GENERAL VIROLOGY 2

Viral Replication

By:

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* تكاثر البكتيريا multiplication

* تكاثر الفيروس ← Replication

→ these cells have things that give the virus to use it in the replication

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Not all infections leads to new progeny virus.

→ one of the virus that its copies out the cell at once time in thousand numbers

* Types of the infection ؟

- **Productive infection:** permissive cells → production of infectious virus.
  → the cell permits the virus to enter
  → the virus enter the cell and replicate and produce intact it's normal
- **Abortive infection:** fails to produce infectious progeny, may be non-permissive cells
  ↳ it don't allow virus to enter
  or the infecting virus may be defective.
  ↳ virus itself has a problem, it may be pseudovirion or defective particle
- **A latent infection:** persistence of viral genomes, the expression of no or a few viral genes, and the survival of the infected cell.
  * these virus may do expresson to some gene or still calm and do supress to gene which use to replicat

→ the virus will enter but it will still persist in the cell (no replicate) until

any problem in Immune system ← as [come the opportunity as herpess virus

٢٠٢٠/٤/١٤٤٢

* eclips period → the time From uptake of the virus (Beginning of its penetration) to just befor the assembly of the first intracellular virus particle (طول ما الفيروس داخل الخلية)

* Feature of viral replication *

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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. complet virus

* the virus enters the cell and reach to its own receptor on the surface of the cell, then interact with this receptor → one of the two might happen: 1 2 period in the life of virus

الإخفاء = داخل الخلية

* Eclipse period

this period depend on the virus and host cell

How much time does the virus need to end replication

the cell → How much time does it need to give the virus its needs

→ With the end of the eclips period and all of things that form the virus is happen and start the sequence of the virus together to make viral particle inside the cell befor it out → this called (latent period)

latent period →

From the virus enter until to form the virus particle inside the cell

* latent period: the time from the initiation of infection until to just prior to the first release of the extracellular virus

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

1. Adsorption.
2. Penetration.
3. Uncoating.
4. Nucleic acid and protein synthesis.
5. Assembly of virions.
6. Release.

→ eclipse period (befor the the appearance of the virus intracellular

→ latency period

→ to receptor → enter the cell → remove protein coat and release its genome

(1) **Early events** (**attachment**, **penetration**, and **uncoating**);

(2) **Middle events** (**gene expression** and **genome replication**); → Formation of structural protein that make the capsid + enzyme

(3) **Late events** (**assembly** and **release**).

→ outside the cell

تركيب جزيئات الفيروس مع بعضها

glycoprotein → recognize receptor

Adsorption (Attachment)

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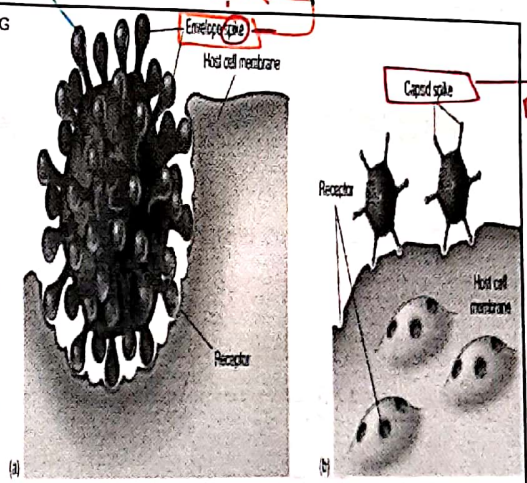
Specific viral outer proteins (or glycoproteins on envelope viruses) bind to receptors on cell membrane. This specificity determines ① the host ② range and tissue tropism e.g, herpes simplex virus type 1 attaches to the fibroblast growth factor receptor, rabies virus to the acetylcholine receptor, and human immunodeficiency virus (HIV) to the CD4 protein on helper T lymphocytes.



the protein will be hone recognize receptor

* tissue tropism → the virus infect certain tissue

Penetration

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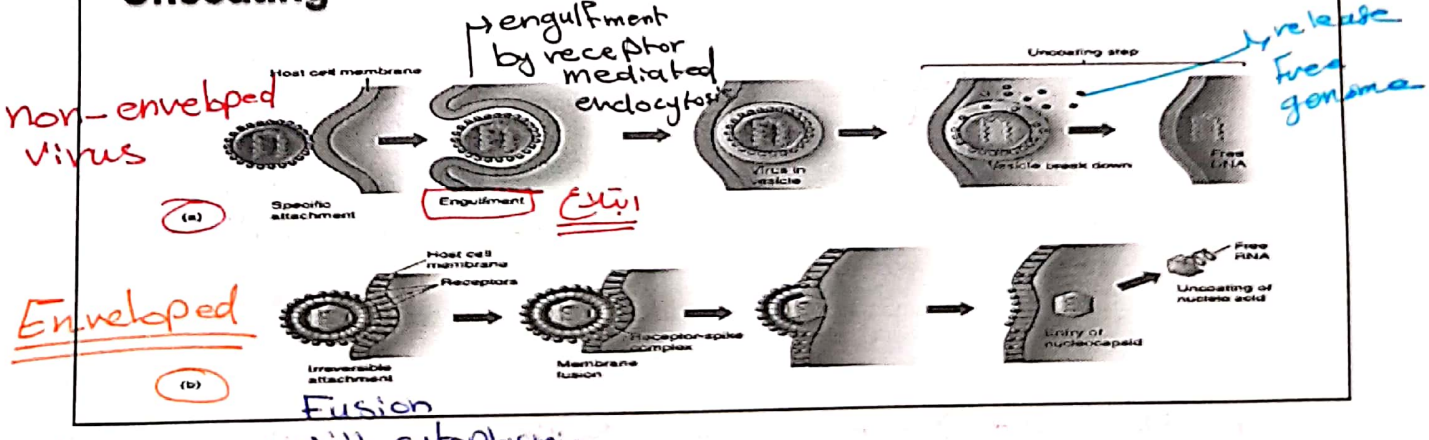
Non endocytosis

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

Uncoating

Nucleic acid released.



engulfment by receptor mediated endocytosis

release free genome

non-enveloped virus

Enveloped

ابتلاع

Fusion with cytoplasmic membrane

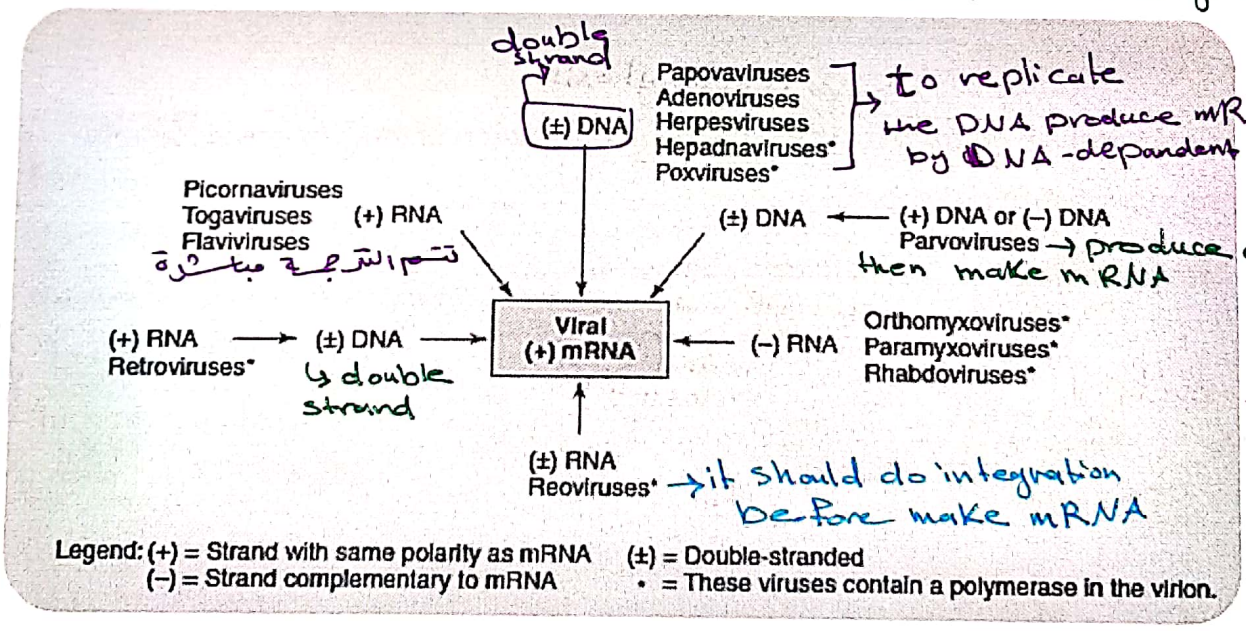
Nucleic acid and protein synthesis

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

The replication happen in 2 stages:

- Early mRNA and proteins are synthesized; the early proteins are enzymes (non-structural protein) used to replicate the viral genome. Late mRNA and proteins are then synthesized. These late proteins are the structural capsid proteins.

→ DNA-dependent polymerase enzyme is in the nucleus because the genome is in the nucleus & mRNA also in the nucleus and out to cytoplasm through the pores



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* poxviruses → the only (±) DNA virus enter with their polymerase
* Hepadnaviruses → also enter with their polymerase (reverse ~~Polymerase~~ Transcriptase activity)

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.

why? → to be integrated inside the host genome

Assembly = Packaging (Take nucleic acid then put it within capsid protein

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.

(extracellular) ←

→ or post translational modification

→ infection متى يكون مؤهل للعدوى

→ non enveloped → fragmentation the cell (lysis) then out from the cell
→ enveloped → For out the cell it does (budding)

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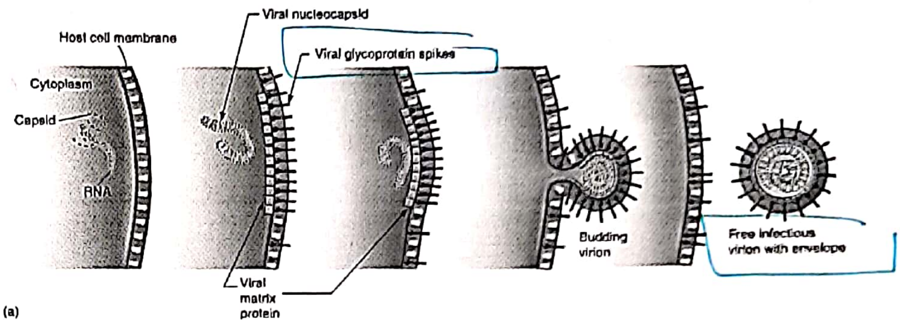
Release

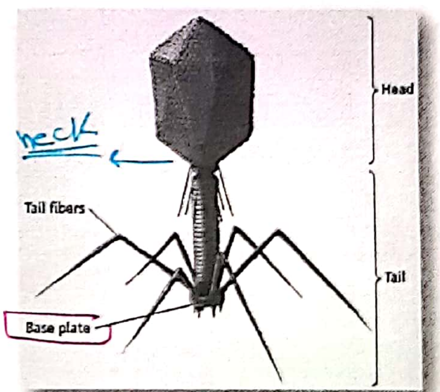
Viruses are released from the host cell by lysis, a process that kills the cell by bursting its membrane. Enveloped viruses (e.g., HIV) typically are released from the host cell by budding. During this process, the virus acquires its envelope which is derived form the host's cell membrane.



- lytic infection: when enter and replicate inside bacterial cell and out it in crops their progeny lysis the cell and rupture and out of the bacterial cell
- Lysogenic infection: enter and integrate their genome the genome of bacterial cell then replicate with normal process of multiplication of bacterial cell so give the bacteria their character

The Bacteriophages

- Viruses that Infect Bacteria.
- Most contain dsDNA.
- Bacteria → more pathogenic for humans. (يجعل البكتيريا أكثر ضراوة / more pathogenic) ①
- Lytic infections and Lysogenic (temperate) infections. ② (it enters in 2 stages)



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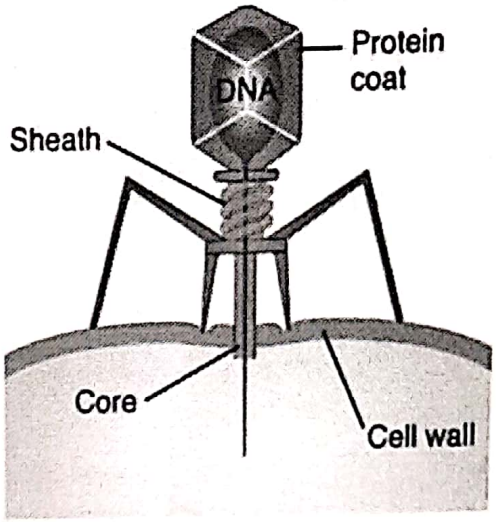
* these structure qualifies the virus to fall on the bacteria and fix the base plate on it.

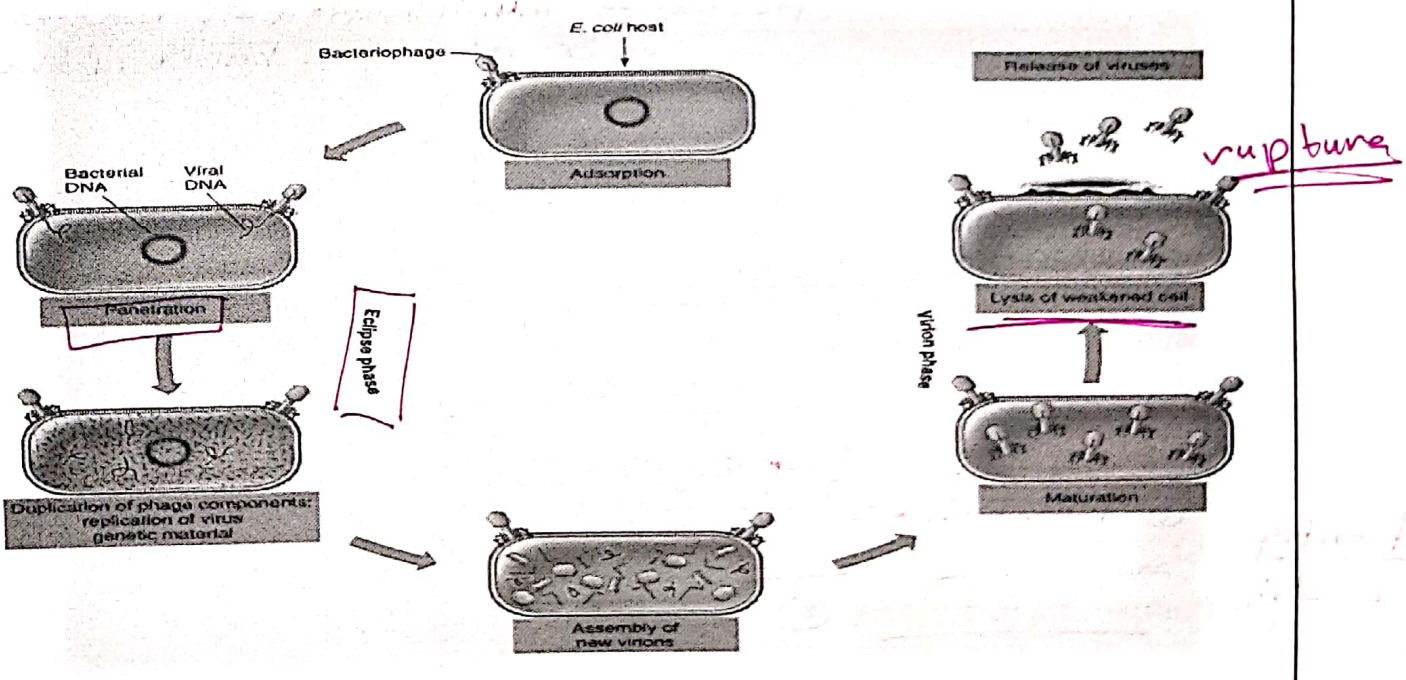
→ The only difference between human viruses and bacteria viruses in penbration is the genome of the bacterl phage enter by ingection

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





rupture

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Lysogenic Infections:

if the genome enter and integrated inside the host genome so called (pro—)

- The Silent Virus Infection
- **Temperate phages:** viral DNA enters an inactive **prophage** stage
- **Lysogeny**: the cell's progeny will also have the temperate phage DNA
- **Lysogenic conversion**: when a bacterium acquires a new trait from its temperate phage

يصبح لديها خصائص جديدة لم تكن لديها

1. ➤ ***Corynebacterium diphtheriae*** **toxin responsible for the disease**
2. ➤ **Lysogenized streptococci erythrogenic toxin.**
3. ➤ **Botulinum toxins by lysogenized strains of *C. botulinum*.**

البكتيريا إما تدخل مرحلة lytic وتنتج كمية كبيرة من الفيروس

وإما يدخل الفيروس إليها + (lysogentic) integrated inside it

بعد مرحلة من الزمن يتحرر الـ prophage ويبدأ مرحلة الـ lytic