Exercise walk-through

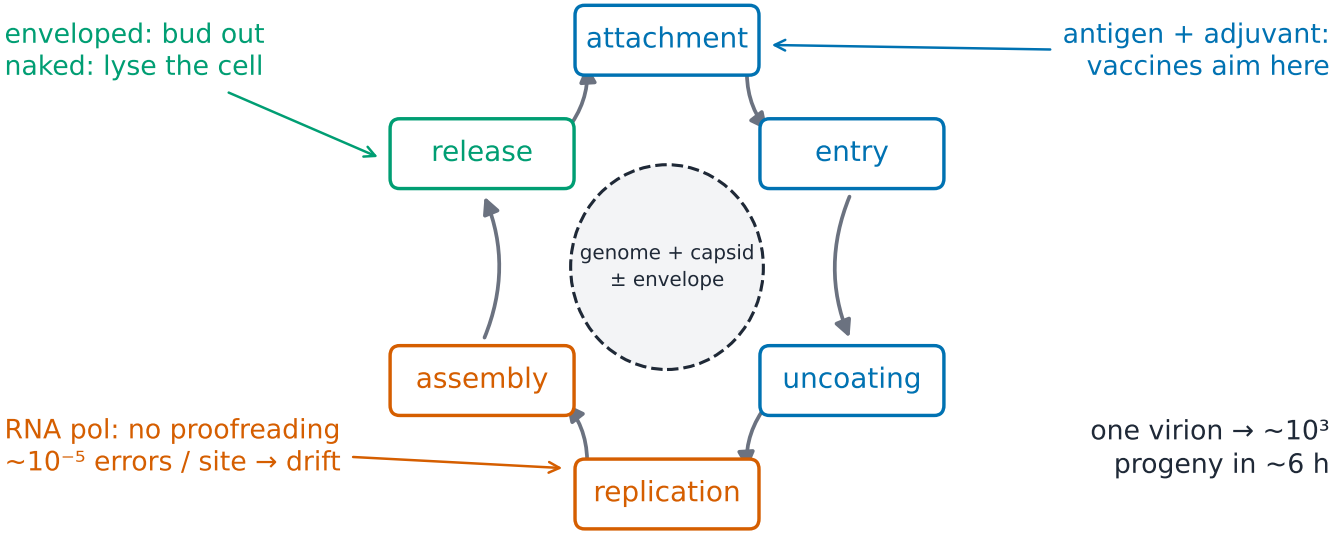
8.3 Viruses

University Medicine

Viruses: six steps around one cell

1. **Cycle** Attachment → entry → uncoating → replication → assembly → release; enveloped viruses bud, naked viruses lyse.
2. **Burst** One virion → ~10^3 progeny in ~6 h; two rounds → 10^6; a 1-2 day incubation is 4-8 rounds.
3. **Drift and shift** No proofreading → ~10^{-5} errors per site → **antigenic drift** (yearly vaccines); 8 segments reassort → **antigenic shift** (pandemics).

The virus replication cycle



Attachment, entry, uncoating, replication, assembly, release - every antiviral target sits on it.

Exercises 2.1–2.3

2.1 List the cycle steps between entry and assembly. [3]

2.2 Distinguish antigenic drift from antigenic shift. [3]

2.3 One virion yields ~10^3 progeny per ~6-h round – how many after two rounds? [3]

Exercises 2.1·2.3

2.1 List the cycle steps between entry and assembly. [3]

2.1

- Uncoating, then replication of genome and proteins ✓.

2.2 Distinguish antigenic drift from antigenic shift. [3]

2.2

- Drift: point mutations accumulating (no proofreading); shift: reassortment of segmented genomes between strains ✓.

2.3 One virion yields ~10^3 progeny per ~6-h round – how many after two rounds? [3]

2.3

- $(10^3)^2 = 10^6$ progeny after 12 h ✓.

Exercise 3.1

3.1 A fictional winter outbreak: incubation 1–2 days, attack rates ~20 % in offices; a second fictional community outbreak shows incubation 2–3 weeks.

Use the burst arithmetic (~10^3 per round, ~6 h) to explain why the first virus outruns contact tracing while the second spreads slowly and peaks later. State which genome chemistry predicts yearly vaccine updates and why. [7]

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3.1

- Each round multiplies by ~10^3: two rounds (12 h) give 10^6; 1–2 days of incubation is only 4–8 rounds ✓.
- Fast cycles → many infectious people within a day → contact tracing is outrun.
- A 2–3-week incubation (DNA virus such as varicella) spreads slowly and peaks later ✓.
- RNA without proofreading (~10^{-5}/site) → drift → yearly vaccine updates ✓.

Exercise 3.2

3.2 A fictional antiviral blocks the step where the viral genome and proteins are copied inside the cell; a fictional vaccine presents the surface glycoprotein that docks the virion to the receptor.

Name the two cycle steps targeted. Explain why the vaccine antigen choice makes immunological sense (antibodies meet the outside of the virion first). Explain why enveloped viruses exit without lysing the cell. [7]

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3.2

- Replication (the antiviral) and attachment (the vaccine antigen) ✓.
- Antibodies act outside the cell: the attachment glycoprotein is the surface they can reach before entry.
- Enveloped viruses bud – host membrane flows around the virion, cell stays intact ✓.