Acellular Organisms / Viruses

- Bacteriophage .
- Viruses .
- Viroid's .
- Prions .
- Viral disease in animals .
- Viral disease in plants .
- Viral disease in human .

1. Definition of viruses :

Viruses are molecules from a nucleic acid DNA or RNA surrounded by a protein coat .

2. Characteristics of viruses :

1- viruses reproduce only in host cell .
2- viruses cannot carry out metabolic activities outside of a host cell .
3- viruses are smaller and simpler than those prokaryotic and eukaryotic cells .
4- viruses are lacking the structures of cell .
5- most viruses are little more the genes . packaged in protein coats .
6- viral composition or viral structure that consists from DNA or RNA called " genome ".
7- viral capsid are built from a number of protein subunits called " capsomeres"

8- some viruses have accessory structures that help them infect their hosts example : Tail , tailfibers , spikes .
9- viruses are obligated parasites of animals , plants , bacteria and other organisms .
10- Bacteriophages : are viruses that infected bacteria.

3- Discovery of viruses :

1- the story of how viruses were discovered begins near the end of the 19^{th} century .
2- Adolf Mayer , a German scientist in 1883 discovered " TMD" or " TMV" which that stunts the growth of tobacco mosaic disease and gives their leaves a mottled or mosaic coloration . he found that " TMD " could transmit from plant to plant by rubbing extracted from leaves disease into healthy plants .
3- Adolf Mayer suggested that disease was caused by small bacteria that were invisible under microscope .
4- Later by Dimitri Ivanowsky , a Russian biologist who passed sap from infected tobacco leaves through a filter designed to remove bacteria , after filtration , the sap still produce mosaic disease .
5- Ivanowsky clung to the hypothesis that bacteria were very small enough the filter or made "a toxin " that could do so .
6- Beijerinck Martinus , Dutch botanist , showed that unlike bacteria used in the lab. At that time agent of mosaic disease could not be cultivated on nutrient media in the test – tubes or petri-dishes .
7- Wendell Stanly (W. Stanly) in 1953 was confirmed that tobacco mosaic viruses could be crystallized .
8- TMV and many other viruses , viroids , and prions were actually seen with the help of the electron microscope .

Tobacco mosaic virus causes yellow spots on tobacco leaves, making them unmarketable **(A)**. In contrast, another virus causes the beautiful stripes of Rembrandt tulips, making them more desirable **(B)**.

4- Structure of viruses :

The finniest viruses are only 20 nm in diameter smaller than a ribosome .

Viruses consists of :

1. Nuclic acid DNA or RNA .
2. Protein coat called " capsid " .
3. Some viruses have accessory structures help them infected their host example :
   Tail, Tails fibers , and spike .

5- Viral genomes :

According to the kind of nucleic acid , their genomes may consist of :

1. Double stranded DNA = ds DNA .
2. single stranded DNA = ss DNA .
3. Double stranded RNA = ds RNA .
4. single stranded RNA = ds RNA .

The kind of nucleic acid depending on the kind of virus which that makes up of it's genome .

The virus is called a DNA virus or an RNA virus . in either case , the genome is usually organized as a single linear or circular molecule of nucleic acid , although , the genome of some viruses consist of multiple molecules of nucleic acid . the smallest viruses known have only four genes in their genomes while the largest have several hundred to a thousand for comparison , bacterial genomes contains about 200 to few thousand genes .

6.Capsid and Envelopes :

Capsid is a protein shell that enclosing the viral genome . capsid or viral shapes ,

7. viral shapes : (capsid shape).

Viral shape depending on the type of virus , the capsid may be :

1- Rod – shaped .
2- Polyhedral .
3- Complex in shape –capsid .
4- Phages .

The kinds of proteins in capsid and their arrangement give the shape of virus. arranged in a helix , rod – shaped viruses are commonly called " helical " viruses for this reason . adenoviruses , which infect the respiratory tracts of animals , have 252 identical protein molecules arranged in polyhedral capsid with 20 triangular facts – on icosahedron , some viruses have accessory structures that help the infect their hosts . for instance , membranous envelope surrounds the capsids of influenza viruses and many other viruses found . these " viral envelope " which are derived from the

membranes of the host , contain host cell phospholipids and membrane proteins many of the most complex capsids are found among the viruses that infect bacteria , called " bacteriophages " or simply " phages ".

The first phages studied included seven that infect E. coli . these seven phages were named type 1 (T1) , type 2 (T2) , and so forth , in the order their discovery .

The three T-even phages (T2, T4 , and T6) , their capsid have elongated icosahedral heads enclosing their DNA . attached to the head is a protein tail piece with fibers by which the phages attaché to a bacterium .

8-Viral reproductive cycle :

Viruses are reproducing only in host cells . they are obligate intracellular parasites , and they are lack metabolic enzymes and equipment for making protein , such as ribosomes .

Each type of virus can infect cells of a limited variety of hosts , called " the host range of the viruses" a viral infection begins when a virus binds to a host cell and the viral genome makes its way inside .

A- The simplified viral reproductive cycle :

A viral infection begins when a virus binds to a host cell and the viral genome makes its way inside . figure ( )

1- Virus enters the cell (the host cell) and is uncoated .
2- Virus releasing viral DNA and capsid proteins .
3- Host enzymes replicate the viral genome .
4- Host enzymes transcribe the viral genome into viral mRNA which host ribosomes use to make more capsid proteins .

5- Viral genomes and capsid proteins self-assemble into new virus particles , which exit the cell .

B- <u>Reproductive cycle of phages :</u>

Mechanisms phages are the beast understood of all viruses , some of them are also among the most complex . research on phages led to the discovery that some double – stranded DNA viruses can reproduce by two alternative mechanisms , the lytic cycle and the lysogenic cycle .

1. <u>Lytic cycle :</u>

A phage reproductive cycle that culminates in death of the host is know as a lytic cycle .

a phage that reproduces only by a lytic is a virulent phage.

Steps of a virulent phage cycle (lytic cycle) :

1. Attachment : the T4 phage uses its tail fibers to bind to specific receptor sites into outer surface of an E. coli cell .
2. Entry of phage DNA and degradation of host DNA . the sheath of the tail contracts, injecting the phage DNA into the cell and leaving an empty capsid outside . the cell DNA is hydrolyzed .
3. Synthesis of viral genomes and proteins . the phage DNA directs production of phage proteins and copies of the phage genome by host enzymes, using components with in the cell .
4. Assembly : three separate sets of proteins self-assemble to form phage heads, tail , and tail fibers . the phage genome is packaged inside the capsid as the head forms .
5. Release : the phage directs production of an enzyme that damages the bacterial cell wall , allowing fluid to enter the cell swells and finally burst, releasing to 200 phage particles .

2- Lysogenic cycle

Steps of a temperate phage cycle .

In contrast to the lytic cycle , which kills the host cell , the " lysogenic cycle" allows replication of the phage genome without destroying the host .

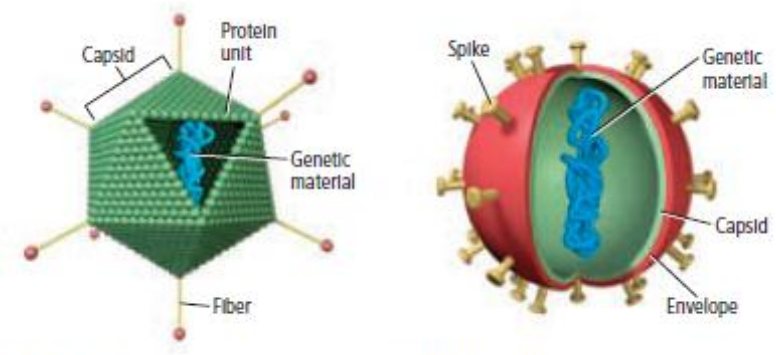
Phages capable of using both modes of reproducing with in a bacterium are called " temperate " phages .

A temperate phage called " lambda " .

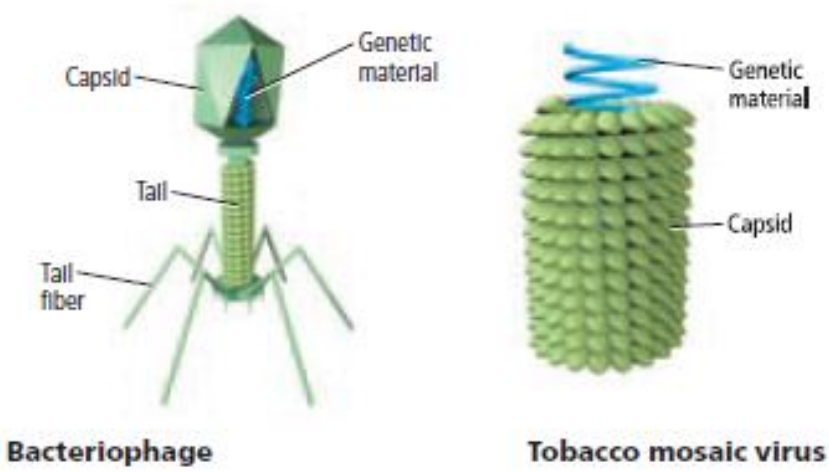
When and why is occur the lysogenic cell ?

For different factors activities , the kind of bacterial strain environment and specific of phage .

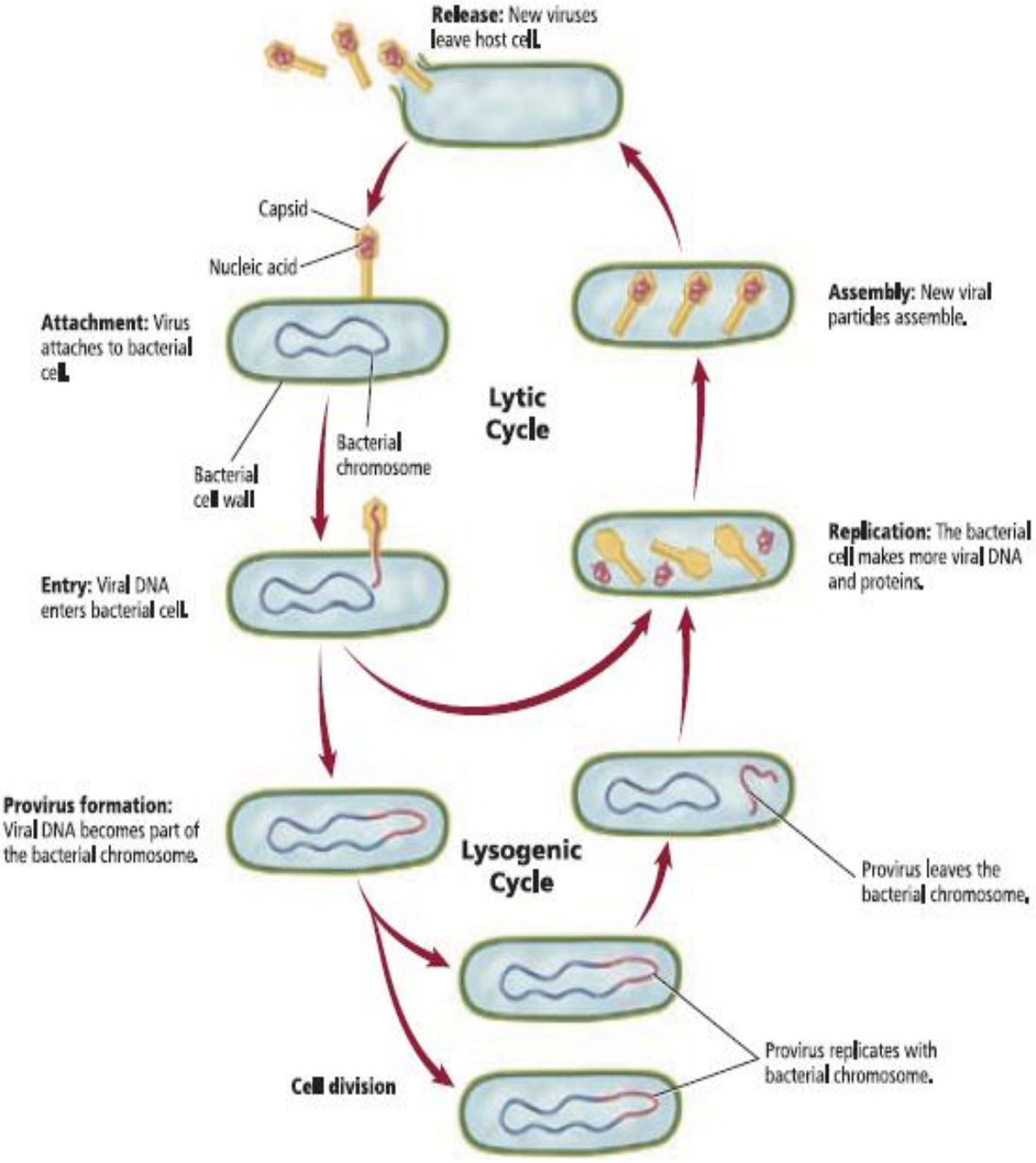
1. Phage DNA integrates into the bacterial chromosome becoming a prophage .
2. The bacterium reproduces normally , coping the prophage and transmitting it to daughter cells .
3. Occasionally a prophage exit from the bacterial chromosomes , initiating a lytic cycle .
4. Phage DNA circularizes .

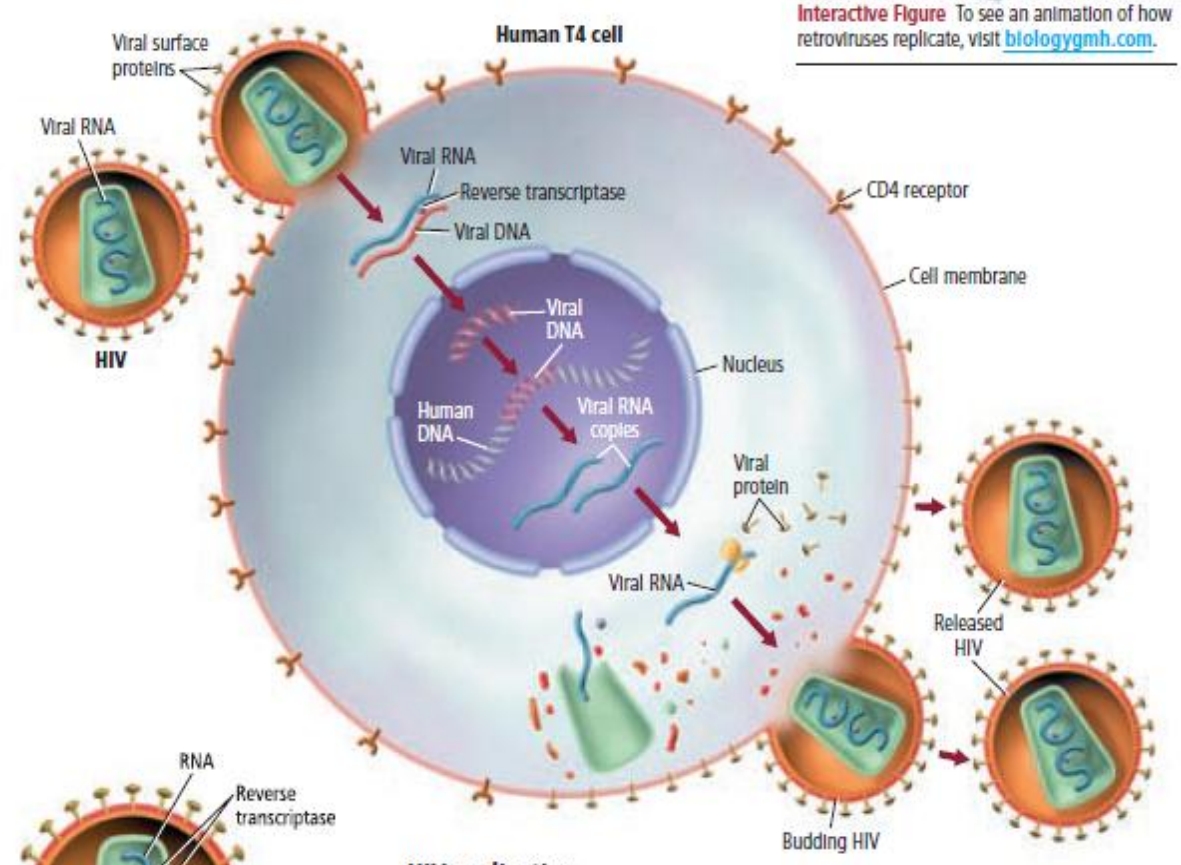


Adenovirus Influenza virus



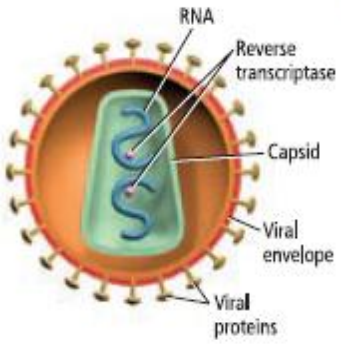
Bacteriophage **Tobacco mosaic virus**





Interactive Figure To see an animation of how retroviruses replicate, visit biologygmh.com.

HIV replication



HIV structure

The genetic material and replication cycle of a retrovirus, such as HIV, is different from that of DNA viruses.

Infer ***What is unique about the function of reverse transcriptase?***

The End