



Virology for 2nd Year MD Students

(02) Virus Classification, Replication & Pathogenesis

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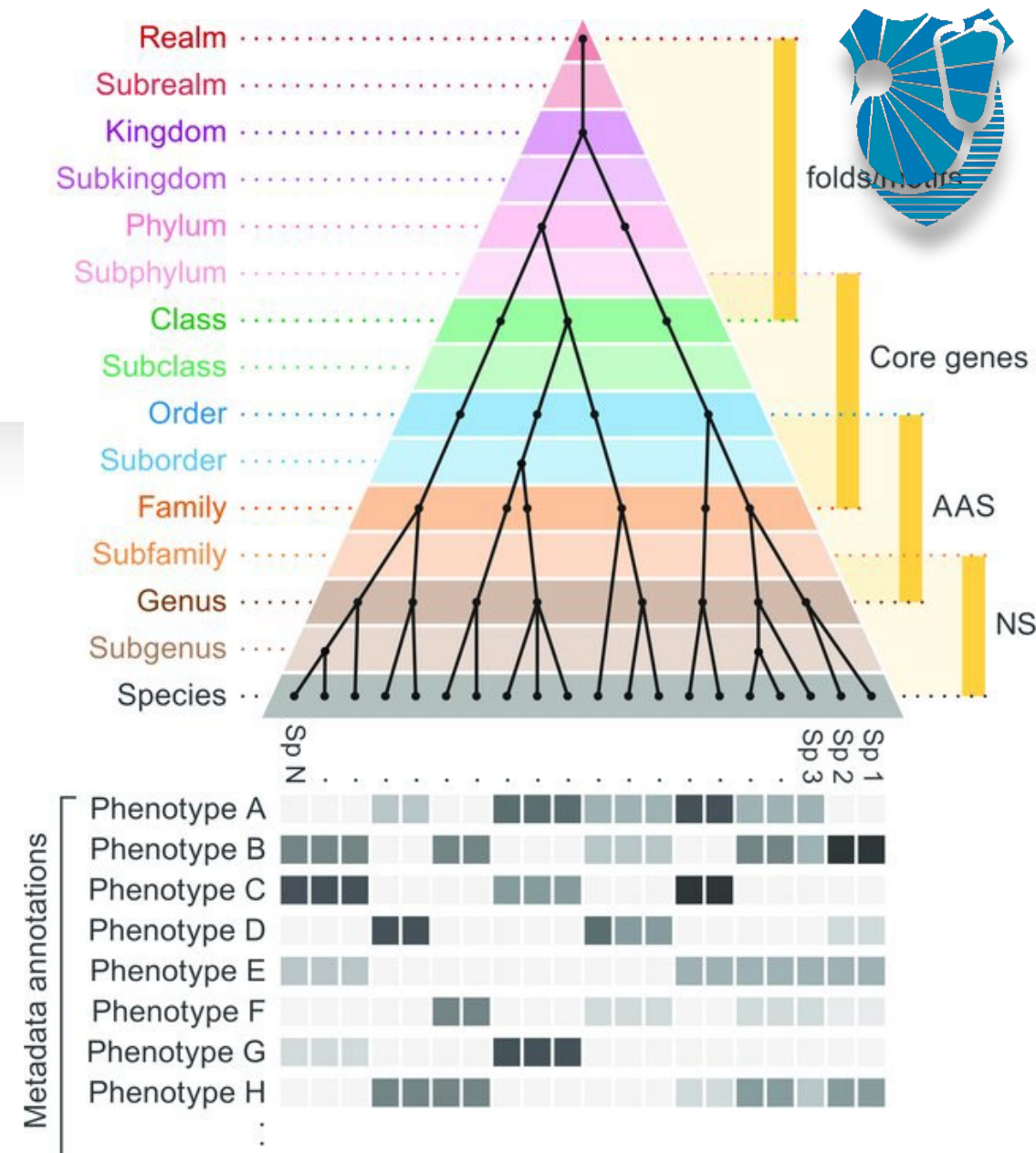
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Virus Classification

- **Classification of viruses can be based on shared features:**
 1. Virus family (the name ends in *viridae*).
Example: Coronaviruses are classified in the family *Coronaviridae*.
 2. Virus sub-family (the name ends in *virinae*).
Example: SARS coronavirus 2 is classified in the subfamily *Orthocoronavirinae*.
 3. Virus genus (the name ends in *virus*). Example: monkeypox virus is classified in the *Orthopoxvirus* genus.



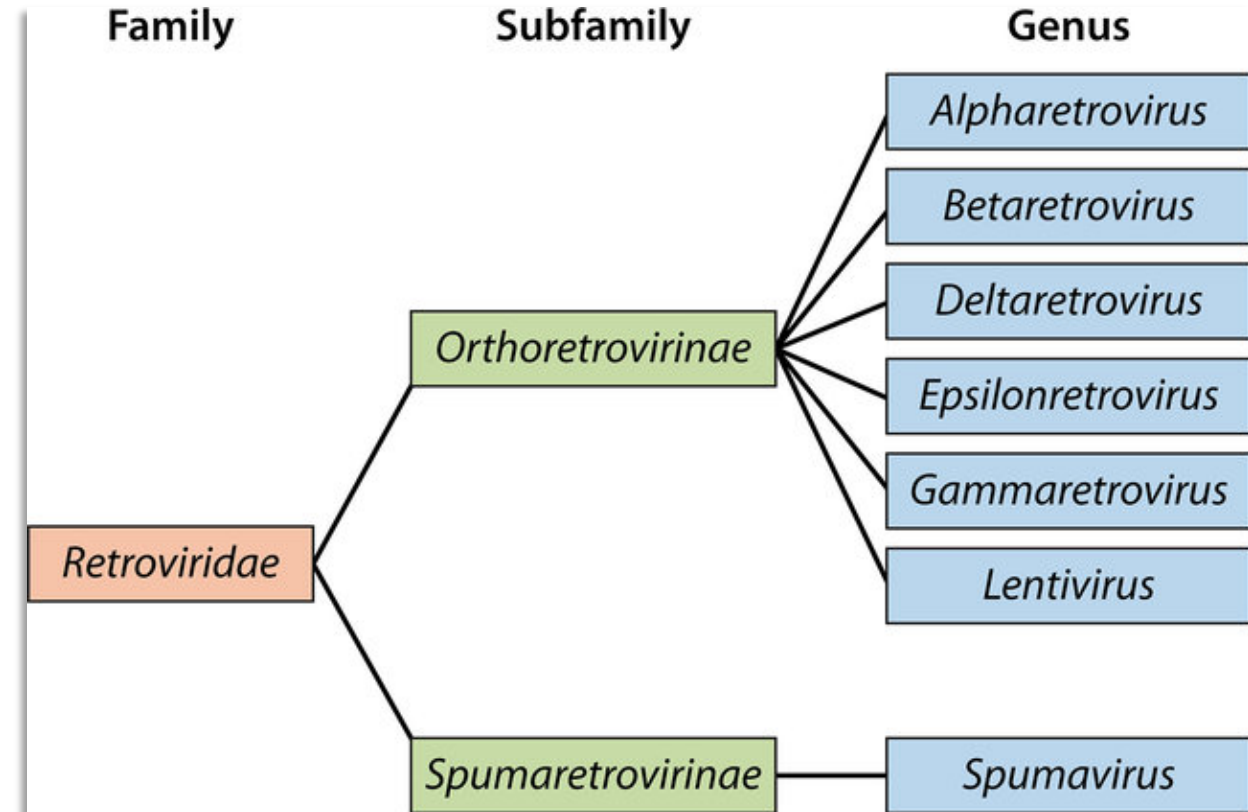
Source: Simmonds P, Adriaenssens EM, Zerbini FM, Abrescia NGA, Aiewsakun P, et al. (2023) Four principles to establish a universal virus taxonomy. PLOS Biology 21(2): e3001922. <https://doi.org/10.1371/journal.pbio.3001922>



Virus Classification



- There are shared features among the members of the same family.
- Similarities increase among the members of the same subfamily.
- The features become very similar among the members of the same genus.



Source: Greenwood AD, Ishida Y, O'Brien SP, Roca AL, Eiden MV. 2018. Transmission, Evolution, and Endogenization: Lessons Learned from Recent Retroviral Invasions. Microbiol Mol Biol Rev 82:10.1128/mmbr.00044-17. <https://doi.org/10.1128/mmbr.00044-17>



Virus Replication

Attachment: The virus recognizes a cell receptor and binds it.

Penetration: The virus enters the cell.

Uncoating: The virus genome is exposed.

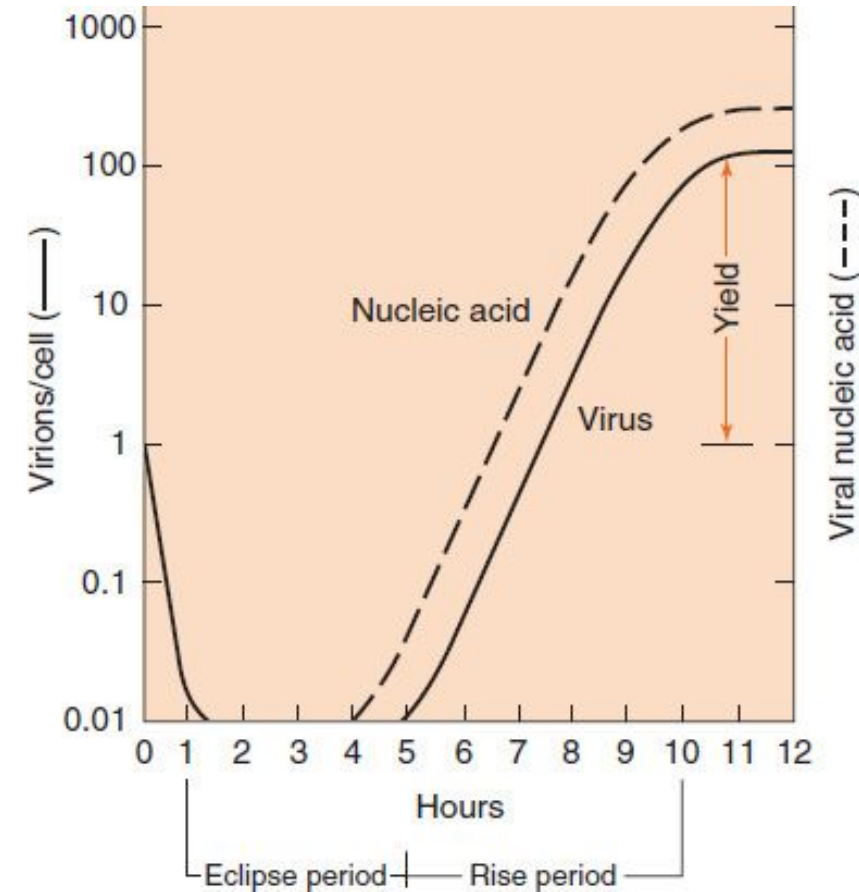
Early transcription and early translation: Production of the early mRNA and its translation into early virus proteins involved in virus replication.

Virus genome synthesis.

Late transcription and late translation: Production of the late mRNA and its translation into late virus proteins involved in virus structure.

Virus assembly: The virus genome and capsid come together.

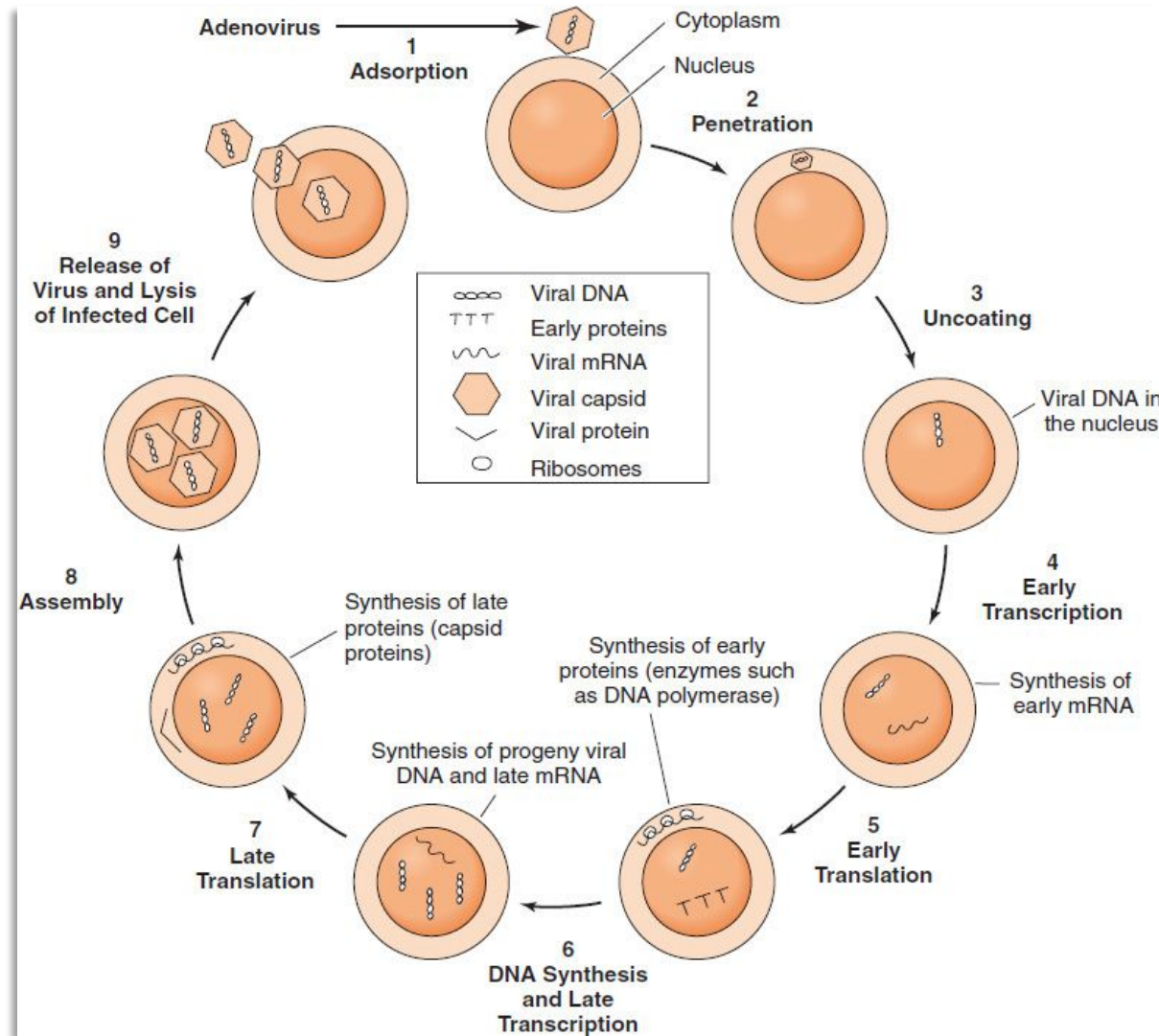
Virus release from the infected cell.



Source: Joklik WK et al. Zinsser Microbiology. 20th ed.



Virus Replication

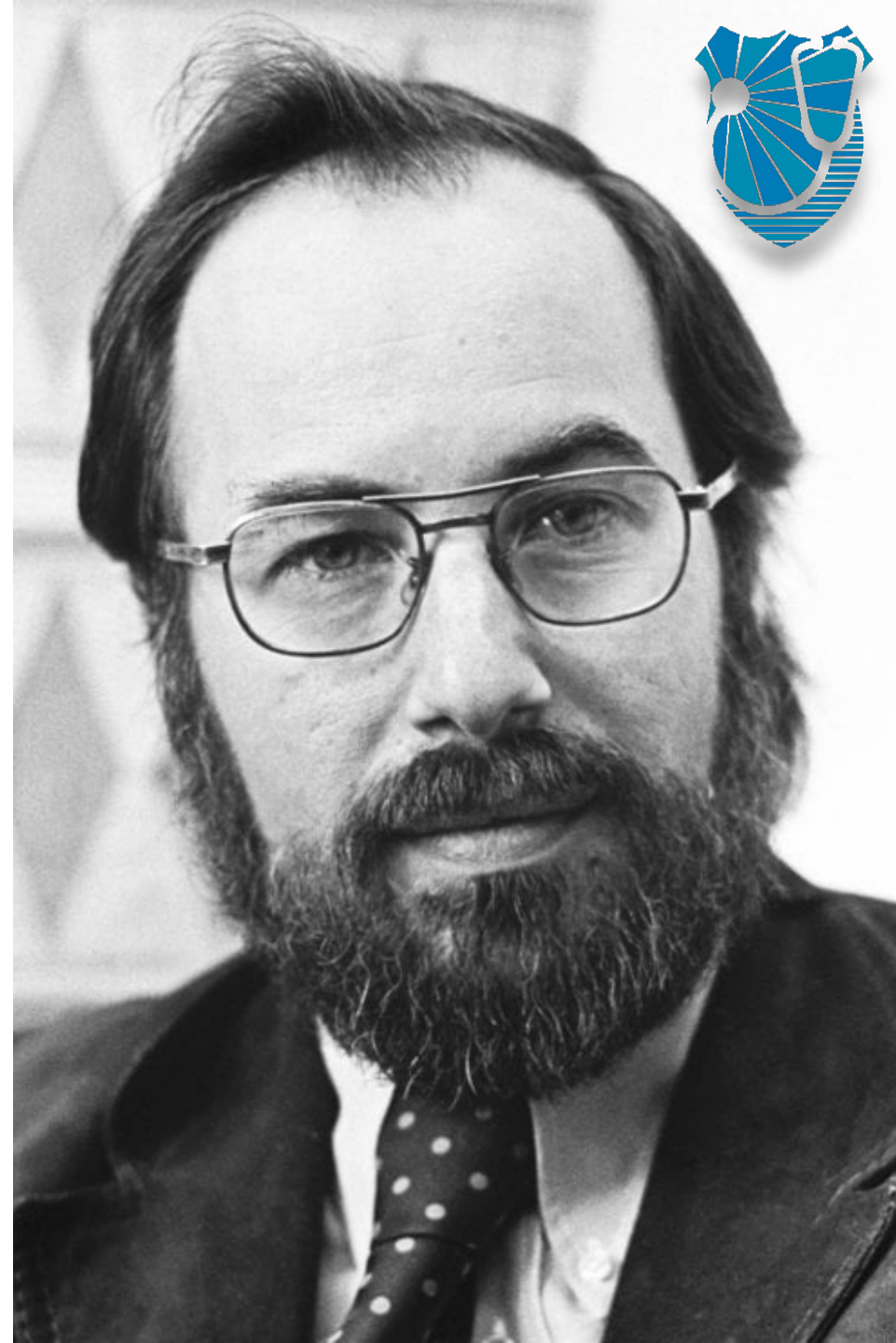




Baltimore Classification



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- Baltimore classification of viruses depends on genome type:
 - A) DNA vs. RNA
 - B) double stranded vs. single stranded
 - C) reverse transcription
 - Note: transcription is the conversion of DNA into RNA. So, reverse transcription is the conversion of RNA into DNA.



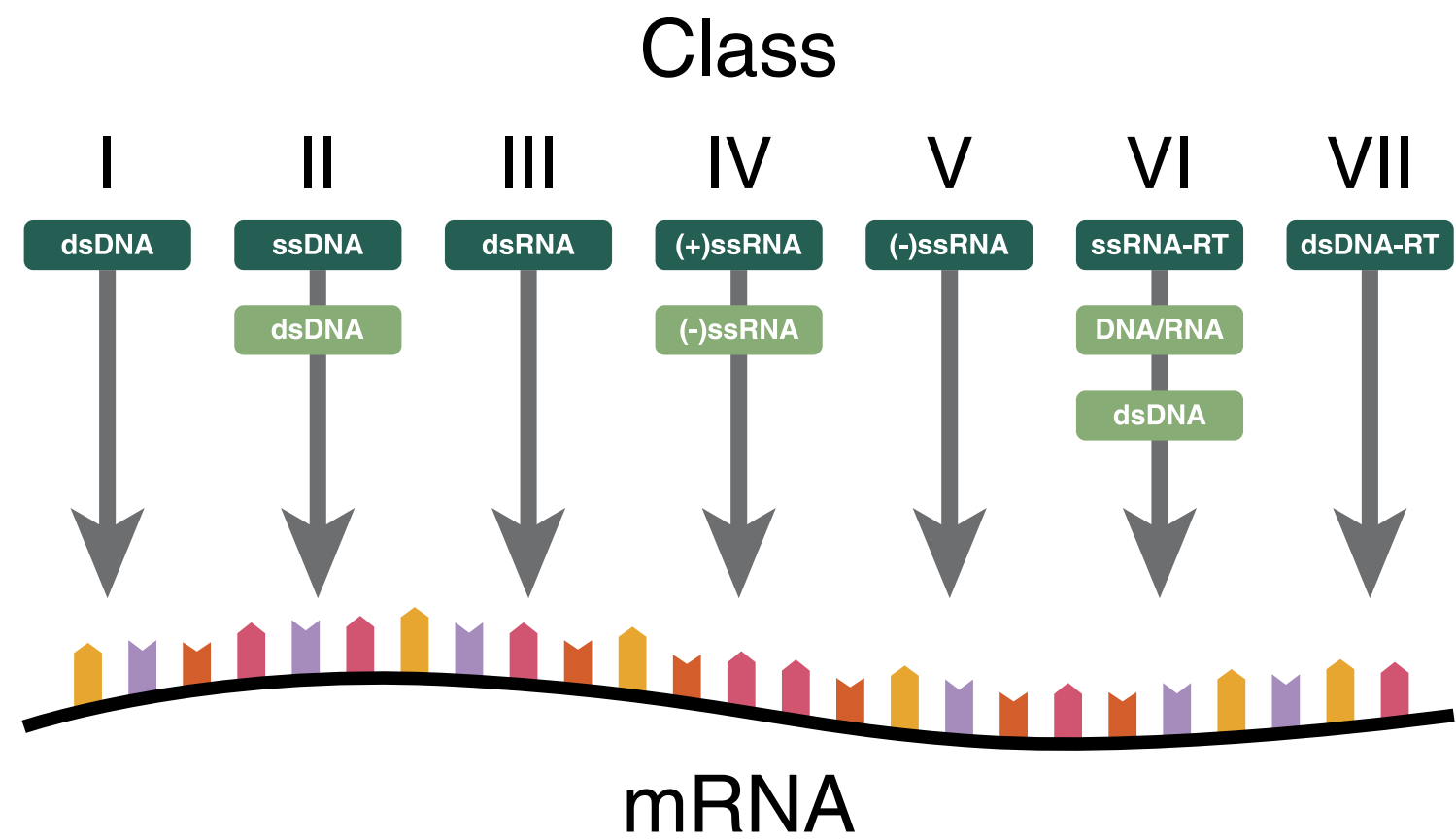


Baltimore classification system

Group	Description
1	Double-stranded DNA
2	Single-stranded DNA
3	Double-stranded RNA
4	Positive-sense single-stranded RNA
5	Negative-sense single-stranded RNA
6	Positive-sense single-stranded RNA with reverse transcription
7	Double-stranded DNA with reverse transcription



**Baltimore
classification
system**





Pathogenesis of virus infections



Pathogenesis of virus infections involves the processes including direct virus effect and host responses.

Pathogenic viruses cause disease. So, non-pathogenic viruses do not cause disease.

Virulent viruses cause more severe disease.



What are the possible outcomes of exposure to viruses?



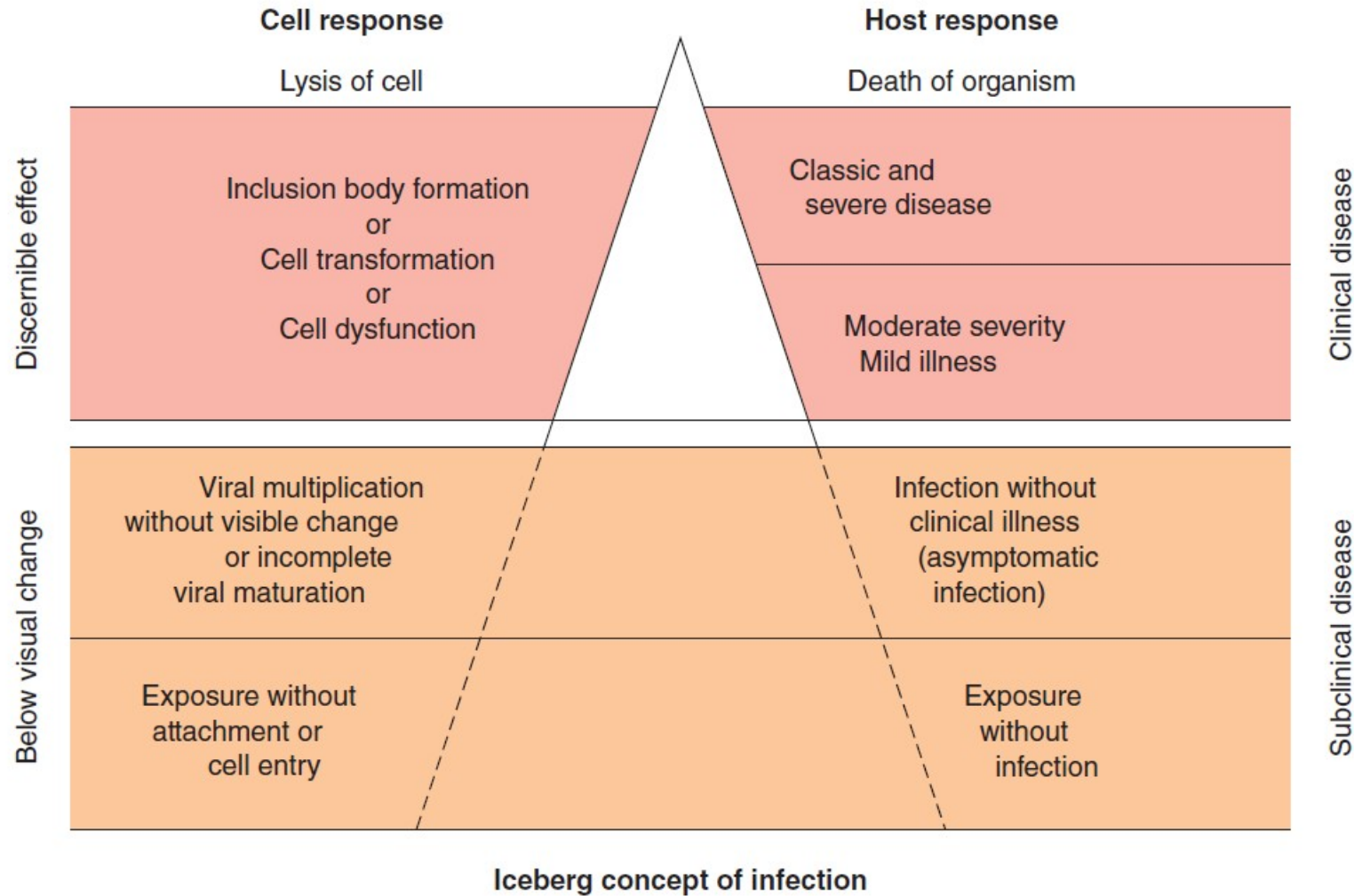
1. Exposure without virus attachment and without infection.
2. Virus infection but without obvious damage: Asymptomatic infection
3. Infection with cell damage or cell transformation Symptomatic disease.
Sometimes this can lead to fatality

So, the possible clinical outcomes of acute virus infection can be:

- A. Acute infection with complete virus clearance.
- B. Acute infection followed by chronic infection.
- C. Acute infection followed by silent persistence and periodic reactivation.
- D. Acute infection followed by death.



What are the possible outcomes of exposure to viruses?

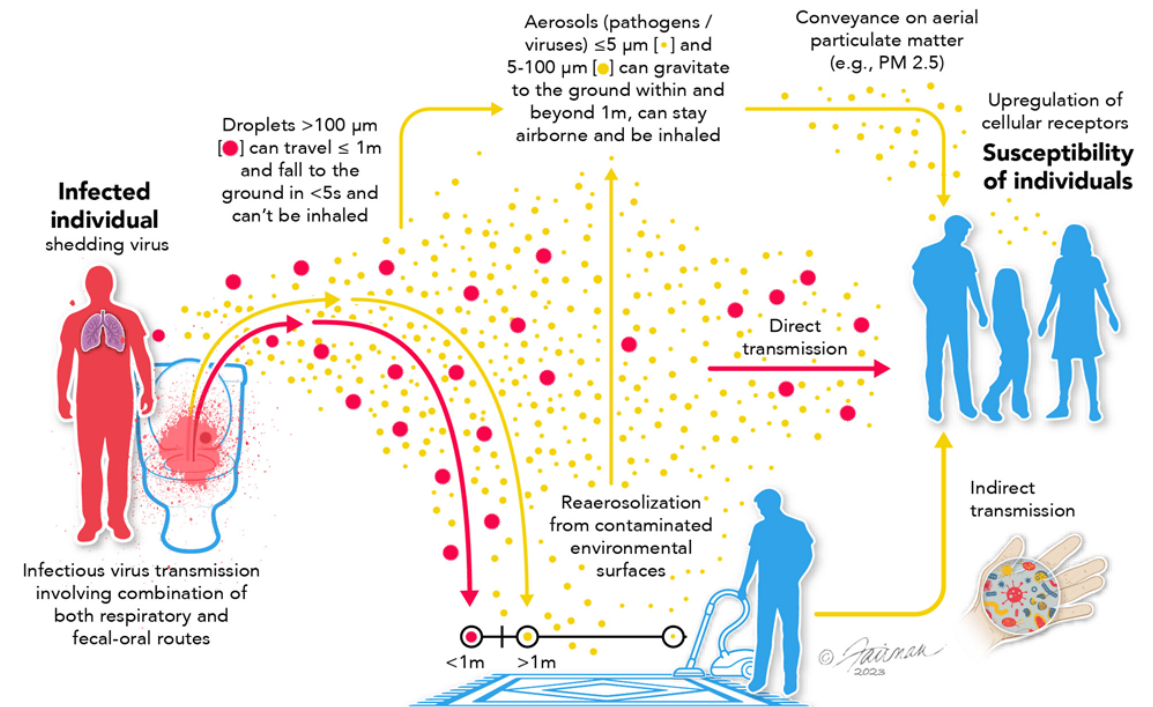
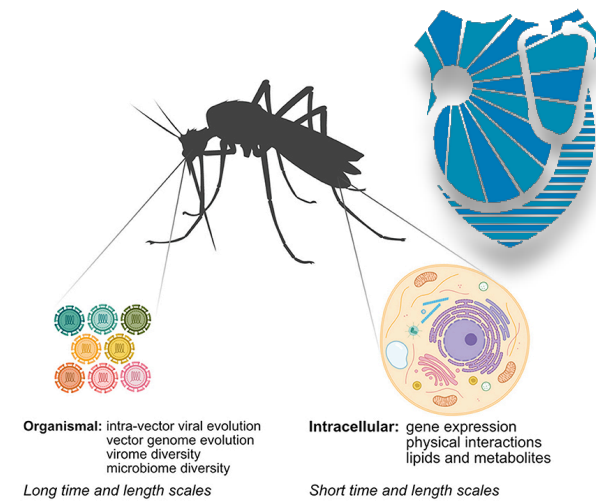




How can viruses enter the body?

- A. Direct: Skin contact. Respiratory aerosols or droplets. Blood. Genital secretions. Saliva.
- B. Indirect: Fomites (non-living object) or Vector (e.g. insects).

Viruses are foreign entities. Upon entry into the body, the immune system will react. The immune response to virus infection can contribute to the disease process.





Thank You...
Wishing you all the best!