

review: 1. The cell theory 2. Prokaryotic cells 3. Eukaryotic cells		
	bacteria	human cell
size	small	bigger
shape	varied	varied
cell wall	yes	no
nucleus	no	yes
organelles	no	yes
ribosome	70S	80S
PTG	yes	no
cell division form	binary fission	meiosis/mitosis
cell division rate	fast	slower
Genome size	small	large

Preview: VIRUSES

By host

animal virus

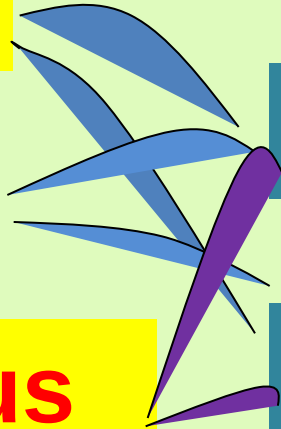
plant virus

**bacterial virus
(bacteriophage)**

By nucleic acids

DNA virus

RNA virus

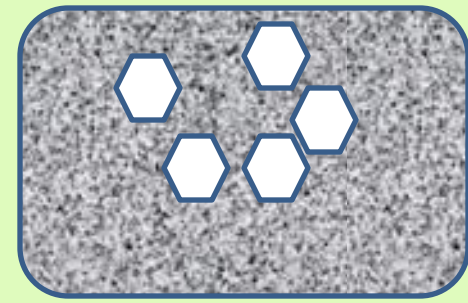


By strands,
ds,
ss

By structure,
Circular,
Linear,
Segmented

By sense,
+ strand,
_ strand

What are Viruses?



- Obligate intracellular parasites

- From *Latin*, means **poison**, come in English in 1392

- Dmitry Ivanosky, 1892 (TMV)

- Martinus Beijerinck (**virus**)

1898: *contagium vivum fluidum*

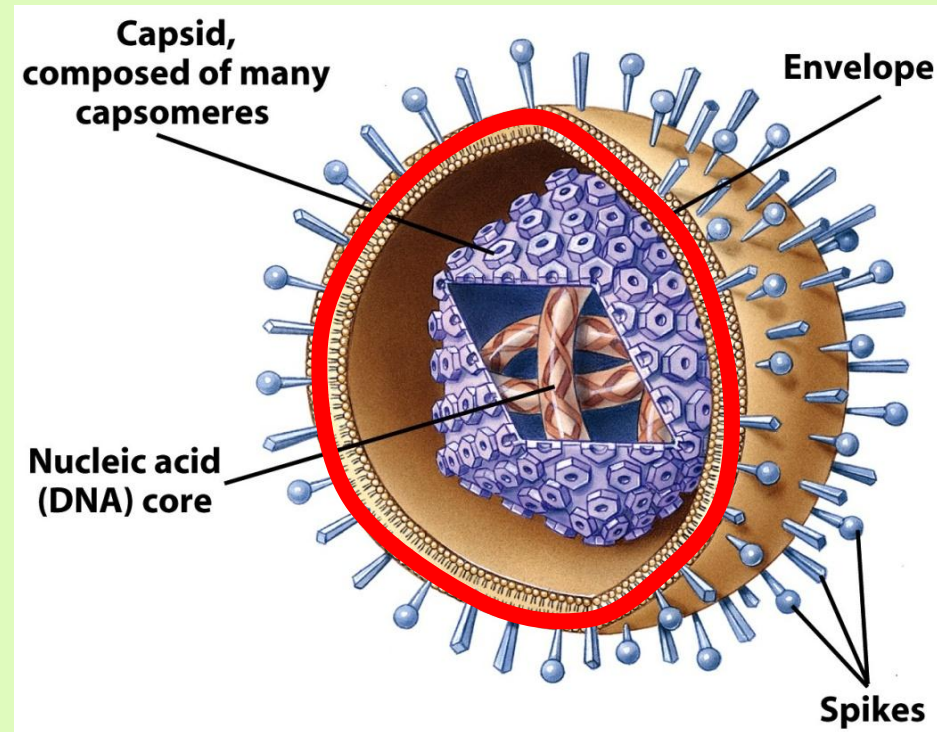
- Viral components

- Nucleic acids

- Capsid

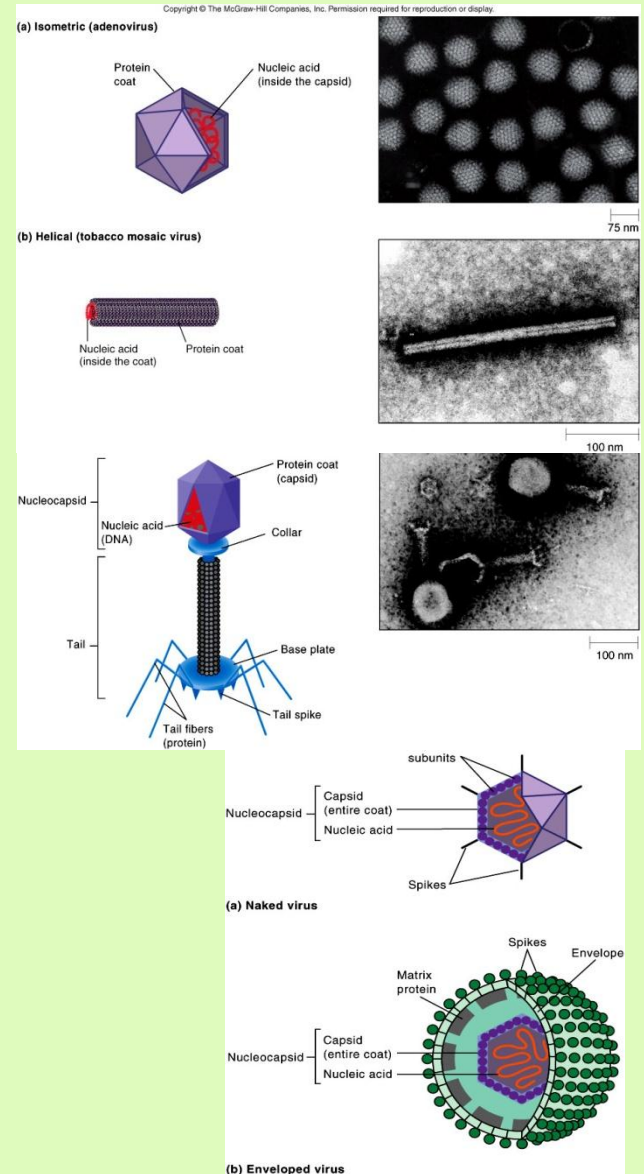
- Envelope

(enveloped/naked)



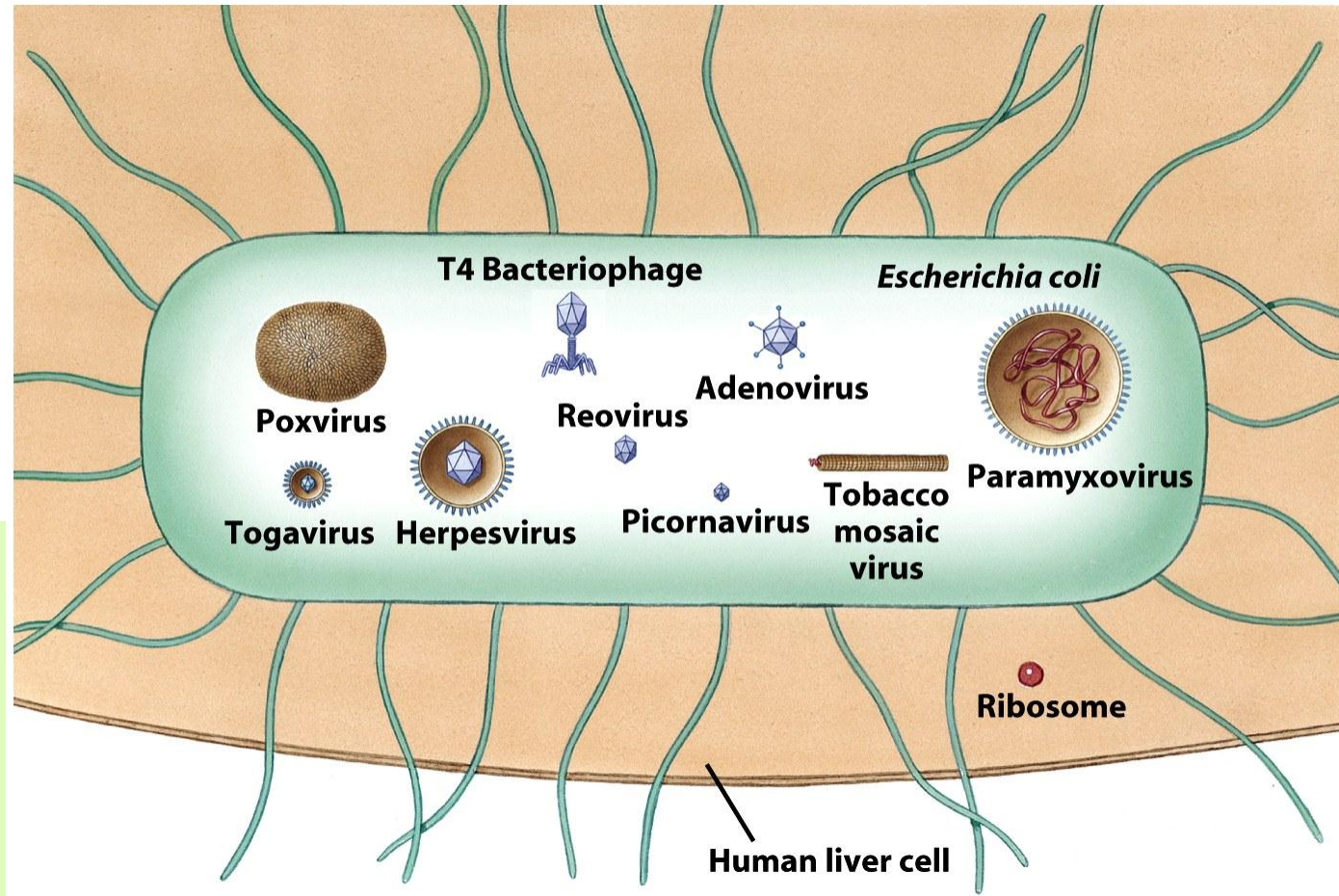
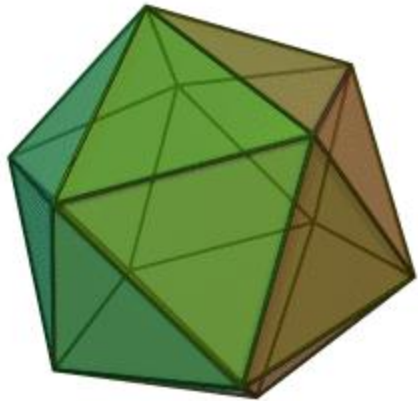
General Characteristics of Viruses

- Virus architecture
 - Virus particle called virion
 - Consists of nucleic acid surrounded by protein coat
 - Protein coat termed capsid
 - Capsid composed of capsomers
 - Viruses have different shapes
 - Isometric
 - Helical
 - Complex
 - Two types of virion
 - Naked – without envelope
 - Enveloped – surrounded by lipid membrane



Viral Shapes and Sizes

- Helical
- Icosahedral
- spherical
- Tubular
- Filamentous
- Complex

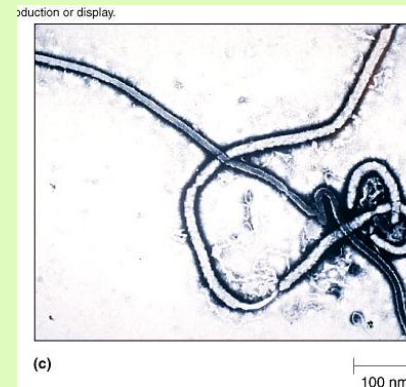
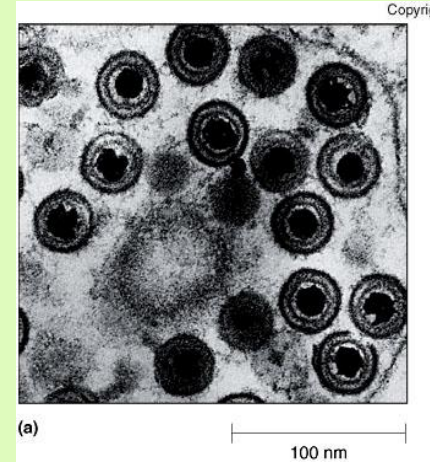


Animal Viruses: Structure and Classification

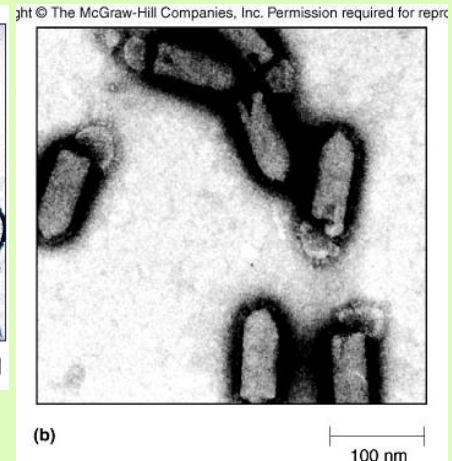
- Classification of animal viruses
 - Taxonomic criteria based on
 - Genomic structure
 - DNA or RNA
 - Single-stranded or double-stranded
 - Virus particle structure
 - Isometric
 - Pleomorphic
 - Helical
 - Presence or absence of envelope



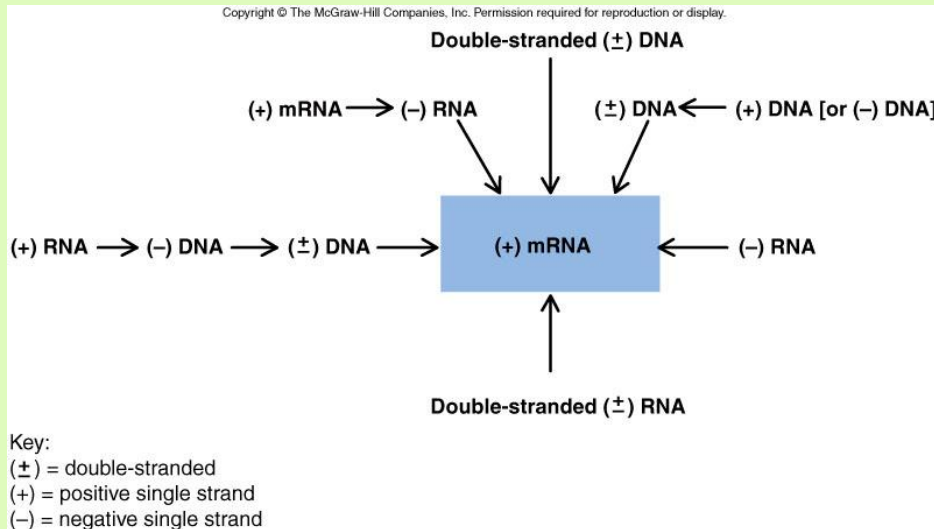
Papillomavirus:cancer



Ebola virus



Rhabdovirus: rabie



Infectious Properties

- Viral Host range

A spectrum of hosts that a virus can infect

- Viral specificity

The selection whether a virus can infect a host

- Viral eco-role

promote gene transfer/diversity

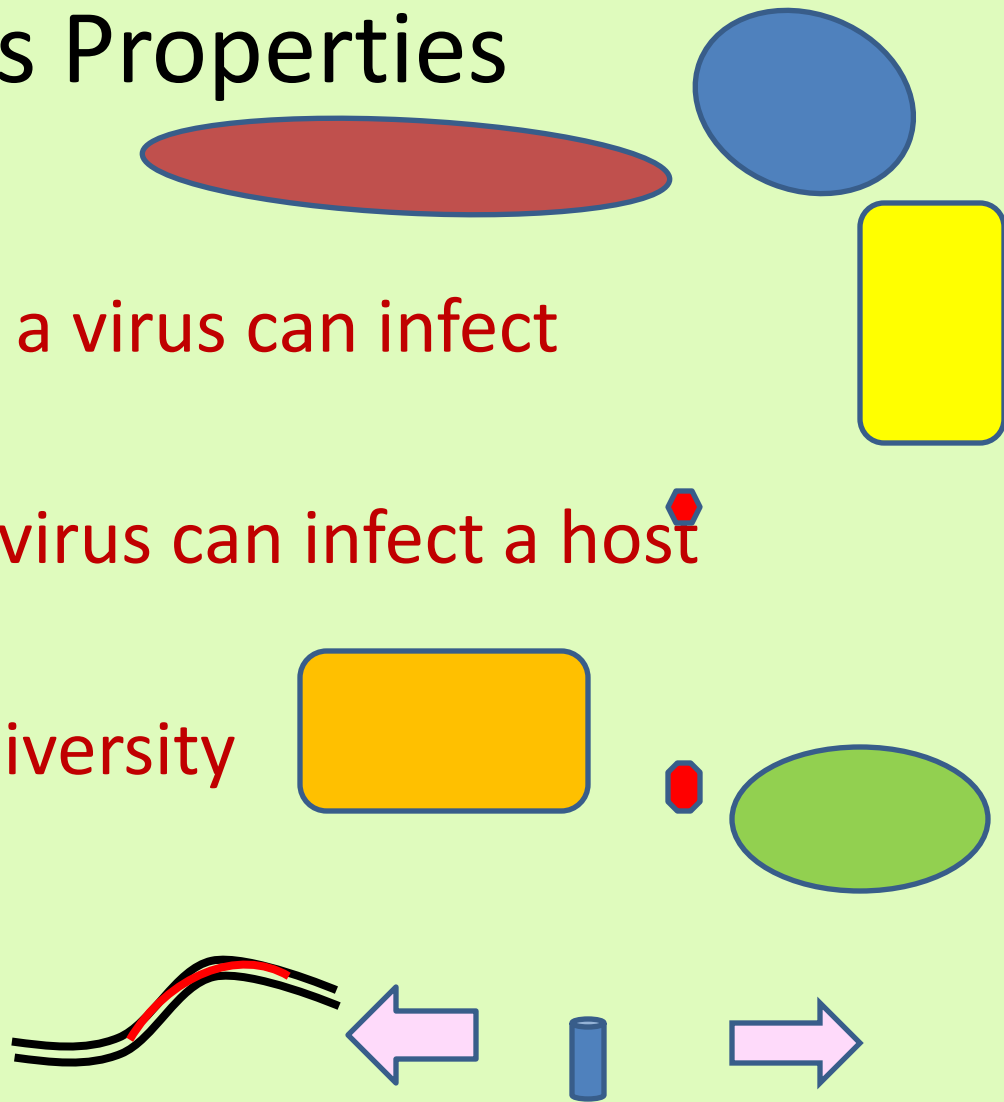
- Viral Origins

RNA world

Simplified bacteria

Developed plasmid or transposon

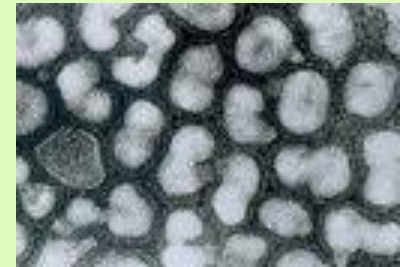
Co-evolution



Animal Viruses: Structure and Classification



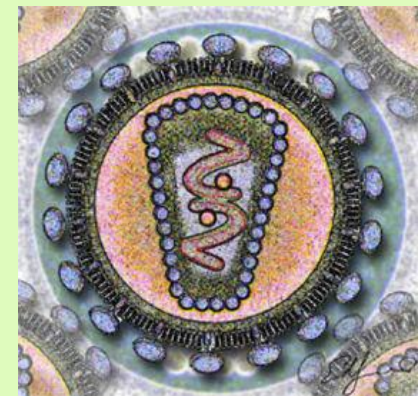
Rotavirus: diarrhoea, dsRNA



influenza A virus: ssRNA (8)



Herpes virus B: ds DNA
monkey to human



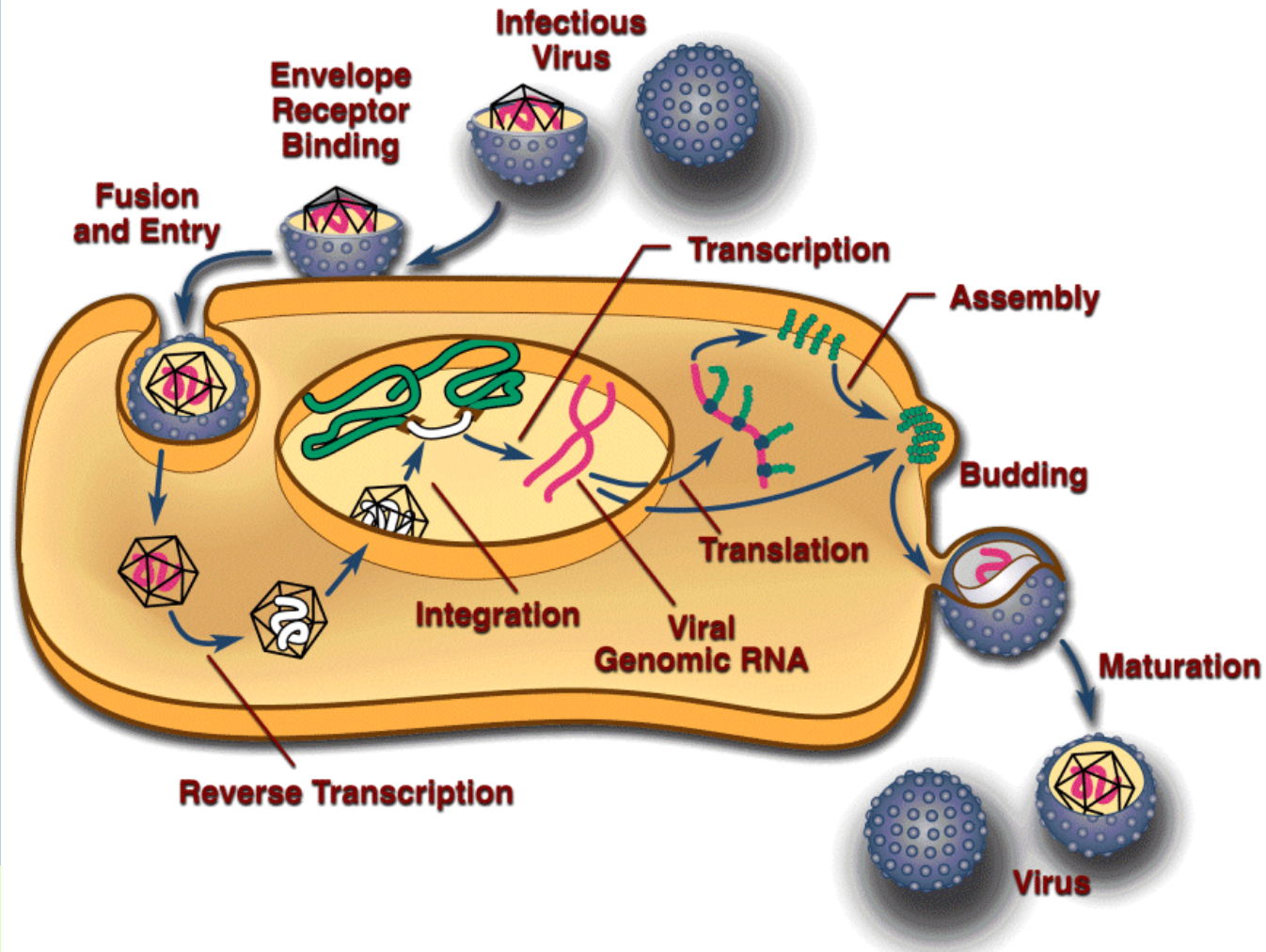
HIV: ss RNA(+)

- Groupings based on route of transmission
 - Disease-causing viruses often grouped by route of transmission
 - Enteric viruses
 - Generally transmitted via fecal-oral route
 - Often cause gastroenteritis
 - Some can cause systemic disease
 - Respiratory viruses
 - Usually inhaled via infected respiratory droplets
 - Generally remain localized in respiratory tract
 - Zoonotic viruses
 - Transmitted from animal to human via animal vector
 - Sexually transmitted viruses
 - Can causes lesions on genitalia or cause systemic infections

Viral Replication

Activities

- Adsorption
- Penetration (virus or chromosome)
- Synthesis
- Maturation
- Release



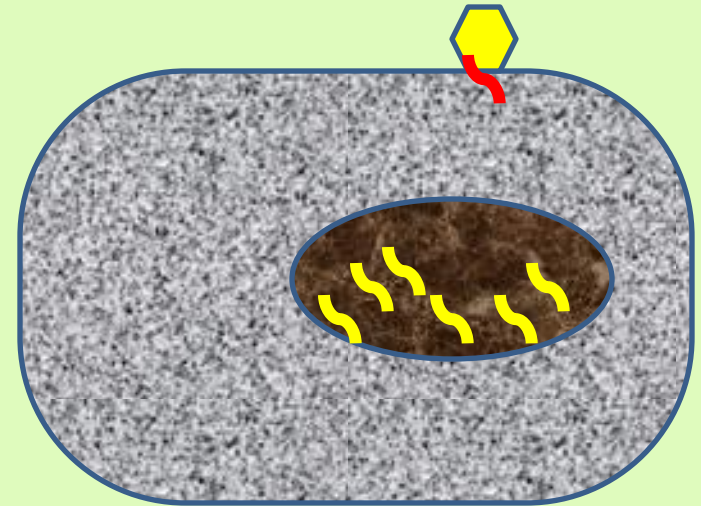
[HIV attack human cells:](http://www.youtube.com/watch?v=9leO28ydyfU)

<http://www.youtube.com/watch?v=9leO28ydyfU>

Viral replication: how long it takes

Hours to days

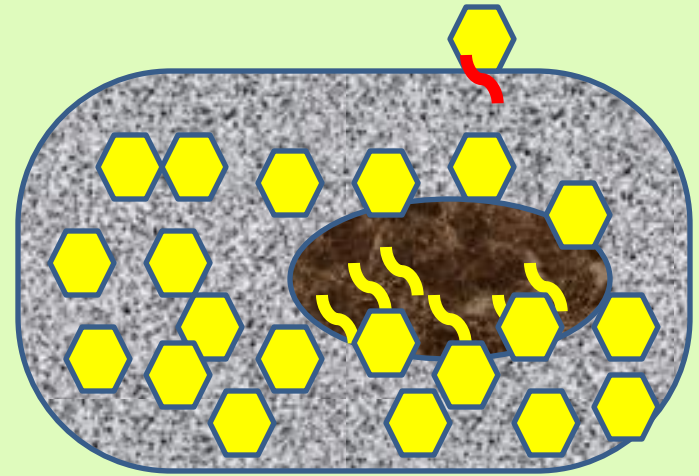
- Adsorption
- Penetration
(virus or chromosome)
- Synthesis
- Maturation
- Release



Viral replication: how many it makes

hundreds

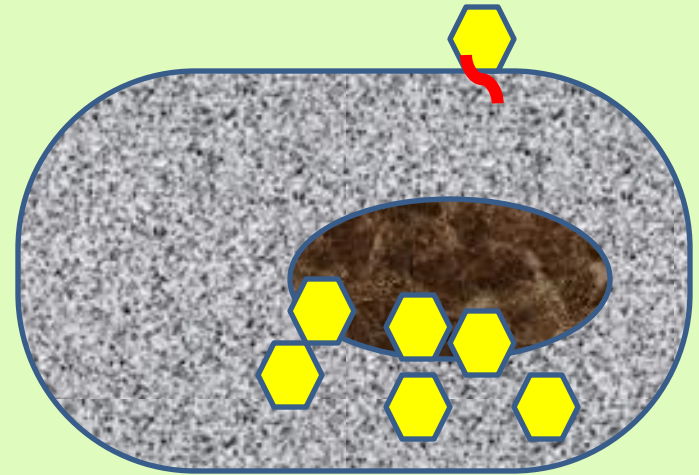
- Adsorption
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(virus or chromosome)
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Viral replication: how bad is the host

Damaged to death

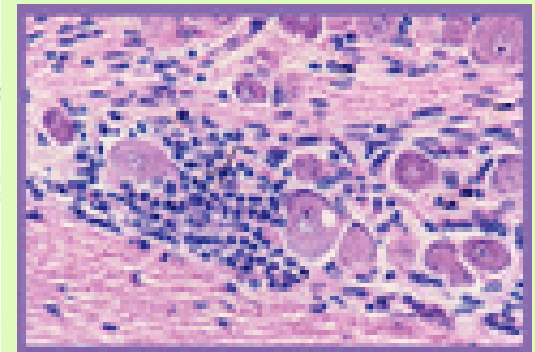
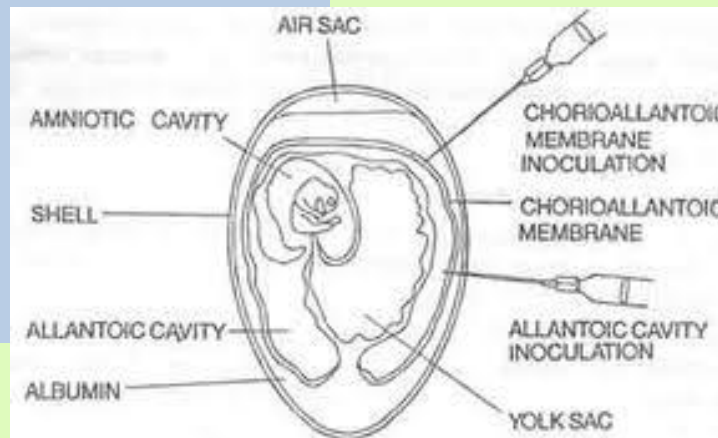
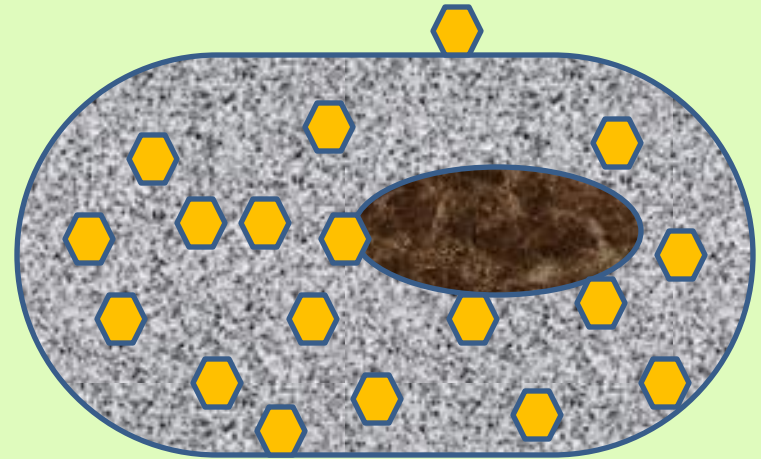
- Adsorption
- Penetration
(virus or chromosome)
- Synthesis
- Maturation
- Release



Viral replication: culture

Controlled replication

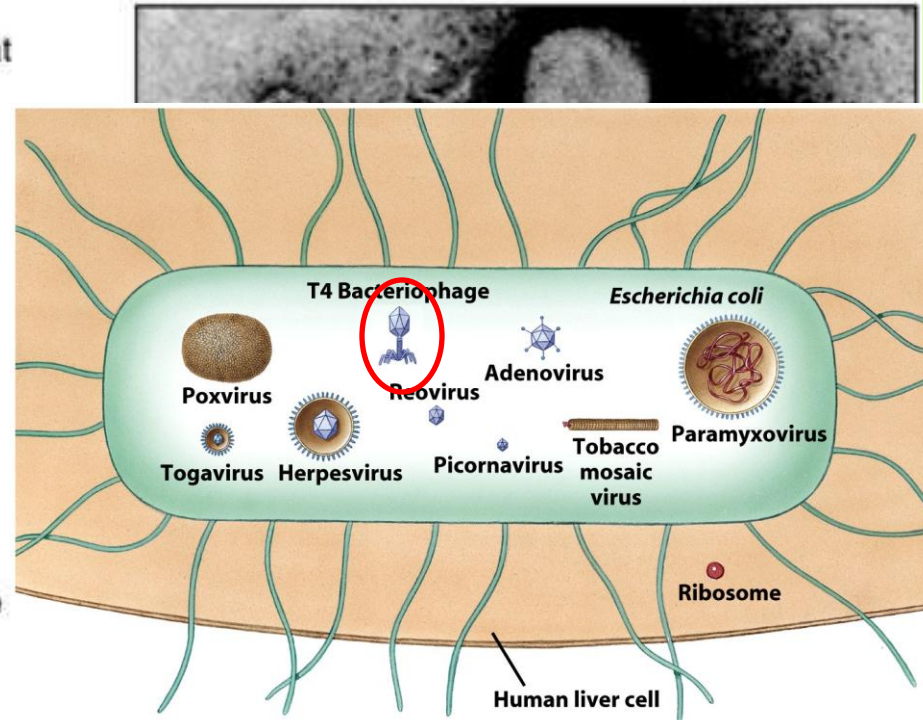
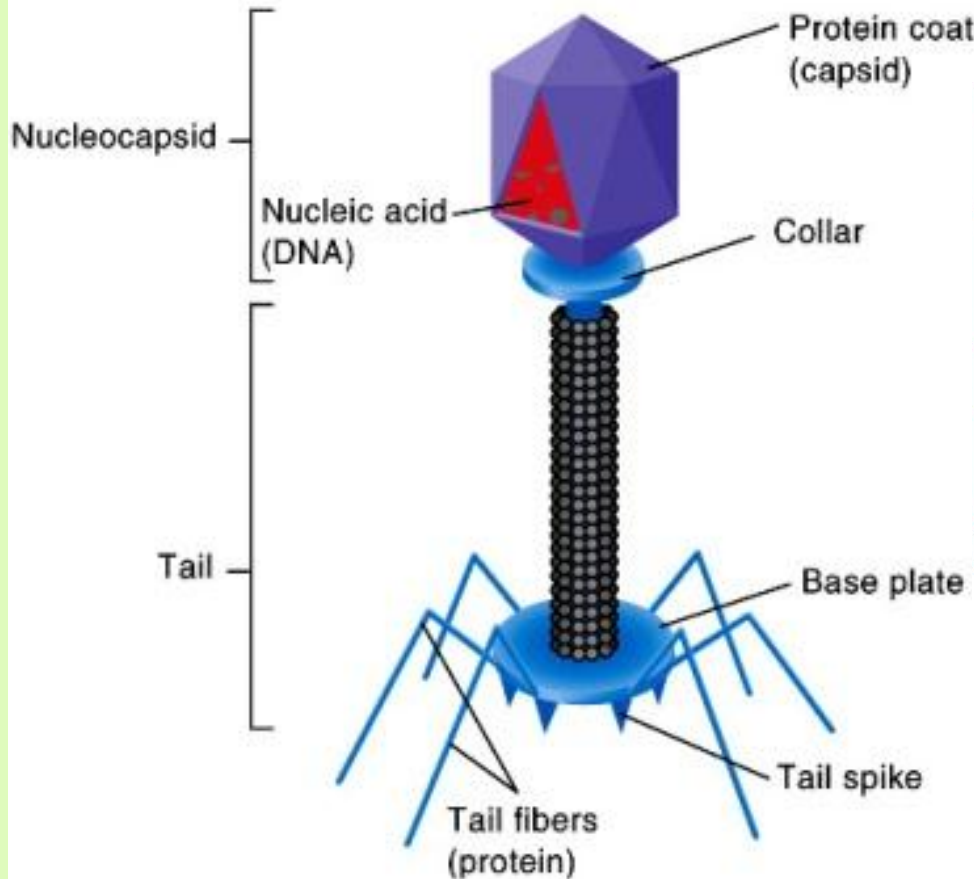
- Adsorption
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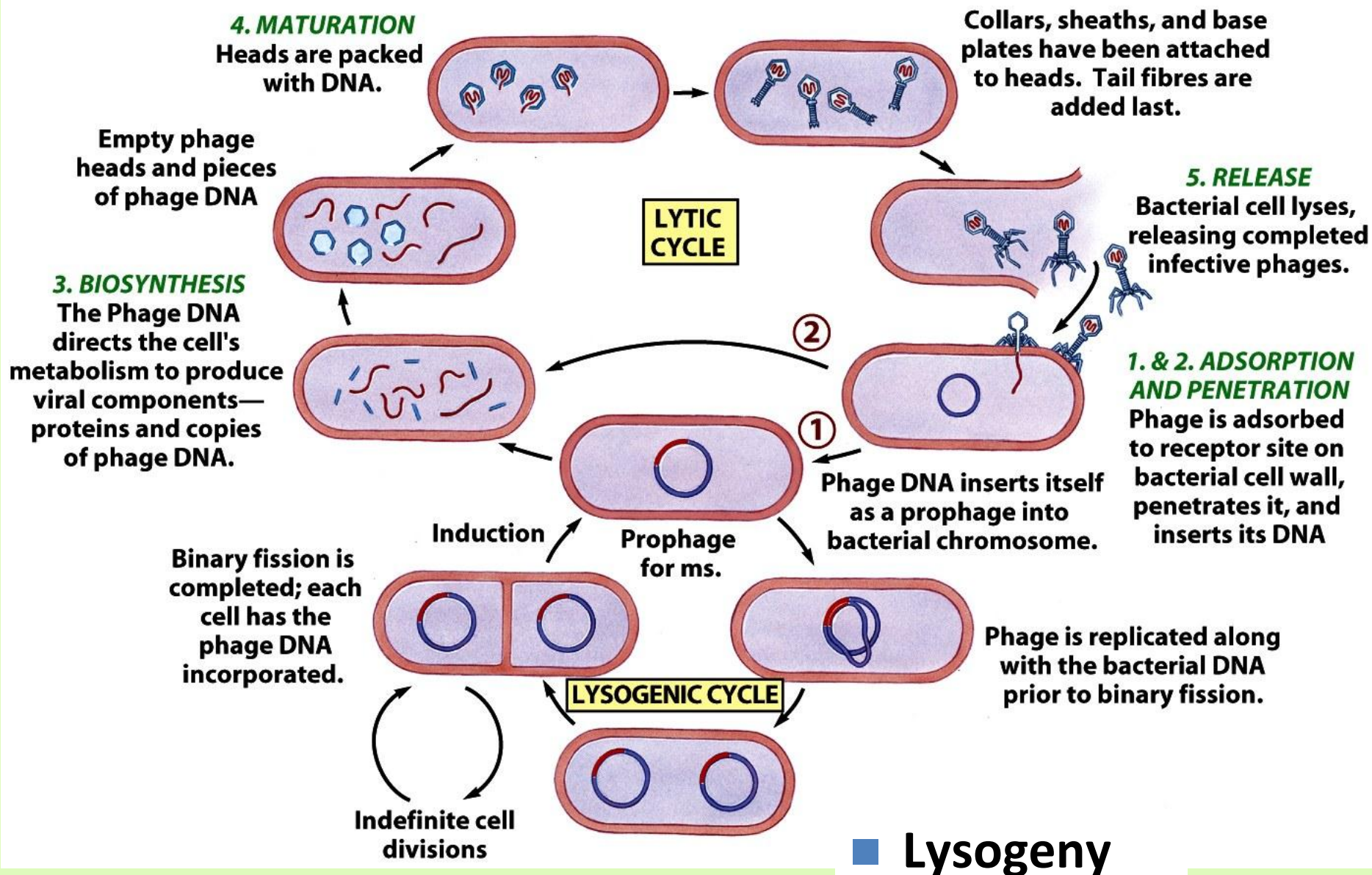
Bacteriophages: types and host

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(c) Complex (T4 bacteriophage)

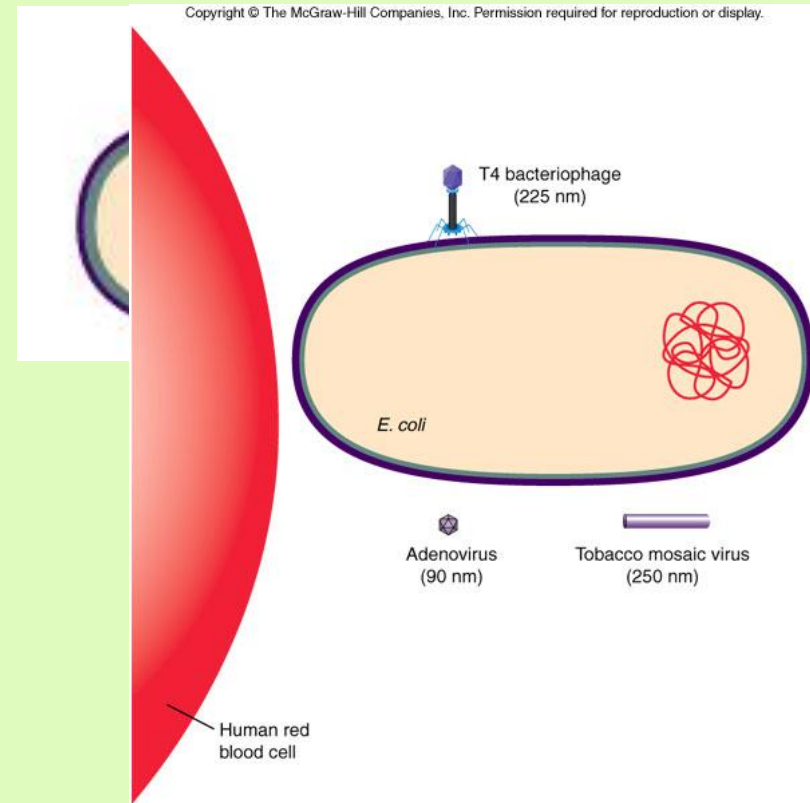


Bacteriophages: replication



Host Ranges of Phages

- Number of different bacteria that a phage can infect termed **host range**
 - Usually limited to single bacterial species for a single phage
- Factors limit host range
 - Two most important
 - Phage must be able to **attach** to host receptors
 - must overcome **restriction-modification** system in the host cell



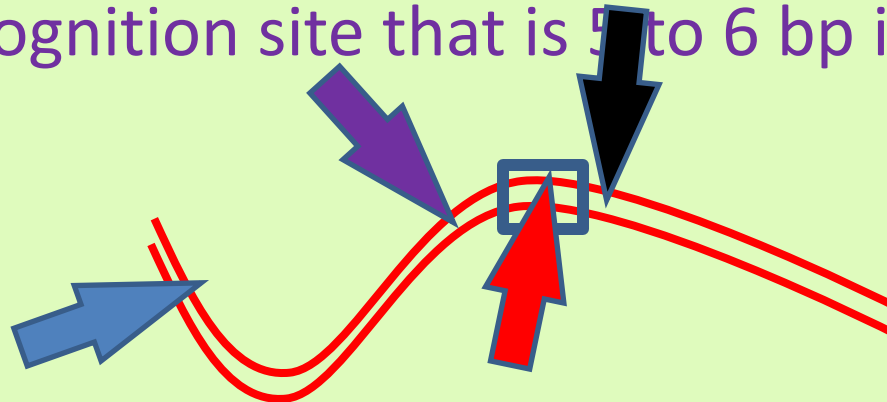
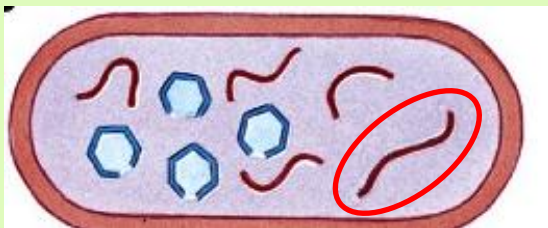
Restriction and Modification Systems

Type I: DNA cleavage occurs randomly at significant distances from an asymmetric recognition site (400 to 7,000 bp)

Type II: DNA cleavage or methylation occurs within symmetrical recognition sites

Type IIS: DNA cleavage occurs at a fixed distance (1 to 20 bp) from an asymmetrical recognition site

Type III: DNA cleavage occurs 25 to 27 bp 3' to an asymmetrical recognition site that is 5 to 6 bp in length.

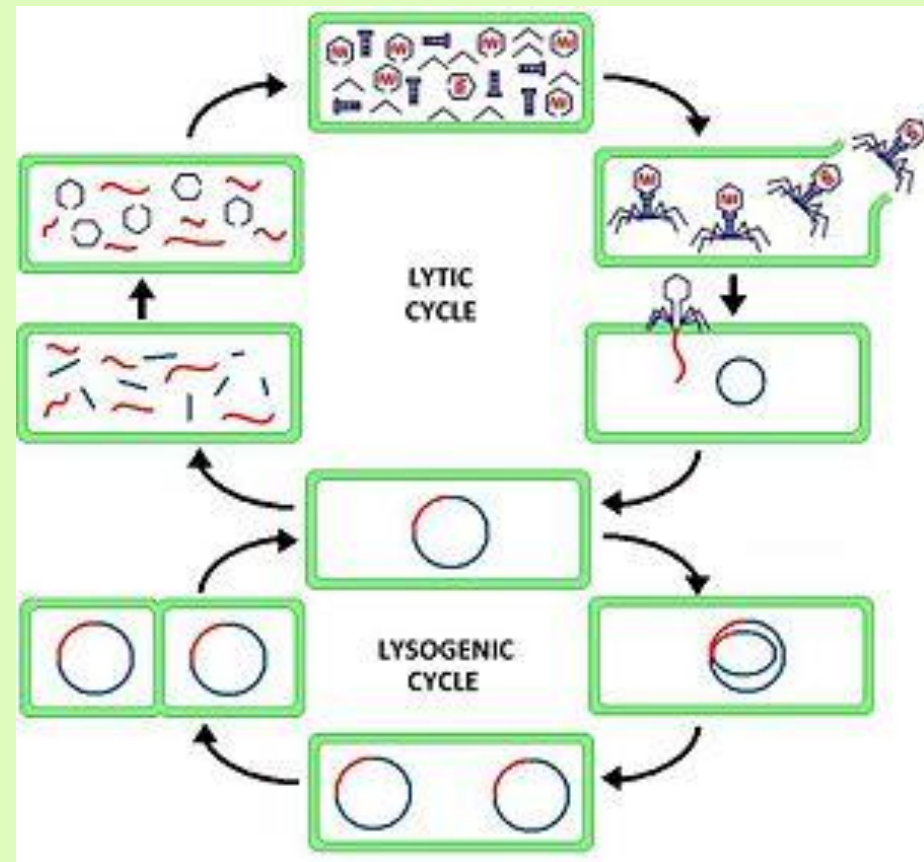


Virus Interactions with Host Cells

- Effect on cells depends on infecting phage
 - Some phage multiply inside cell, producing numerous progeny
 - Termed productive cycle
 - Lytic cycle
 - » Phage lyse infected cell
 - Some phage integrate into host genome
 - Termed latent cycle
 - Lysogenic state

Phage attack bacteria:

<http://www.youtube.com/watch?v=41aqxcxsX2w&feature=related>



Plant Viruses

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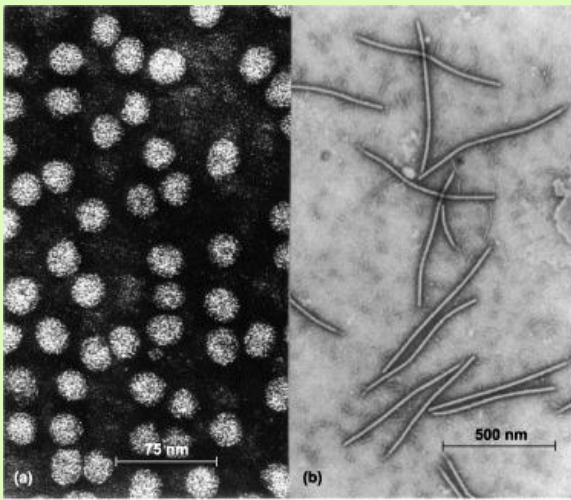
- Number of plant diseases are caused by viruses
 - Can be of major economic importance
- Infection may be recognized via outward signs including
 - Pigment loss
 - Marks on leaves and fruit
 - Tumors
 - Stunted growth
- Plants generally do not recover from viral infections



(a)



(b)

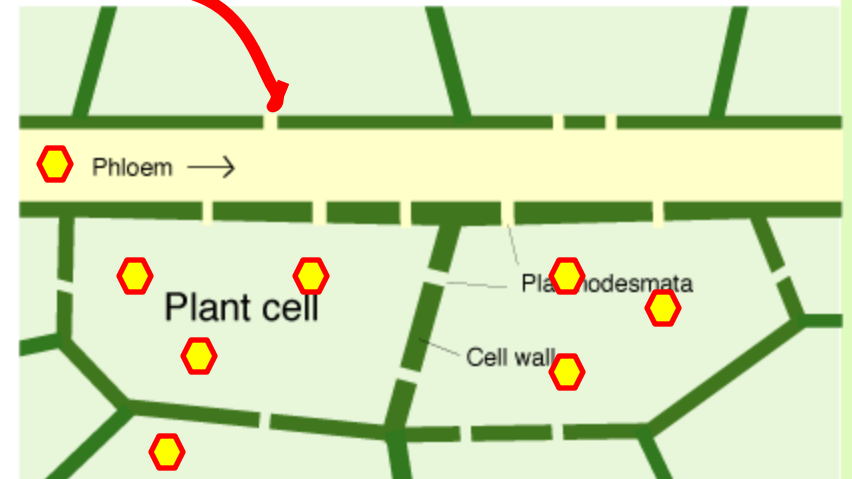


TMV: tobacco mosaic virus

Plant Viruses

Spread of plant viruses

- Viruses infect plants through wound in plant cell wall
 - Viruses do not attach to specific cell receptors
- Once started, infection spreads from cell to cell through plasmodesmata
- Many viruses resistant to inactivation
- Viruses can be transmitted through soil contaminated by prior growth
- Viruses spread through grafting healthy plants to infected plants



Plant viruses

- Viruses can spread via parasitic vine called **dodder (Cuscuta)**
- Vine establishes simultaneous connection between two plants
 - Serves as conduit of transfer



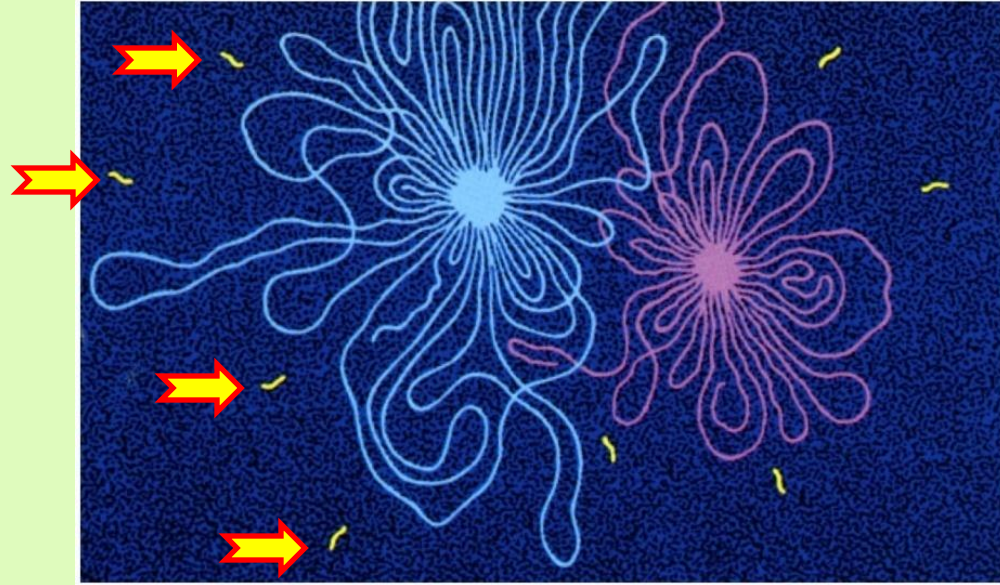
Not so easy to see...

**Quiz Q: Most time
virus is dangerous
to human.
Where could they
be useful?**



Virus-like Agents

- Satellites
 - Satellite viruses
 - Satellite nucleic acids
 - Need helper virus
- Viroids
 - No helper virus
 - No protein coat
 - No capsid
 - Varied size



Viroids

- 
- UGA0162083

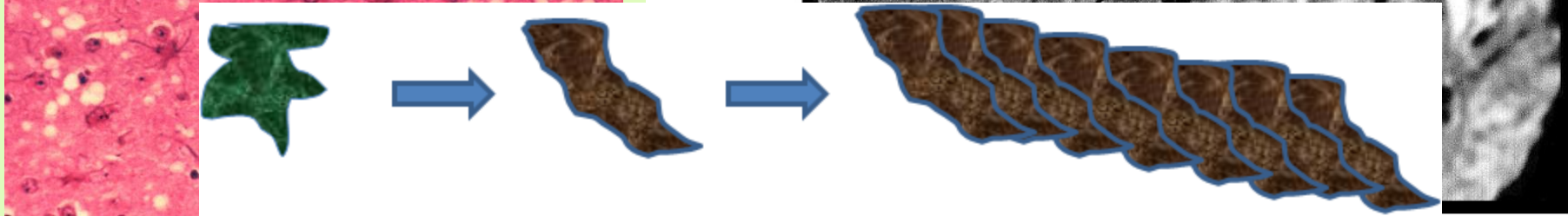
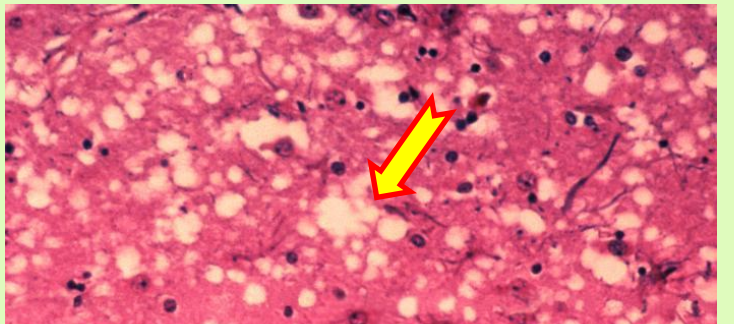


Coconut cadang-cadang viroid



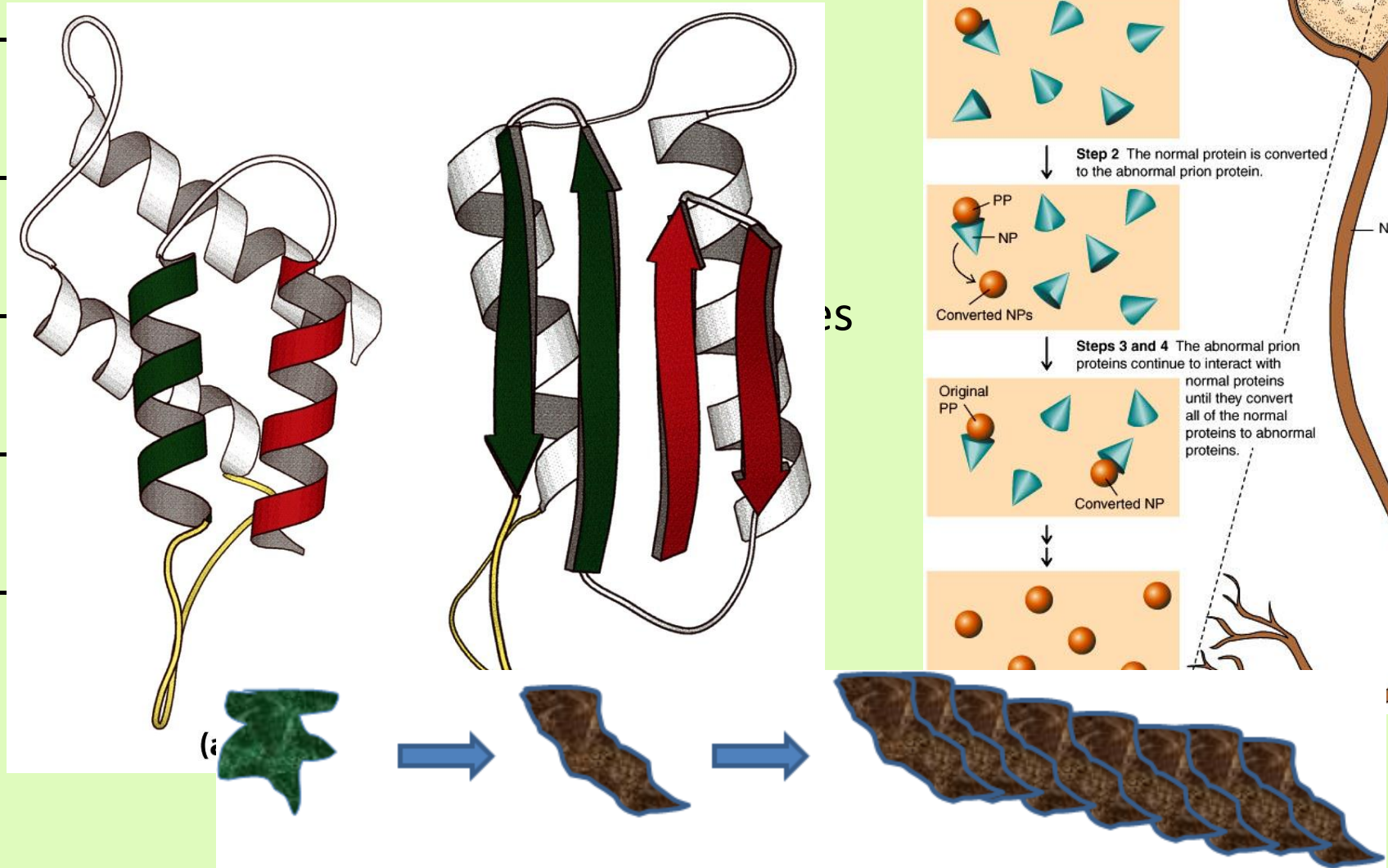
Other Infectious Agents

- Prions
 - Proteinaceous infectious agent
 - Linked to a number of fatal human diseases
 - All afflictions cause brain degeneration
 - Brain tissue develops sponge like holes
 - Disease termed transmissible spongiform encephalopathies
 - Symptoms may not appear for years after infection



Other Infectious Agents

- Prions



Overview of Viral infections

Encephalitis/ meningitis

- JC virus
- Measles
- LCM virus
- Arbovirus
- Rabies

Common cold

- Rhinoviruses
- Parainfluenza virus
- Respiratory syncytial virus

Eye infections

- Herpes simplex virus
- Adenovirus
- Cytomegalovirus

Pharyngitis

- Adenovirus
- Epstein-Barr virus
- Cytomegalovirus

Gingivostomatitis

- Herpes simplex type 1

Parotitis

- Mumps virus

Pneumonia

- Influenza virus, Types A and B
- Parainfluenza virus
- Respiratory syncytial virus
- Adenovirus
- SARS coronavirus

Cardiovascular

- Coxsackie B virus

Hepatitis

- Hepatitis virus types A, B, C, D, E

Myelitis

- Poliovirus
- HTLV-I

Skin infections

- Varicella zoster virus
- Human herpesvirus 6
- Smallpox
- Molluscum contagiosum
- Human papillomavirus
- Parvovirus B19
- Rubella
- Measles
- Coxsackie A virus

Gastroenteritis

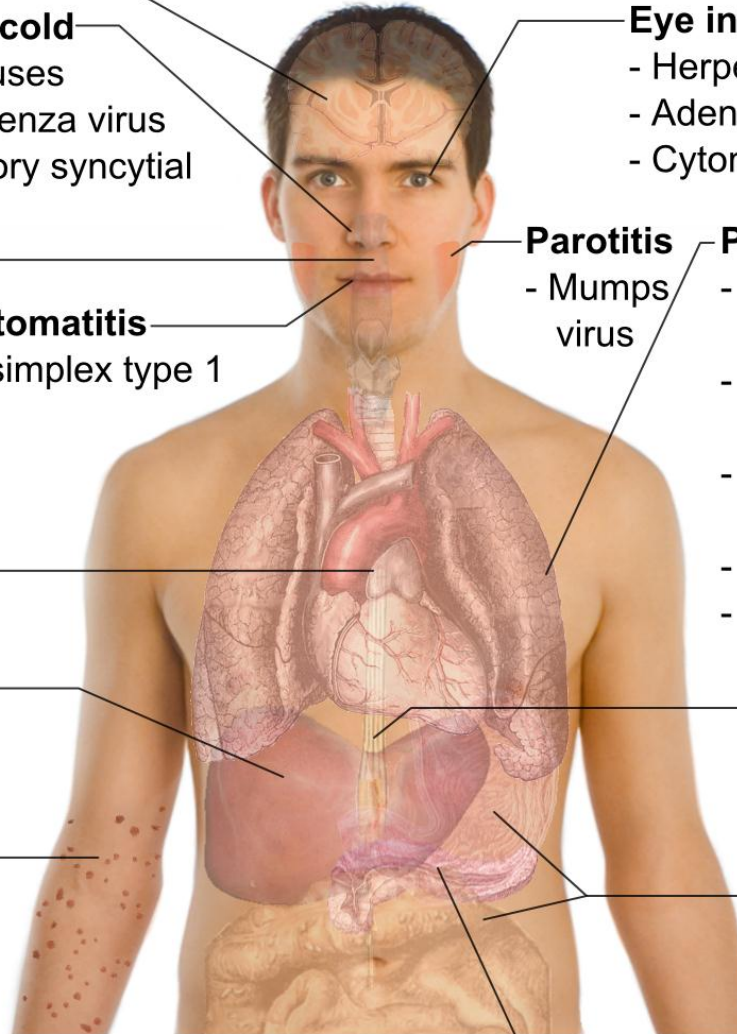
- Adenovirus
- Rotavirus
- Norovirus
- Astrovirus
- Coronavirus

Sexually transmitted diseases

- Herpes simplex type 2
- Human papillomavirus
- HIV

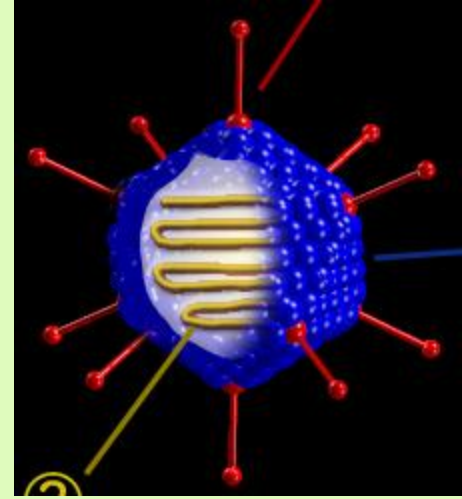
Pancreatitis

- Coxsackie B virus





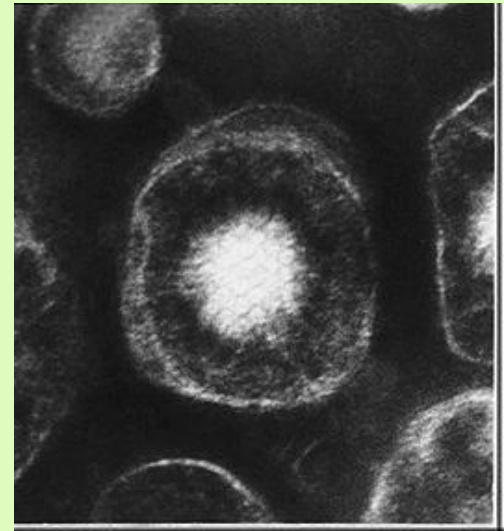
Adenoviridae



- medium-sized (90–100 nm)
- **nonenveloped (naked)**
- icosahedral shape
- **linear dsDNA**
- responsible for 5–10% of upper respiratory infections in children

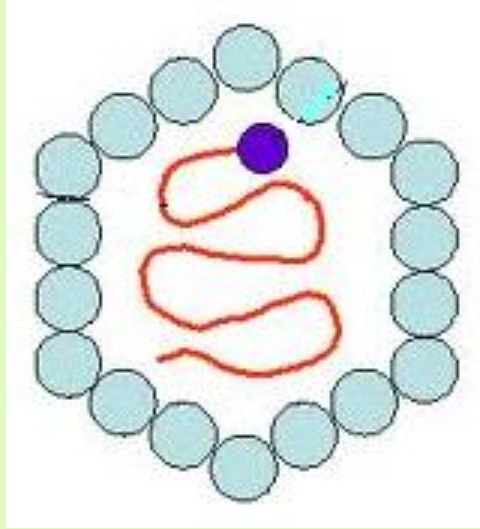
Herpesviridae

- big-sized (100–250 nm)
- **enveloped (naked)**
- icosahedral shape
- linear dsDNA (100-200 gene)
- Eight serotypes to infect human (HHV 1-8)
- Diseases including *chickenpox* and *shingle* (HHV-3), *retinitis* (HHV-5)



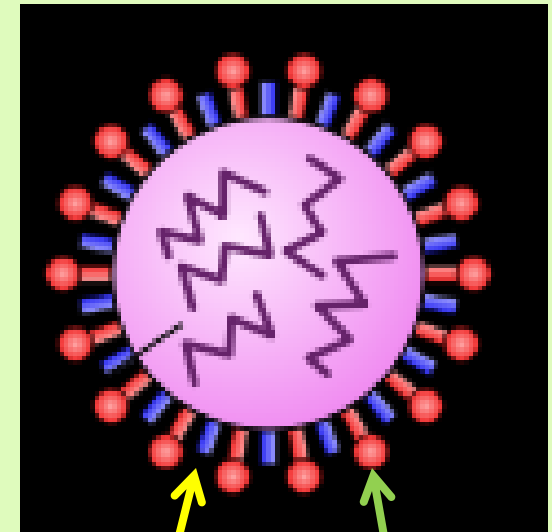
Picornavirus

- Small-sized (20–30 nm)
- Non-**enveloped** (**naked**)
- icosahedral shape
- linear (+) ssRNA (7200-9000 bases)
- A genome binding protein
- Diseases including *digestive(enterovirus)*, *cardiovascular(cardiovirus)* and *hepatitis A*



Orthomyxoviridae

- Medium-sized (50–300 nm)
- **enveloped**
- rod shape
- linear (-) ssRNA, 7-8 fragmented
- coding five proteins
- Diseases including *influenza, H1N1, H3N2 etc.*



H: hemagglutinin, 1-16

N: Neuraminidase, 1-9

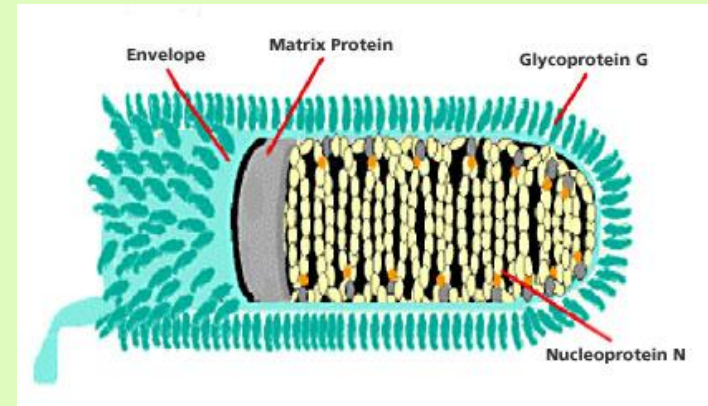
Flaviviridae



- Small-sized (40–60 nm)
- **enveloped**
- Spherical shape
- linear (+) ssRNA (9600-12300 bases)
- spread through arthropod vectors (mainly ticks and mosquitoes)
- Diseases including *yellow fever, West Nile encephalitis, Dengue Fever, and hepatitis C*

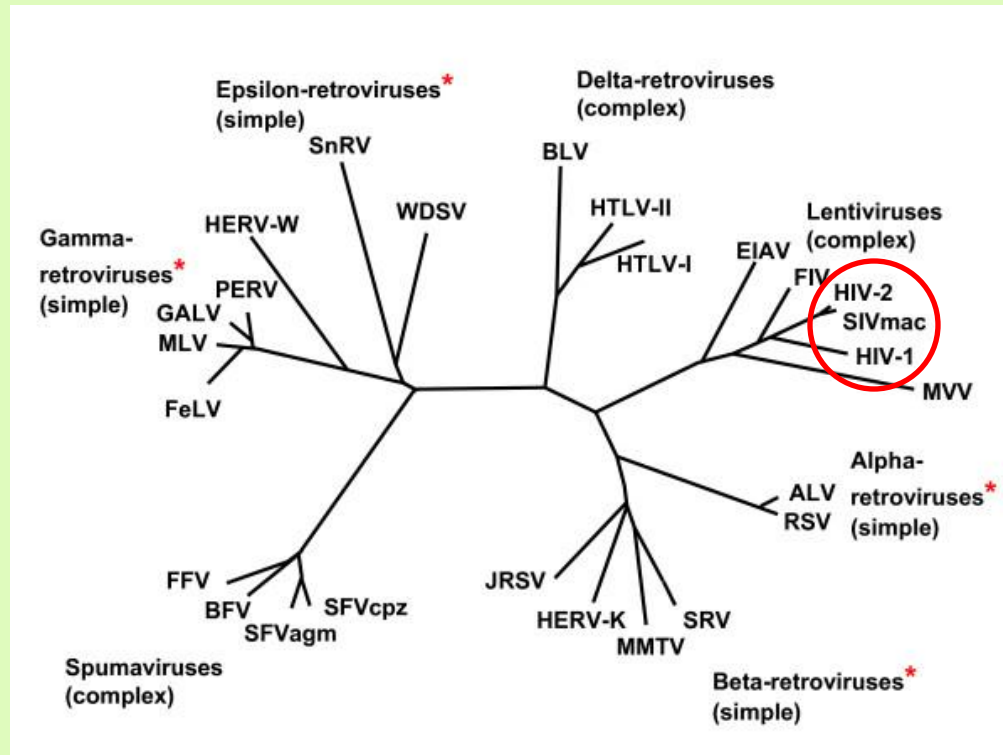
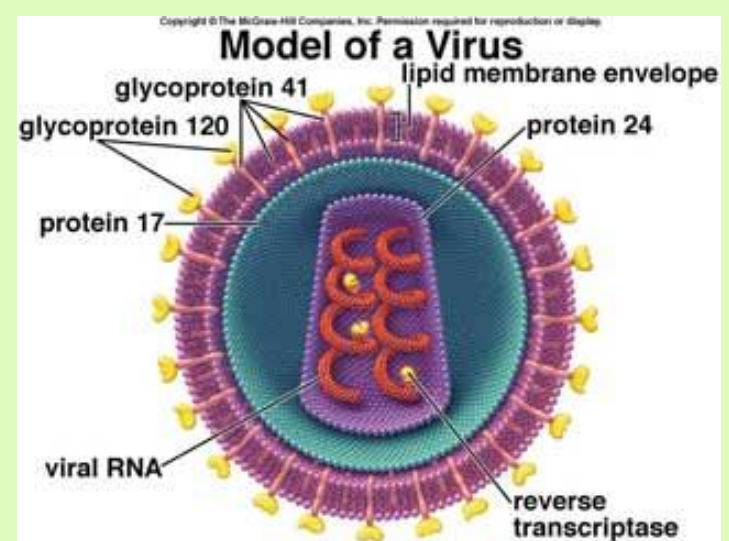
Rhabdoviridae

- Small-sized (30–40 nm)
- **enveloped**
- rod shape
- linear (-) ssRNA
- coding five proteins
- Diseases including *Rabies*



Retrovirus

- Small-sized (30–40 nm)
- **enveloped**
- Spherical shape
- linear (+) ssRNA, dimer
- Reverse transcription
- Diseases including *HIV*



Phylogeny of Retroviruses