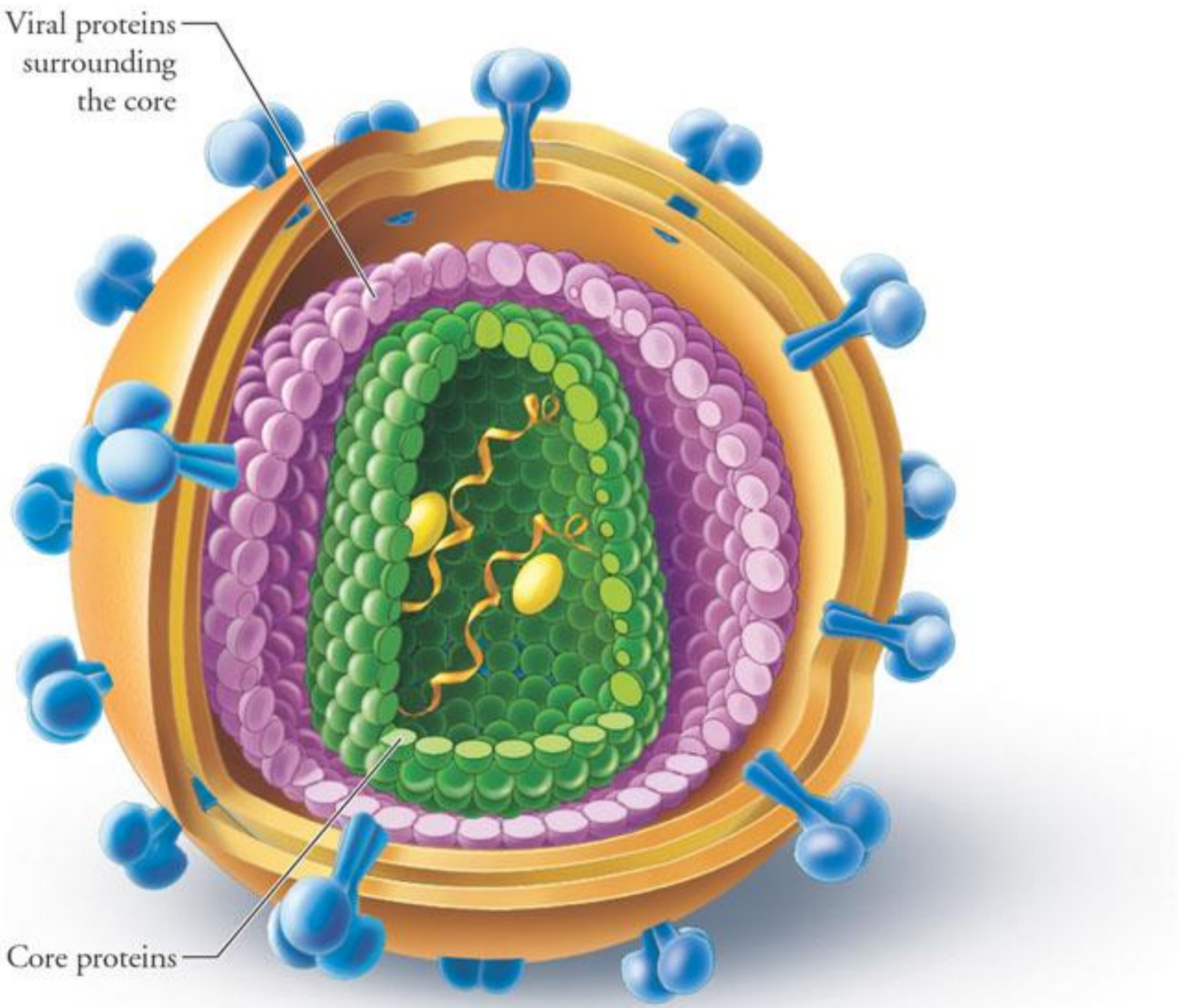
Chapter 17a

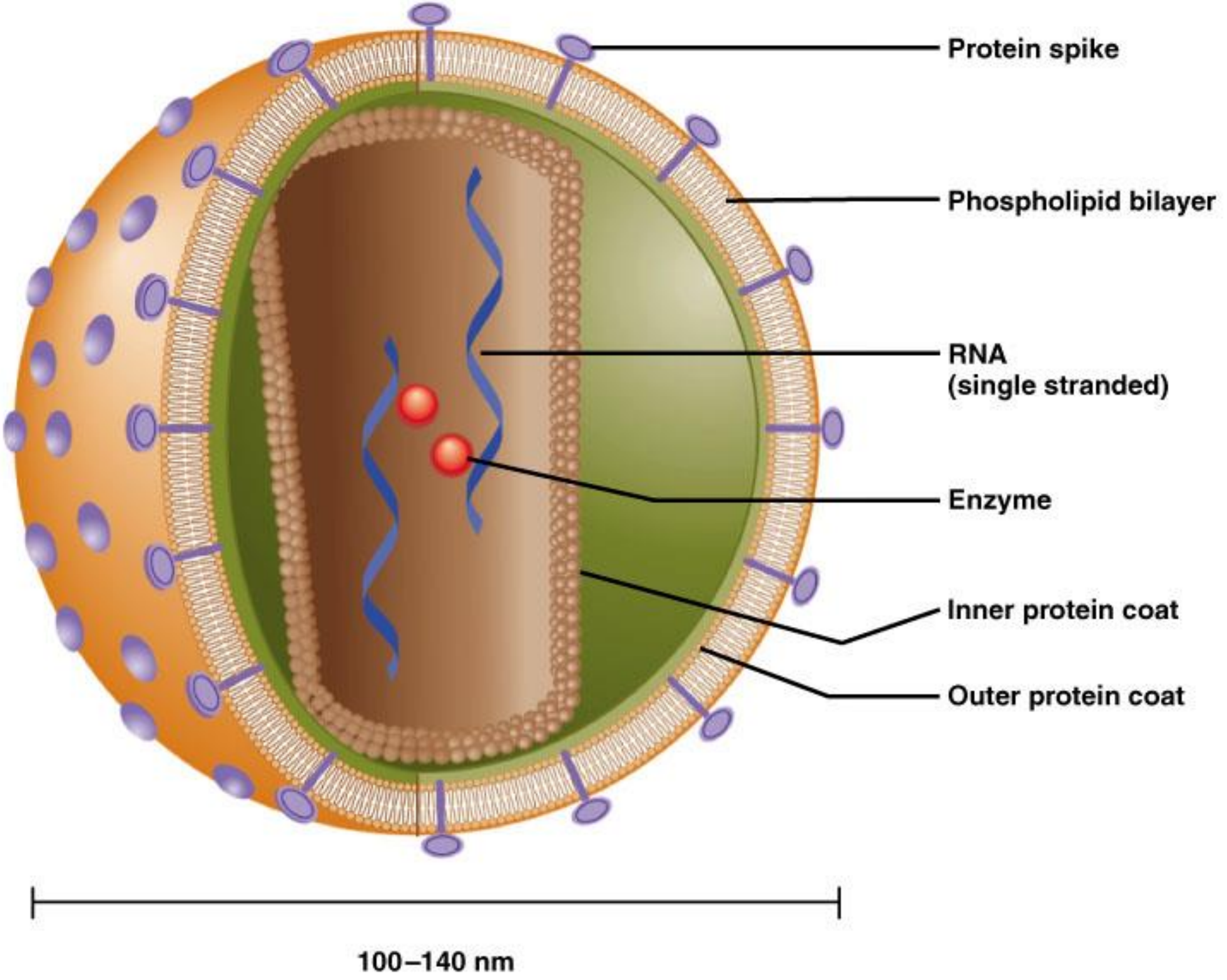
HIV infection and AIDS

AIDS Pandemic

- HIV/AIDS is a global epidemic
- More than 36 million infected with HIV worldwide
- Most infections in sub-Sahara of Africa
- Increasing spread in Asia and India
- Most often spread by heterosexual contact outside U.S.

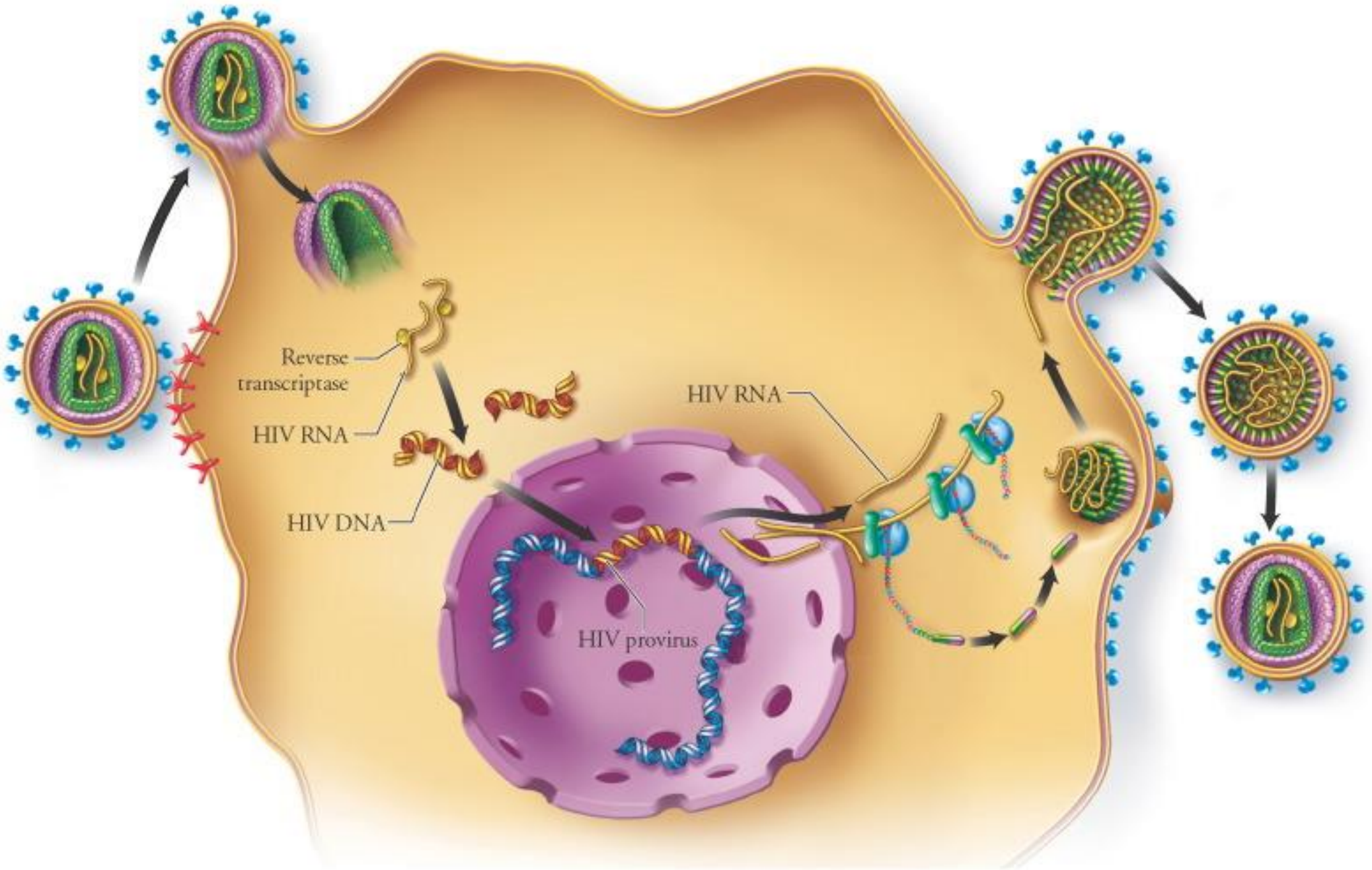
HIV consists of RNA and enzymes encased in a protein coat




Protein spike
Phospholipid bilayer
RNA
(single stranded)
Enzyme
Inner protein coat
Outer protein coat
100–140 nm

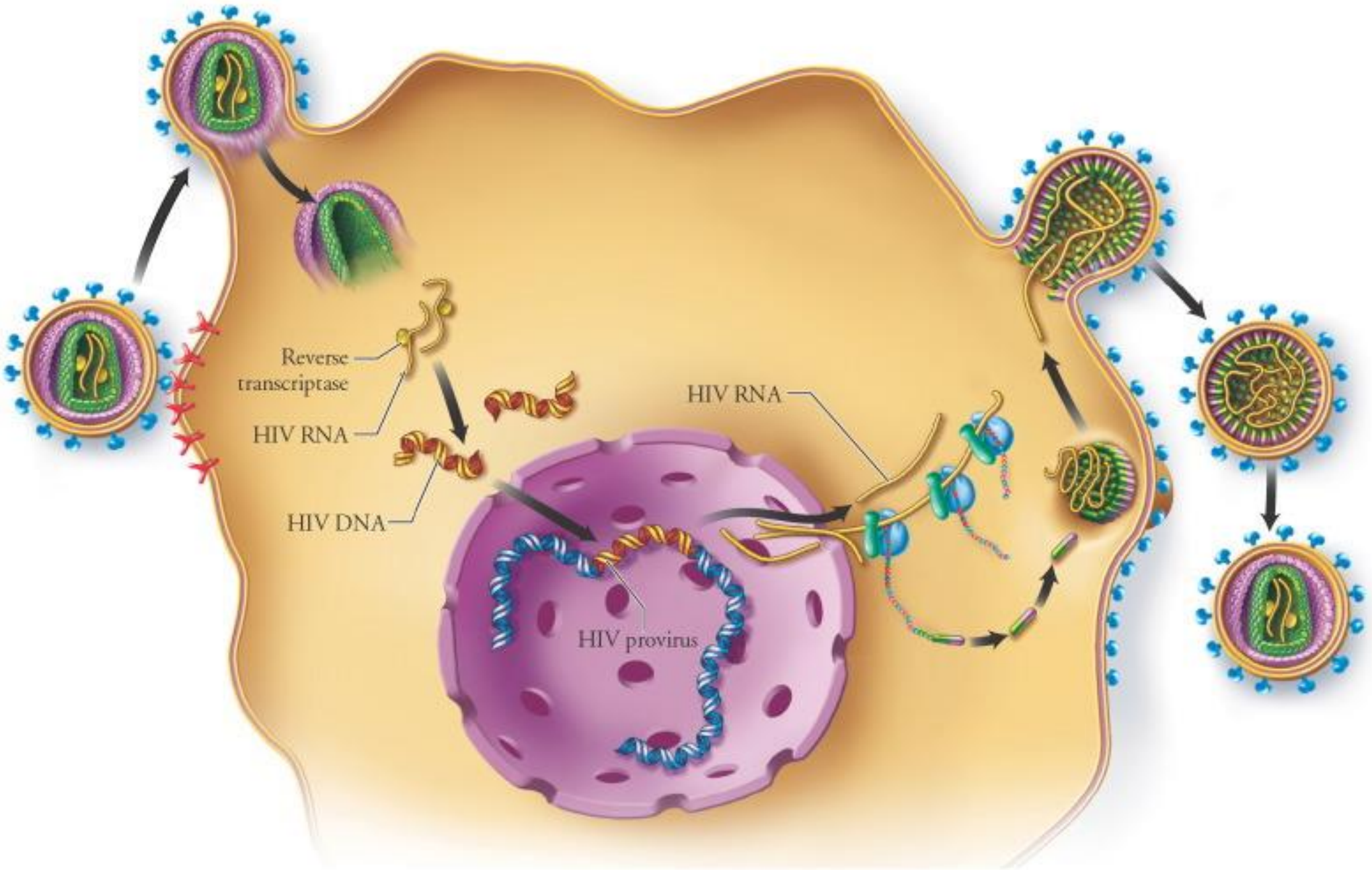
Immune Deficiency: AIDS

- HIV targets immune T cells
- Retrovirus attaches to two protein receptors (CD4 & CCR5) on T cells
  - Transmission: Body fluids, e.g., blood, semen, breast milk, vaginal secretions
  - Transmission: Vaginal intercourse, anal intercourse, oral sex, breast feeding



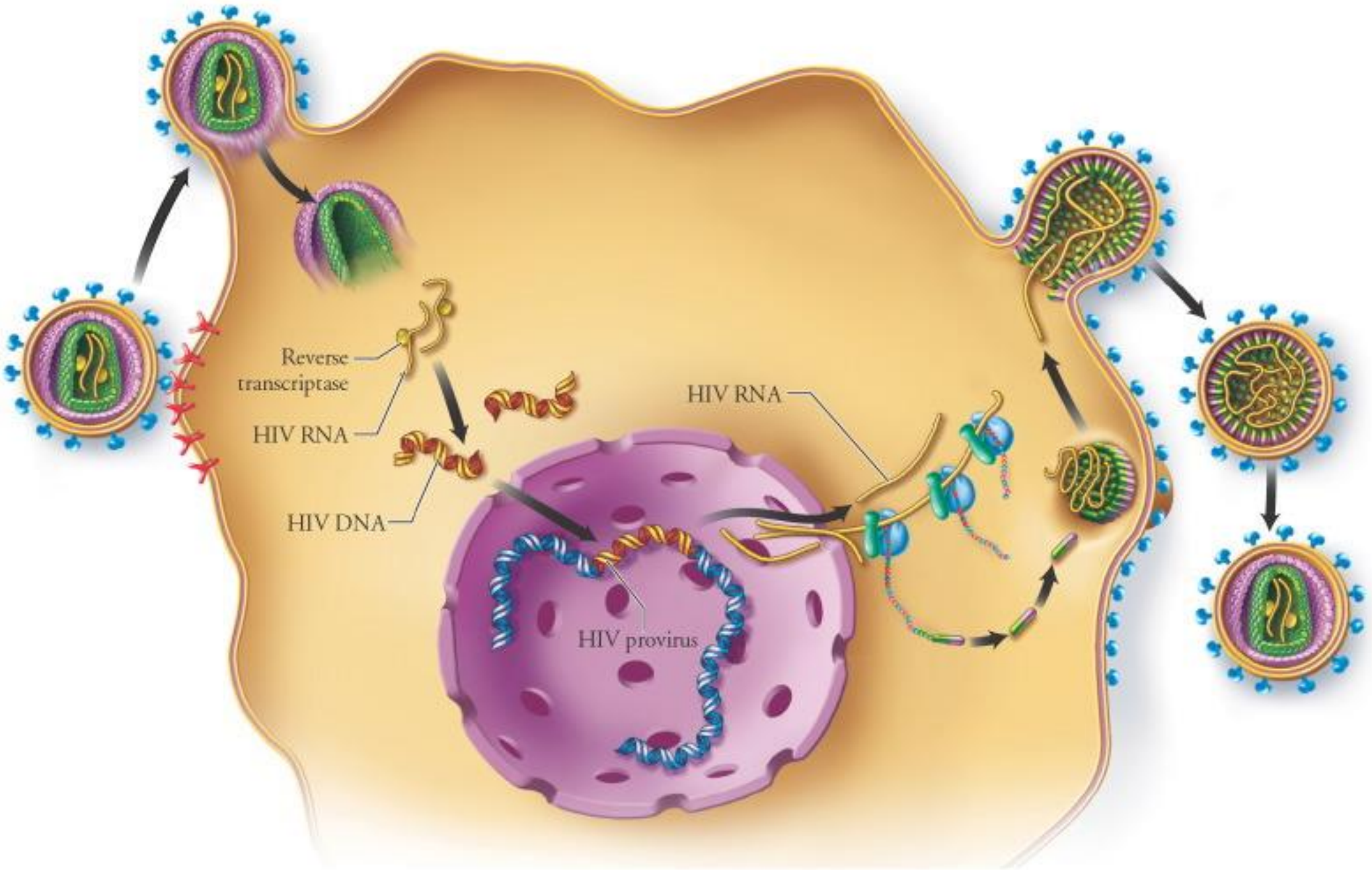
HIV Life Cycle

- Entry into T cell
  - HIV must bind to two proteins on surface of human cell in order to enter (infect) the cell
  - These proteins act as *receptors* for HIV
  - People that lack, or have mutant varieties of these protein receptors are resistant to HIV infection



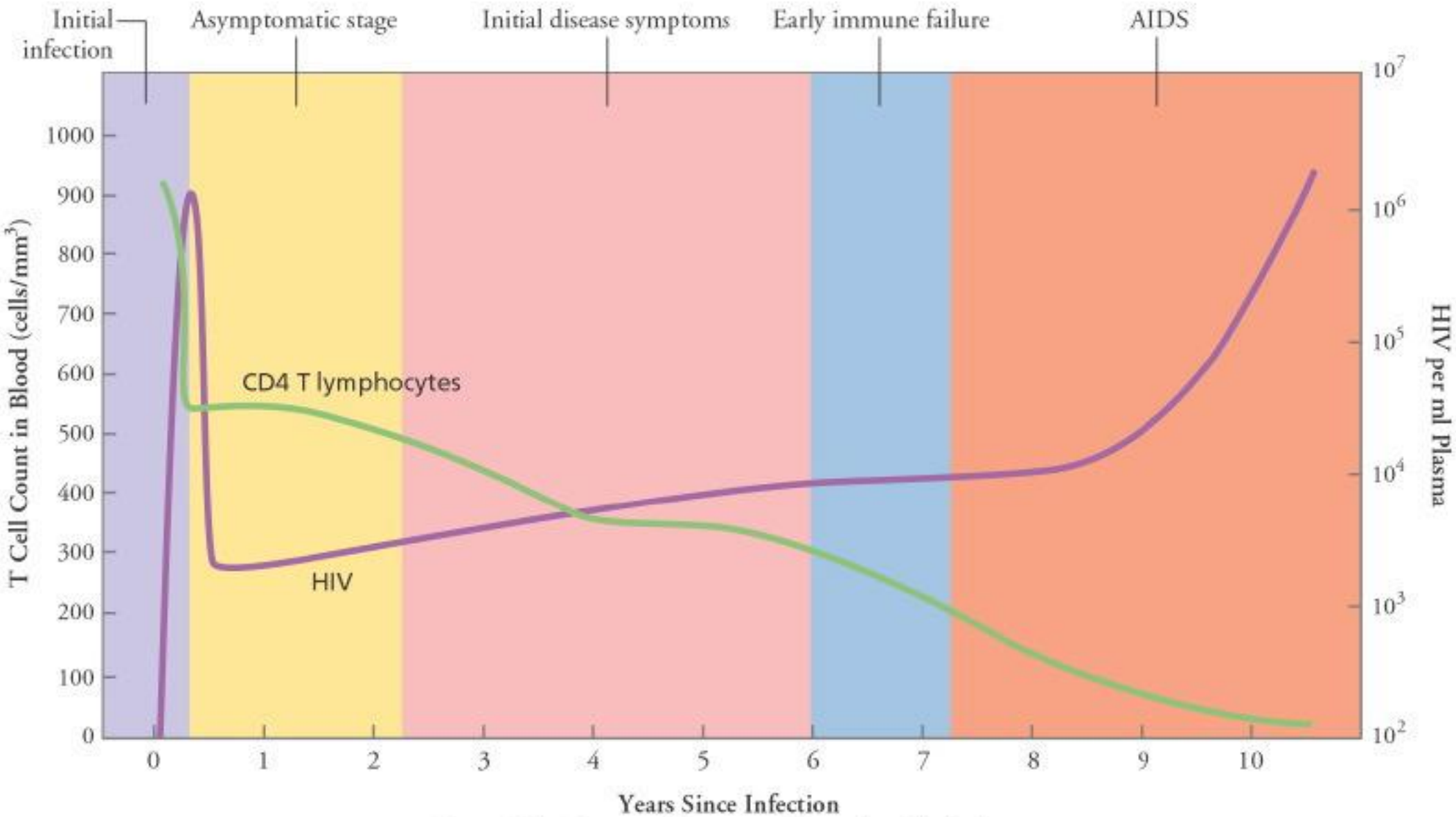
HIV Life Cycle (cont)

- Reverse transcriptase: copies RNA genome → DNA (copy)
- DNA genome (copy) → nucleus → integration into chromosomes
- mRNA transcription of viral proteins
- Protease cuts large protein → smaller proteins
- Budding and self assembly



An HIV Infection Progresses to AIDS (Acquired Immune Deficiency Syndrome)

- Most HIV is transmitted through sexual contact, intravenous drug use, or from a pregnant woman to her fetus
- Sites of HIV infection include the immune system and the brain
- An HIV infection progresses through several stages as T cell numbers decline



HIV Infection Progresses to AIDS

- Phase I: few weeks to a few years; flu like symptoms, swollen lymph nodes, chills, fever, fatigue, body aches.
  - Virus is multiplying, antibodies are made but ineffective for complete virus removal
- Phase II: within six months to 10 years; opportunistic infections present
- Phase III: T cells below 200 cells/mm., opportunistic infections and /or cancers present, clinical AIDS, death

Treatments for HIV infection are designed to block specific steps in HIV's replication cycle

- Reverse Transcriptase enzyme inhibitors:
  - zidovudine/*Retrovir* (AZT, ZDV)
  - didanosine/*Videx, Videx EC* (ddI)
  - zalcitabine/*HIVID* (ddC)
  - stavudine/*Zerit* (d4T)
  - lamivudine/*Epivir* (3TC)
  - abacavir/*Ziagen* (ABC)
  - nevirapine/*Viramune* (NVP)
  - delavirdine/*Rescriptor* (DLV)
  - efavirenz/*Sustiva* (EFV)
  - tenofovir DF/*Viread* (TDF)

Treatments for HIV infection are designed to block specific steps in HIV's replication cycle

- **Protease Inhibitors**
  - indinavir/*Crixivan*
  - ritonavir/*Norvir*
  - saquinavir/*Invirase*, *Fortovase*
  - nelfinavir/*Viracept*
  - amprenavir/*Agenerase*
  - lopinavir/ritonavir, *Kaletra*

HIV Mutation Rate

- About 1/3 of all HIV viruses produced have a mutation in the genome
- Up to 10^{10} HIV viruses are produced per person/day
- Therefore, approx. 3×10^{9} mutant viruses per person/day are produced
- High mutation rate of HIV genes and high rate of multiplication leads to virus rapidly acquiring resistance to individual drugs

Multiple Drug Therapy

- Why multiple therapies work better than single therapy
- Chance of mutation to resistance:
  - Single drug: 1×10^5
  - Two drugs: $10^5 \times 10^5 = 10^{10}$
  - Three drugs: $10^5 \times 10^5 \times 10^5 = 10^{15}$
- Vaccine: virus mutates rapidly preventing effective vaccine production at this time

What College Students Should Know About HIV/AIDS

- 1 in 500 college students are HIV positive
  - Statistically about 6-10 students at FSC
- 1 in 200 to 250 Massachusetts residents is infected with HIV and 7 more become infected each day
- 1 in 5 people with AIDS were infected as teenagers or college students

Safer Sex

- Abstinence
- Limit number of sexual partners
- Choose sexual partners with low risk behavior
- Avoid high risk sexual partners
- Use latex or polyurethane condoms or barriers
- GET TESTED

TABLE 17a.2

THE STAGES OF AN HIV INFECTION

STAGE	HIV	IMMUNE SYSTEM	T CELL COUNT/mm^3	SYMPTOMS
Initial infection	Enters body and replicates	Fights back; produces antibodies	~1000–800	• None • Flulike • Neurological
Asymptomatic	Replicating in lymph nodes	Vigorously produces helper T cells	~800–600	• None • Considered HIV positive when antibodies against HIV detected in blood
Initial disease symptoms	• Replicating • Viral load gradually increasing	Production of helper T cells cannot keep pace with destruction of helper T cells	~600–400	• Wasting syndrome • Lymphadenopathy • Neurological
Early immune failure	• Replicating • Viral load gradually increasing	Helper T cell number continues to decline	~400–200	• Thrush (and vaginal yeast infections) • Shingles • Hairy leukoplakia • Herpes simplex recurrences
AIDS	• Replicating • Viral load rapidly increasing	Helper T cell number continues to decline	200–below	