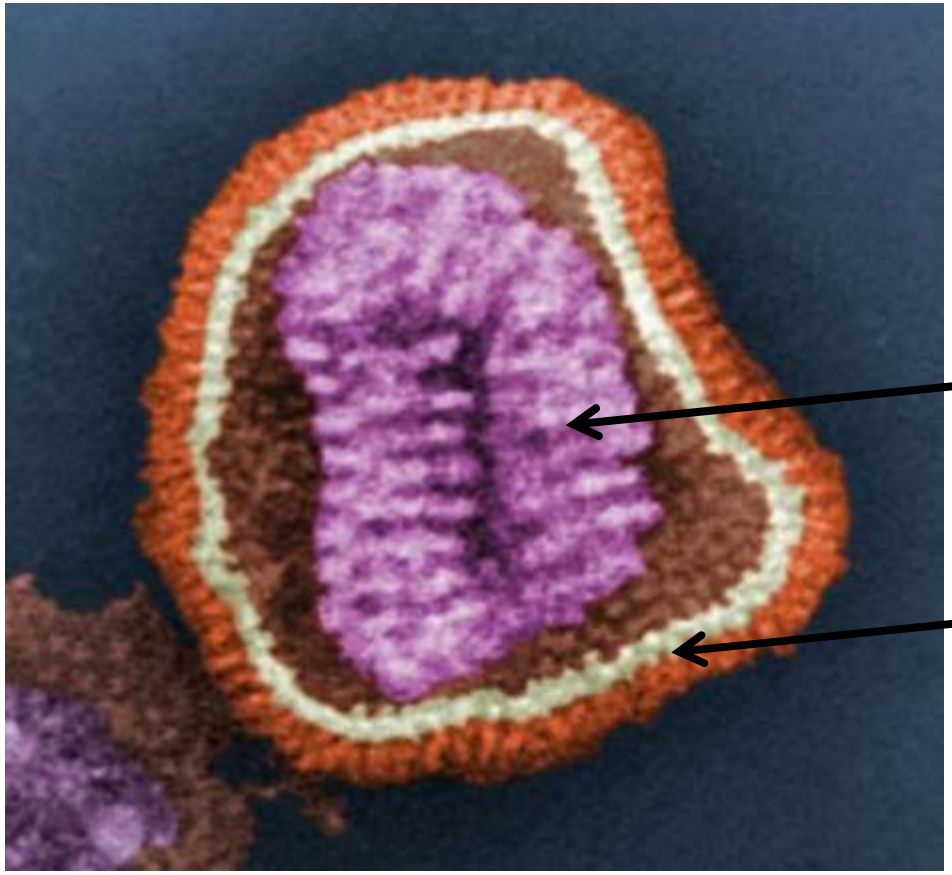
Unit IV
Virus attachment and entry into host Cells

What is a virus?



‘Infectious particle’

Genetic material

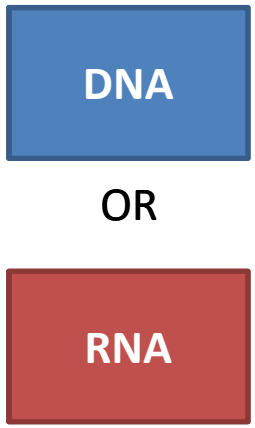
Protein coat

Properties of a virus

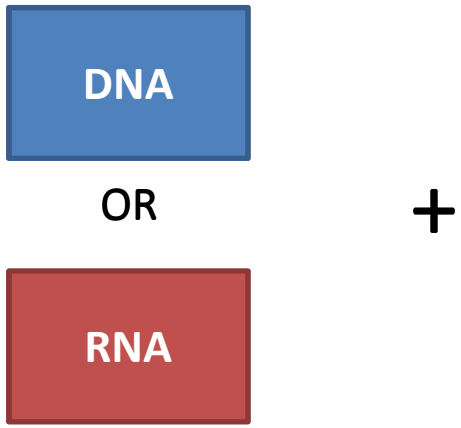
- A virus is a very small, infectious, obligate intracellular parasite
- Virus particles are **not** living
- Viruses are chemicals, and by themselves cannot reproduce
- A susceptible and permissive cellular host is needed for viruses to reproduce
- All viruses must make mRNA that can be translated by host ribosomes

Basic virus structure

Basic virus structure



Basic virus structure



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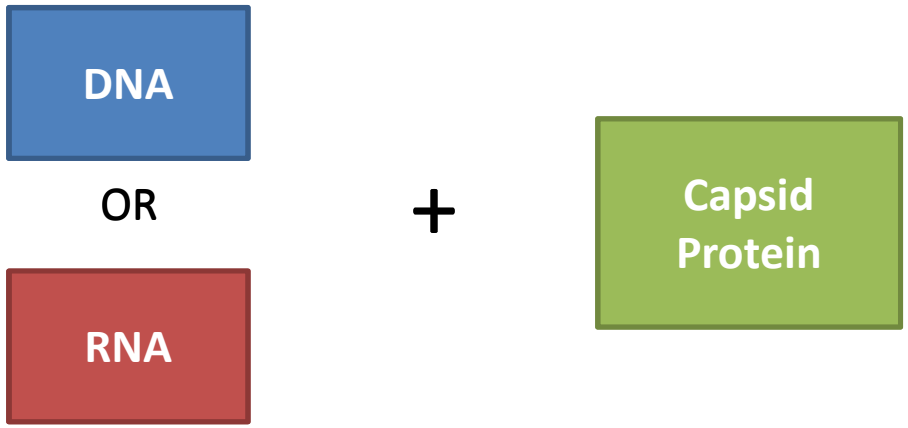
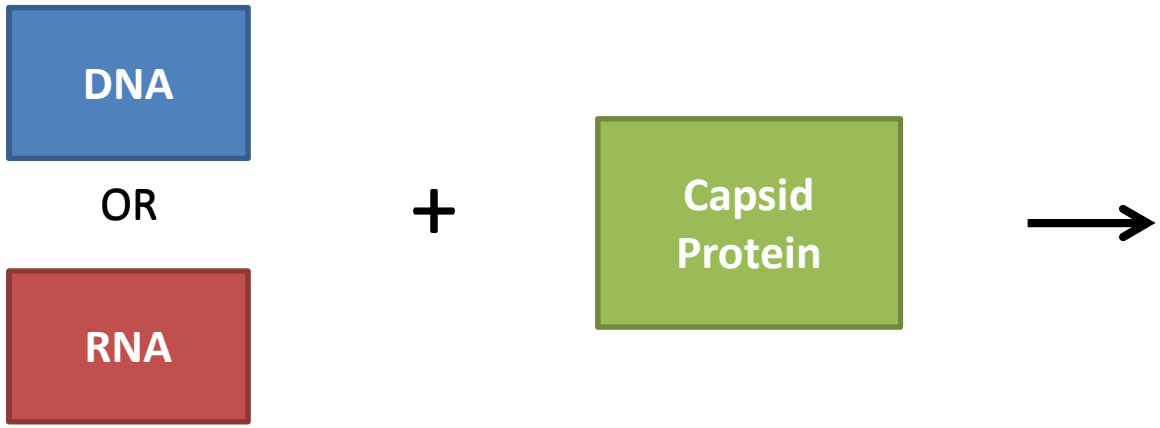
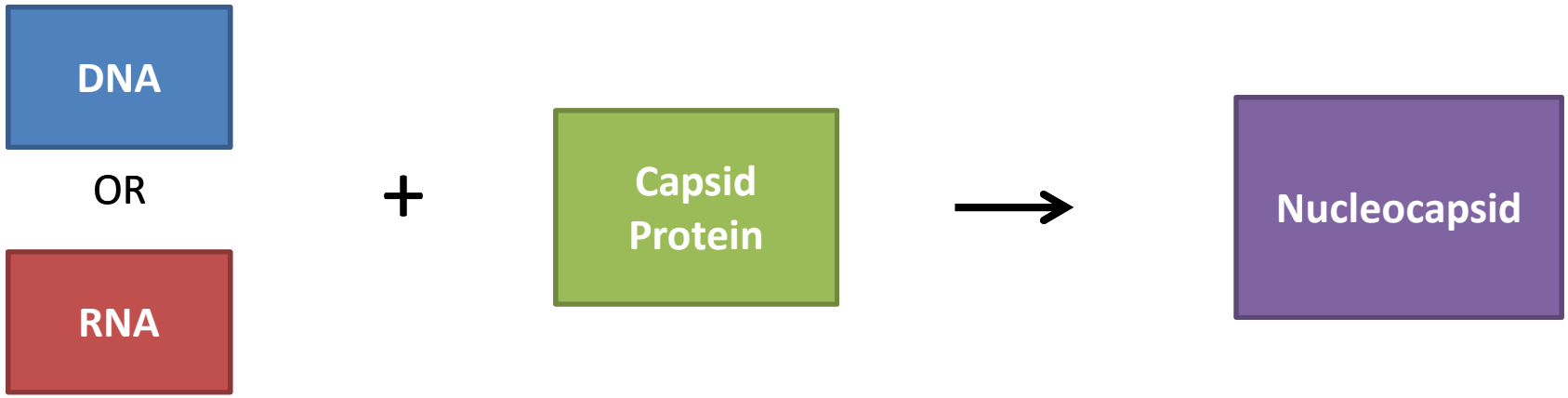
Basic virus structure



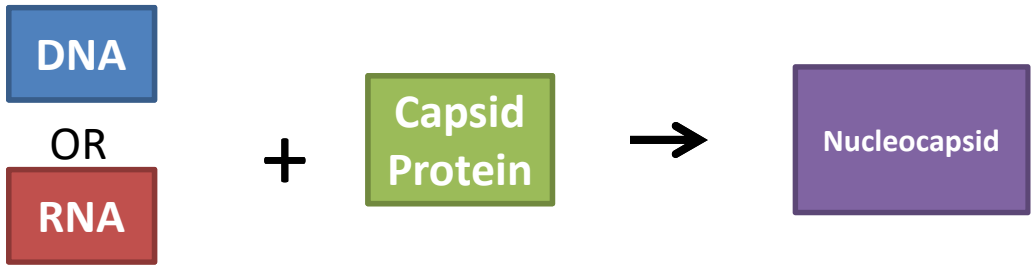
Basic virus structure



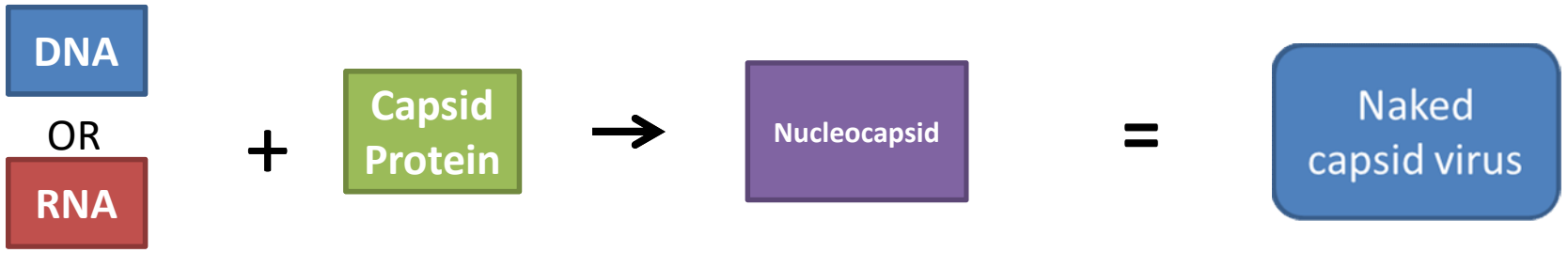
Basic virus structure



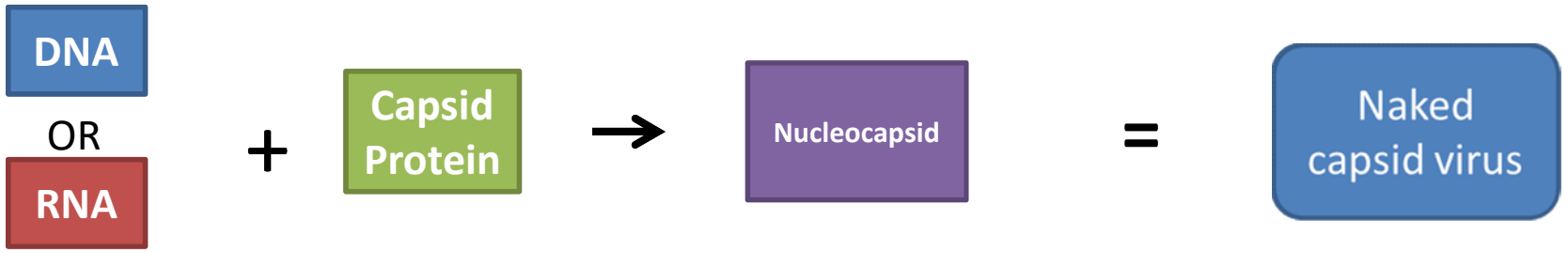
Basic virus structure



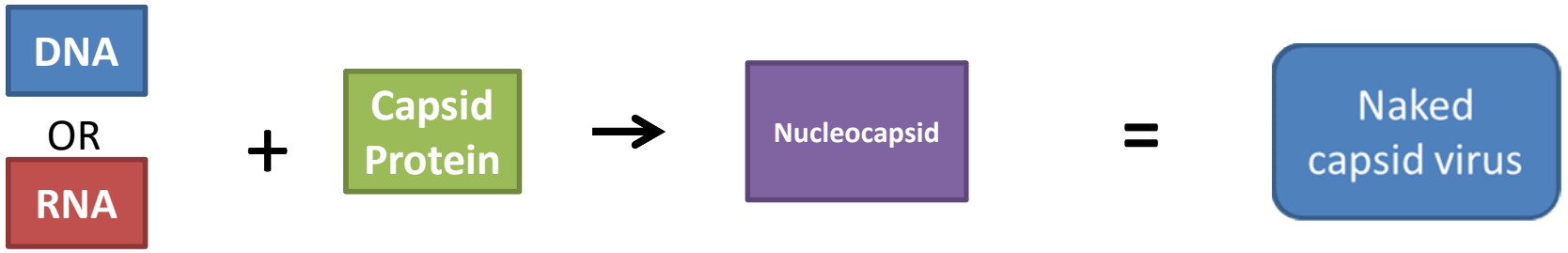
Basic virus structure

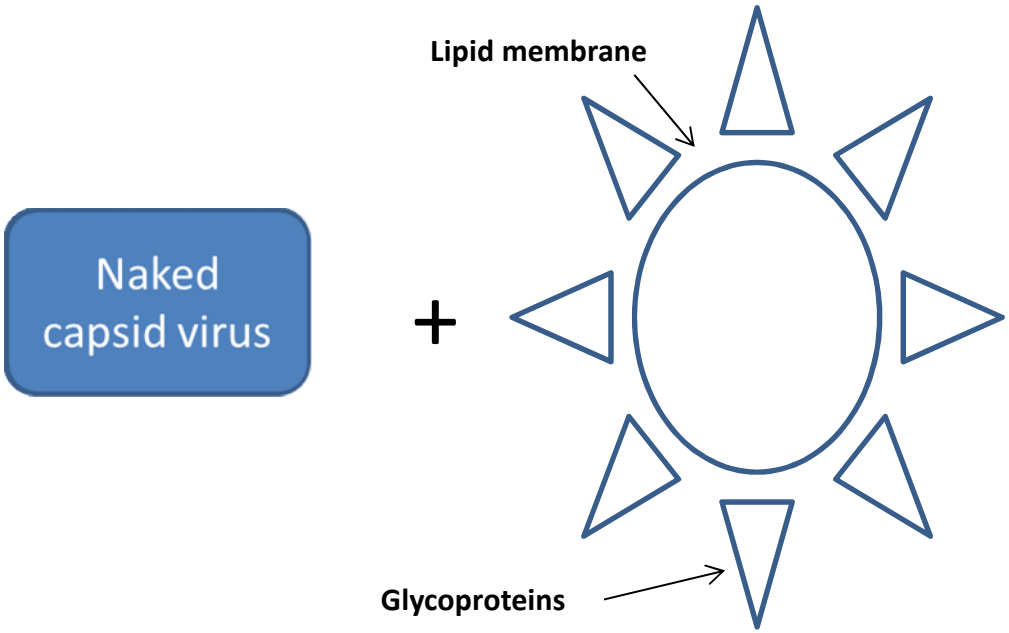


Basic virus structure

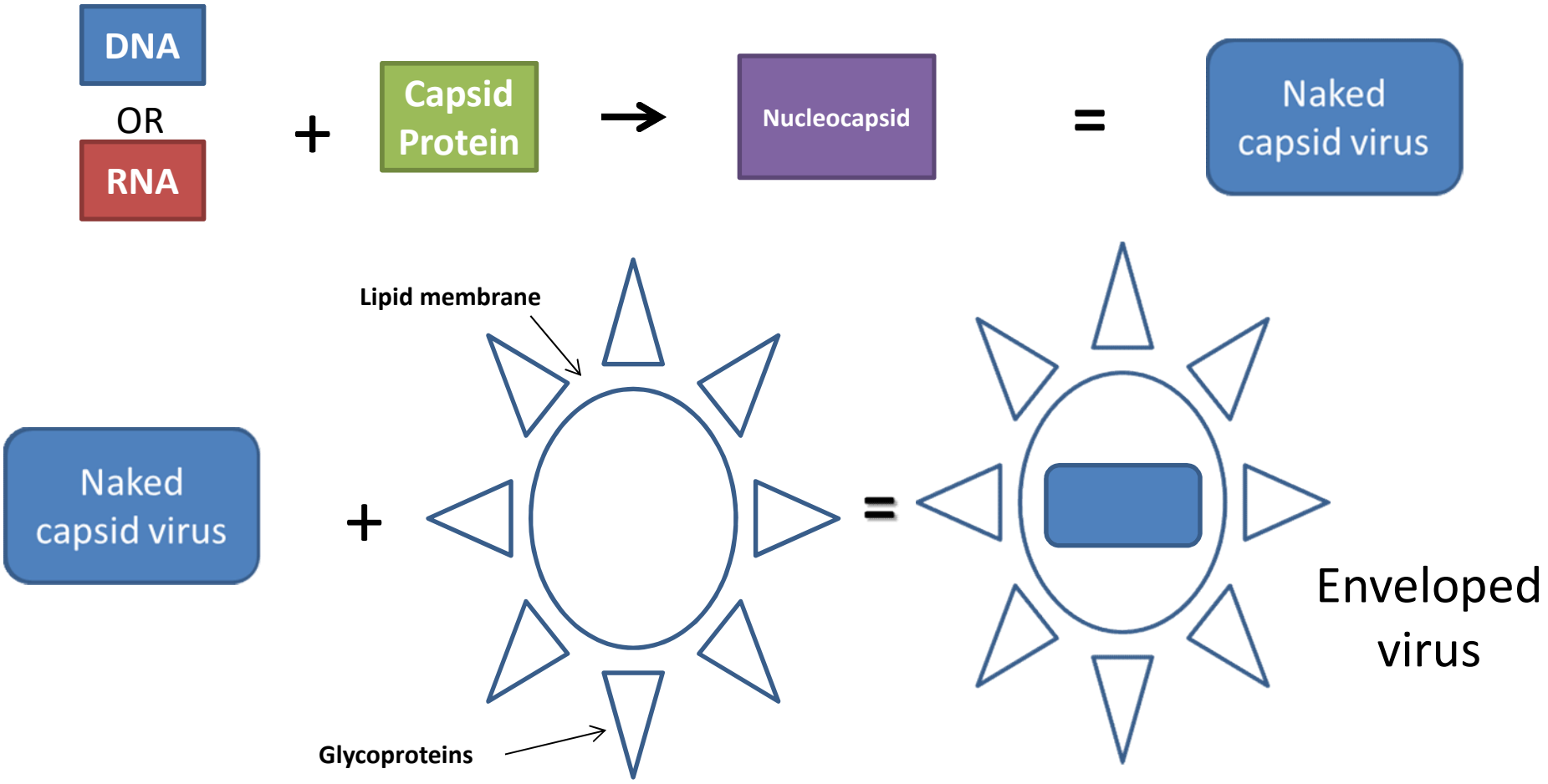


Basic virus structure

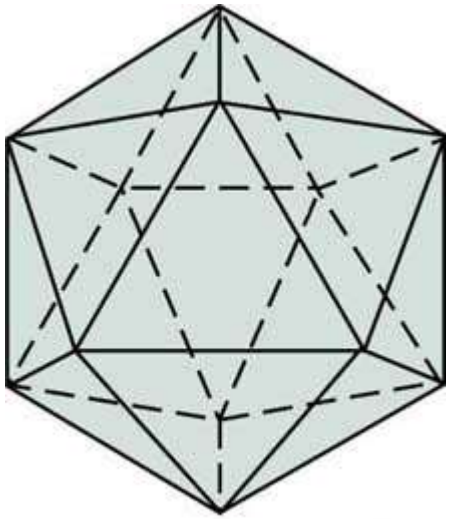




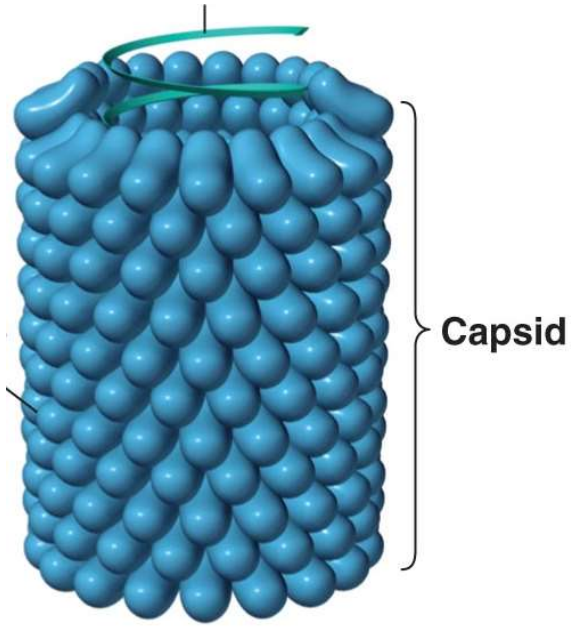
Basic virus structure



Capsid symmetry



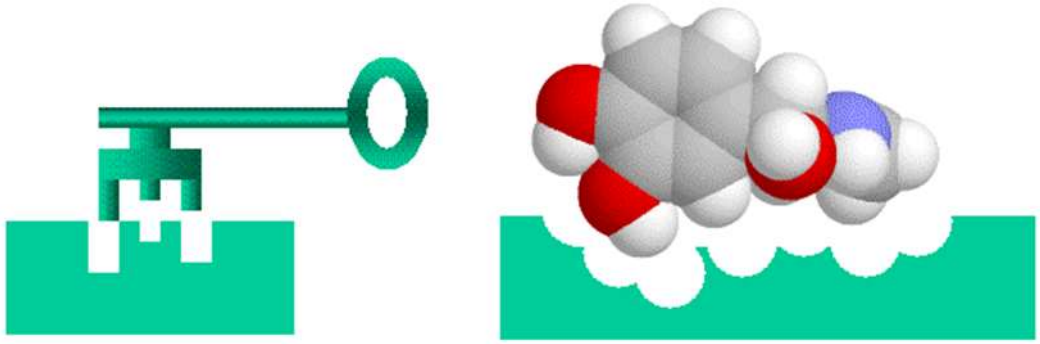
Icosahedral



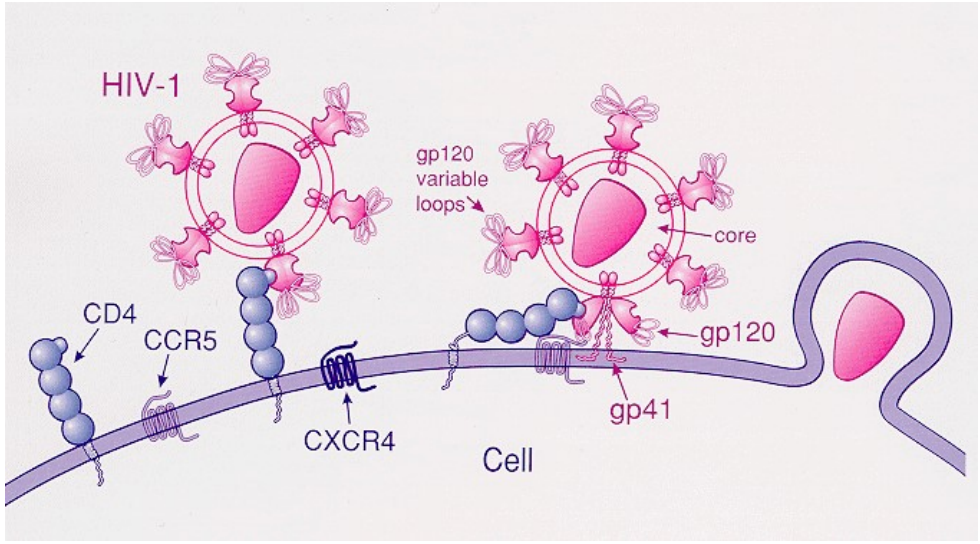
Helical

Attachment

Attachment: tropism



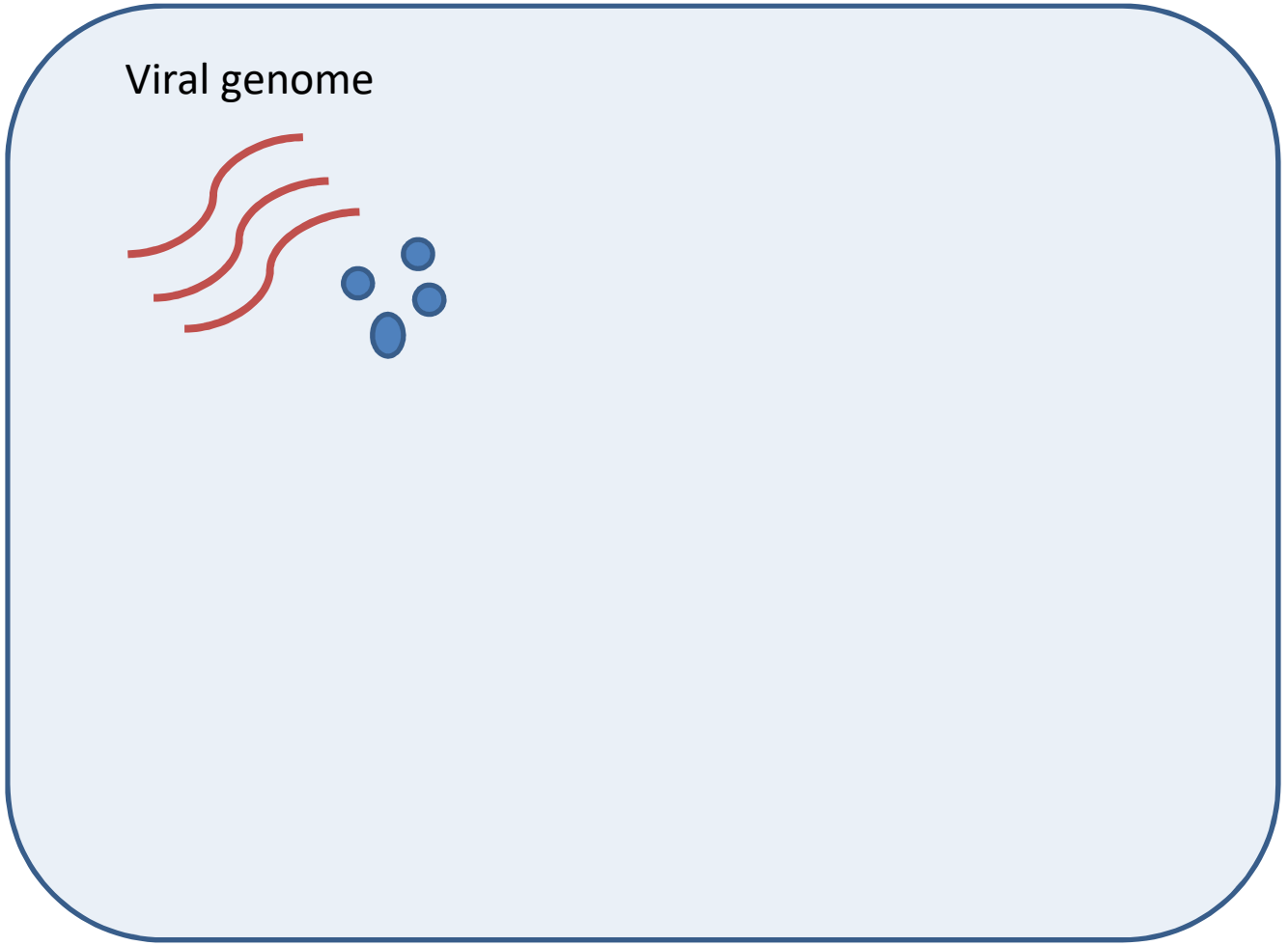
Lock and key



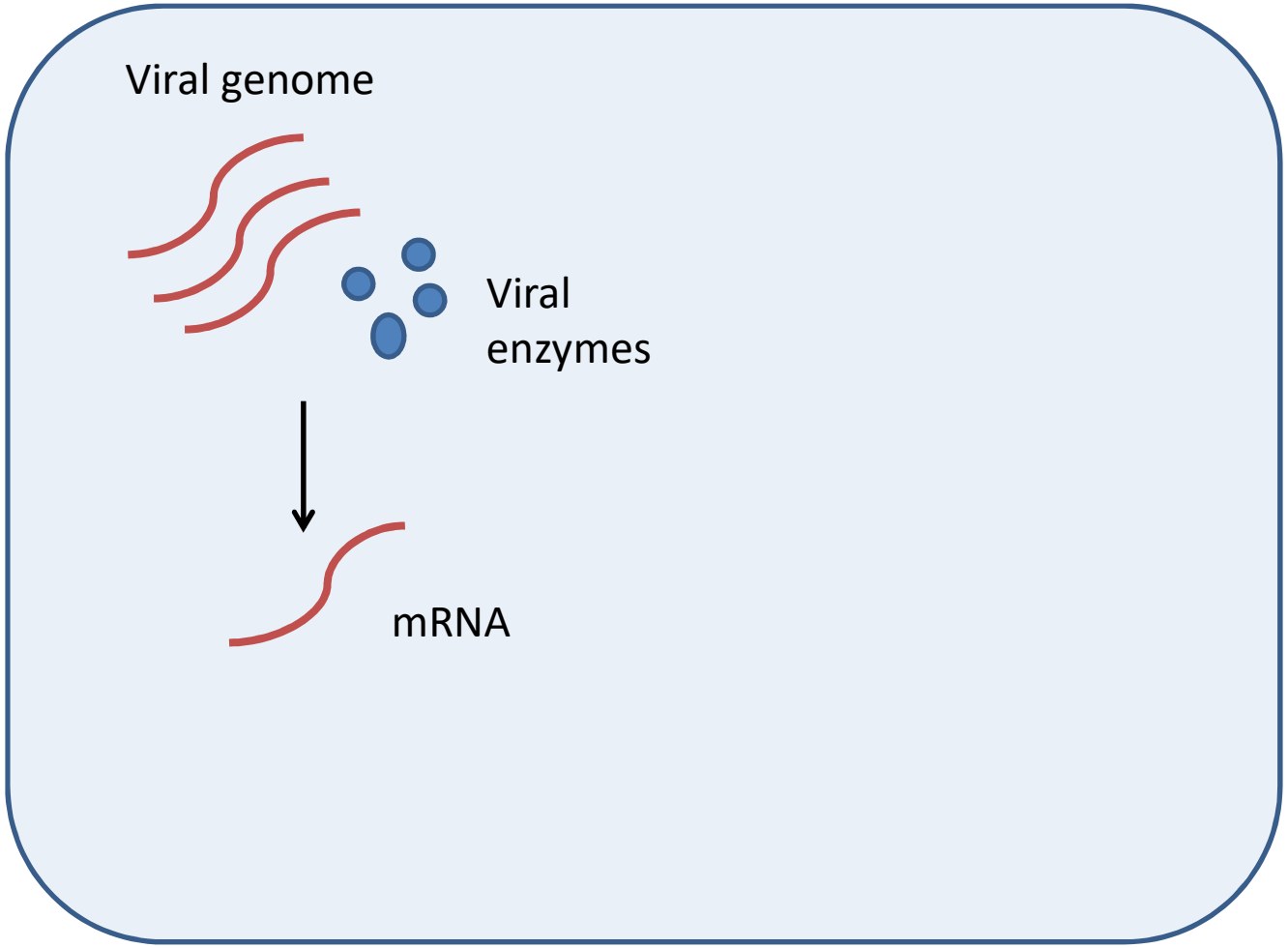
Penetration

Disassembly

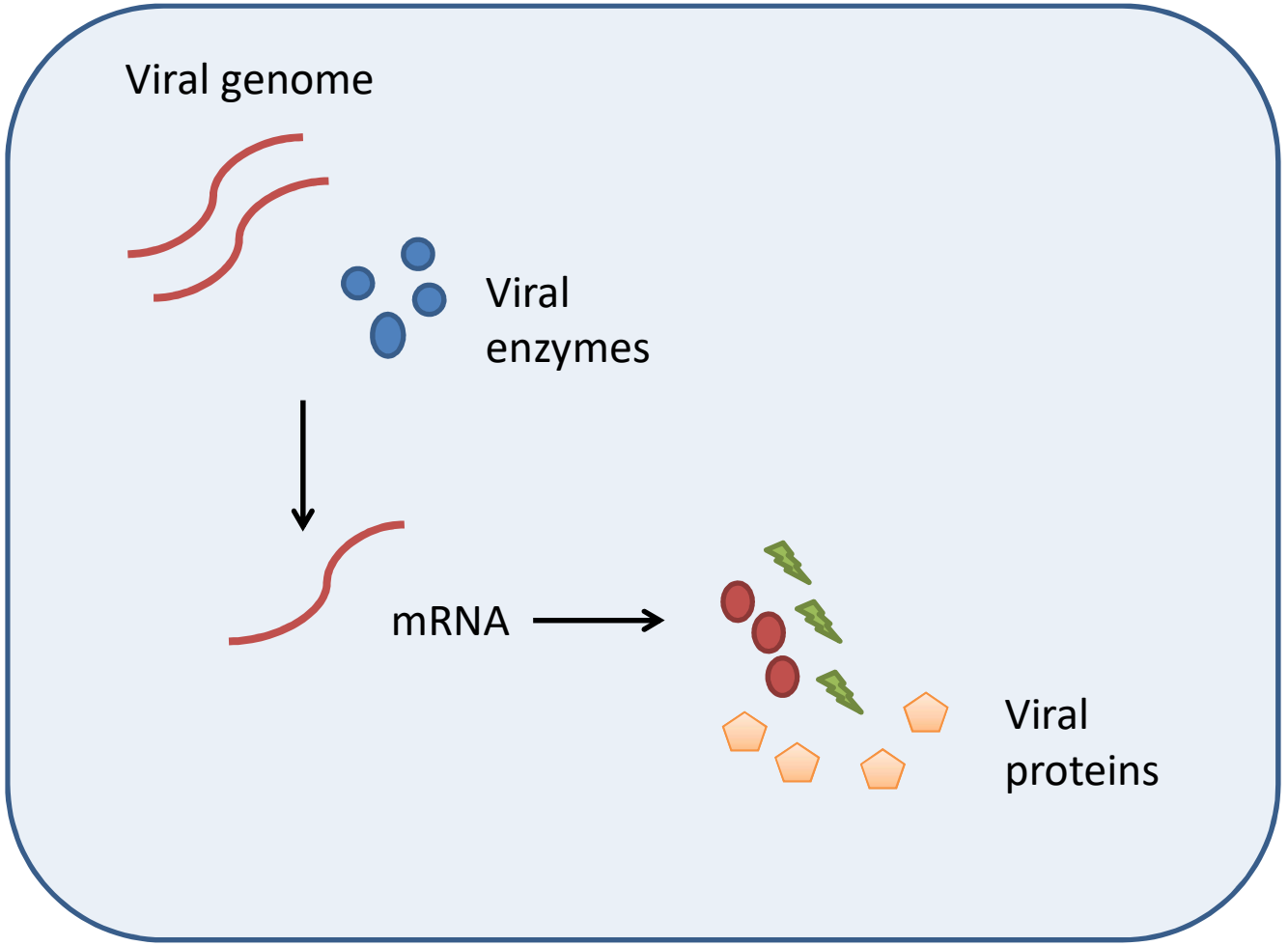
Disassembly



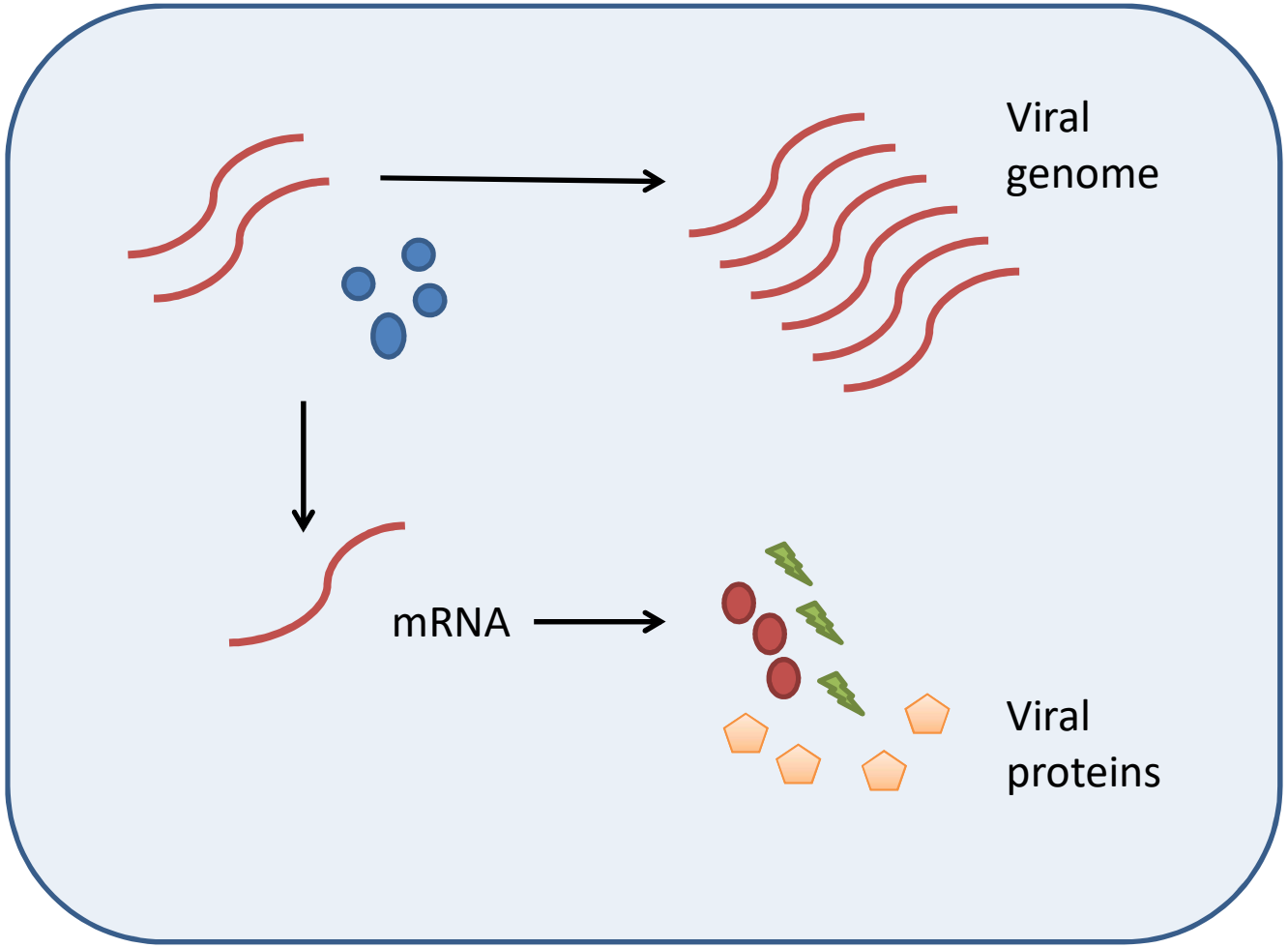
Transcription



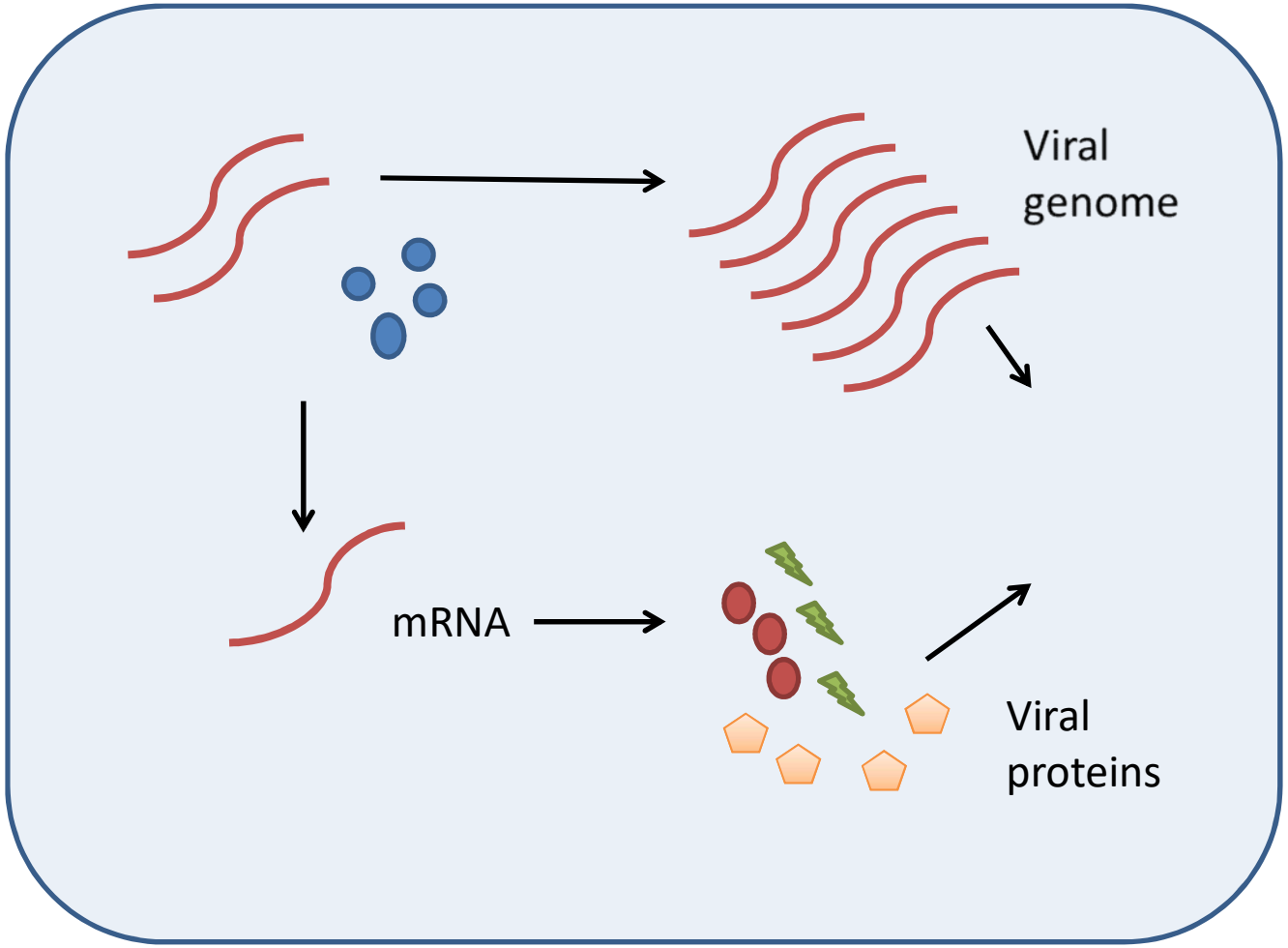
Translation



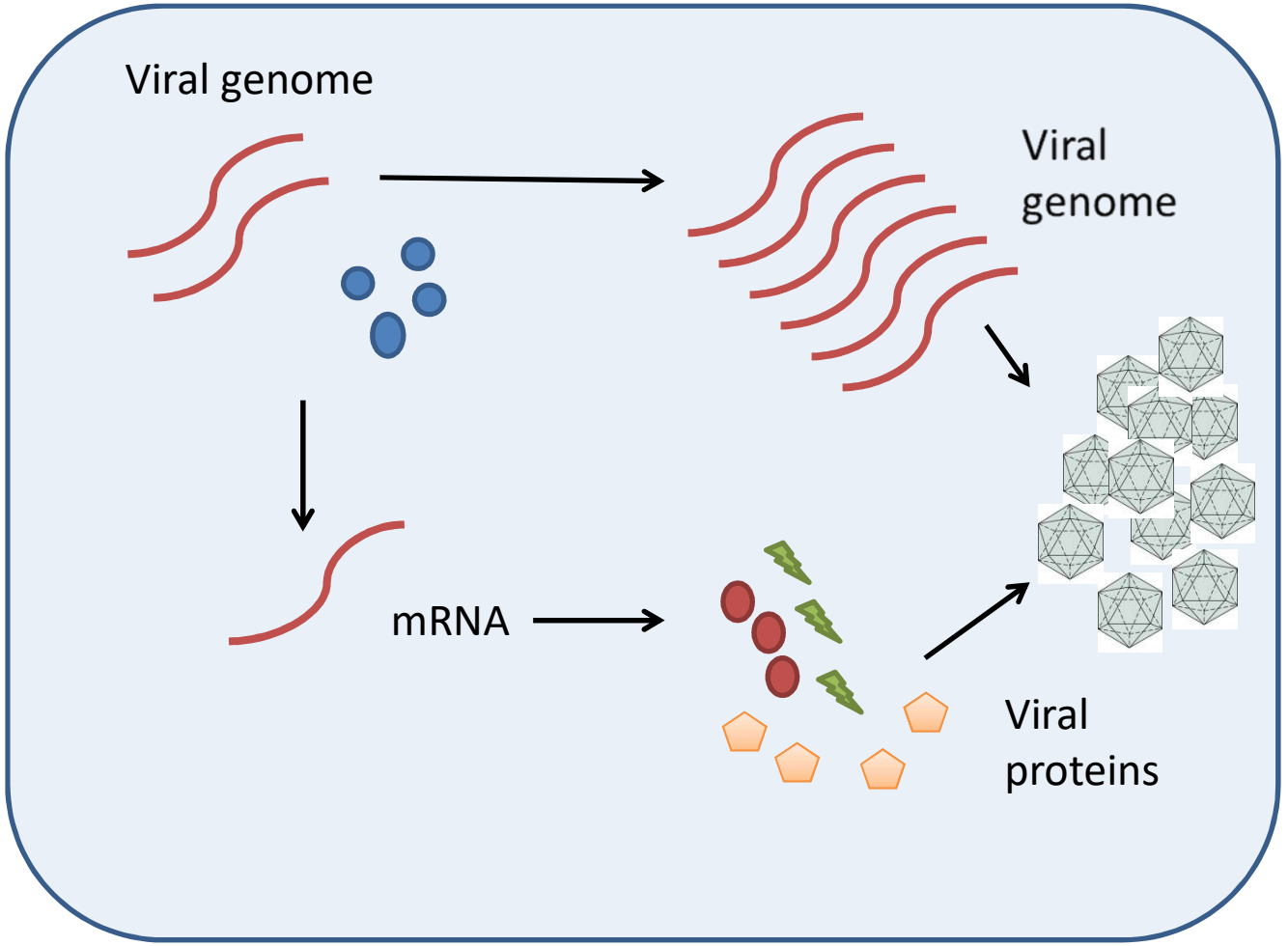
Genome replication



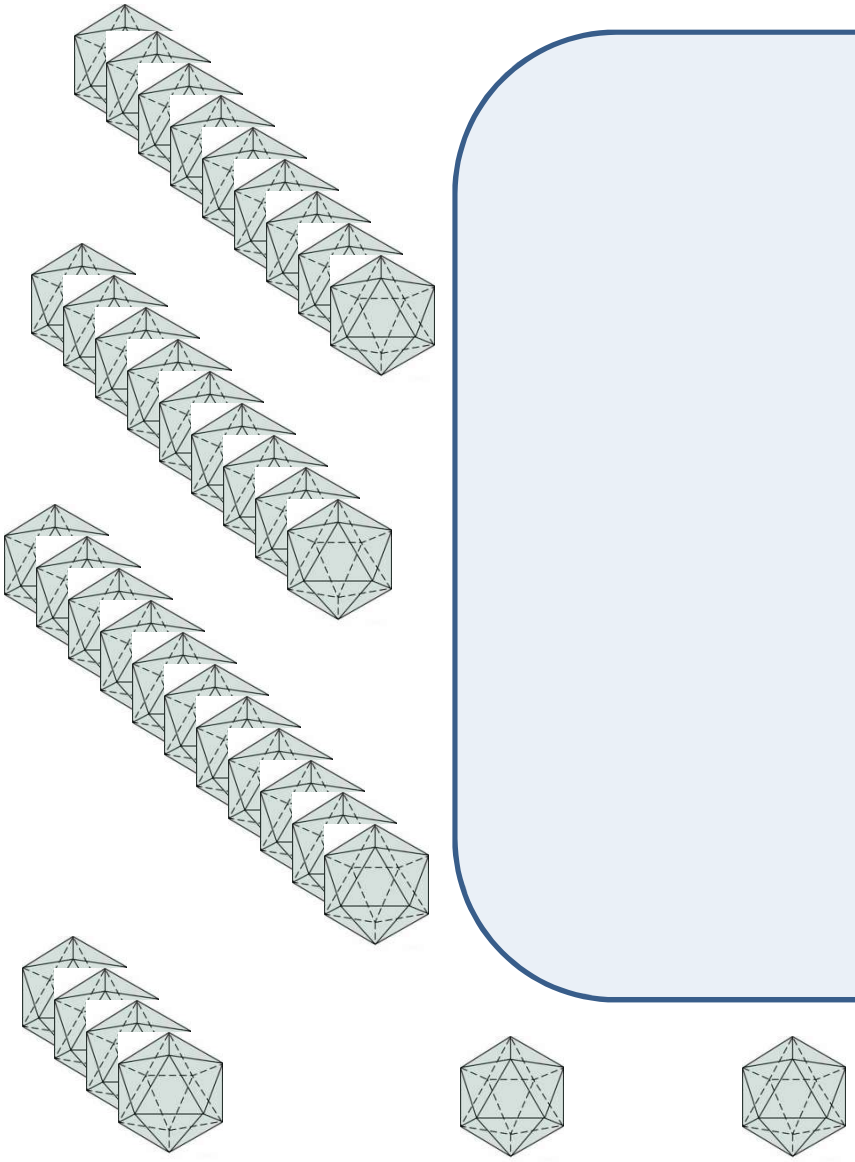
Assembly



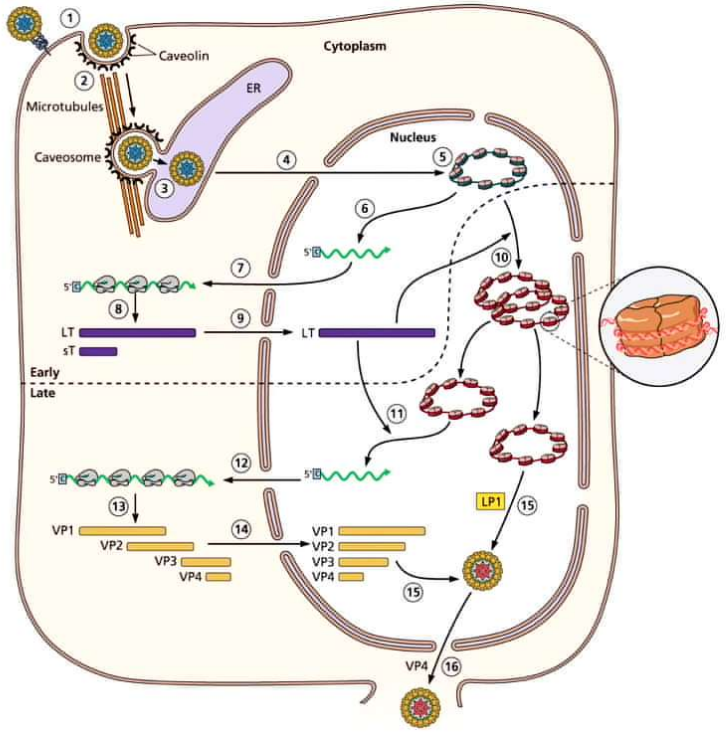
Assembly



Release

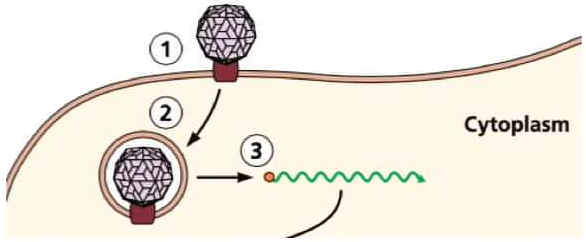


Viruses are obligate intracellular parasites



Virus particles are too large to diffuse across the plasma membrane

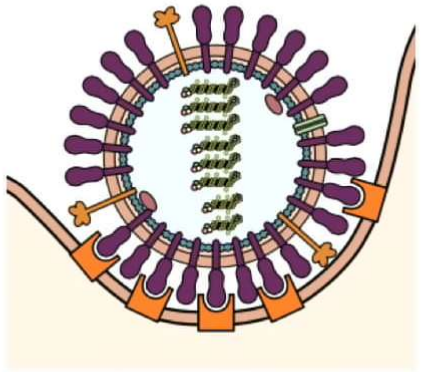
Finding the 'right' cell receptor



- Step 1: adhere to cell surface (random collisions & electrostatics)
  - No specificity
- Step 2: Attach to specific receptor molecules on cell surface
  - More than one receptor may be involved
- Step 3: Transfer genome inside the cell

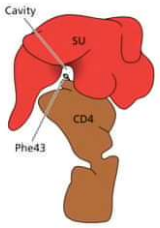
Cellular receptors for viruses

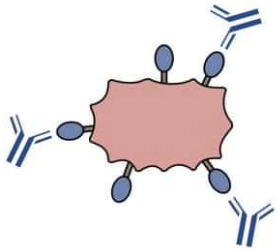
- Essential for all viruses except those of fungi (no extracellular phases) and plants (enter cells by mechanical damage)
- 1985: one receptor known, sialic acid for influenza virus

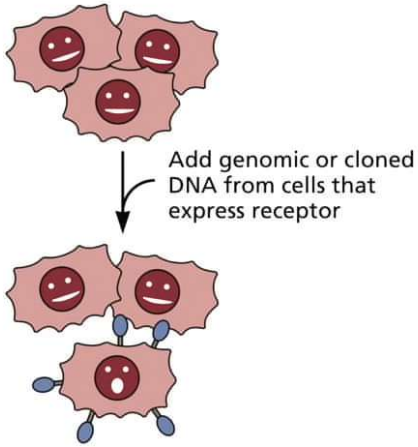


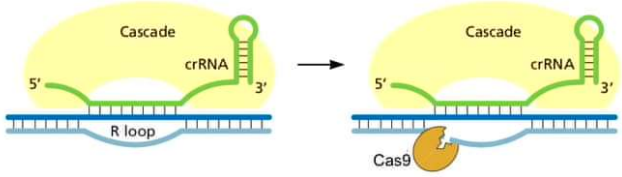
Criteria for identifying cell receptors for viruses

- Receptor binds virus particle
- Antibody to receptor blocks infection
- Receptor gene confers susceptibility
  - More than one receptor may be involved
- Disruption of receptor gene blocks infection

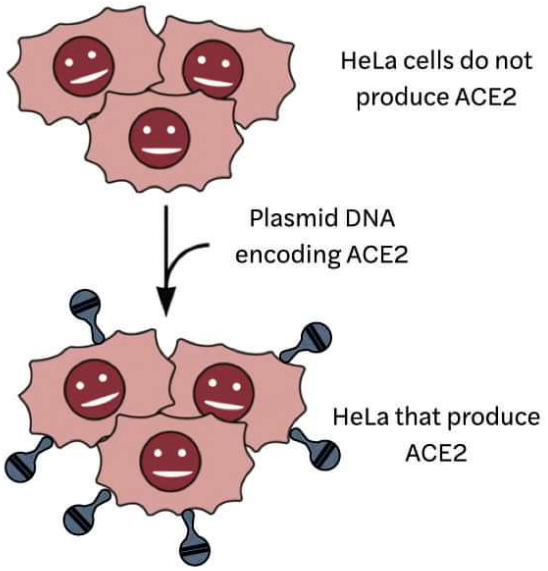


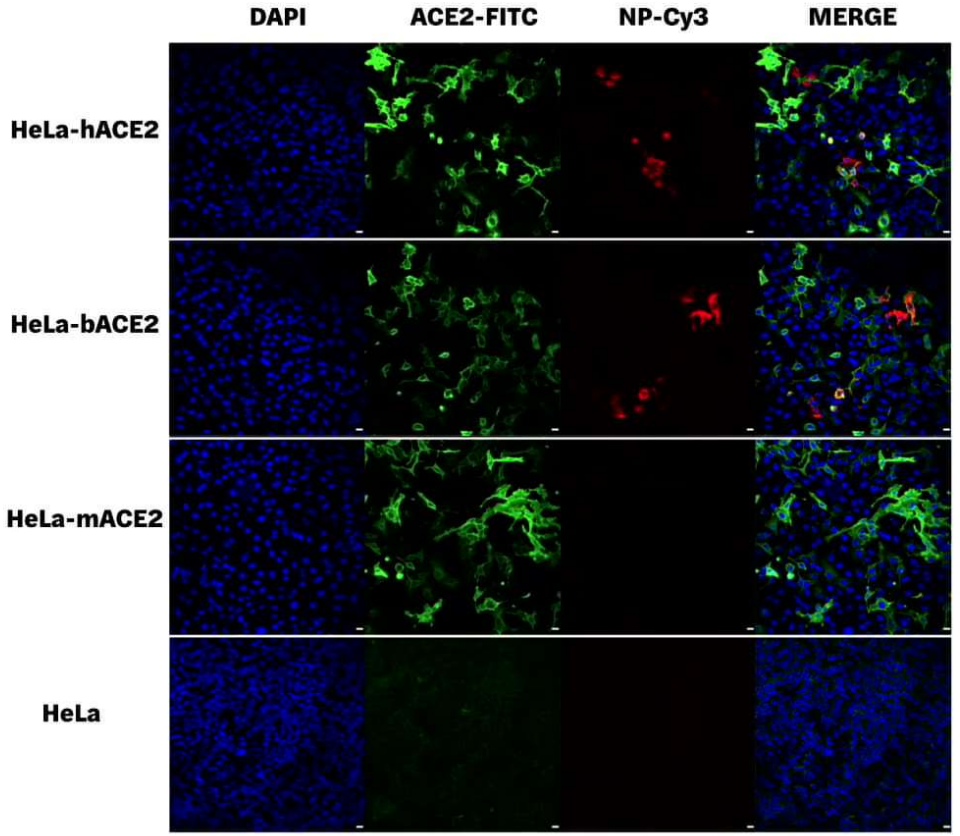




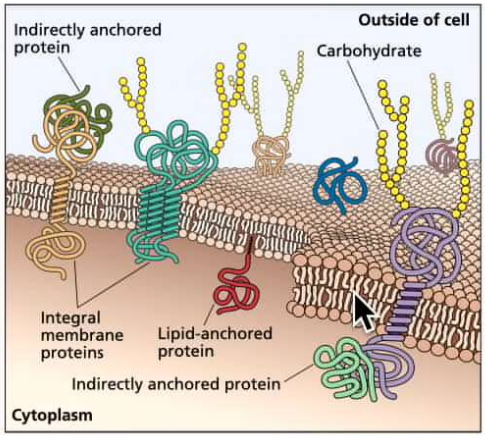


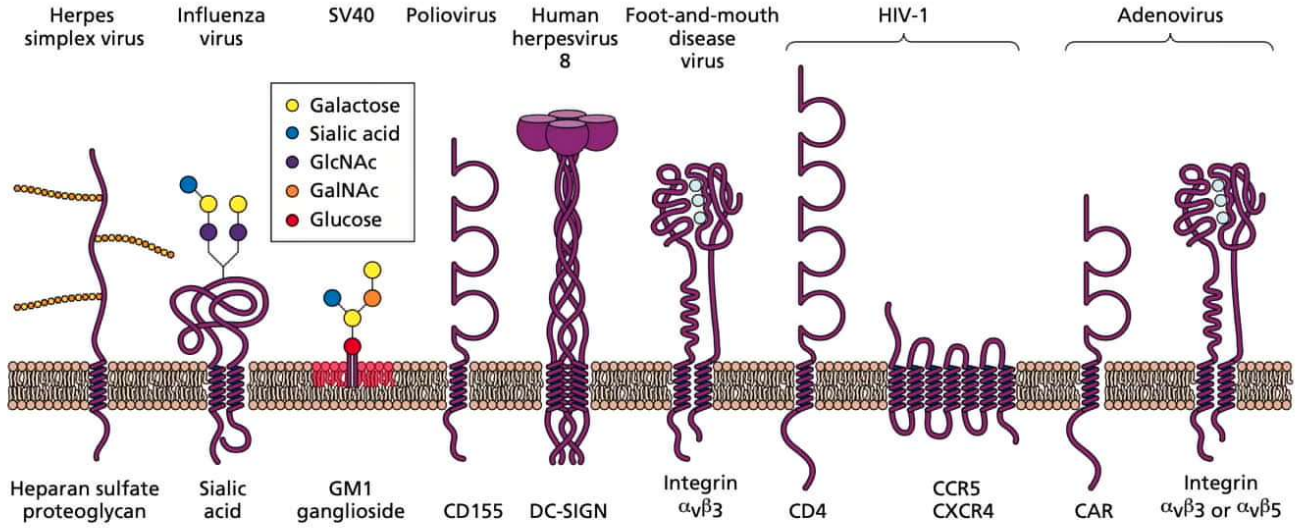
ACE2 is receptor for SARS-CoV-2





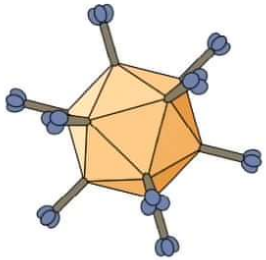
https://www.nature.com/articles/s41586-020-2012-7

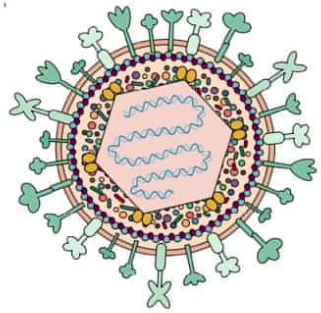




Cell functions!

Different viruses can bind the same receptor

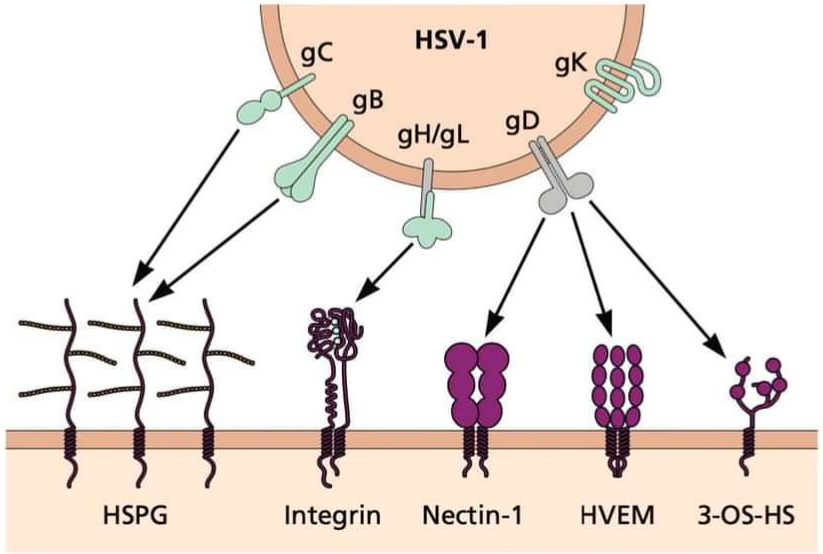




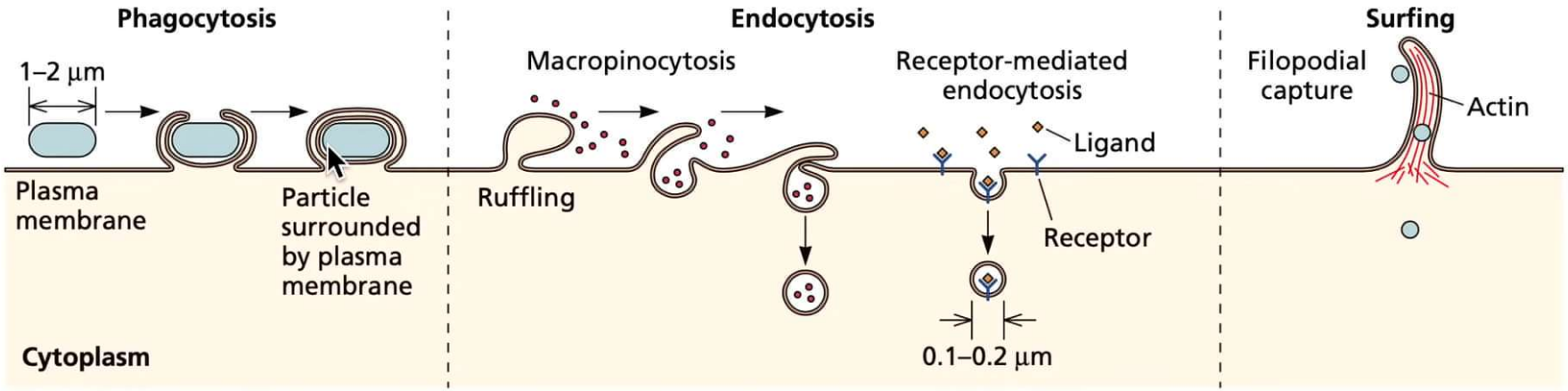
- Adenovirus and Coxsackievirus B3 have common primary receptor
- The swine herpesvirus, pseudorabies virus, binds same receptor as human poliovirus

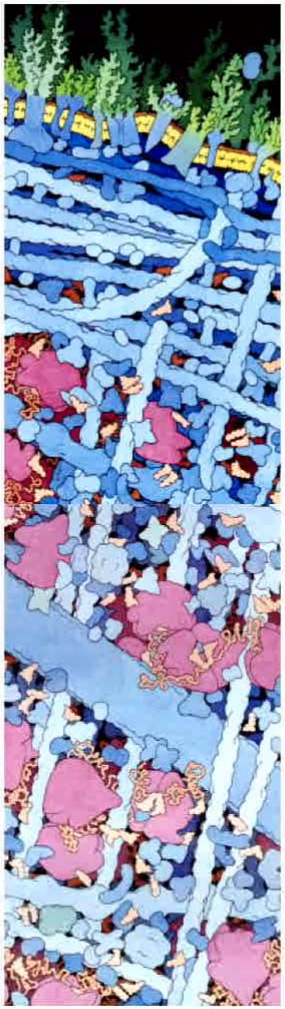
Viruses of the same family may bind different receptors

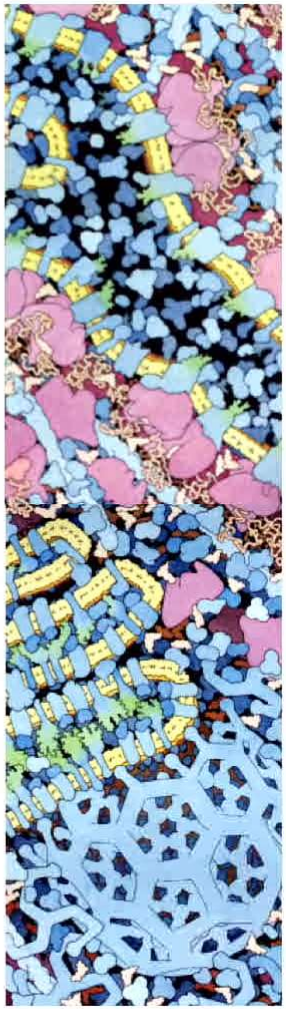
- Rhinoviruses (3), retroviruses (16)
- One virus may bind multiple receptors

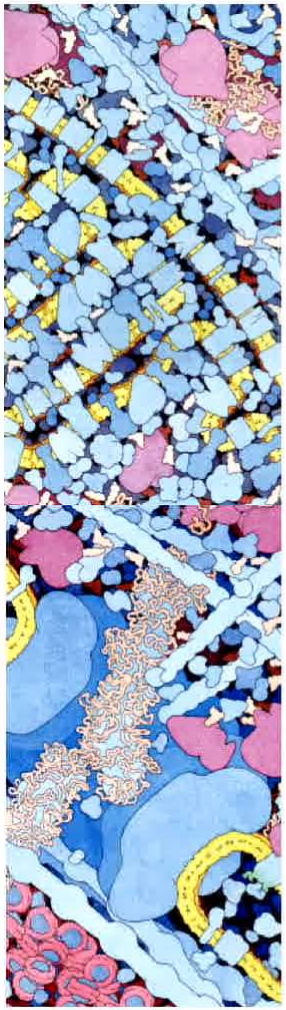


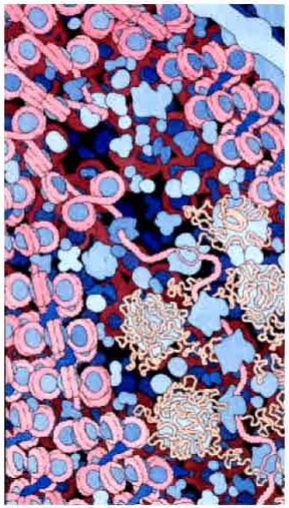
Entry into cells









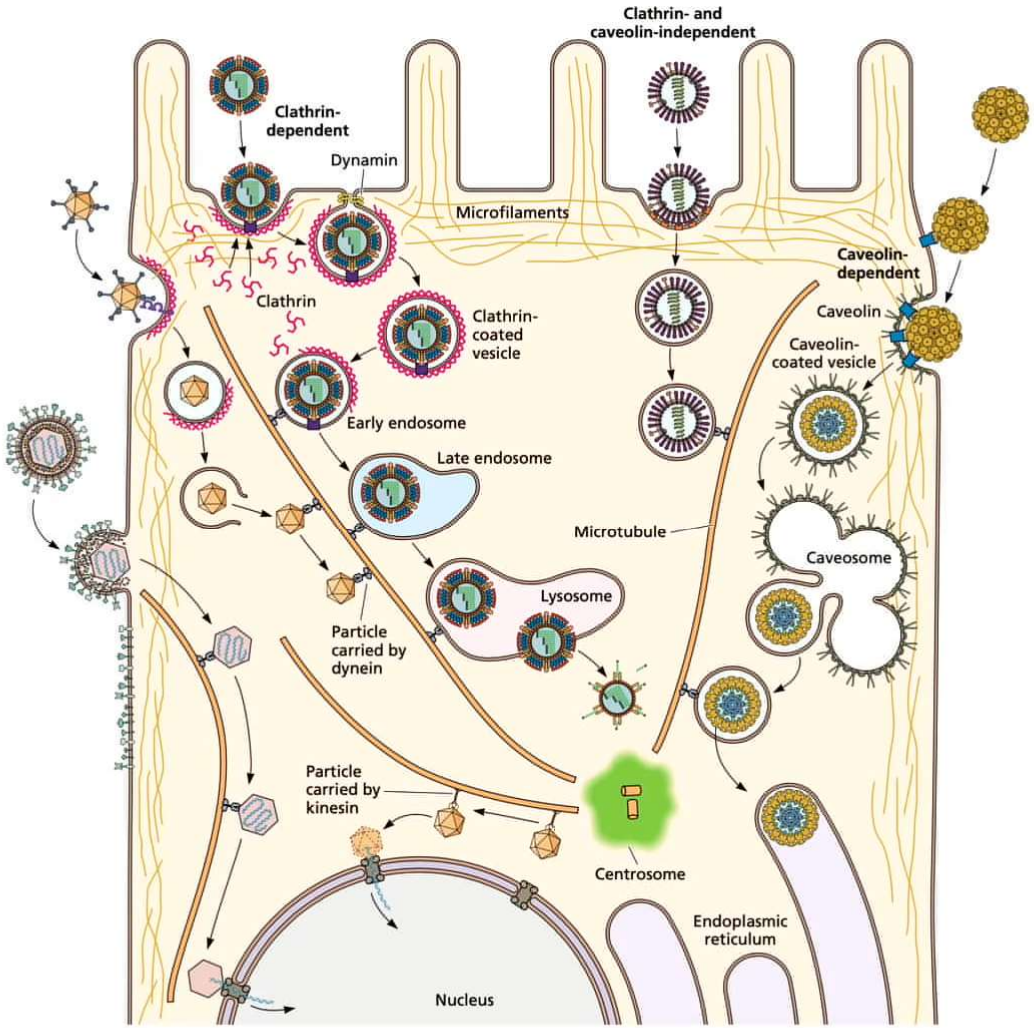


https://ccsb.scripps.edu/goodsell/

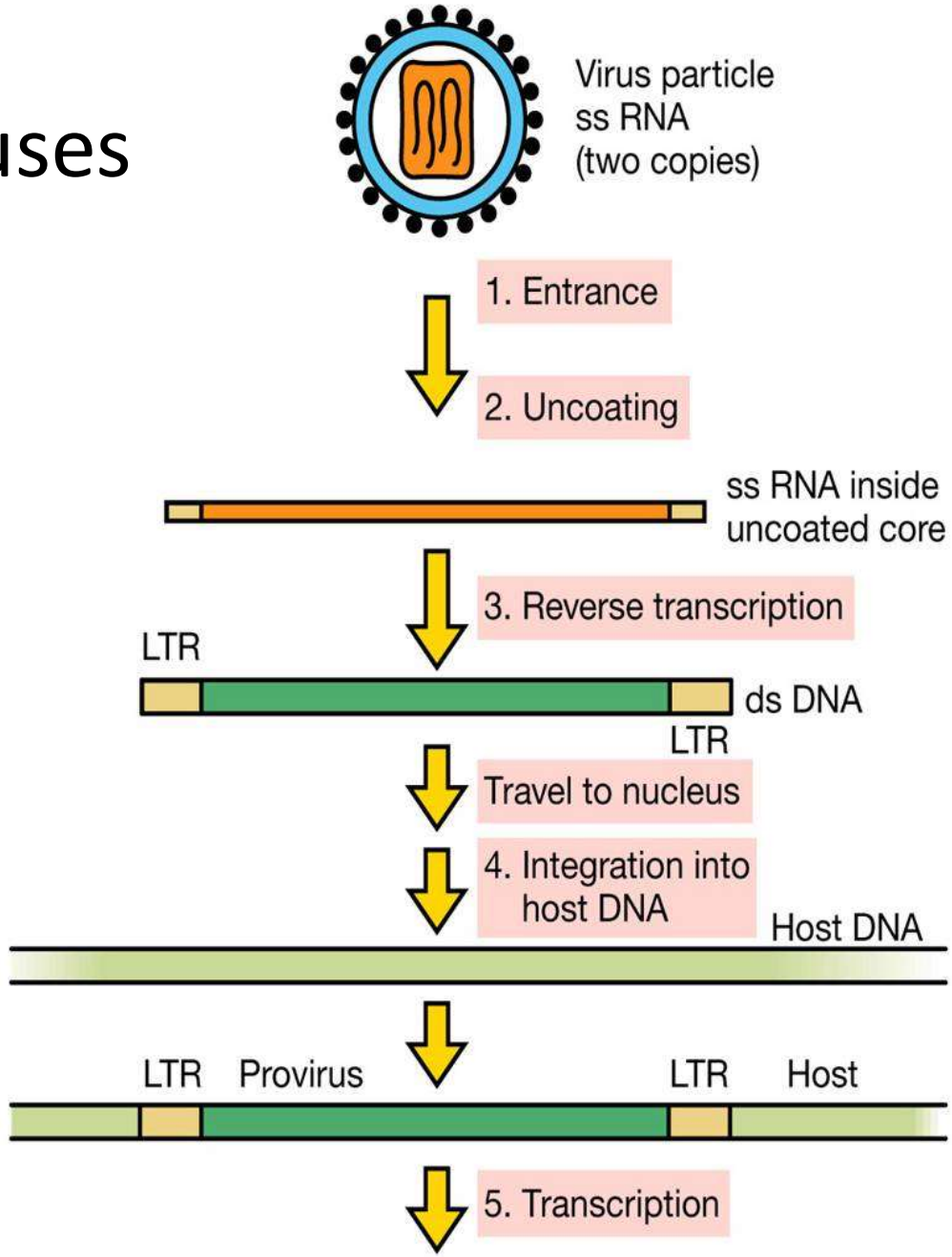
The cytoplasm is crowded!

Movement of large protein complexes will not occur by diffusion!

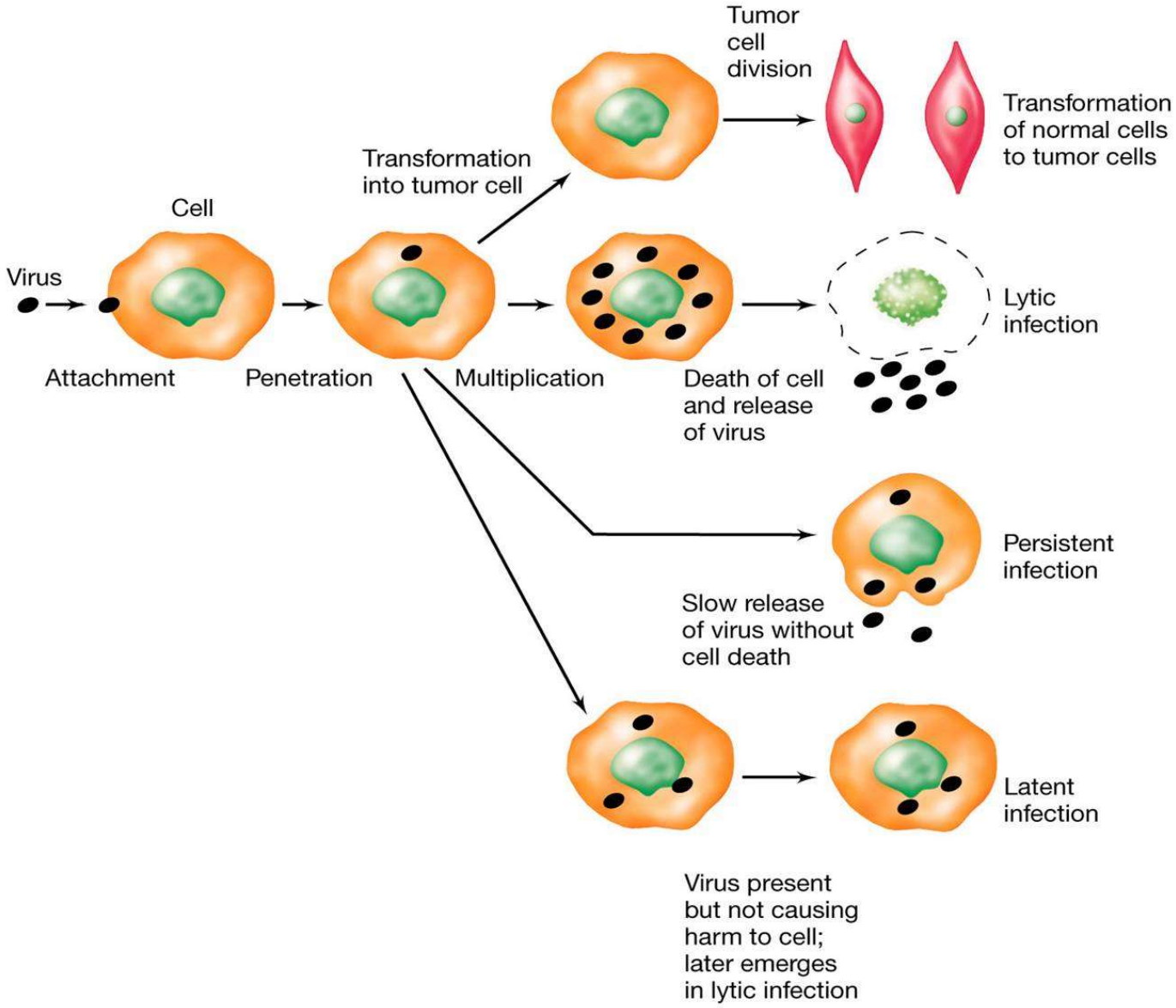
Fusion of viral and host cell membranes mediated by viral fusion proteins



Retroviruses

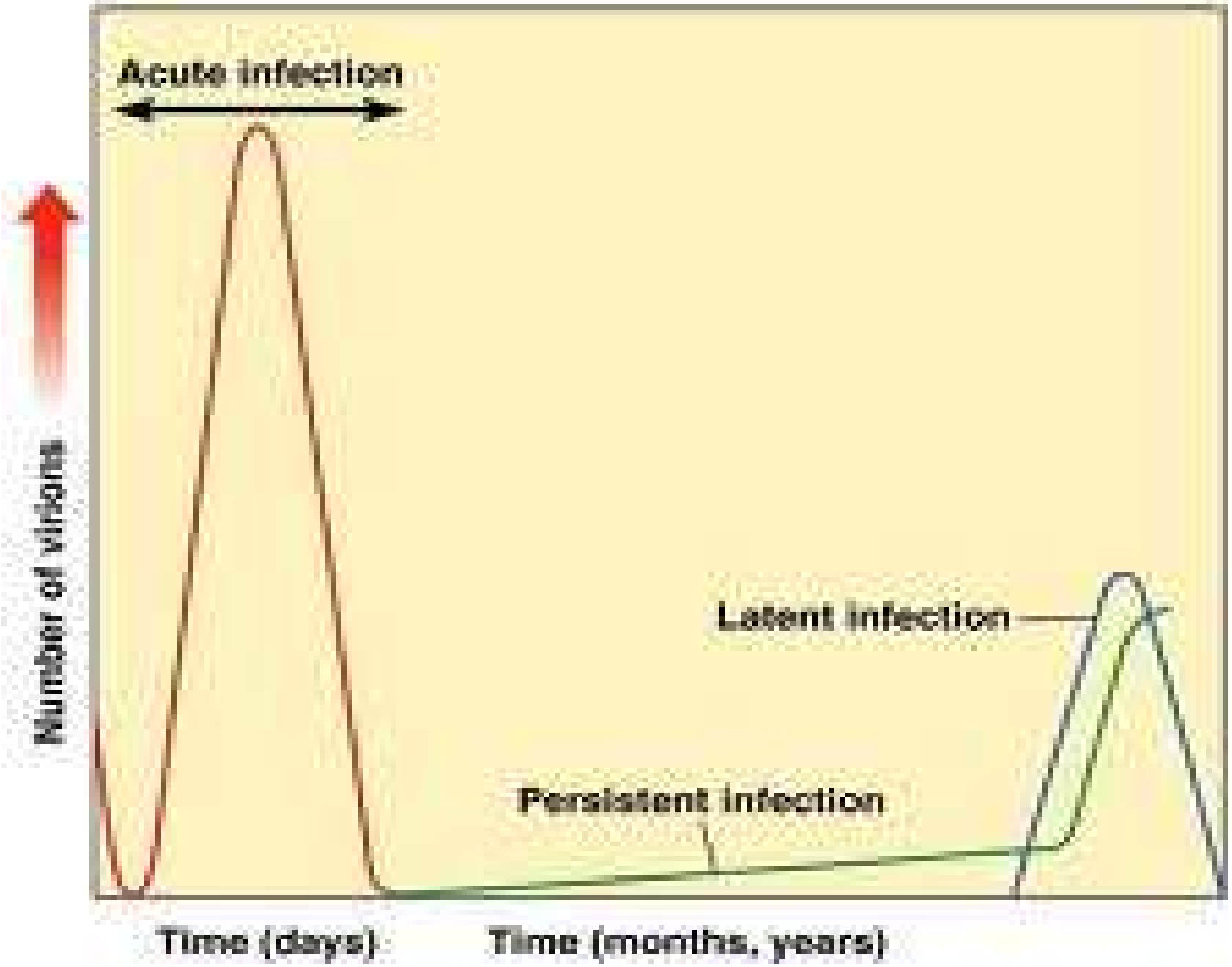


Outcome of cellular infection



Immune response

- Cell mediated immunity
  - Important in the recovery from viral illness
- Antibodies
  - Important in the protection from repeat exposure


Acute infection
Number of virions
Latent infection
Persistent infection
Time (days)
Time (months, years)