

## Chapter 18 Viruses and Prokaryotes

### Section 18-1: Viruses

#### I. What is a virus?

- Viruses = are composed of *nucleic acids* enclosed in a *protein* coat and are smaller than the smallest *prokaryote*.
- Viruses can only be seen by *electron microscopes*.
- Most biologists consider viruses to be *nonliving* because they don't exhibit all the criteria for life.
  - they don't carry out *respiration*
  - they don't *grow or develop*
- All viruses can do is *replicate* - which they cannot do without the help of *living* cells.

- Host cell = *a cell in which a virus replicates* .
- Because viruses are **nonliving** they are *not named* in the same way as organisms.
- A virus that infects a bacterium is called a *bacteriophage*, or phage ("*eater*") for short.

#### A. Viral Structure

1. A virus has an *inner* core of nucleic acid, either *DNA* or *RNA*, and an outer protein coat called a *capsid*.
2. Larger viruses may have an additional layer called an *envelope* surrounding their capsids.

3. Envelopes are composed mainly of the same materials found in the *plasma membrane of the host cell*.
4. The core of *nucleic* acid contains a virus' genetic material (DNA or RNA) and contains *instructions* for making copies of the virus.
5. The arrangement of *proteins* in the capsid determines the shape of the virus and determines what type of *cell* can be infected.

### **B. Attachment to a host cell**

1. Before a virus can *replicate*, it must enter a *host* cell. Before it can enter, it must first recognize and *attach its surface proteins* to a *receptor molecules* on the *plasma membrane* of the host cell.
2. The *recognition* and *attachment process* is like two pieces of a puzzle fitting together.

### **C. Attachment is a specific process**

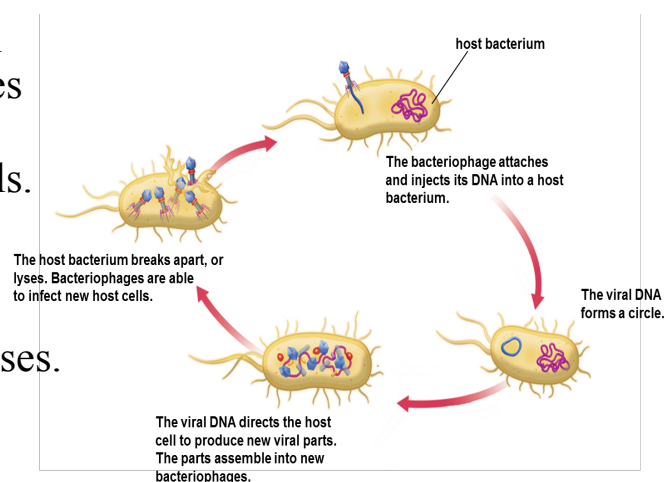
1. Each *virus* can usually attach to only a few kinds of *cells*.
2. In general, viruses are *species specific* but there are cases where they are not. EX: West Nile Virus infects birds, horses, and *humans*.

## II. Viral Replication Cycles

- Once attached to the *host* cell, the virus enters and takes over its *metabolism* - this is when the virus can *replicate*.
- Viruses have **two ways of getting into their host cell**
  1. Virus *injects* its nucleic acid into the host cell.
  2. Host cell surrounds the virus that is *attached* which produces a virus-filled vacuole inside the host cell's cytoplasm. (*Phagocytosis*)

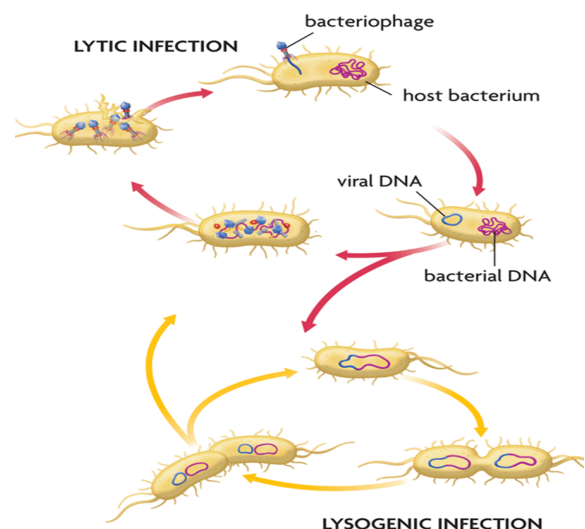
### A. Lytic Cycle

1. In the lytic cycle, a virus takes over the host cell's *genetic* material causing the host cell to make *new* viruses.
2. The host cell breaks open (*lysis*), killing it, and releases new viruses, which can *infect* and *kill* other host cells.
3. A typical lytic cycle takes about **30** minutes and produces about **200** viruses.



## B. Lysogenic Cycle

1. Not all viruses *kill* the cells they infect, some go through a lysogenic cycle - a *replication* cycle in which the virus' nucleic acid is *integrated* into the genetic material of the host cell and replicates with it for a while *before* entering the lytic cycle.
2. **Prophage** (if in *prokaryote*; called *provirus* if in **eukaryotic cell**)- a viral DNA that is integrated into the host cell's chromosomes.
3. A virus *may not* affect the host cell, but every time the host cell reproduces the *prophage* is replicated, also.
4. The *lysogenic* phase can continue for *many* years, however, at *any* time the provirus can be activated and enter a *lytic* cycle - replicating and killing the host cell.



### C. Disease symptoms of provirus

1. The lysogenic process explains the *reoccurrence* of cold sores, which are caused by the herpes simplex I virus.
2. When the *provirus* enters a lytic cycle another cold sore erupts.
3. Many disease-causing *viruses* have lysogenic cycles.  
EX: **herpes simplex I & II, hepatitis B**

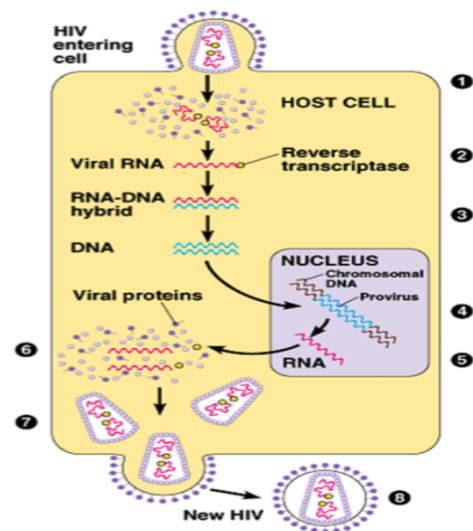
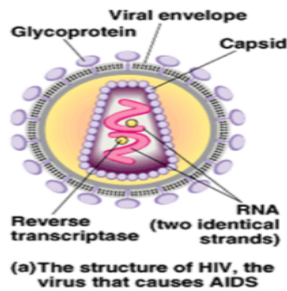
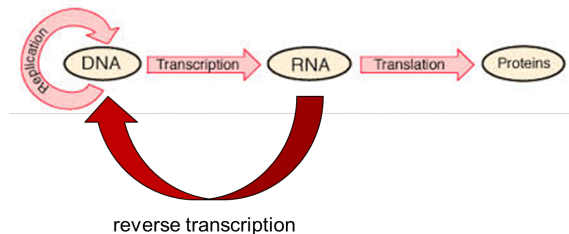
### D. Release of viruses

- Both lysis (*bursting* of cell) and exocytosis *releases* new viruses from the host cell.

### E. Retroviruses

1. Many viruses are *RNA* viruses - RNA being their only nucleic acid. EX: Human immunodeficiency virus(*HIV*).
  2. The RNA virus with the most *complex* replication cycle is the retrovirus.
  3. Retroviruses have an enzyme, *reverse* transcriptase that *transcribes* their *RNA* into DNA. The *viral* DNA becomes a provirus that steadily produces small numbers of new *viruses* without immediately destroying the *cell*.
- If reverse transcriptase is *found* in a person, it is evidence of an *infection* of a retrovirus.

# Retrovirus



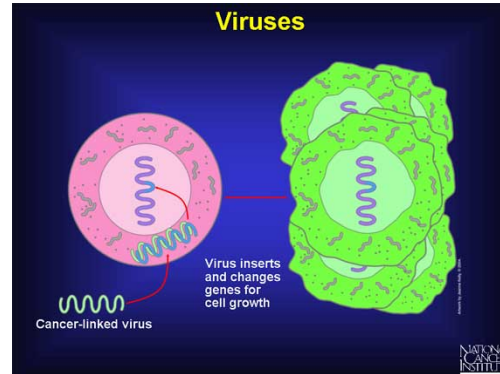
## F. HIV: An infection of white blood cells.

1. HIV infects *white* blood cells; some infected are called *helper T* cells.
2. Infected host's WBCs can function *normally* as provirus produces a small number of new viruses at a time.
3. Infected person may *not* appear sick and pass virus on in their body *fluids*. The *symptoms* may not appear from a few months to over 10 years after infection.
4. With the increasing loss of WBCs and the *ability* of the body to *protect* itself from organisms, Acquired Immune Deficiency, *AIDS*, can develop.

### III. Cancer and Viruses

- Some types of **cancer** have been linked **indirectly** to viruses. These viruses can **disrupt** the normal growth and division of the host cell, causing the **abnormal** growth and creating **tumors**.

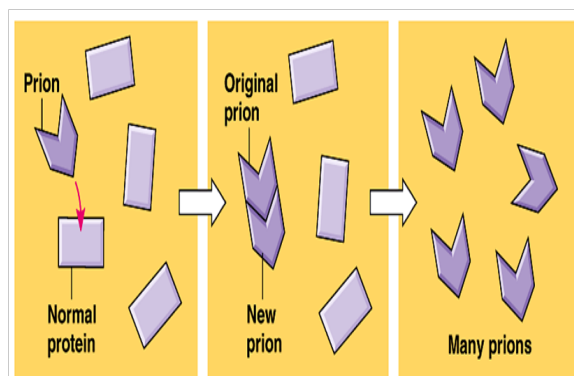
Ex: Hepatitis B to liver cancer.



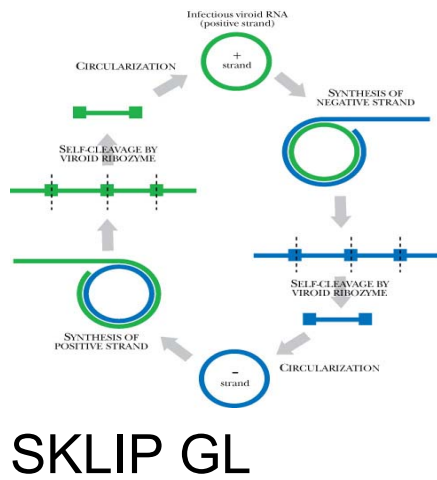
### A. Prions and viroids

- Prions** = proteins with **no** nucleic acid, cause other proteins to incorrectly form (fold improperly), results in the improper function of the protein.

Ex: Mad Cow Disease



2. **Viroids** = single circular strand of RNA, **no** protein coat. Less RNA amount than viruses, known to cause **plant** diseases.



## B. Vaccines are made from weakened pathogens.

1. **Vaccine** - Substance that stimulates the body's **own immune response** against invasion by microbes.
2. Made from the **same pathogen** that it is supposed to protect against. Made of **weakened** versions of the virus, or parts of the virus, that will cause the body to produce a response.





VIRAL INFECTION	SYMPTOMS OF DISEASE	TRANSMISSION OF DISEASE	U.S. VACCINE RECOMMENDATION
Chickenpox	rash, itchy skin, fever, fatigue	contact with rash, droplet inhalation	for children between 12 and 18 months
Hepatitis A	yellow skin, fatigue, abdominal pain	contact with contaminated feces	for people traveling to infected locations and protection during outbreaks
Mumps	painful swelling in salivary glands, fever	droplet inhalation	for children between 12 and 15 months and again at 4 to 6 years
Rabies	anxiety, paralysis, fear of water	bite from infected animal	for veterinarians and biologists in contact with wildlife
West Nile	fever, headache, body ache	bite from infected mosquito	no available vaccine

### Diseases that do NOT have vaccines:

- *Malaria* – while there are anti-malarial pills, some malaria parasites in some areas.
- *Dengue fever* – mosquito-borne virus
- *West Nile Virus* – mosquito-borne virus
- *Common cold*
- *HIV*
- *SARS*



## IV. Origins of Viruses

- Escaped *nucleic acid* fragment of host cell.
- *Specific* to host & replicates parasitically
- As many, or more, viruses as # of organisms.

