

# **BIOL 240: General Microbiology**

**Spring 2020** **WMW, 4/22-4/29**

<http://accounts.smccd.edu/staplesn/biol240/>

1. **Extra Credit: STEM SPEAKER SERIES**, Weds. @ 5pm-6pm, are **DONE** and should be **ONLINE**. **ALL DUE by NEXT FRIDAY!!!!**
2. **FIRST ONLINE LAB EXERCISE** info coming **THIS Friday!!**  
☺ It will be assigned next week, with an associated quiz and/or worksheet. 2<sup>nd</sup> online lab will be the next week: 16.
3. **Quiz #7 will open in TWO weeks.**
  - It will include **FINAL** lecture and Online/Virtual lab questions, **AND** might be more than 20 points!
  - (It will be **MANDATORY** and **NOT** droppable).
4. Remaining Chapters: 13, 15\*, 16-17 (Immun.), 22-25, 27.

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## **Ch. 13: Viruses**

**OBJECTIVES:** Students should be able to: .....

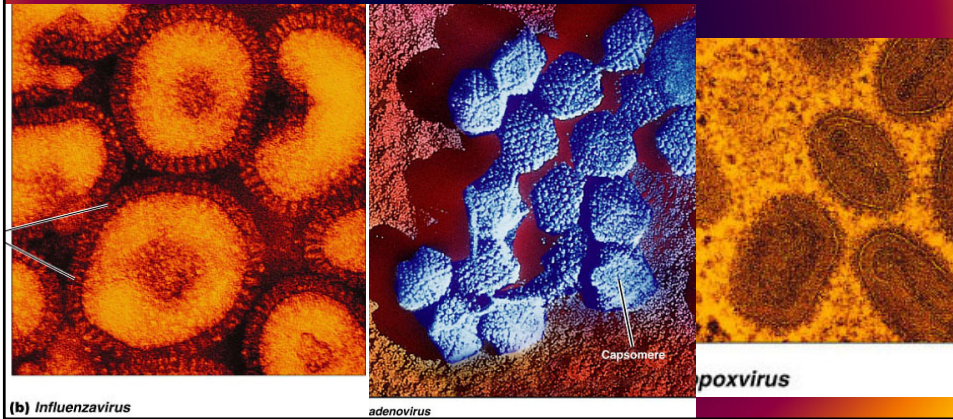
1. **Ch. 13:** Diagram & compare the **lytic** & **lysogenic** reproductive cycles of bacteriophages.
2. Diagram & compare the reproductive cycles of **Bacteriophages** & **animal Viruses**.
3. Diagram and compare the reproductive cycles of **enveloped** and **non-enveloped** animal viruses. Cite a specific example of each.
4. Compare the structures & replication mechanisms of **Viroids**, **Prions**, & **true Viruses**.

❖ **Objectives are your HOMEWORK between classes!!!** *\*\*Read, Review, Draw!!*

2



# Chapter 13

## Viruses, Viroids, and Prions



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# Viruses

1. Viruses contain DNA or RNA, and
2. Protein coat = capsid (capsomeres)
3. Some are enclosed by an envelope
4. Some viruses have **spikes**
5. Most viruses infect only specific types of cells in one host
6. **Host range** is determined by specific host attachment sites and cellular factors

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# 13.1) Types of Viruses

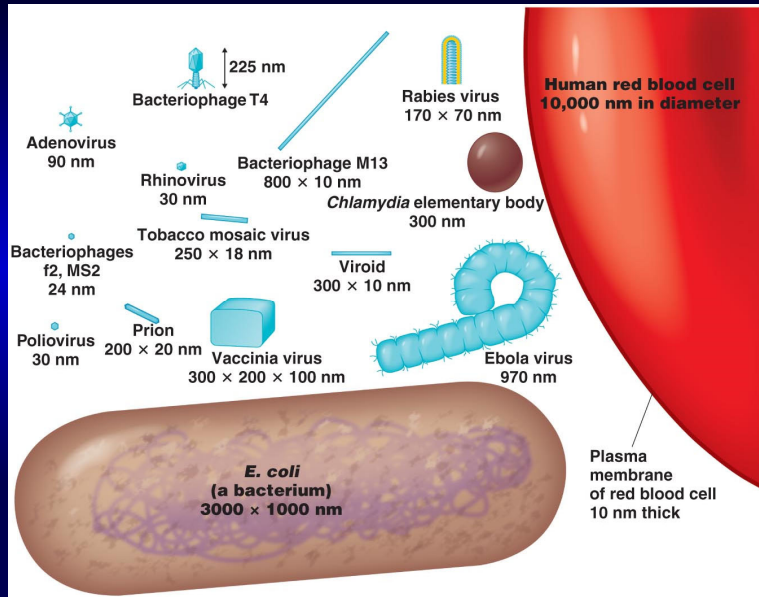
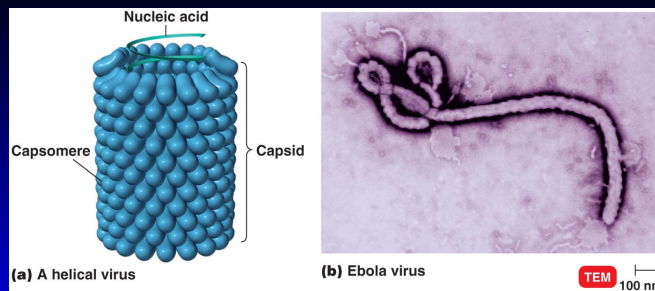


Figure 13.1

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## A. Helical Viruses

Figure 13.4a, b



## B. Polyhedral Viruses

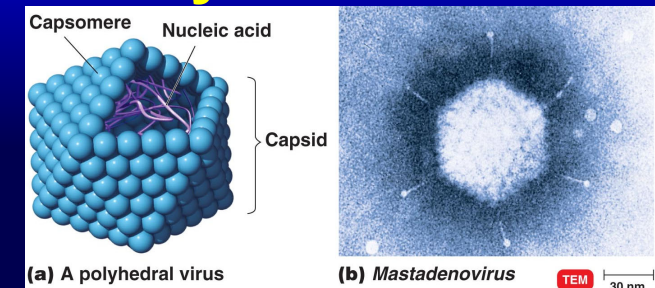
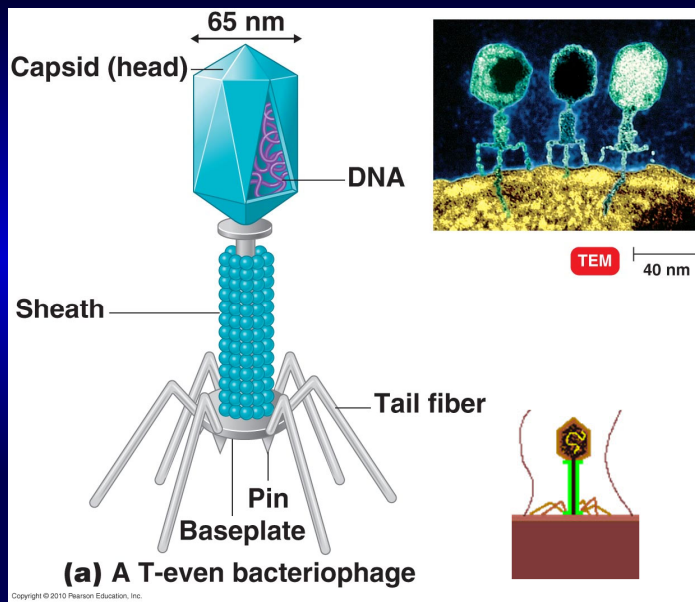


Figure 13.2a, b

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## C. Complex Viruses



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## Growing Viruses

- Viruses must be grown in living cells.
  - Bacteriophages form plaques on a lawn of bacteria.

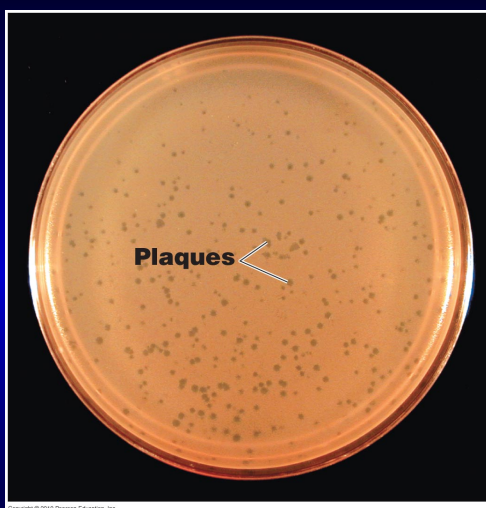
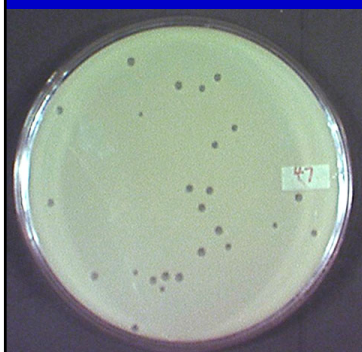


Figure 13.6

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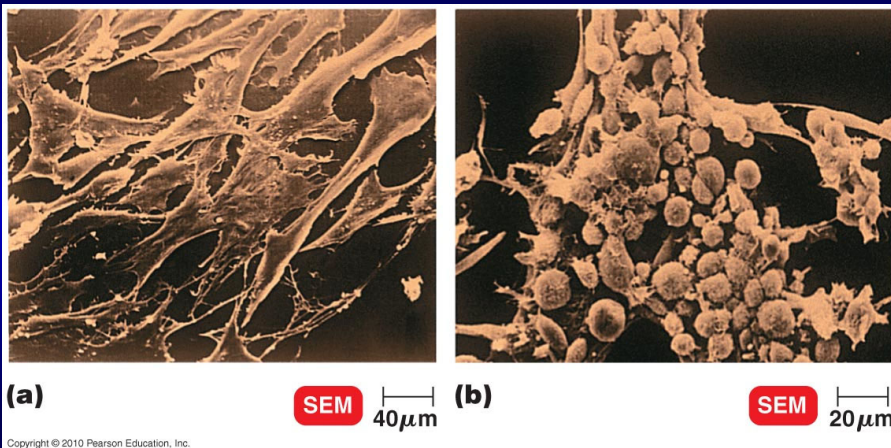


## 13.2) Virus Identification

1. **Cytopathic effects** – deadly effects on host cells
2. **Serological tests**
  - Detect antibodies against viruses in a patient
  - Use antibodies to identify viruses in neutralization tests, viral hemagglutination, and Western blot (immunoblot)
3. **Nucleic acids: ss/ds-DNA, ss/ds-RNA**
  - **PCR** → specific primers for detection
  - **DNA hybridization** – detect complementary viral genomes with a probe.
  - **(RFLPs** = differences in restriction fragment sizes)

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## Virus Identification (Cytopathic Effects)



Uninfected monolayer of mouse cells

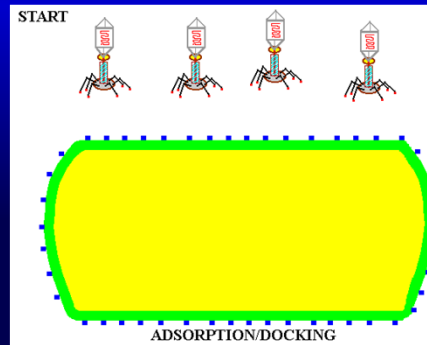
Infected with vesicular stomatitis virus

Figure 13.9

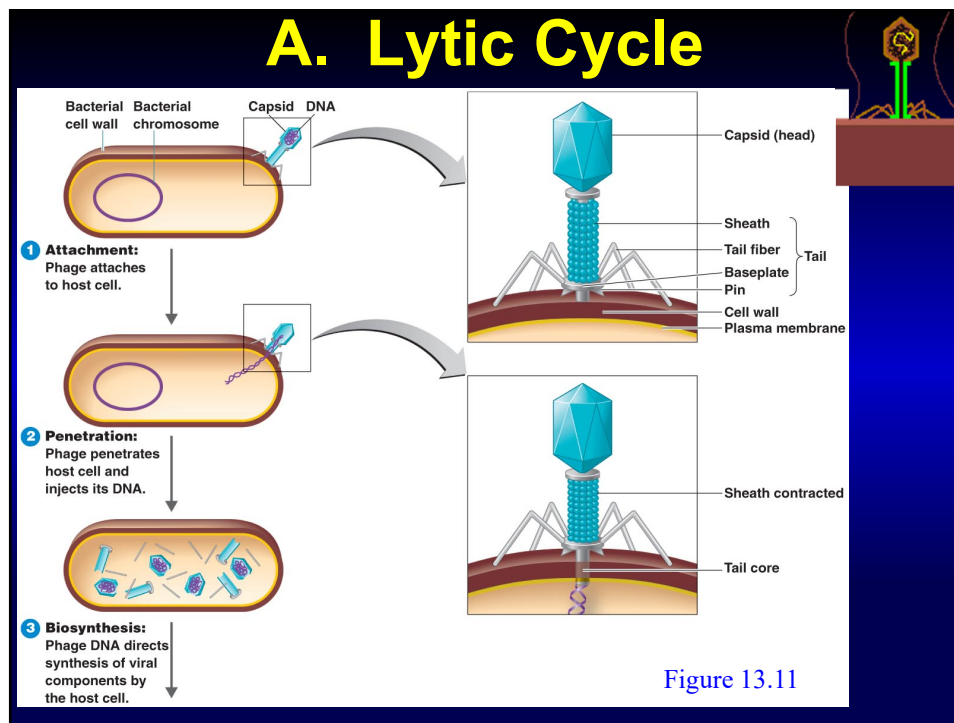
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## 13.3) Multiplication of Bacteriophages (Lytic Cycle)

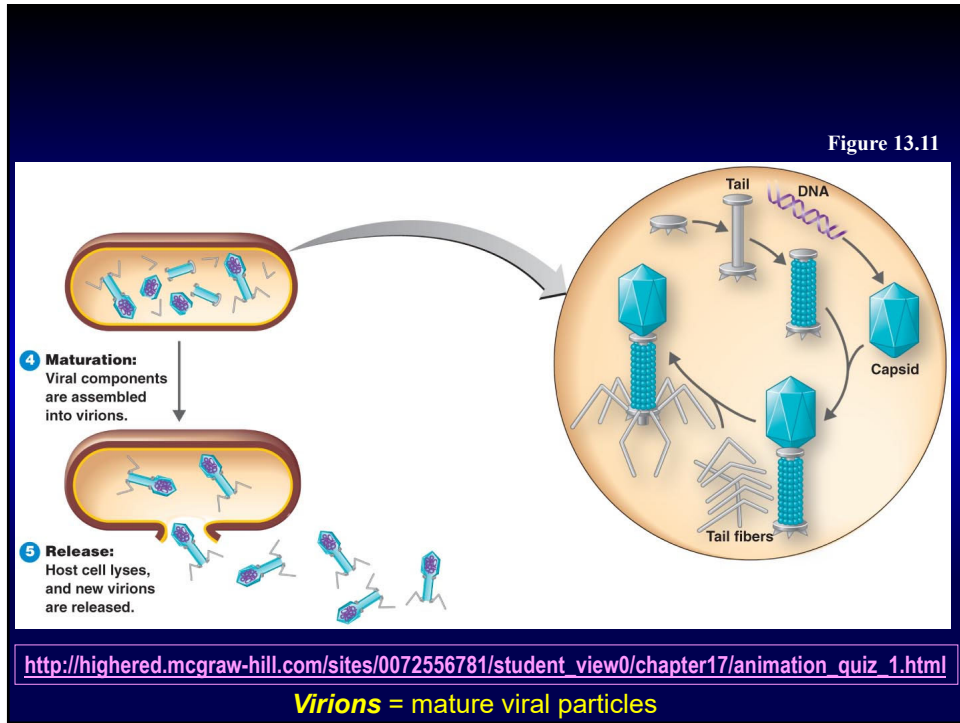
1. **Attachment:** Phage attaches by tail fibers to host cell
2. **Penetration:** Phage *lysozyme* opens cell wall, tail sheath contracts to force tail core and DNA into cell
3. **Biosynthesis:** Production of phage DNA and proteins
4. **Maturation:** Assembly of phage particles
5. **Release:** Phage *lysozyme* breaks cell wall



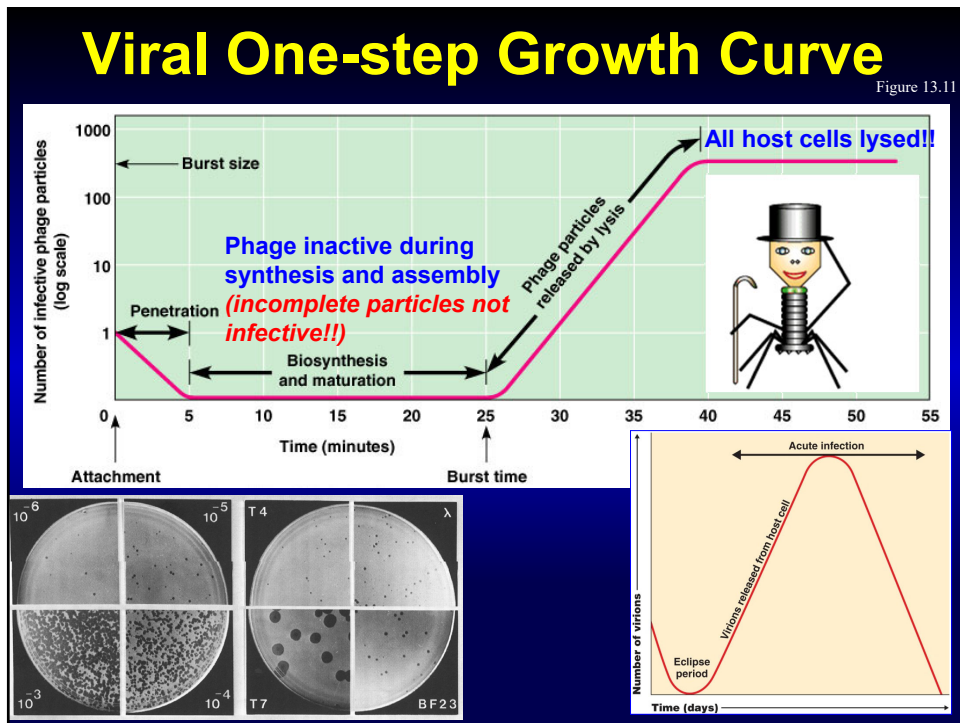
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13



14

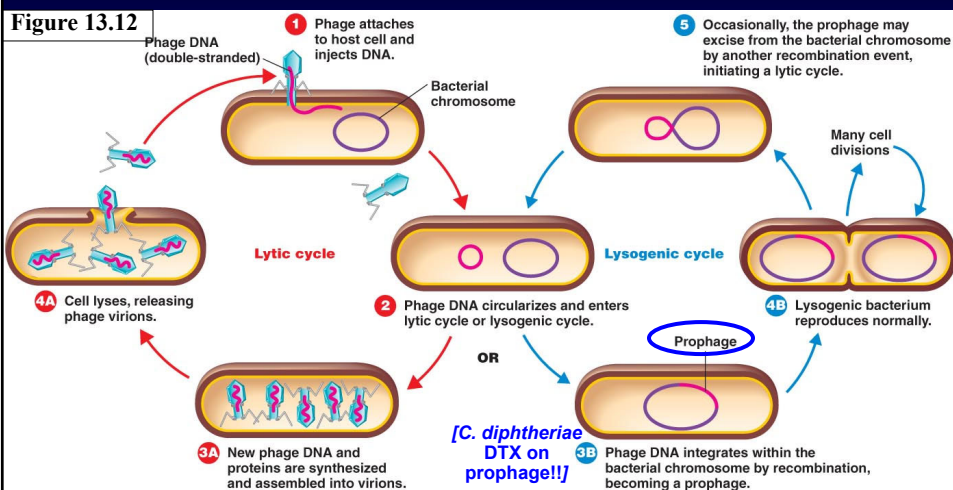
- **Lytic cycle** = Phage causes lysis and death of host cell
  - Attach, infect, synthesize, destroy.... (repeat as necessary...) 😊

- **Lysogenic cycle** =
  - Prophage DNA incorporated into host DNA
    - Passive replication with host chromosome
  - **Phage conversion**
  - **Specialized transduction**



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## B. The Lysogenic Cycle



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[http://highered.mcgraw-hill.com/sites/0072556781/student\\_view0/chapter17/animation\\_quiz\\_2.html](http://highered.mcgraw-hill.com/sites/0072556781/student_view0/chapter17/animation_quiz_2.html)

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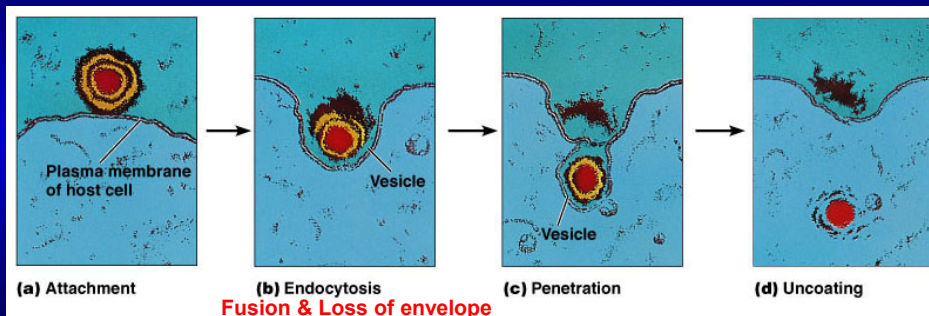
# 13.4) Multiplication of Animal Viruses

|                                      |  |
|--------------------------------------|--|
| <b>1. Attachment:</b>                | Viruses attaches to cell membrane                        |
| <b>2. Penetration:</b>               | By <u>endocytosis</u> or <u>fusion</u>                   |
| <b>3. Uncoating:</b>                 | By viral or host enzymes                                 |
| <b>4. Biosynthesis:</b>              | Production of nucleic acid and proteins                  |
| <b>5. Maturation:<br/>(Assembly)</b> | Nucleic acid and capsid proteins assemble                |
| <b>6. Release:</b>                   | By <u>budding</u> (if enveloped virus) or <u>rupture</u> |

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## Attachment, Penetration (Fusion), and Uncoating

Figure 13.14

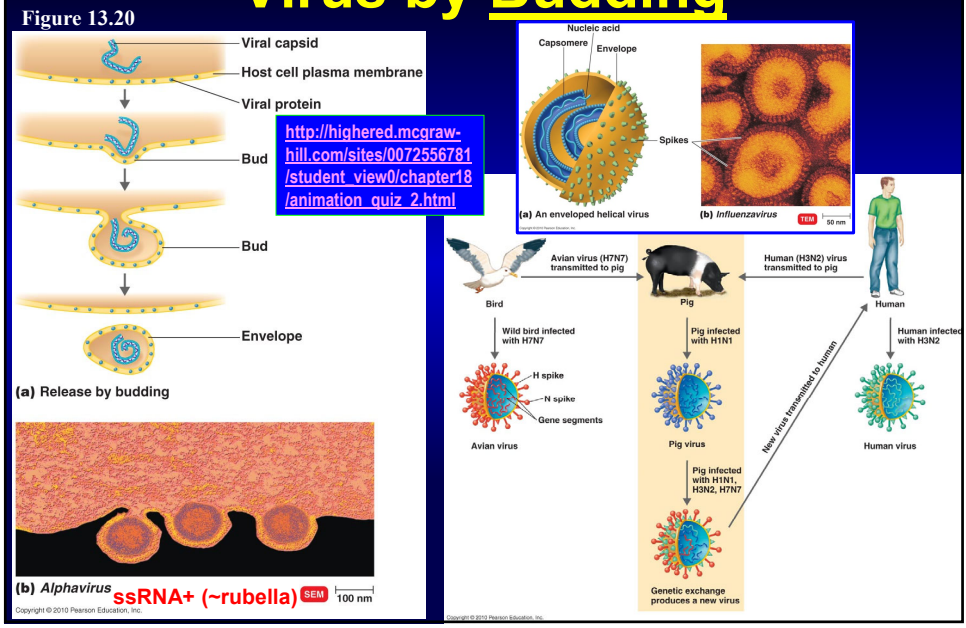


Herpes Virus (dsDNA virus) – by Fusion

[http://highered.mcgraw-hill.com/sites/0072556781/student\\_view0/chapter18/animation\\_quiz\\_1.html](http://highered.mcgraw-hill.com/sites/0072556781/student_view0/chapter18/animation_quiz_1.html)

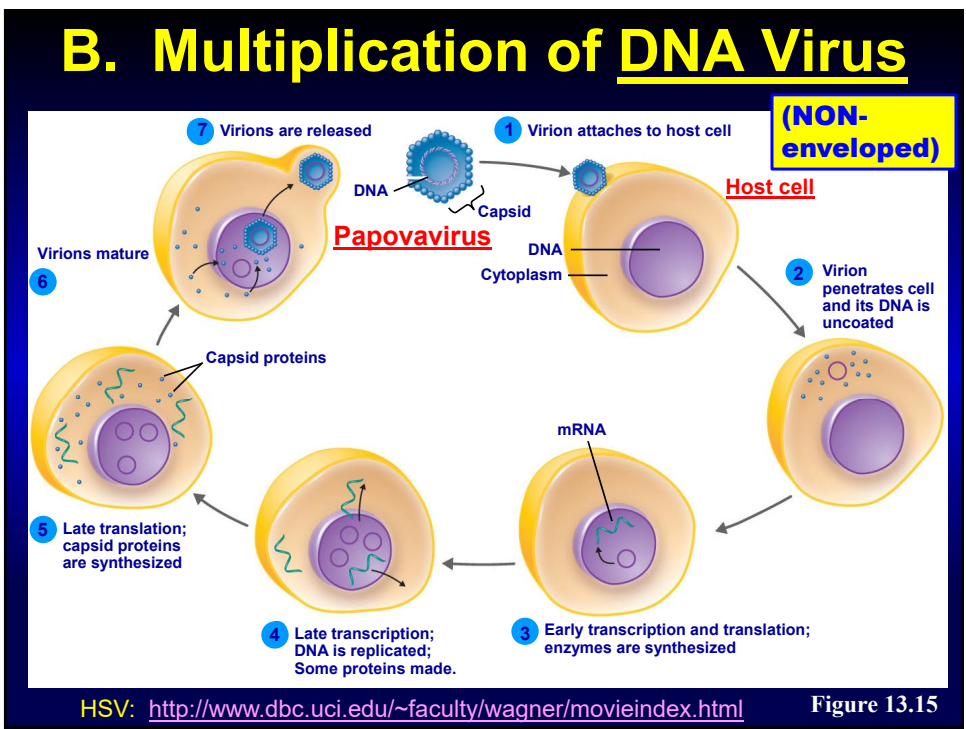
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# A. Release of an Enveloped Virus by Budding



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# B. Multiplication of DNA Virus



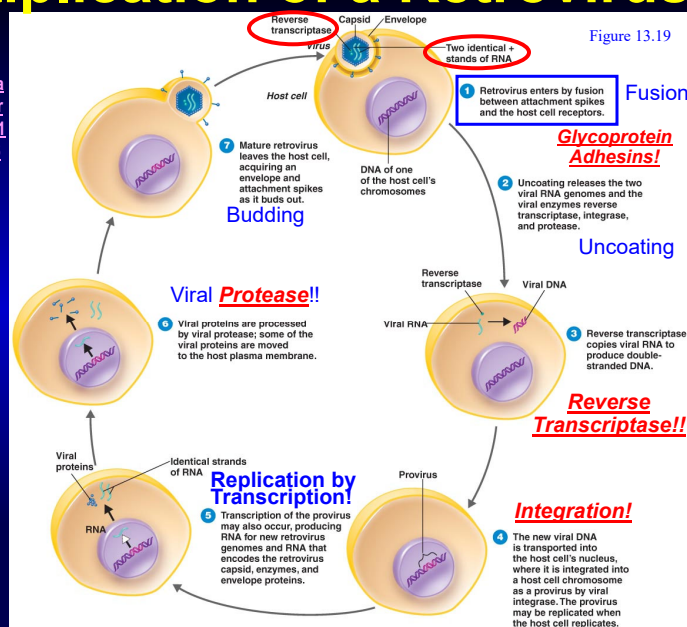
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## C. Multiplication of a Retrovirus

### 3D drama! ☺ :

<http://www.bing.com/videos/search?q=Battlefield+cell+discover+v&view=detail&mid=680C8CEC1B85E665251680C8CEC1B85E665251&FORM=VIRE>

[http://highered.mcgraw-hill.com/sites/0072556781/student\\_view0/chapter18/animation\\_quiz\\_1.html](http://highered.mcgraw-hill.com/sites/0072556781/student_view0/chapter18/animation_quiz_1.html)

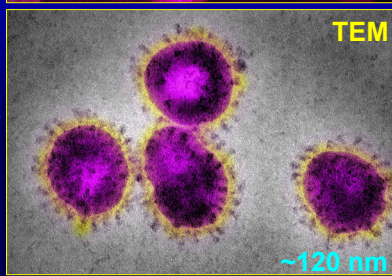


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## D. Coronavirus: SARS-CoV2

- 1. Enveloped, + sense strand, RNA virus.**
- 2. Enters cell by attachment and fusion.**
  - a) Attachment to the ACE2 receptor – Angiotensin Converting Enzyme 2.**
  - b) ACE2 inactivates Ang-II, regulating blood pressure, CV health, & heart contractility. Host NZs aid binding.**
  - c) On epithelial cells – lungs, arteries, heart, kidneys, intestines.**
- 3. Virus-encoded RNA-Dependent RNA Polymerase replicates the viral genome.**
- 4. Viral proteins produced as a continuous Poly-Protein.**
- 5. Polyprotein cleaved by Viral Protease into separate viral proteins that assemble/mature.**



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## SARS-CoV/CoV2

**\*\*\* RECEPTOR AFFINITY: CoV2 >> CoV RBD (~2X?)**

<https://youtu.be/j4Xiow30bGo>  
<https://youtu.be/l-Yd-XIWJq?t=150>

The entry of SARS-CoV-2 into the type II pneumocyte is via endocytosis and then multiplies in the cytoplasm. The high protein manufacturing stress induced upon the type II pneumocytes leads to apoptosis. Additionally, the RNA from the SARS-CoV-2 acts as a pathogen-associated molecular pattern (PAMP) and will be recognized by the pattern recognition receptor or toll-like receptors.

This leads to a chemokine surge which causes neutrophil migration and activation. This leads to the destruction of the alveolar-capillary walls. At a microscopic level, this leads to a loss in the interface between the intra-alveolar space and the surrounding stroma. Therefore, fluid leaks through and fills into the alveolar sacs.

<https://doi.org/10.1038/s41423-020-0400-4>  
<https://doi.org/10.1007/s00134-020-05985-9>

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# E. Viral Cancer

- Activated **oncogenes** transform normal cells into cancerous cells.
- Transformed cells have
  - increased growth,
  - loss of contact inhibition,
  - tumor specific transplant and T antigens.
- The genetic material of oncogenic viruses becomes integrated into the host cell's DNA.

START

RELEASE OF GENOME

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# Oncogenic Viruses

(-viridae = genus name)

- Oncogenic DNA Viruses

- Adenoviridae
- Herpesviridae
- Poxviridae
- Papovaviridae
- Hepadnaviridae

(hepatitis C)

- Oncogenic RNA Viruses

- Retroviridae

- Viral RNA is transcribed to DNA which can integrate into host DNA
- **HTLV 1**
- **HTLV 2**

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## 13.5) Prions

- Infectious proteins
- Inherited and transmissible by ingestion, transplant, & surgical instruments
  - Spongiform encephalopathies:
    - Sheep scrapie, Creutzfeldt-Jakob disease, mad cow disease....
  - PrP<sup>C</sup>, normal cellular prion protein, on cell surface (chrom. 20 in humans)
  - PrP<sup>Sc</sup>, scrapie protein, accumulates in brain cells forming **plaques**
    - Diagnostic; not cause of cell damage?

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# Prions

Figure 13.21

**Figure 13.22: How a protein can be infectious**

- 1 PrP<sup>c</sup> produced by cells is secreted to the cell surface.
- 2 PrP<sup>Sc</sup> may be acquired or produced by an altered PrP<sup>c</sup> gene.
- 3 PrP<sup>Sc</sup> reacts with PrP<sup>c</sup> on the cell surface.
- 4 PrP<sup>Sc</sup> converts the PrP<sup>c</sup> to PrP<sup>Sc</sup>.
- 5 The new PrP<sup>Sc</sup> converts more PrP<sup>c</sup>.
- 6 The new PrP<sup>Sc</sup> is taken in by endocytosis.
- 7 PrP<sup>Sc</sup> accumulates in endosomes.
- 8 PrP<sup>Sc</sup> continues to accumulate as the endosome contents are transferred to lysosomes. The result is cell death.

**PrP<sup>Sc</sup> taken in from surface by endocytosis**

<https://learn.genetics.utah.edu/content/basics/prions/>

<http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::sites/dl/free/0072437316/120088/bio43.swf::How%20Prions%20Arise>

[http://www.nobelprize.org/nobel\\_prizes/medicine/laureates/1997/medanim/animation.html](http://www.nobelprize.org/nobel_prizes/medicine/laureates/1997/medanim/animation.html)

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# 13.6) Plant Viruses

- **Plant Viruses**
  - Plant viruses enter through wounds or via insects
  - **TMV** – tobacco mosaic virus
- **Viroids**
  - Viroids are infectious RNA; potato spindle tuber disease
  - **PSTVd** – Potato spindle tuber viroid

**PSTV (~120nm)**

Figure 13.22

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