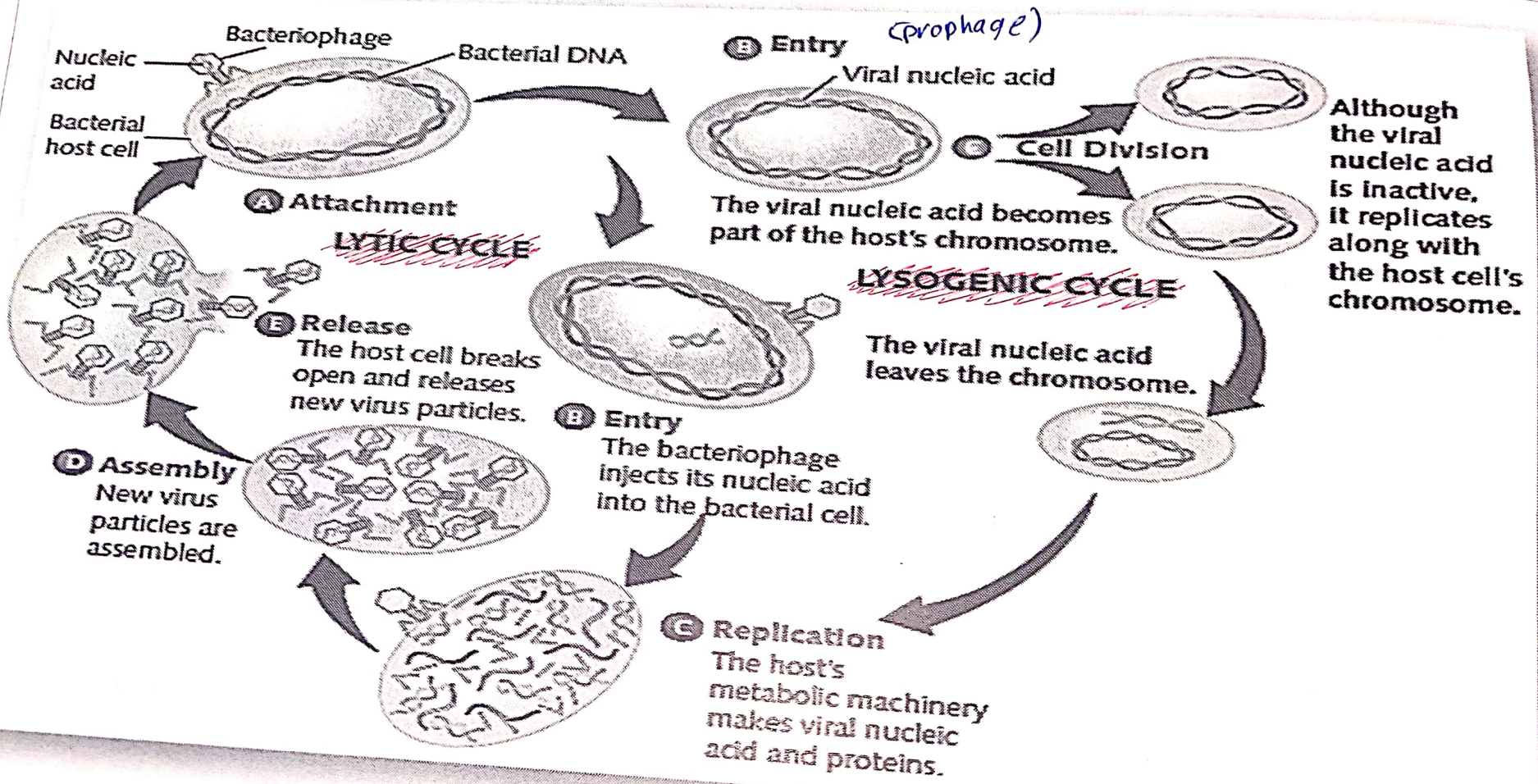
Lysogenic Infections:

- *The Silent Virus Infection*
- ***Temperate phages:*** viral DNA enters an inactive **prophage** stage (→ means integrated)
- ***Lysogeny***: the cell's progeny will also have the temperate phage DNA (phage integrated inside a cell genome)
- ***Lysogenic conversion***: when a bacterium acquires a new trait from its temperate phage (↳ A-B, toxin)
  - ➢ ***Corynebacterium diphtheriae*** **toxin responsible for the disease**
  - ➢ **Lysogenized streptococci erythrogenic toxin.** → Scarlet fever
  - ➢ **Botulinum toxins by lysogenized strains of *C. botulinum*.**

↳ Botulism
↳ food poisning from



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