

Biology 331
Introduction to Virology
Class I Viruses
Mostly Chapters 9, 16

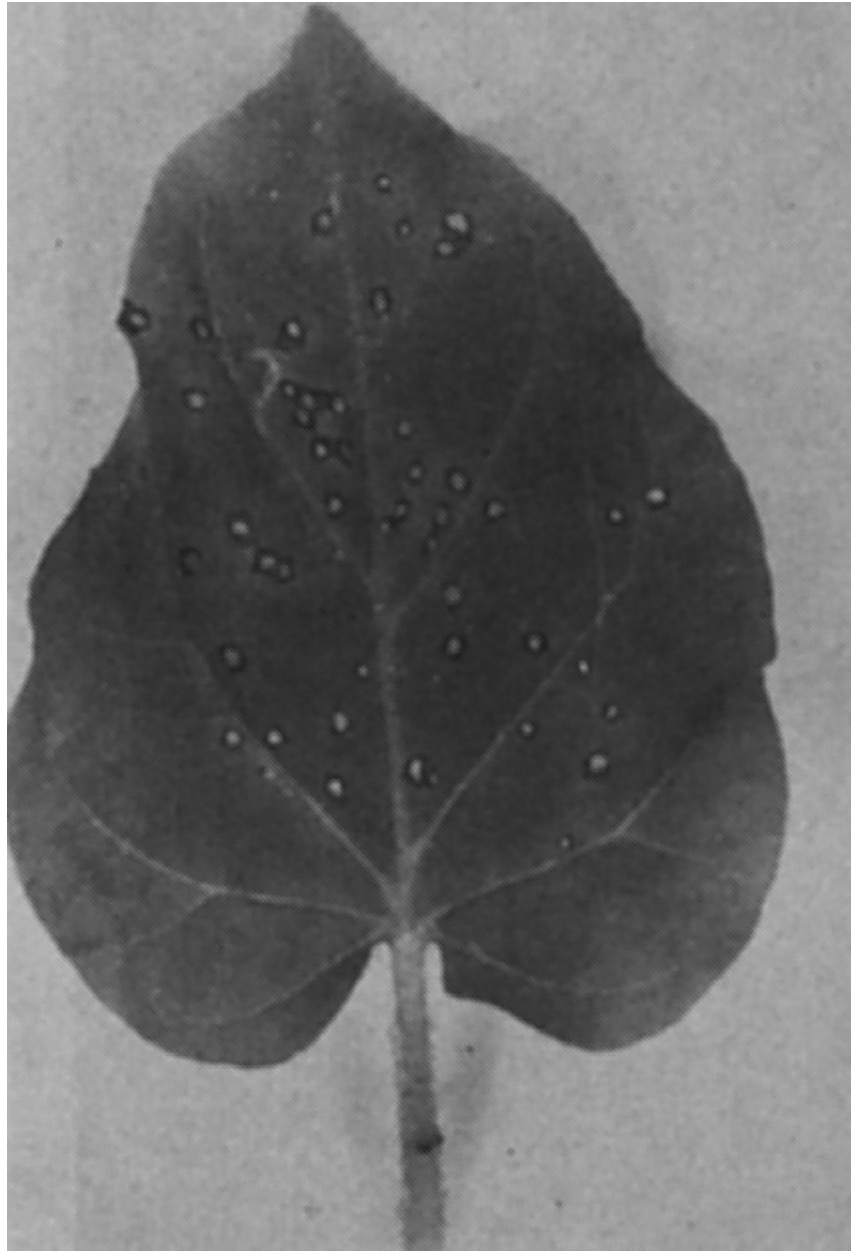
Virology

Obligate Intracellular Parasites, Non-Cellular

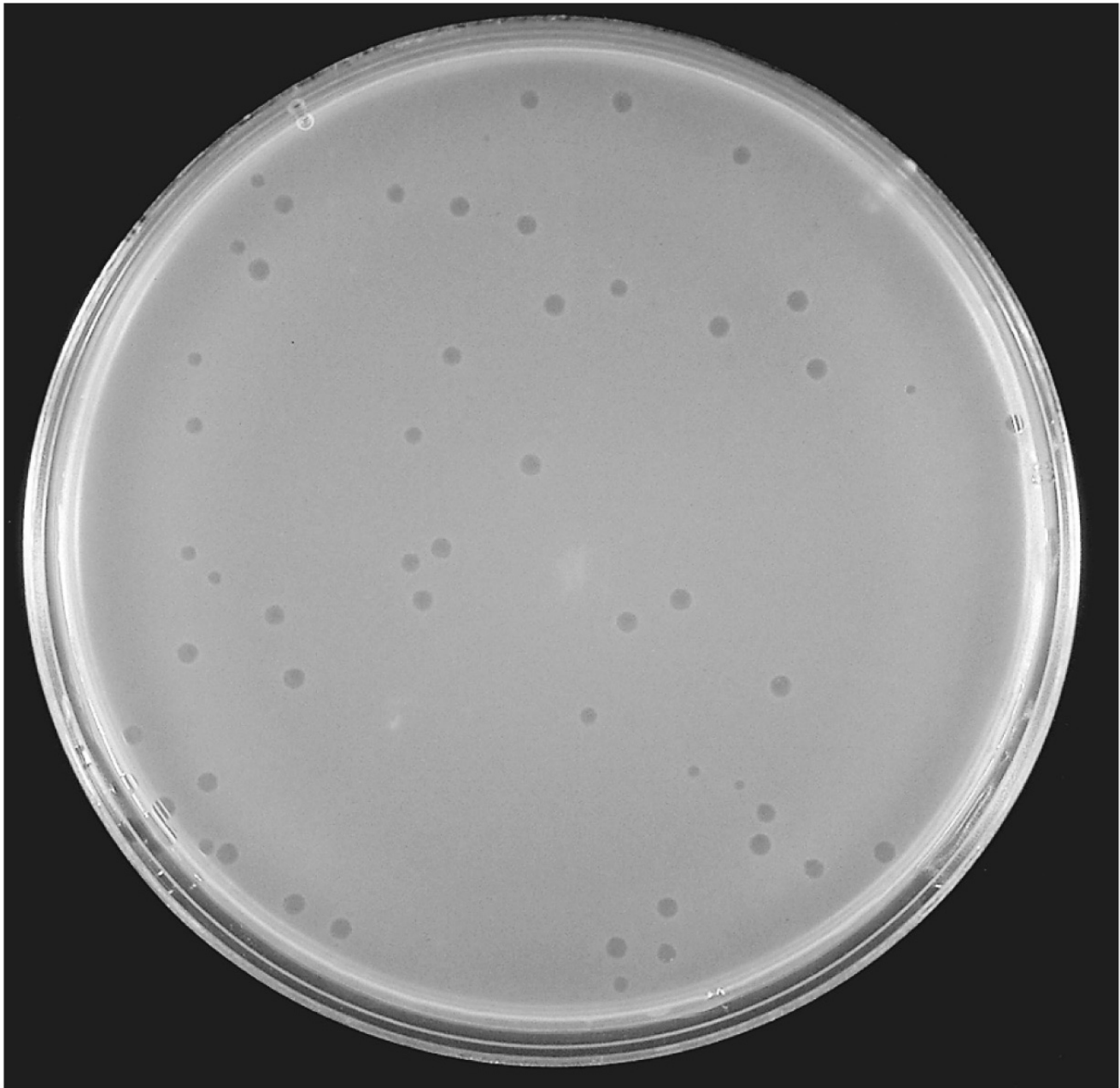
Early History

- 1889 - Beijerinck, Tobacco Mosaic Virus, “filterable”
- 1911 - Rous, first cancer virus (Rous Sarcoma)
- 1915 - Twort, first bacteriophage

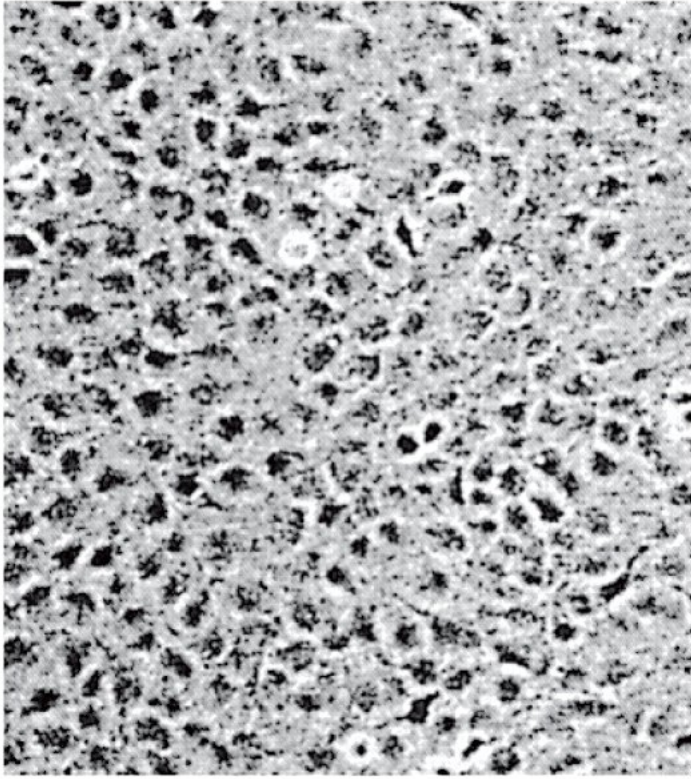
Electron microscopy and X-ray crystallography (mid-1900's) required to actually see viruses.





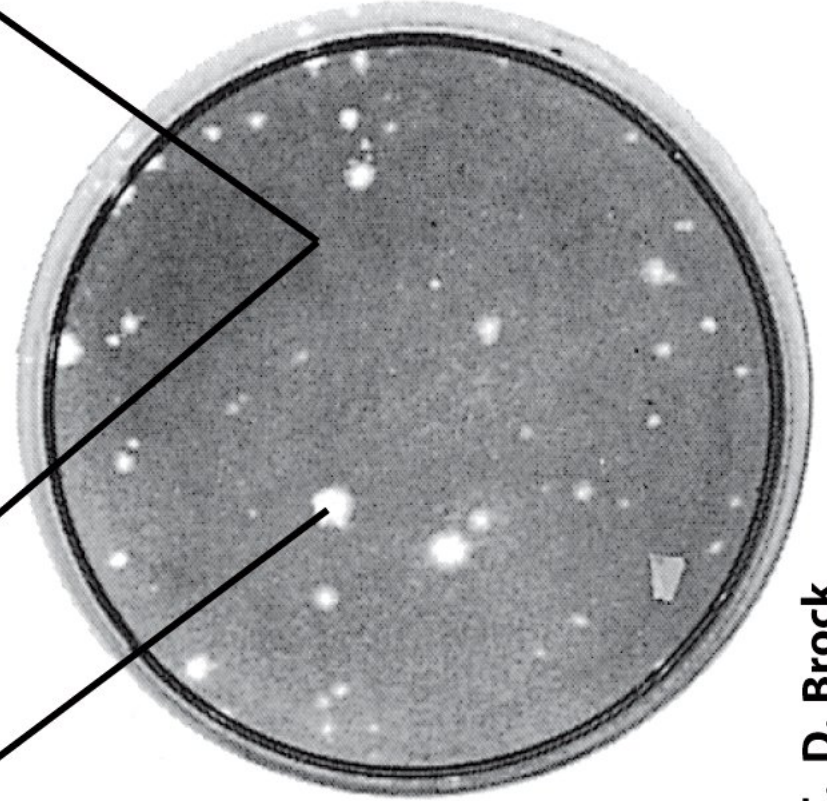


Paul Kaplan

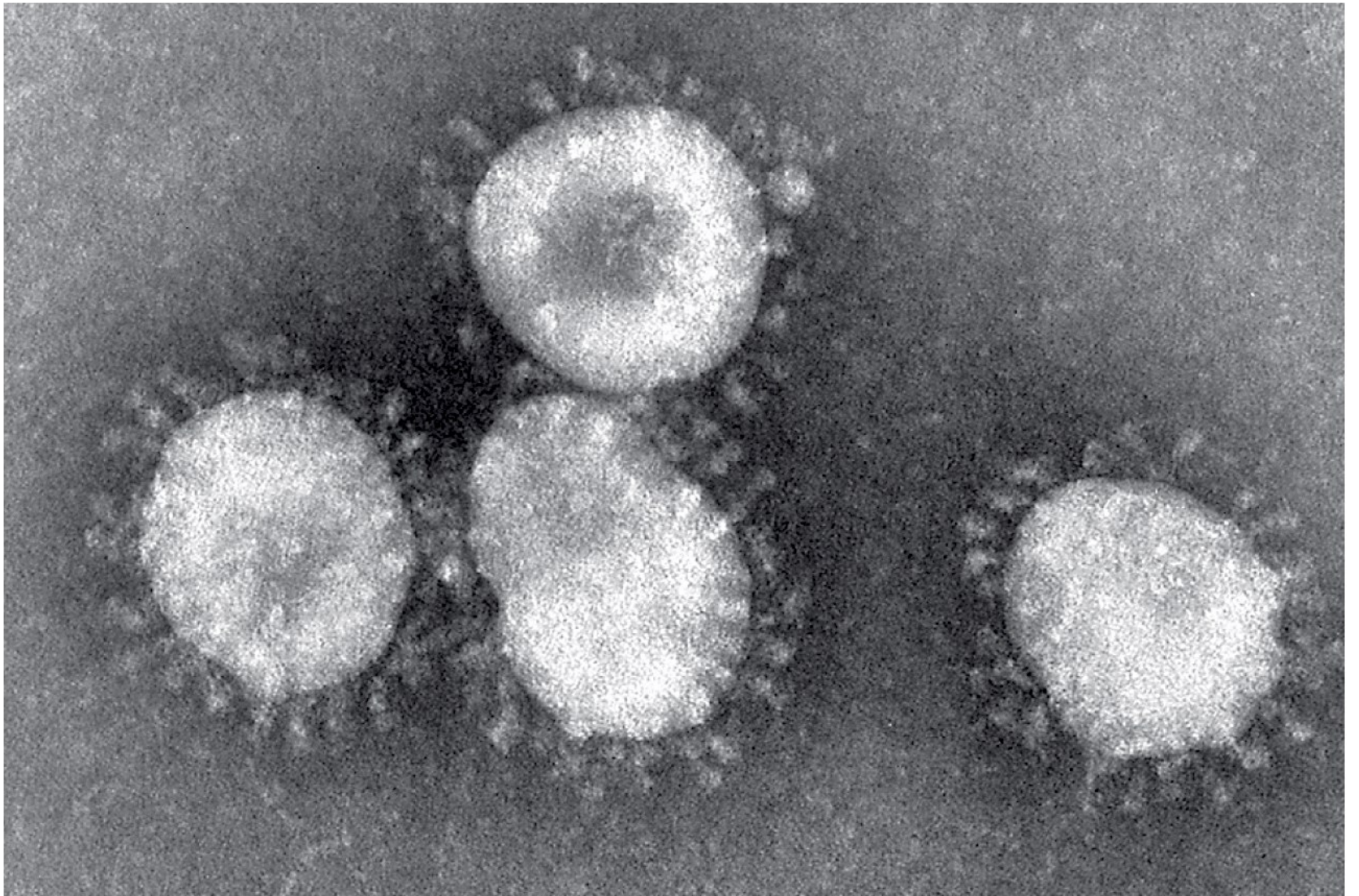


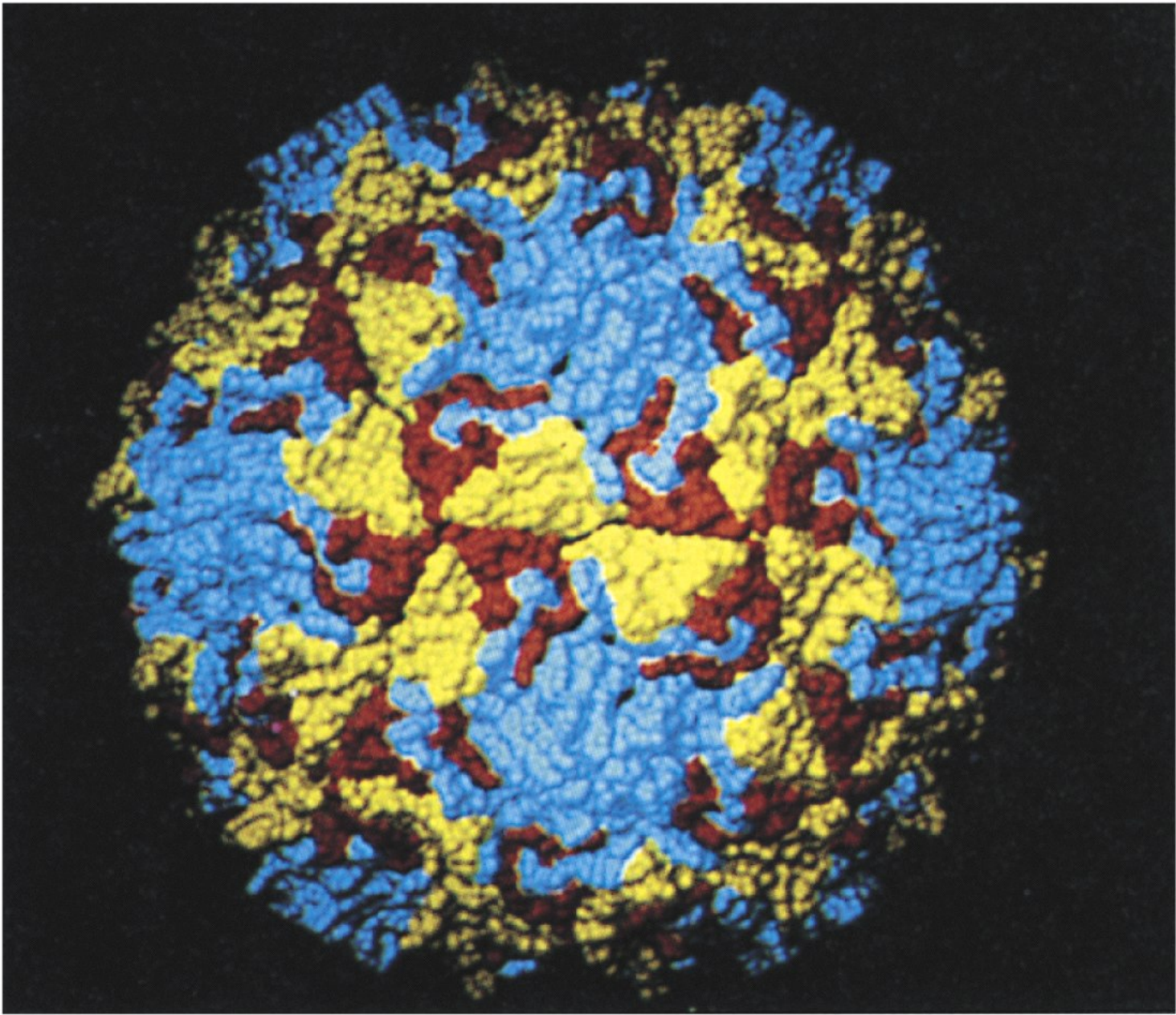
Confluent monolayer of tissue culture cells

Viral plaques



T. D. Brock





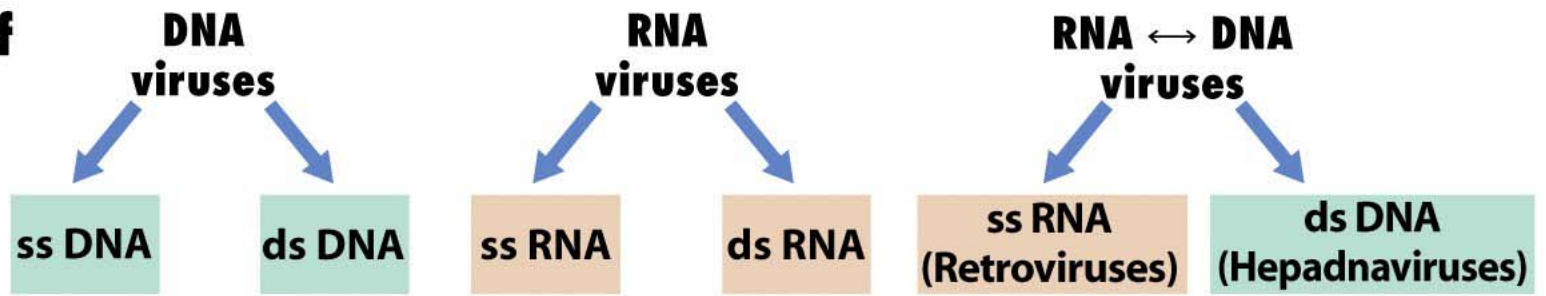
All Viruses Contain Genetic Material

- DNA, RNA, or both - single or double stranded
- Form determines replication strategy
- Some are linear, circular, or segmented

Single stranded can be coding (+) or non-coding (-); (+) means ribosome recognizes and translates it.

Classes of viruses

Genome in virion



Baltimore Classification System - Table 9.2

- Class I - ds DNA genomes
- Class II - ss DNA genome (not covered)
- Class III - ds RNA genome (not covered)
- Class IV - ss (+) RNA genome
- Class V - ss (-) RNA genome
- Class VI - ss (+) RNA with DNA intermediate
- Class VII - ds DNA with RNA intermediate

Baltimore was given this recognition for discovering Class VI retroviruses in 1969.



ds DNA (+) virus
Class I
Class VII



ss DNA (+)
 virus
Class II

Synthesis of other strand

ds DNA intermediate

*-Transcription—
 of minus strand*

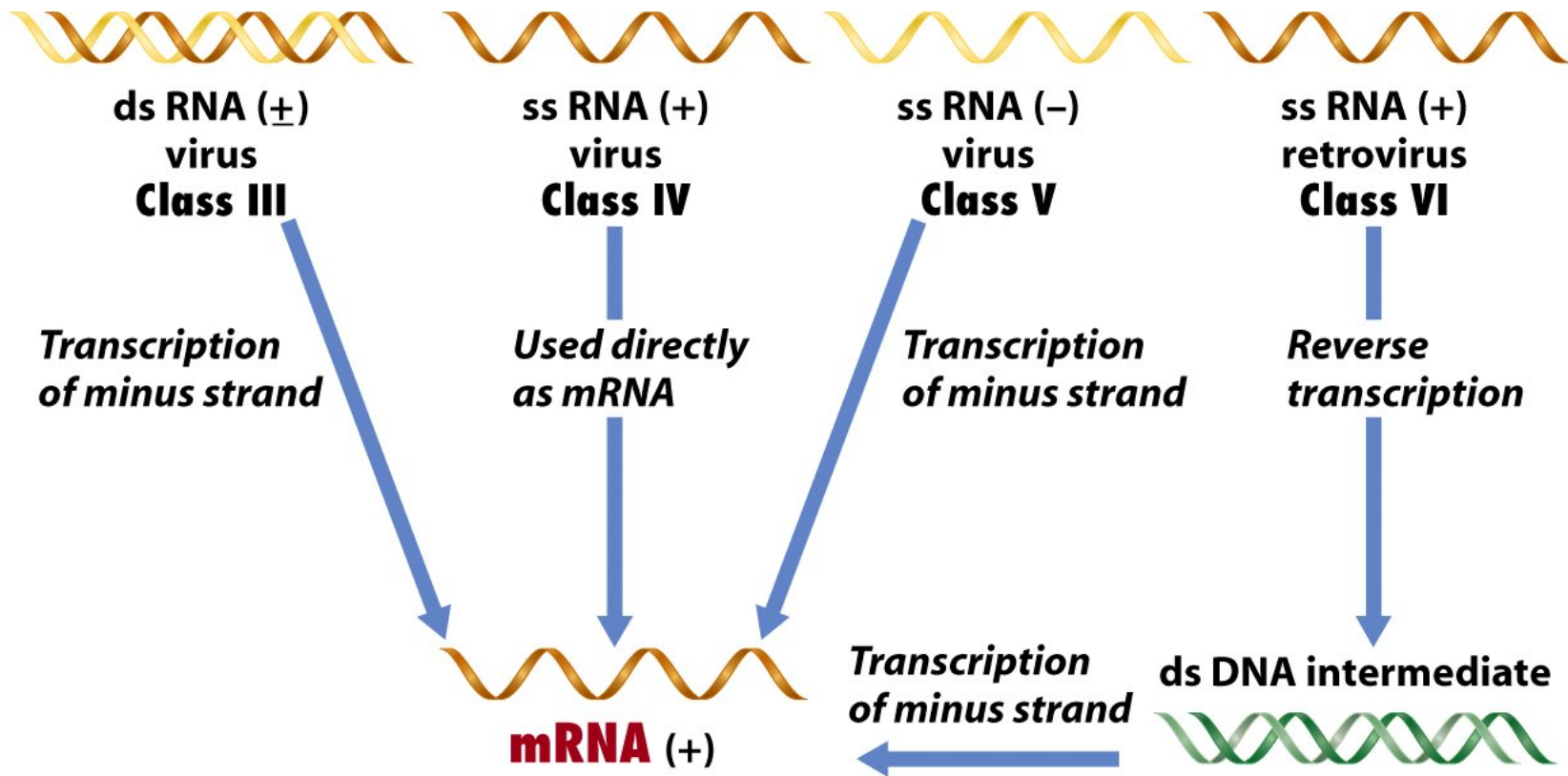


mRNA (+)

Genome

replication: Class I, classical semiconservative
Class II, classical semiconservative,
 discard (-) strand
Class VII, transcription followed by
 reverse transcription

DNA Viruses



Genome

replication: Class III, classical semiconservative replication, but of RNA not DNA

Class IV, make ss RNA (-) and transcribe from this to give ss RNA (+) genome

Class V, make ss RNA (+) and transcribe from this to give ss RNA (-) genome

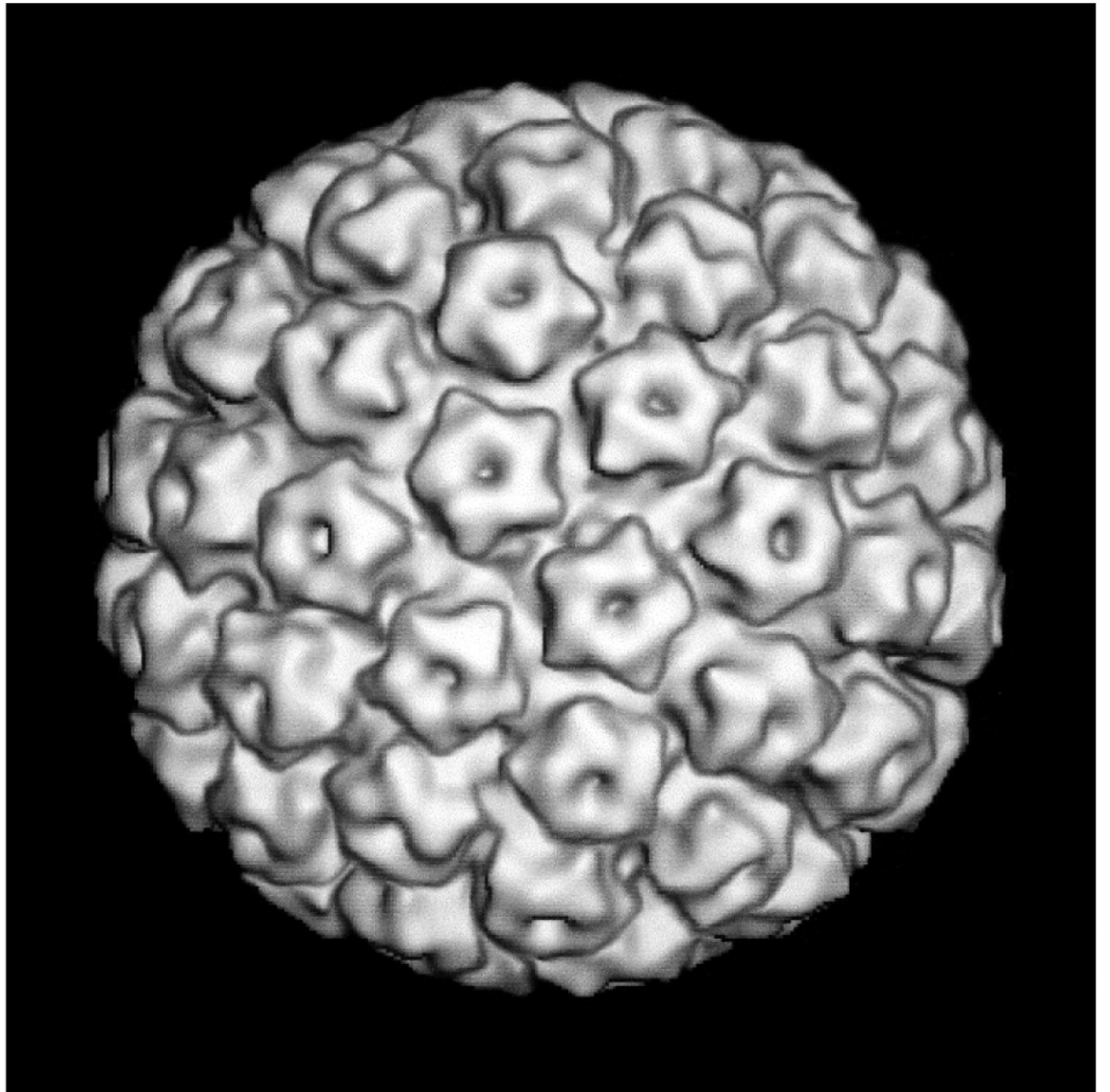
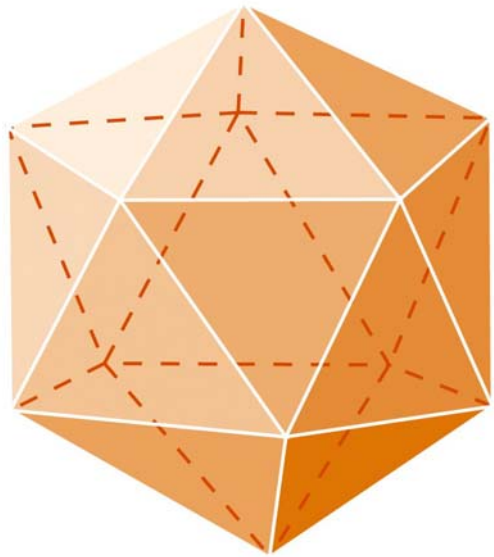
Class VI, make ss RNA (+) genome by transcription off of (-) strand of ds DNA

RNA Viruses

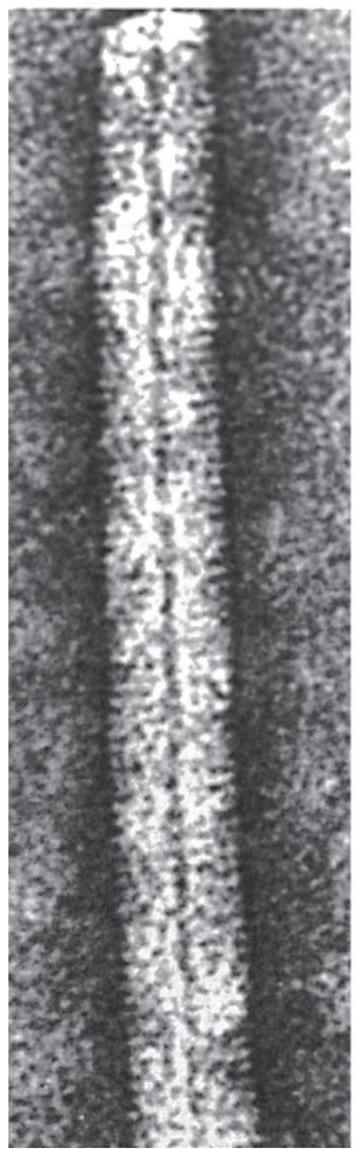
All Viruses Contain Protein Capsids

- Capsid shells hold genetic material
- Confer specific shapes - helical, icosahedron
- Nucleocapsid directly wraps nucleic acid

Some viruses a mix of both icosahedral capsid and helical nucleocapsid - e.g. HIV



18 nm

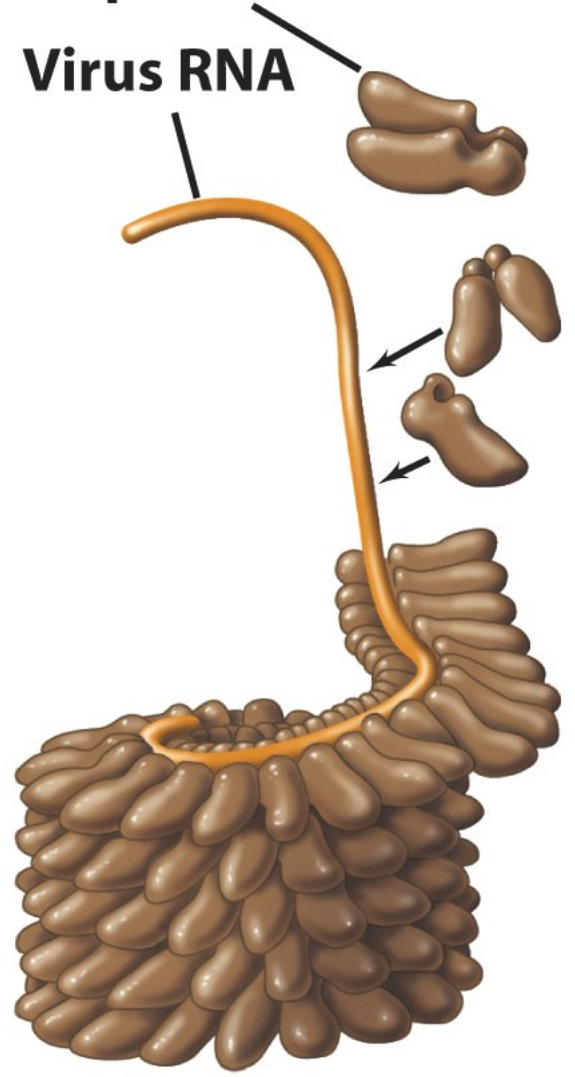


(a)

J. T. Finch

Structural subunits
(capsomers)

Virus RNA



Some Viruses Contain Envelopes

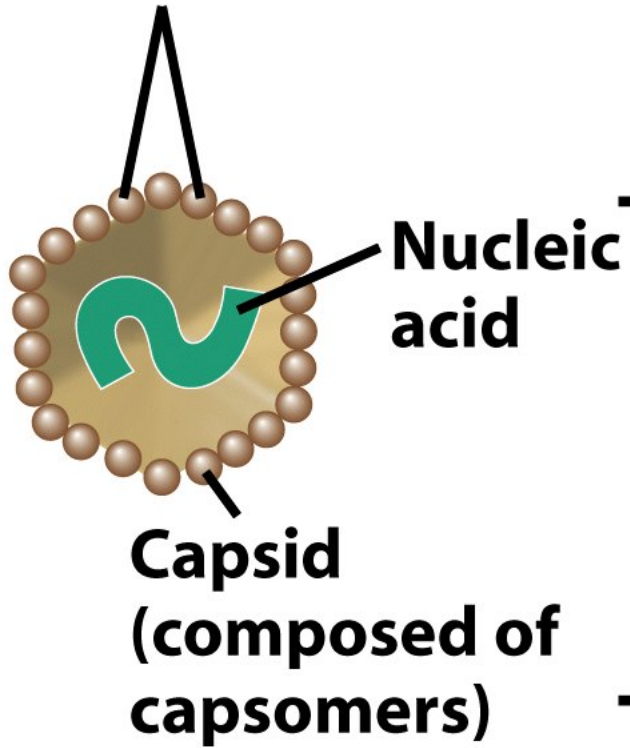
- Host-derived membrane, studded with viral proteins
- Make less hardy outside host - TRANSMISSION

Some viruses also have other accessories - tails, enzymes... BUT - NONE has ribosomes.

Capsomers

Nucleocapsid

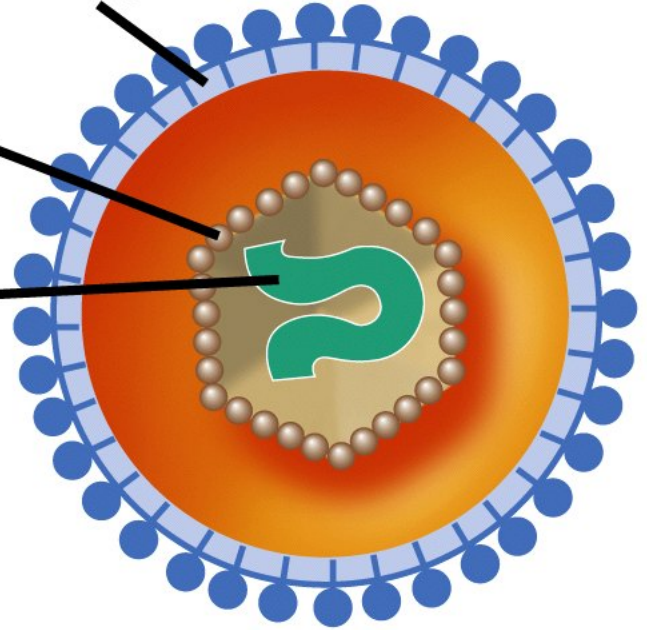
Envelope



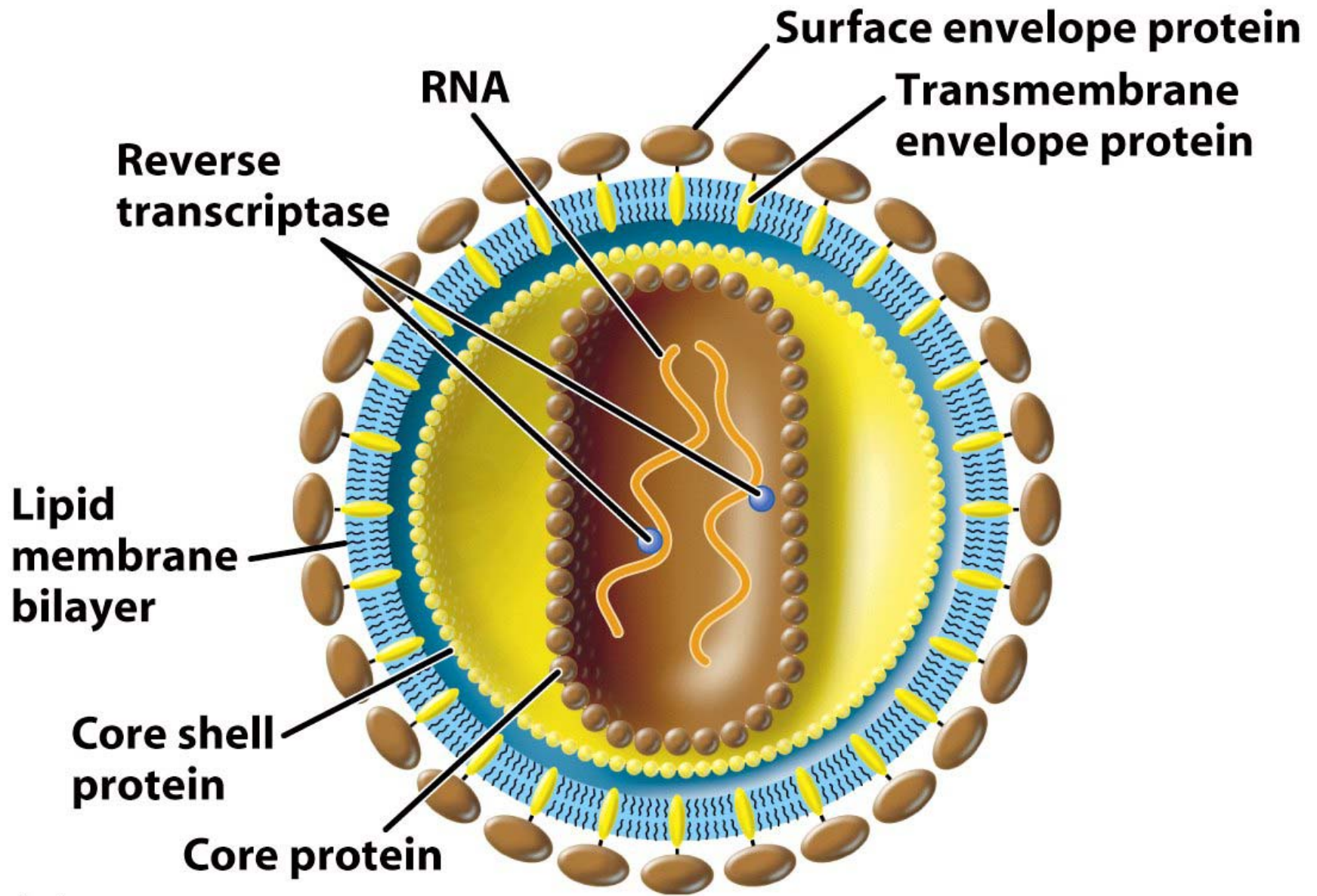
Naked virus

Capsid

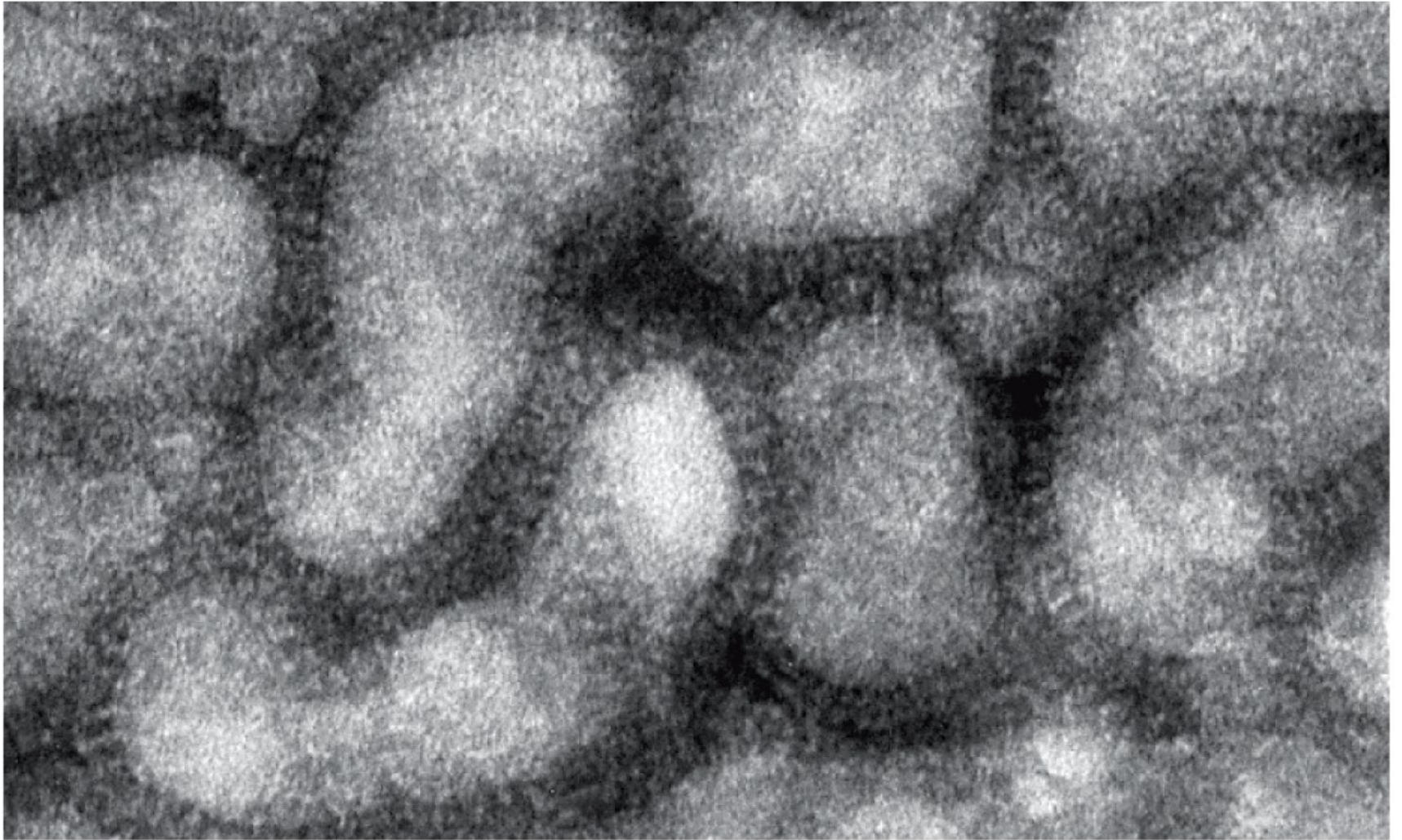
Nucleic acid

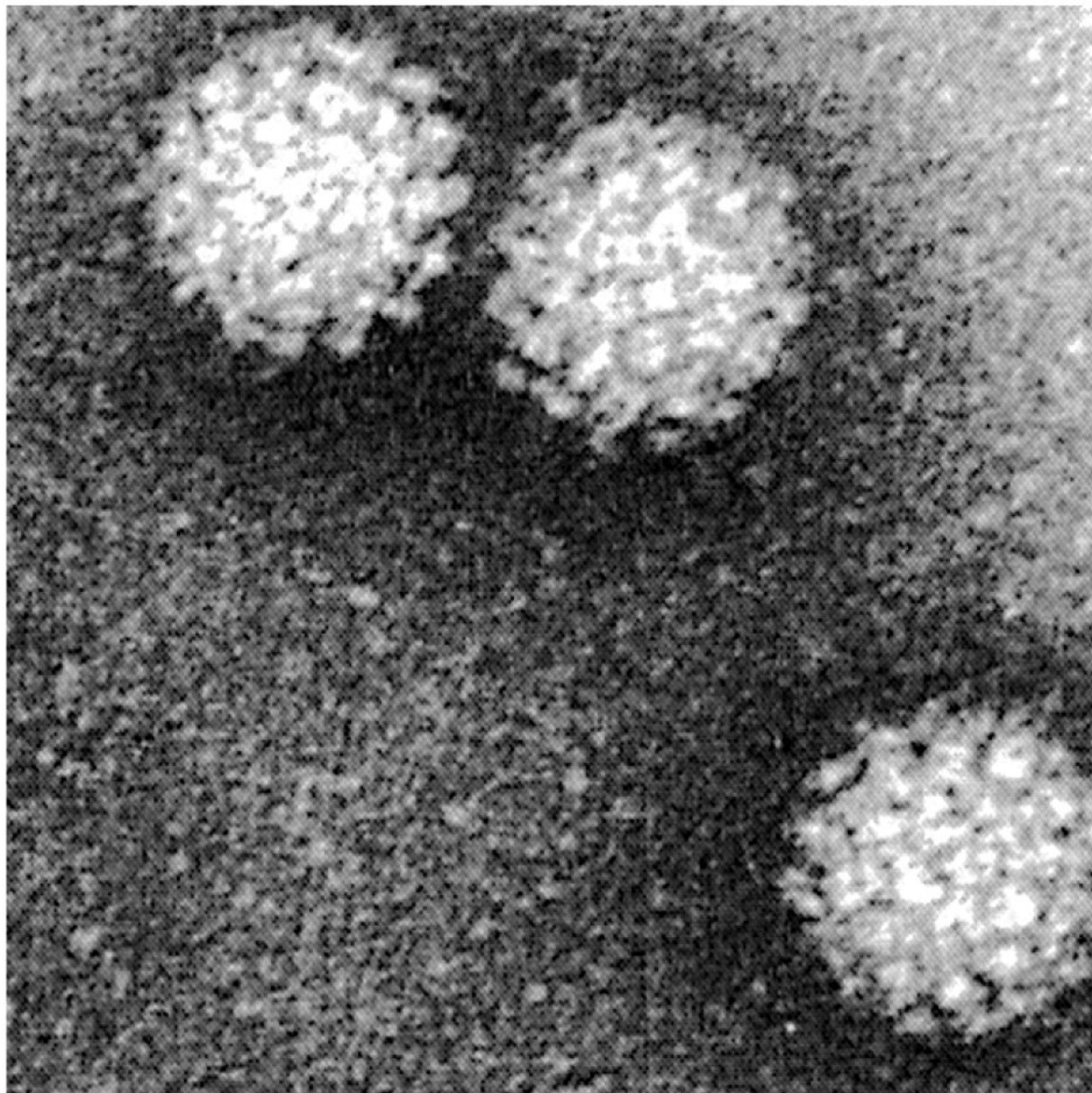


Enveloped virus



(a)

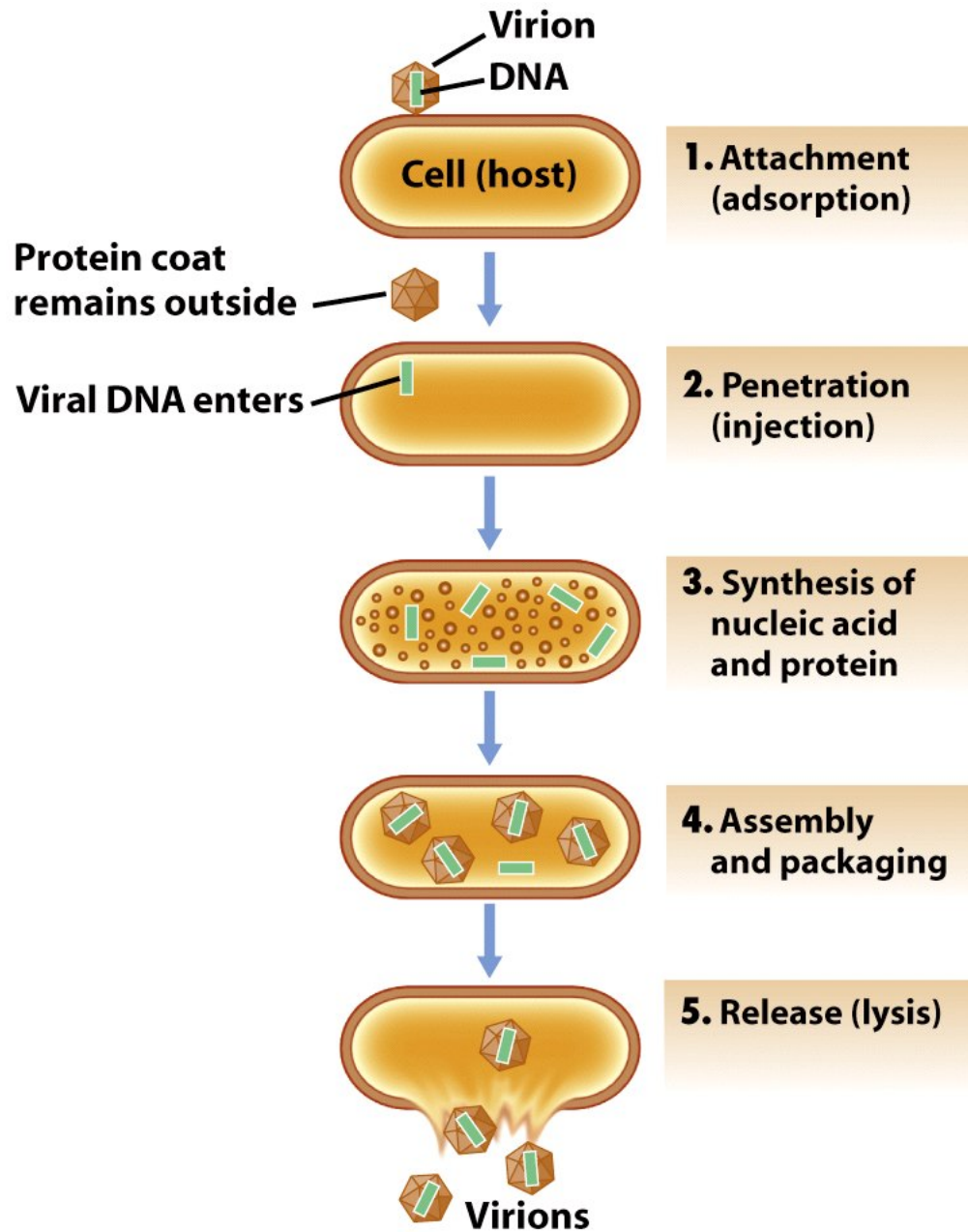


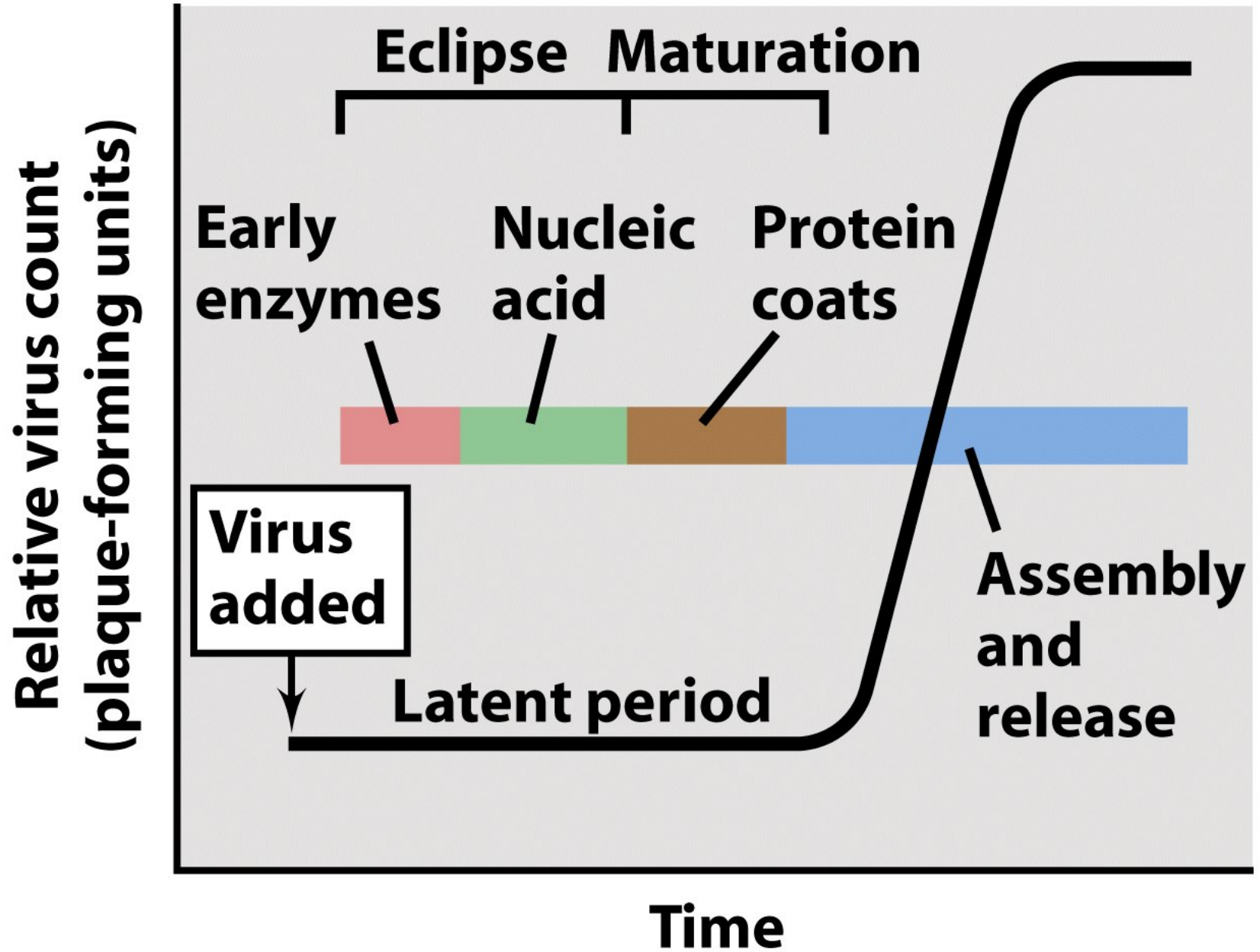


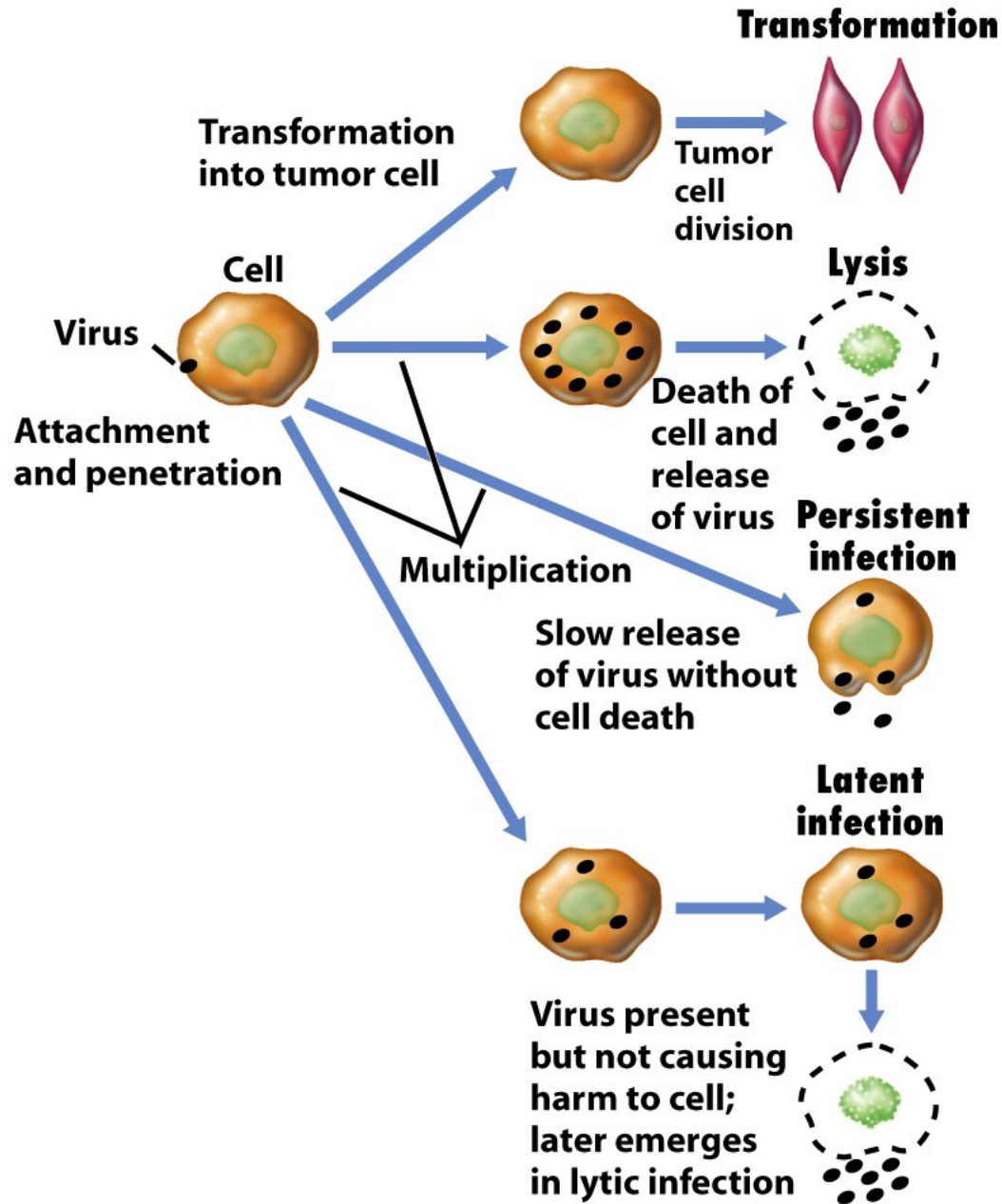
Virus Replication - Common Features

- Attachment - surface protein + specific host receptor
- Penetration - receptor-mediated entry of capsid
- Synthesis - new proteins and genetic material
- Assembly - packaging of viruses
- Release - exit of mature viruses from cell

Which cells a virus can infect = host range; some viruses establish long-term latency... chronic/cancer



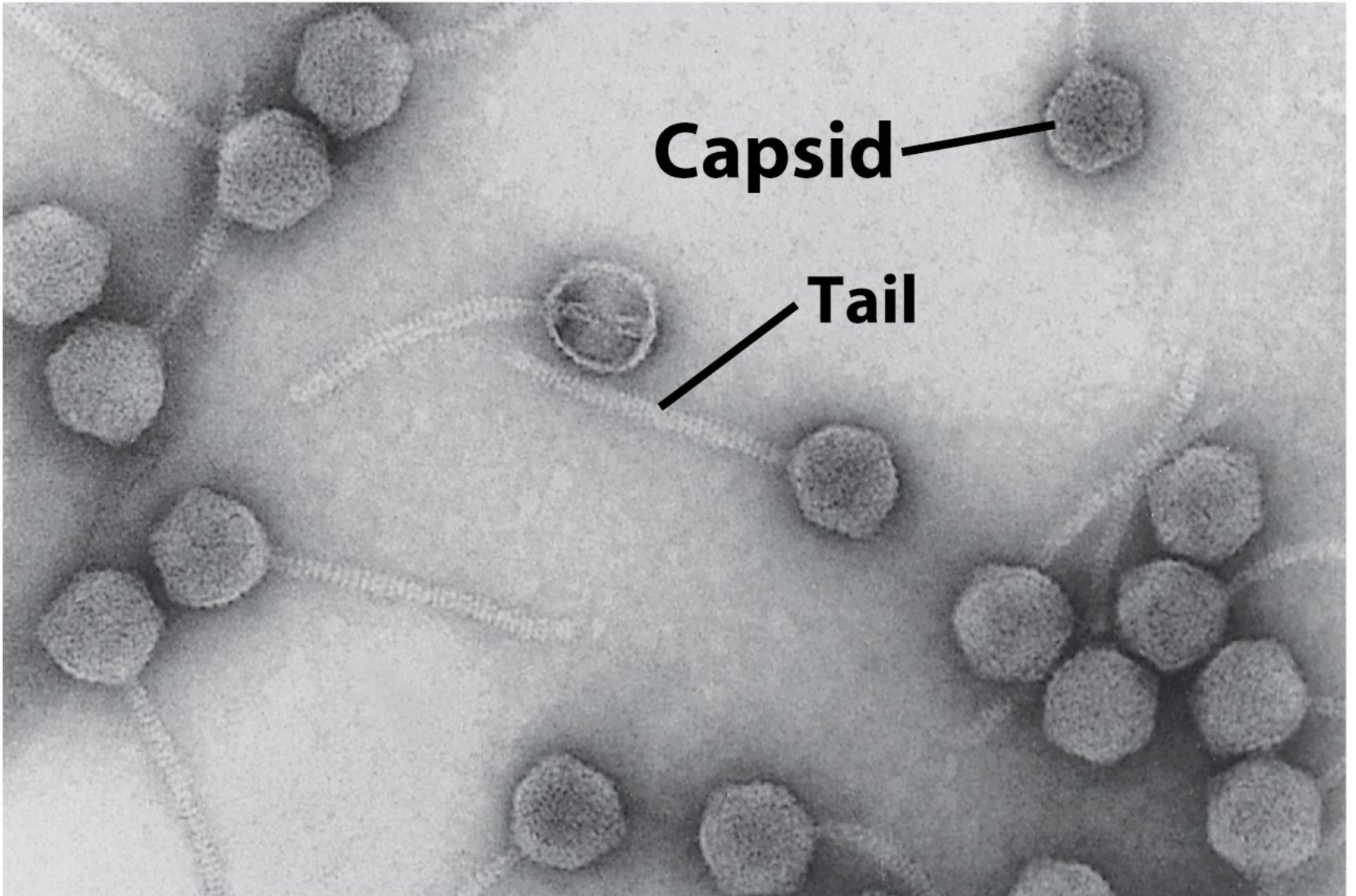


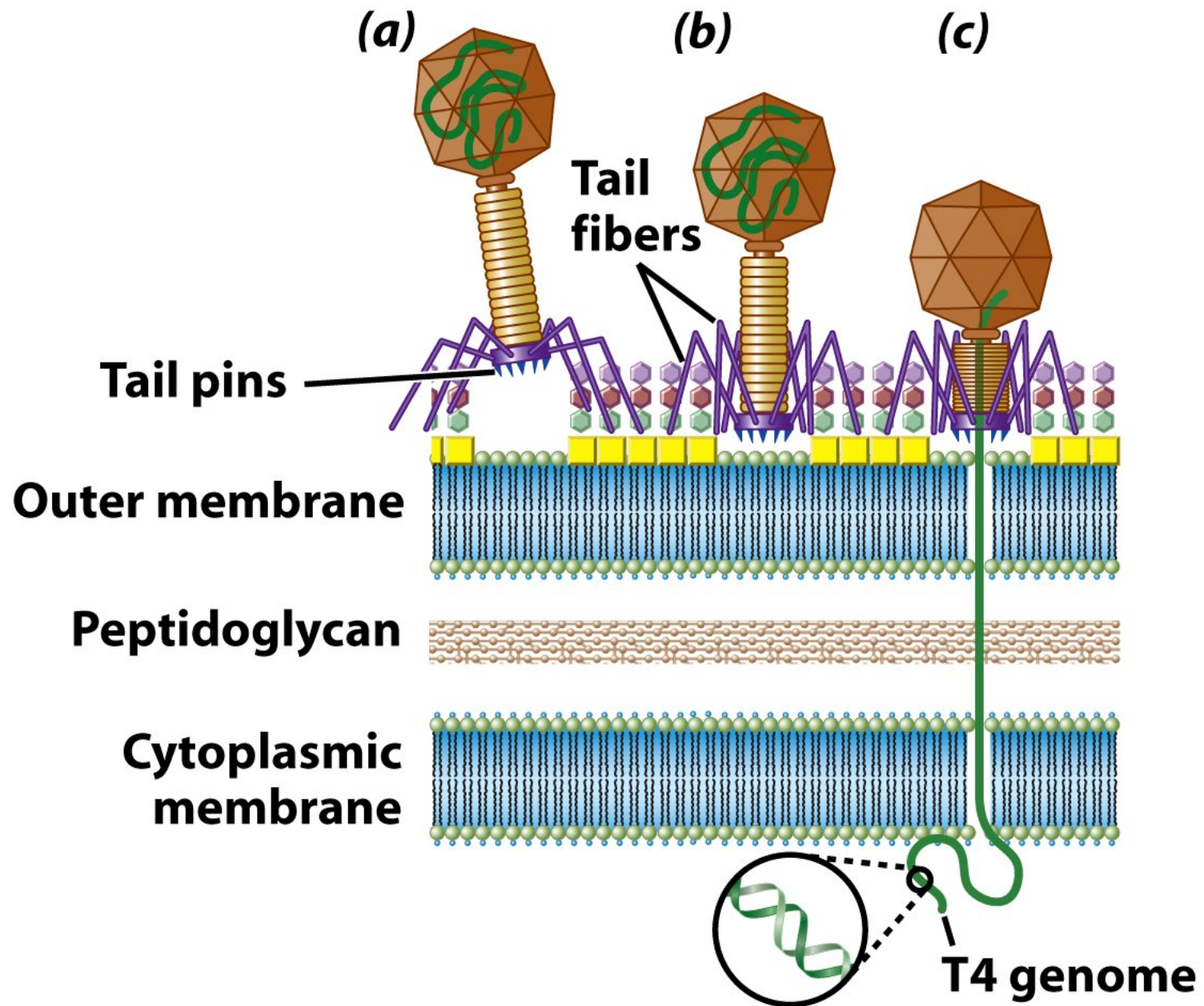


Class I Viruses

Virulent T4 Phage

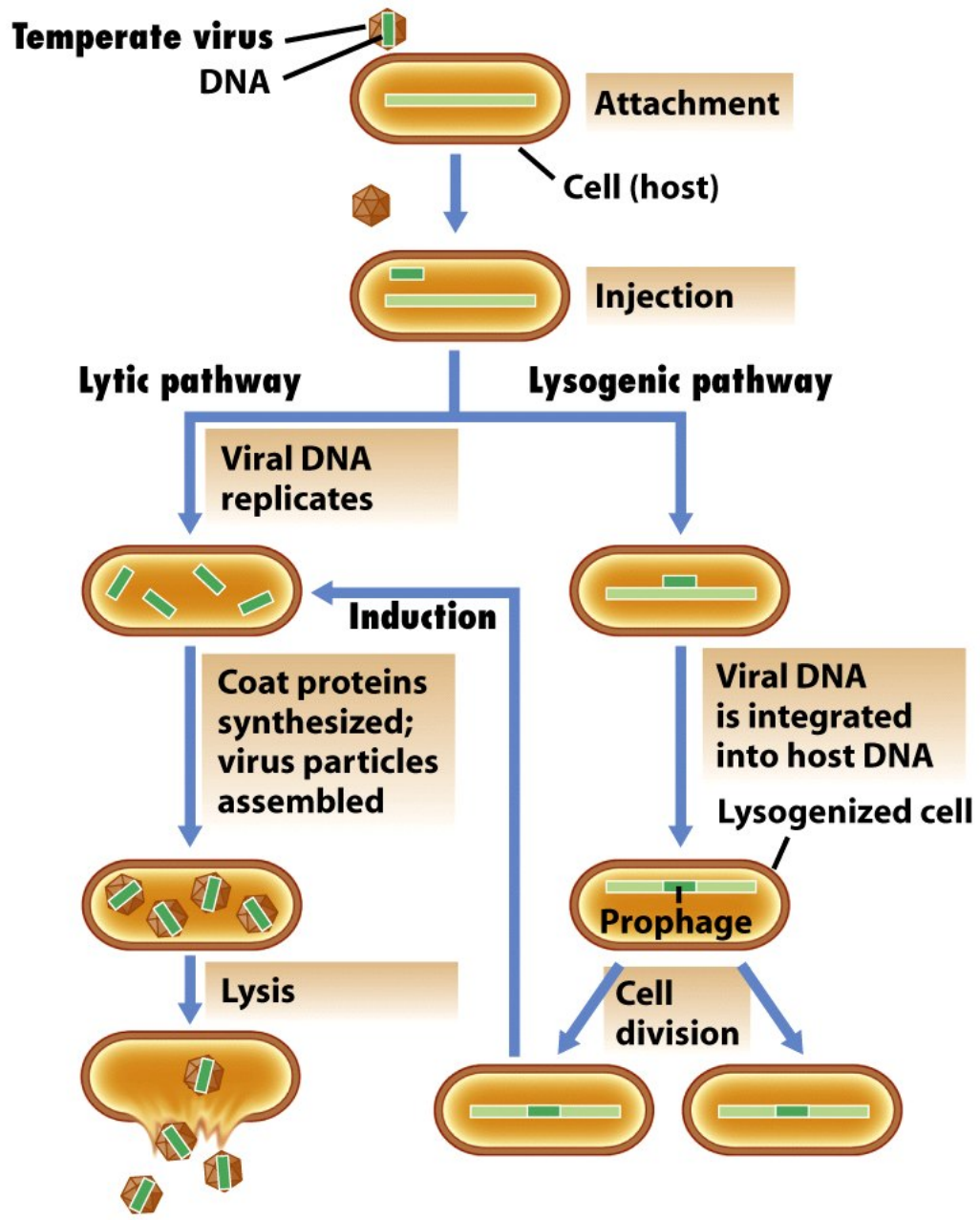
- Replication always lyses host (E. coli, Proteobacteria)
- Unenveloped icosahedron + tail attaches to LPS
- Induces contraction - DNA injected
- Transcription and translation by host machinery
- Genome replication by viral DNA Pol





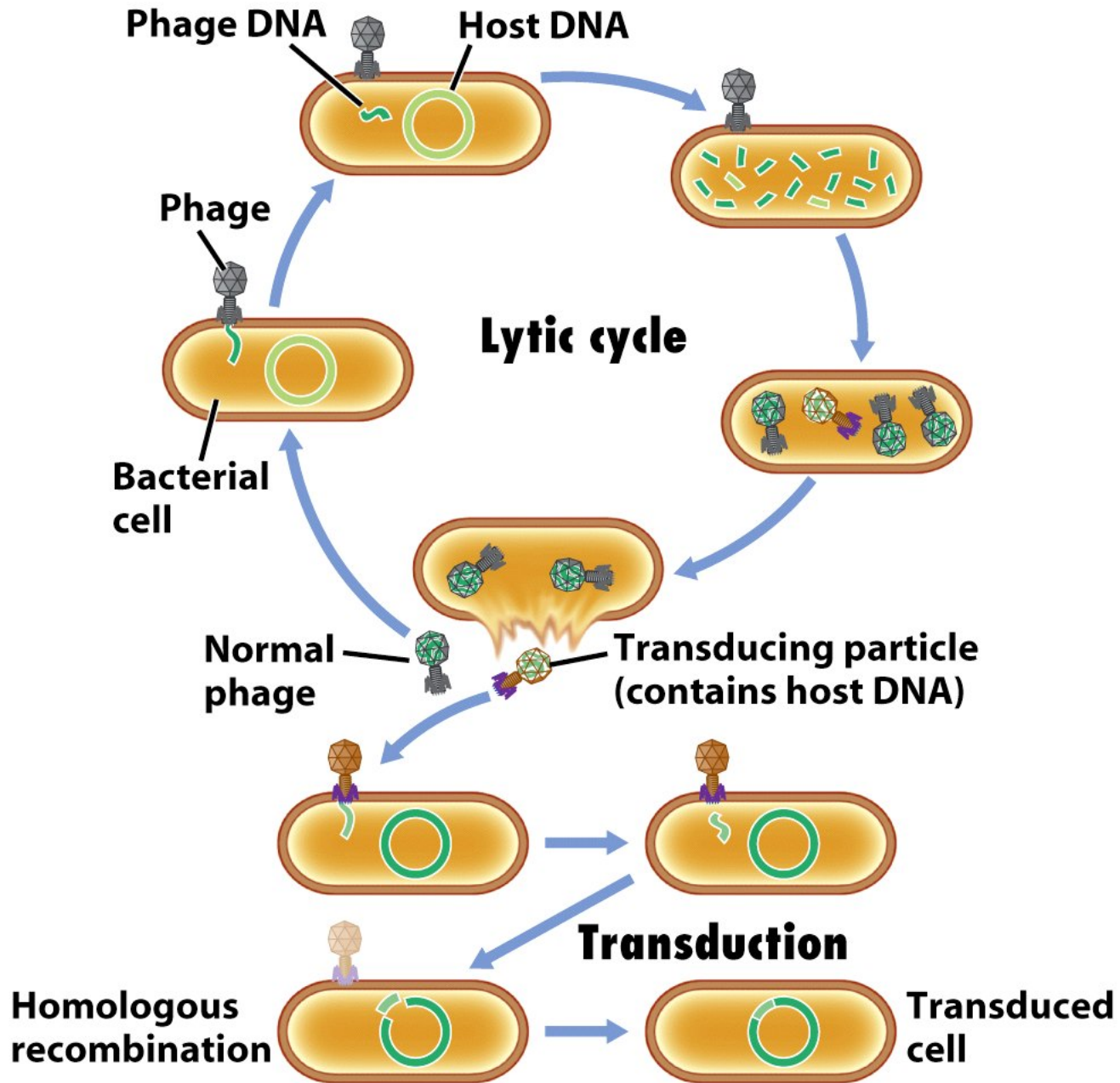
Temperate Lambda Phage

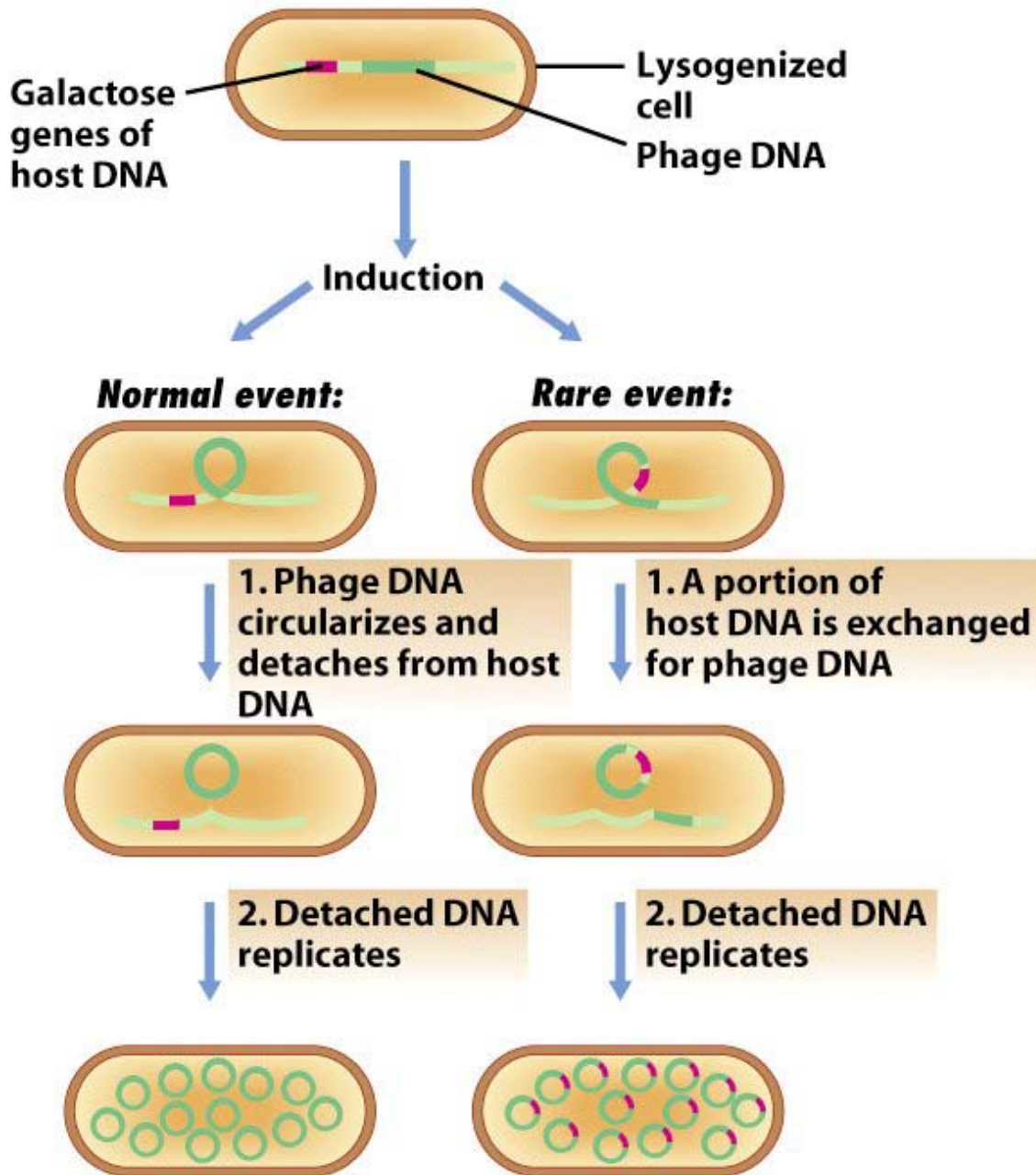
- Temperate - choose lysis or lysogeny of E. coli
- Lysogeny - replication without lysis
- Structure, attachment, penetration like T4
- Early genes: ASSESS HOST HEALTH...
- If BAD: late gene expressed, inducing lysis
- If GOOD: DNA integrates, passively copied by host



Transduction (10.8)

- Transfer of bacterial DNA between hosts via phage
- Generalized: accidental packaging during lysis
- Specialized: recombinant viruses following lysogeny

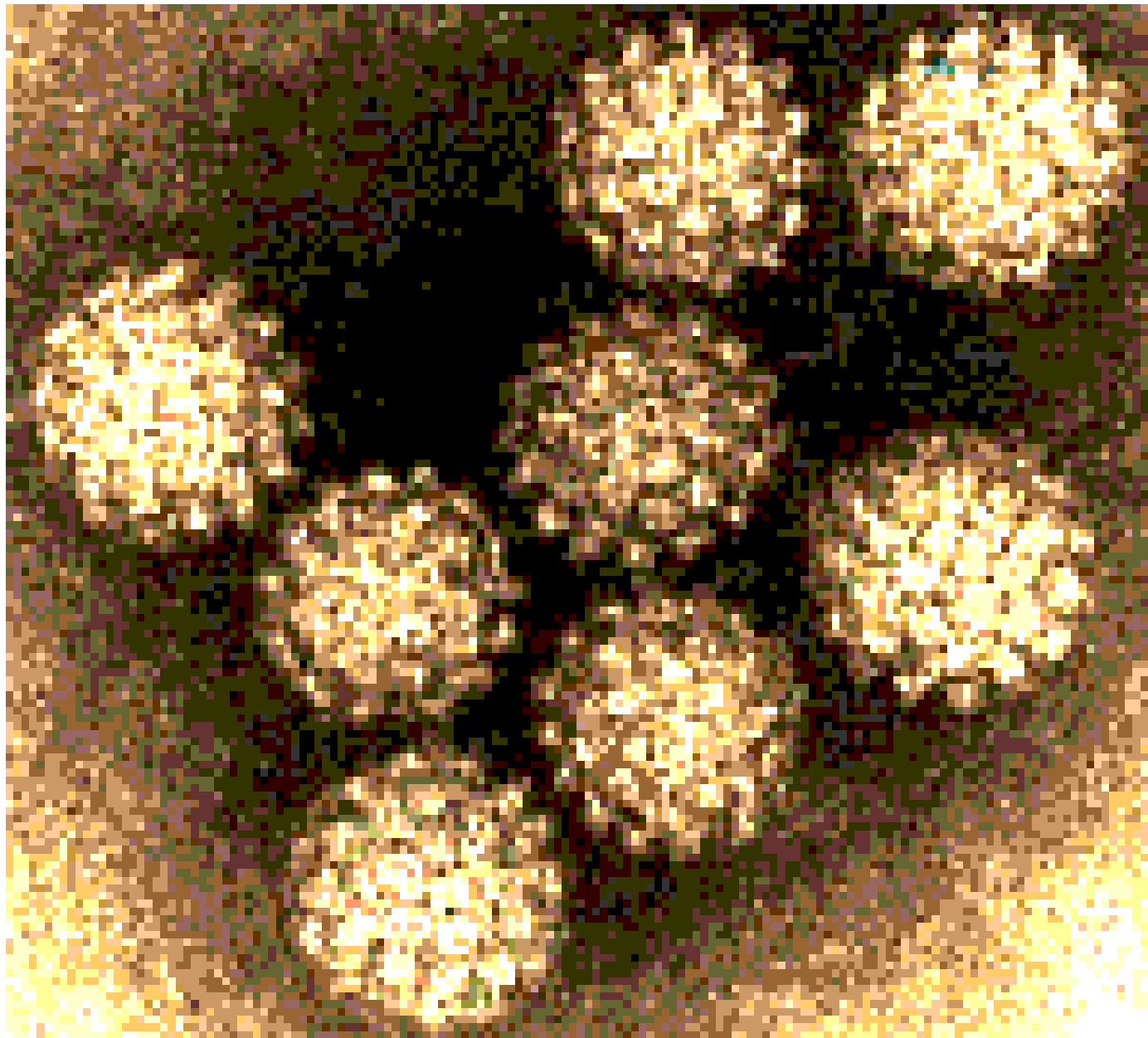


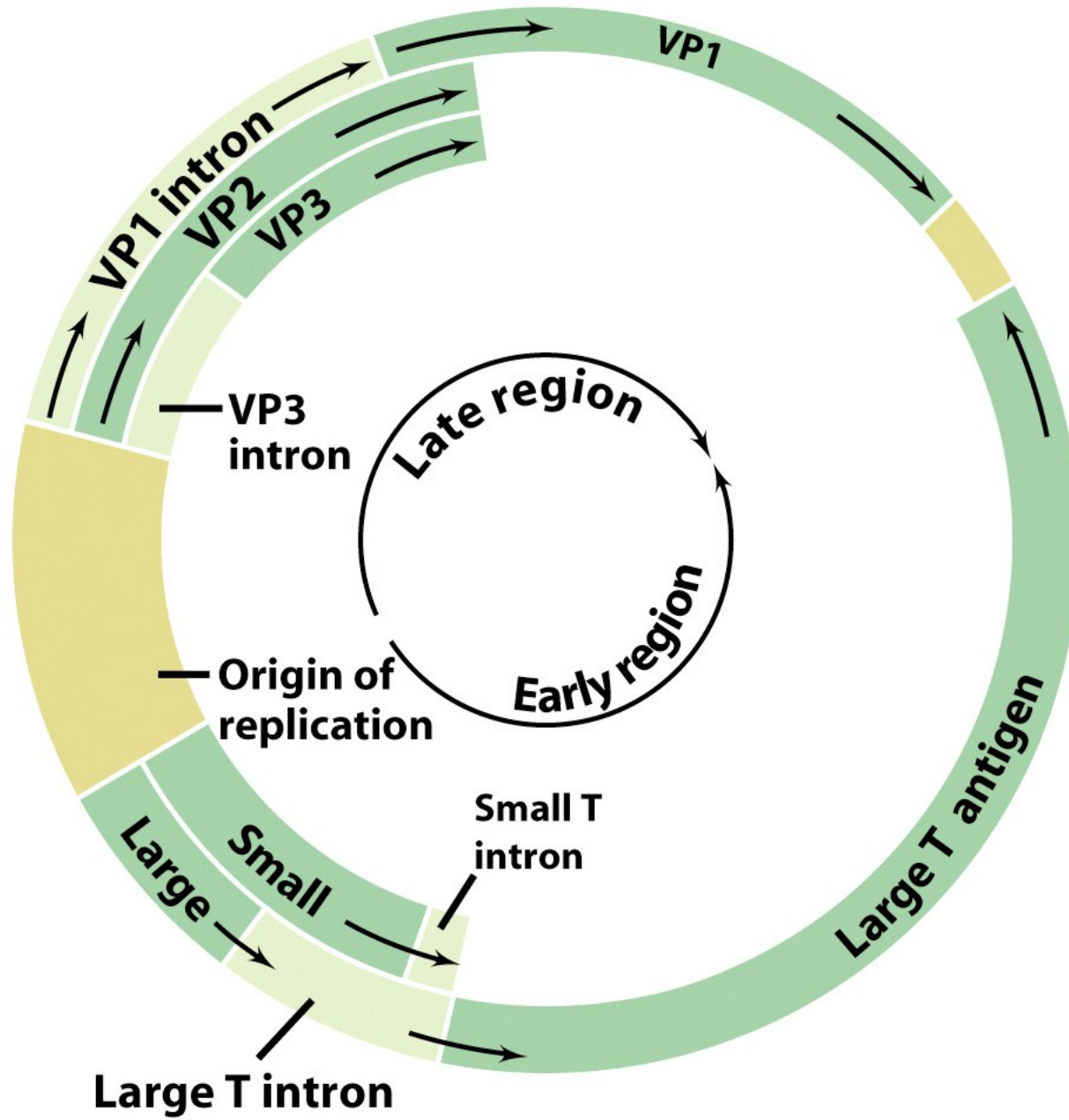


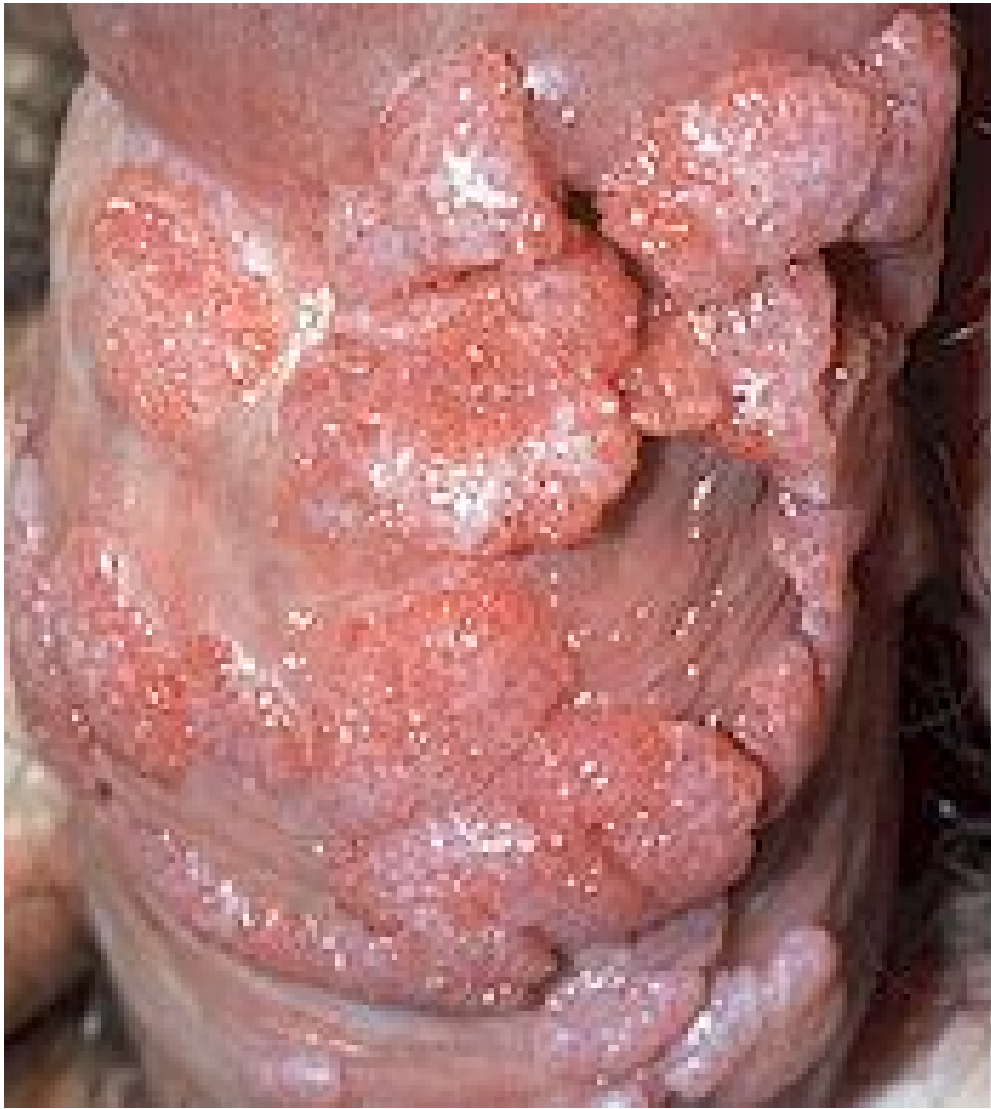
Papillomavirus

- Small enveloped icosahedron, 65+ strains
- DNA + stolen histones, less than 10 genes
- Transcription, translation AND replication by host

For this course, Polyomavirus = Papillomavirus



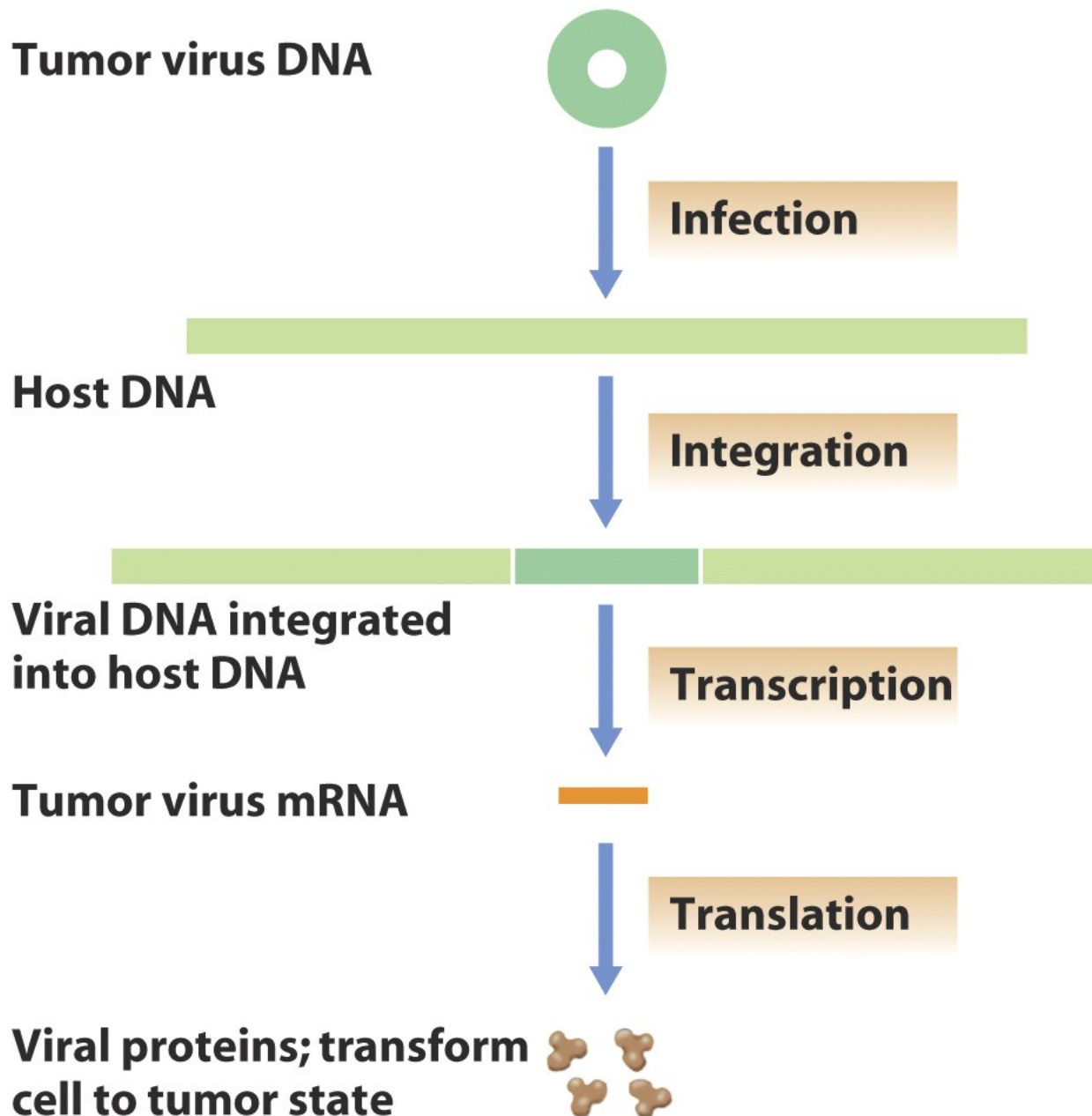




Transformation

- Permissive/dividing cells copy virus - transient warts
- Nonpermissive don't - so cervical cancer via...
- Integration and T-Ag which induce division
- CIS = DNA effect, integration position induces
- TRANS = protein effect, distant from integration

Cervical cancer associated with 2-4 strains, effective vaccine nearly approved.



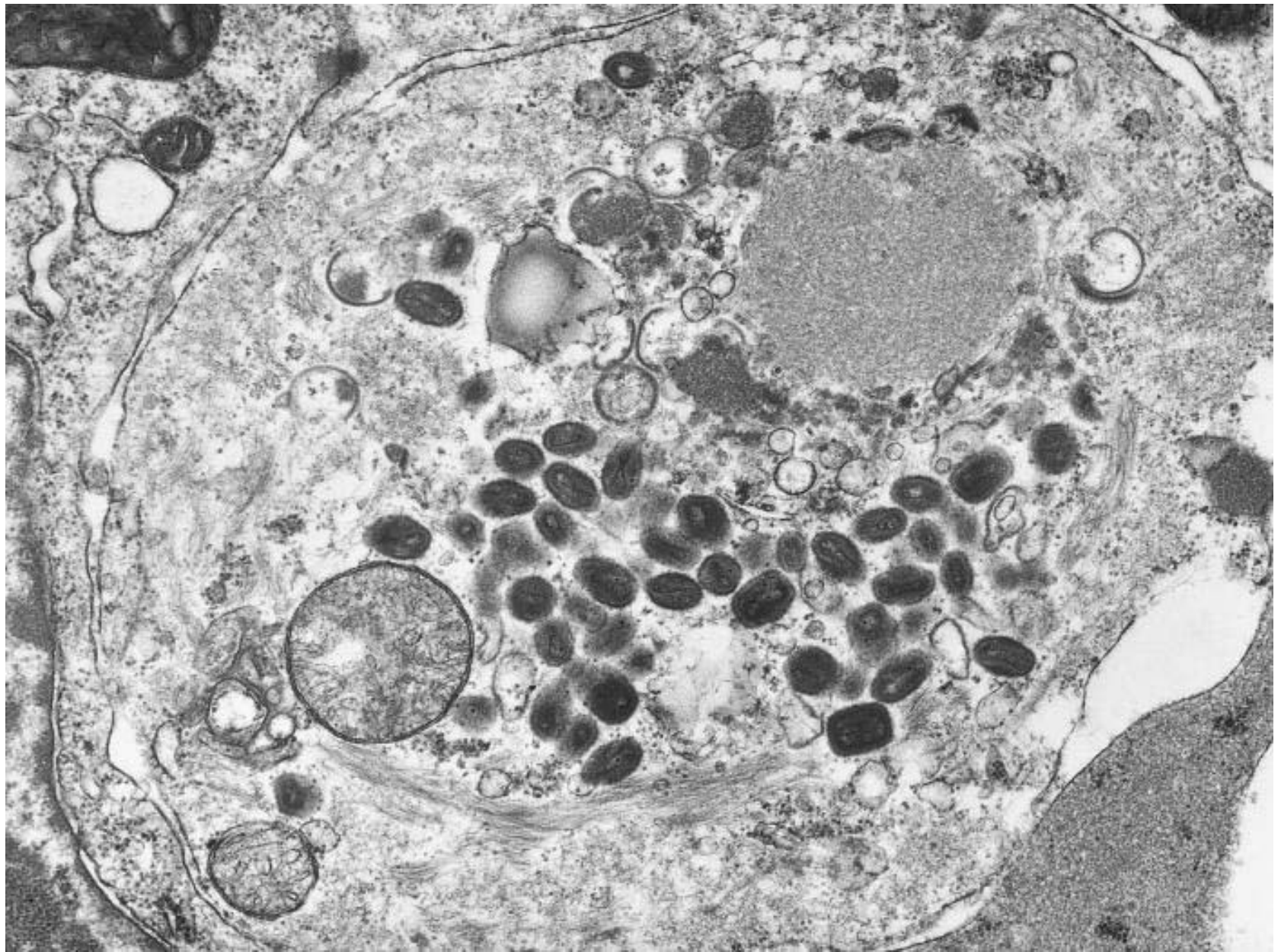
Variola/Smallpox

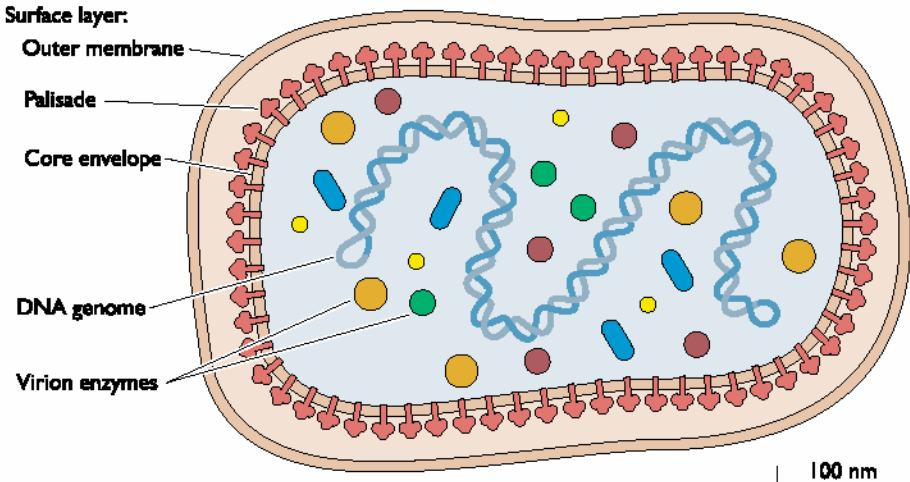
- TWO envelopes, nucleocapsid/genome (200 genes)
- DNA and RNA Pol enzymes in virus - MANY others
- Virus DNA Pol replicates and RNA Pol transcribes
- Host ribosomes translate - ALL occurs in cytoplasm
- Exit via Golgi AND cell membrane - so?

Why is this virus not associated with cancer?









B

