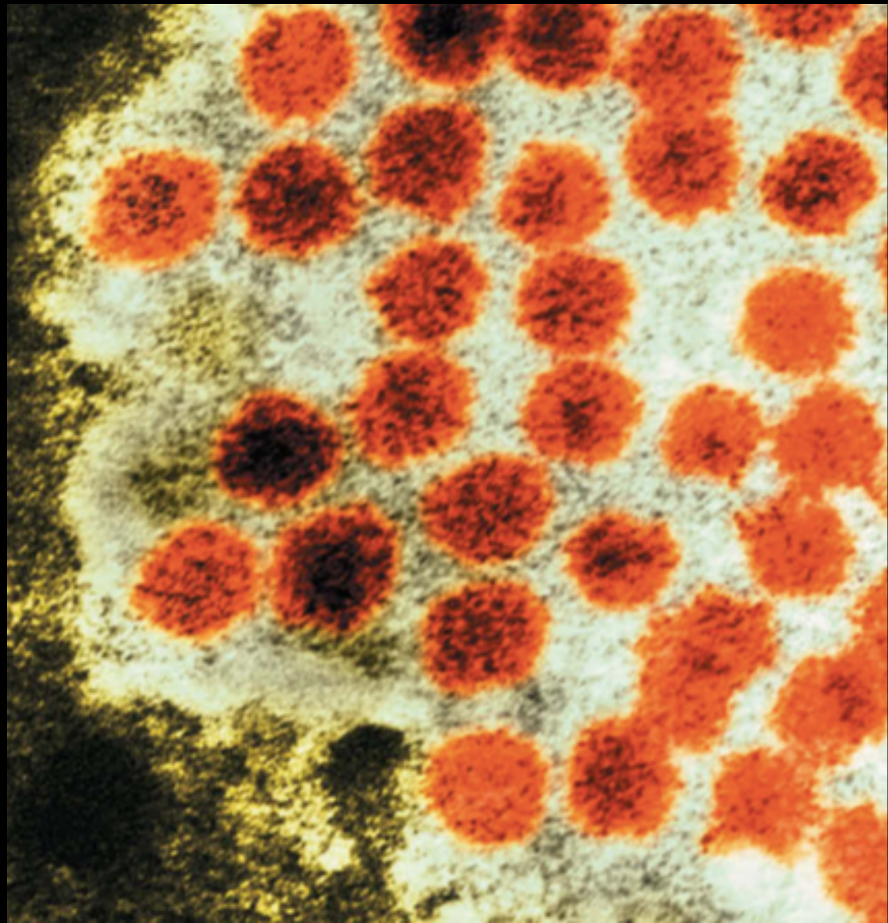
MIKROBIOLOGI

PERTEMUAN KE 6

IRMA MARDIAH M.SI

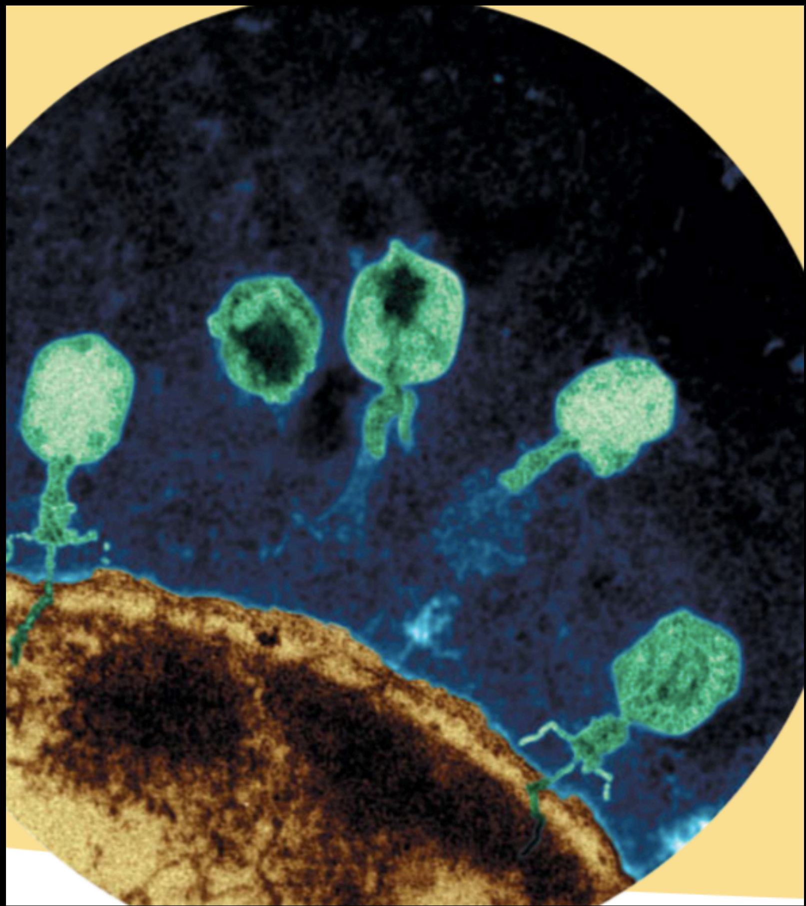


VIRUS

Virus, Viroid dan Prions

KONSEP KUNCI

- Karakteristik Umum Virus
- Struktur Virus
- Taksonomi Virus
- Isolasi, Kultivasi, dan Identifikasi Virus
- Multiplikasi Virus
- Infeksi Virus Laten
- Infeksi Virus Persisten
- Virus Tanaman & Viroid
- Prion



Karakteristik Umum Virus

TABLE 13.1 Viruses and Bacteria Compared

	Bacteria		
	Typical Bacteria	Rickettsias/ Chlamydias	Viruses
Intracellular Parasite	No	Yes	Yes
Plasma Membrane	Yes	Yes	No
Binary Fission	Yes	Yes	No
Pass through Bacteriological Filters	No	No/Yes	Yes
Possess Both DNA and RNA	Yes	Yes	No
ATP-Generating Metabolism	Yes	Yes/No	No
Ribosomes	Yes	Yes	No
Sensitive to Antibiotics	Yes	Yes	No
Sensitive to Interferon	No	No	Yes

Range Inang

- Range Inang: spektrum sel inang yang dapat diinfeksi virus
- Reseptor khusus
- potensi virus untuk menyembuhkan penyakit

Ukuran Virus

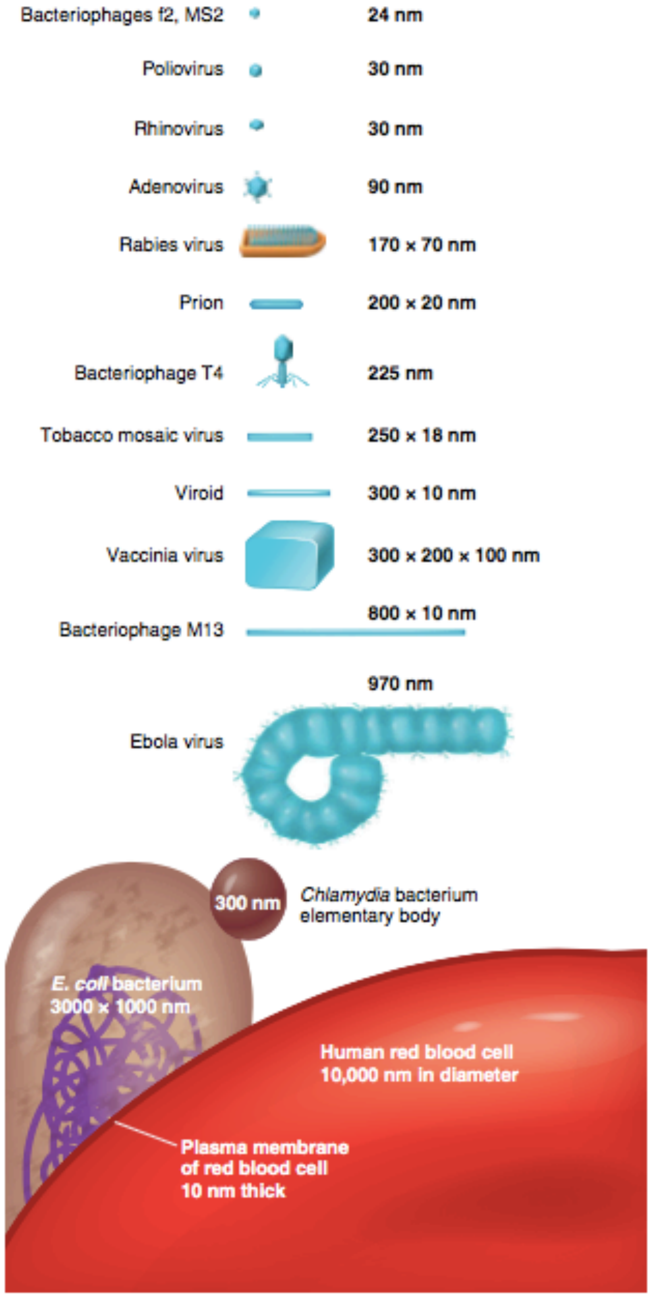


Figure 13.1 Virus sizes. The sizes of several viruses (teal blue) and bacteria (brown) are compared with a human red blood cell, shown below the microbes. Dimensions are given in nanometers (nm) and are either diameters or length by width.

Q How do viruses differ from bacteria?

Struktur Virus

- Asam Nukleat
- Kapsid & Amplop
- Morfologi Umum
  - Virus Helix
  - Virus Polihedral
  - Virus Amplop
  - Virus kompleks

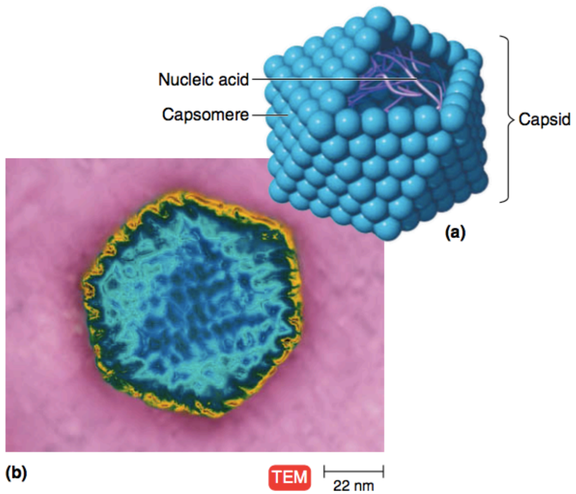


Figure 13.2 Morphology of a nonenveloped polyhedral virus. **(a)** A diagram of a polyhedral (icosahedral) virus. **(b)** A micrograph of the adenovirus *Mastadenovirus*. Individual capsomeres are visible.

Q What is the chemical composition of a capsid?

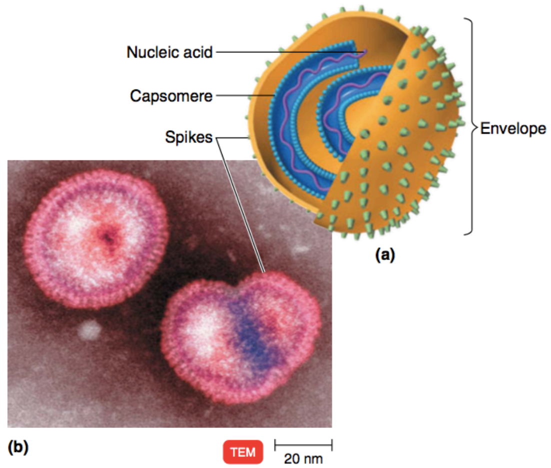


Figure 13.3 Morphology of an enveloped helical virus. **(a)** A diagram of an enveloped helical virus. **(b)** A micrograph of *Influenzavirus* A2. Notice the halo of spikes projecting from the outer surface of each envelope (see Chapter 24).

Q What is the nucleic acid in a virus?

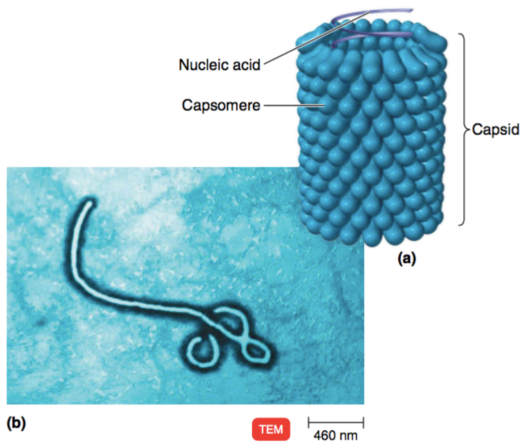
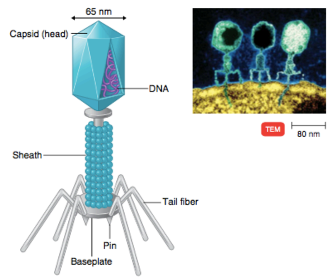
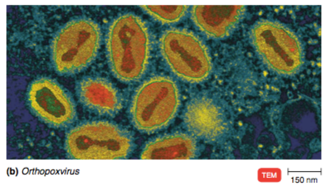


Figure 13.4 Morphology of a helical virus. **(a)** A diagram of a portion of a helical virus. A row of capsomeres has been removed to reveal the nucleic acid. **(b)** A micrograph of Ebola virus, a filovirus, showing a helical rodlike shape.

Q What is the chemical composition of a capsomere?



(a) A T-even bacteriophage



(b) *Orthopoxvirus*

Figure 13.5 Morphology of complex viruses. **(a)** A diagram and micrograph of a T-even bacteriophage. **(b)** A micrograph of variola virus, a species in the genus *Orthopoxvirus*, which causes smallpox.

Q What is the value of a capsid to a virus?

Taksonomi Virus

TABLE 13.2 Families of Viruses That Affect Humans

Class*	Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
I	DOUBLE-STRANDED DNA			
	Nonenveloped			
	70–90 nm	Adenoviridae	*Mastadenovirus*	Medium-sized viruses that cause various respiratory infections in humans; some cause tumors in animals.
	40–57 nm	Papovaviridae	*Papillomavirus* (human wart virus) *Polyomavirus*	Small viruses that cause warts and cervical and anal cancer in humans. Refer to Chapters 21 and 26.
	Enveloped			
	200–350 nm	Poxviridae	*Orthopoxvirus* (vaccinia and smallpox viruses) *Molluscipoxvirus*	Very large, complex, brick-shaped viruses that cause smallpox (variola), molluscum contagiosum (wartlike skin lesion), and cowpox. Refer to Chapter 21.
	150–200 nm	Herpesviridae	*Simplexvirus* (HHV-1 and -2) *Varicellovirus* (HHV-3) *Lymphocryptovirus* (HHV-4) *Cytomegalovirus* (HHV-5) *Roseolovirus* (HHV-6 and HHV-7) *Rhadinovirus* (HHV-8)	Medium-sized viruses that cause various human diseases: fever blisters, chickenpox, shingles, and infectious mononucleosis; cause a type of human cancer called Burkitt's lymphoma. Refer to Chapters 21, 23, and 26.
II	SINGLE-STRANDED DNA			
	Nonenveloped			
	18–25 nm	Parvoviridae	Human parvovirus B19	Fifth disease; anemia in immunocompromised patients. Refer to Chapter 21.
III	DOUBLE-STRANDED RNA			
	Nonenveloped 60–80 nm	Reoviridae	*Reovirus* *Rotavirus*	Generally mild respiratory infections transmitted by arthropods; Colorado tick fever is the best-known. Refer to Chapter 25.
IV	SINGLE-STRANDED RNA, + STRAND			
	Nonenveloped			
	28–30 nm	Picornaviridae	*Enterovirus* *Rhinovirus* (common cold virus) Hepatitis A virus	Includes the polio-, coxsackie-, and echoviruses; hand-foot-mouth virus; more than 100 rhinoviruses exist and are the most common cause of colds. Refer to Chapters 22, 24, and 25.
	35–40 nm	Caliciviridae	Hepatitis E virus *Norovirus*	Includes causes of gastroenteritis and hepatitis E. Refer to Chapter 25.
	Enveloped			
	60–70 nm	Togaviridae	*Alphavirus* *Rubivirus* (rubella virus)	Includes many viruses transmitted by arthropods (*Alphavirus*); diseases include eastern equine encephalitis (EEE), western equine encephalitis (WEE), and chikungunya. Rubella virus is transmitted by the respiratory route. Refer to Chapters 21, 22, and 23.

TABLE 13.2 *(continued)*

Class*	Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
	40–50 nm	Flaviviridae	*Flavivirus* *Pestivirus* Hepatitis C virus	Can replicate in arthropods that transmit them; diseases include yellow fever, dengue, Zika, and West Nile encephalitis. Refer to Chapters 22, 23, and 25.
	80–160 nm	Coronaviridae	*Coronavirus*	Associated with upper respiratory tract infections and the common cold; SARS virus, MERS-CoV. Refer to Chapter 24.
V	SINGLE-STRANDED RNA, – STRAND			
	One strand of RNA, Enveloped			
	70–180 nm	Rhabdoviridae	*Vesiculovirus* (vesicular stomatatis virus) *Lyssavirus* (rabies virus)	Bullet-shaped viruses with a spiked envelope; cause rabies and numerous animal diseases. Refer to Chapter 22.
	80–14,000 nm	Filoviridae	*Filovirus*	Enveloped, helical viruses; Ebola and Marburg viruses are filoviruses. Refer to Chapter 23.
	150–300 nm	Paramyxoviridae	*Paramyxovirus Morbillivirus* (measles virus)	Paramyxoviruses cause parainfluenza, mumps, and Newcastle disease in chickens. Refer to Chapters 21, 24, and 25.
	Virusoid or Satellite RNA			
	32 nm	Deltaviridae	Hepatitis D	Depends on coinfection with hepadnavirus. Refer to Chapter 25.
	Multiple Strands of RNA, Enveloped			
	80–200 nm	Orthomyxoviridae	Influenza virus A, B, and C	Envelope spikes can agglutinate red blood cells. Refer to Chapter 24.
	90–120 nm	Bunyaviridae	*Bunyavirus* (California encephalitis virus) *Hantavirus*	Hantaviruses cause hemorrhagic fevers such as Korean hemorrhagic fever and *Hantavirus* pulmonary syndrome; associated with rodents. Refer to Chapters 22 and 23.
	110–130 nm	Arenaviridae	*Arenavirus*	Helical capsids contain RNA-containing granules; cause lymphocytic choriomeningitis, Venezuelan hemorrhagic fever, and Lassa fever. Refer to Chapter 23.
VI	SINGLE-STRANDED RNA, PRODUCE DNA			
	Enveloped			
	100–120 nm	Retroviridae	Oncoviruses *Lentivirus* (HIV)	Includes all RNA tumor viruses. Oncoviruses cause leukemia and tumors in animals; *Lentivirus* causes AIDS. Refer to Chapter 19.

TABLE 13.2 Families of Viruses That Affect Humans *(continued)*

Class*	Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
VII	DOUBLE-STRANDED DNA, USE REVERSE TRANSCRIPTASE ENVELOPED			
	42 nm	Hepadnaviridae	*Hepadnavirus* (hepatitis B virus)	After protein synthesis, hepatitis B virus uses reverse transcriptase to produce its DNA from mRNA; causes hepatitis B and liver tumors. Refer to Chapter 25.

*The Baltimore classification scheme was developed by David Baltimore, the discoverer of retroviruses.

Isolasi, Kultivasi, dan Identifikasi Virus

- Menumbuhkan Bakteriofaga di laboratorio
- Menumbuhkan Virus Hewan di Laboratorium
    - Pada Hewan Hidup
    - Pada Telur Embrio
    - Pada Kultur Sel
- Identifikasi Virus

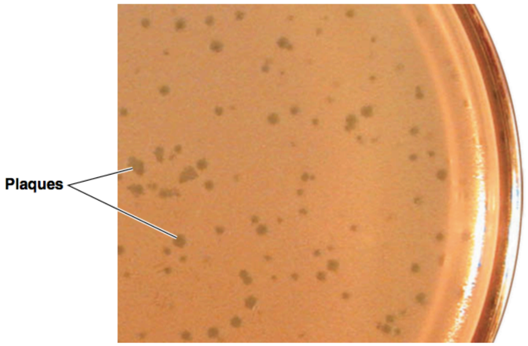


Figure 13.6 Viral plaques formed by bacteriophages. Clear viral plaques of various sizes have been formed by bacteriophage λ (lambda) on a lawn of *E. coli*.

Q What is a plaque-forming unit?

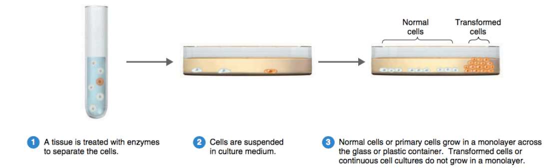


Figure 13.8 Cell cultures. Transformed cells can be grown indefinitely in laboratory culture.

Q Why are transformed cells referred to as "immortal"?

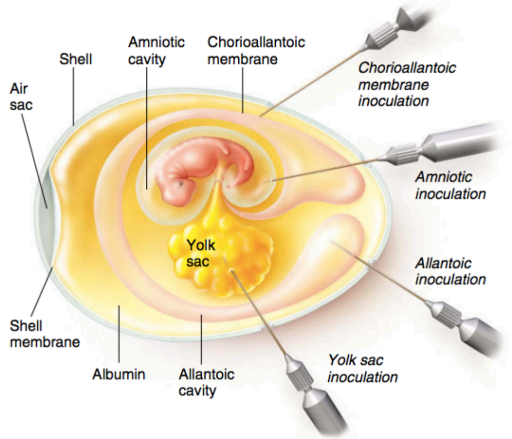


Figure 13.7 Inoculation of an embryonated egg. The viruses will grow on the membrane at the inoculation site.

Q Why are viruses grown in eggs and not in culture media?

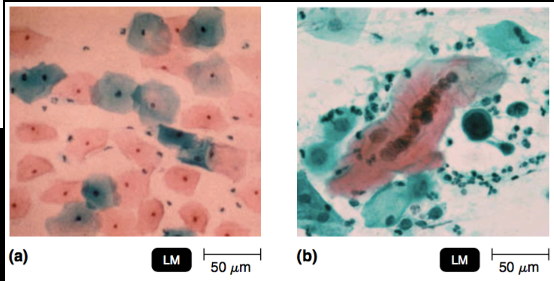


Figure 13.9 The cytopathic effect of viruses. **(a)** Uninfected human cervical cells; each has one nucleus. **(b)** After infection with HHV-2, the red cervical cell has many nuclei that are filled with viruses.

Q How did HHV-2 infection affect the cells?

Multiplikasi Virus

- Siklus Litik T-Bakteriofaga
- Siklus Lisogenik Bakteriofaga
- Perbandingan Multiplikasi Virus (DNA/RNA) Hewan

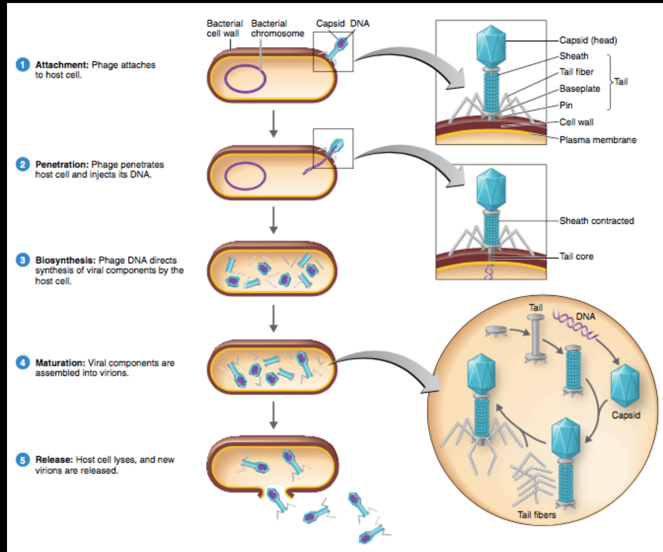


Figure 13.11 The lytic cycle of a T-even bacteriophage.

Q What is the result of the lytic cycle?

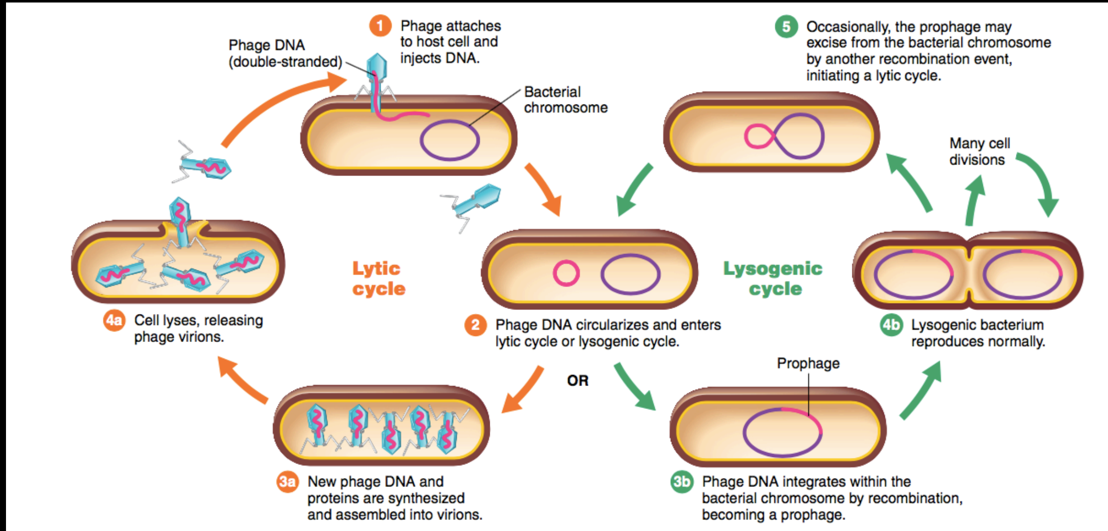


Figure 13.12 The lysogenic cycle of bacteriophage λ in *E. coli*.

Q How does lysogeny differ from the lytic cycle?

Multiplikasi Virus

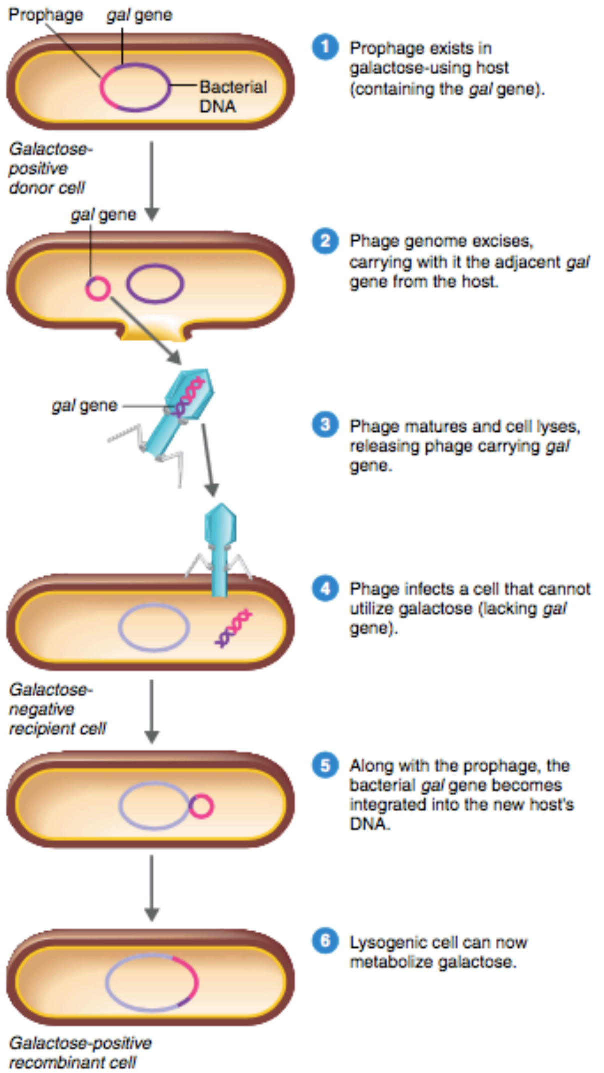
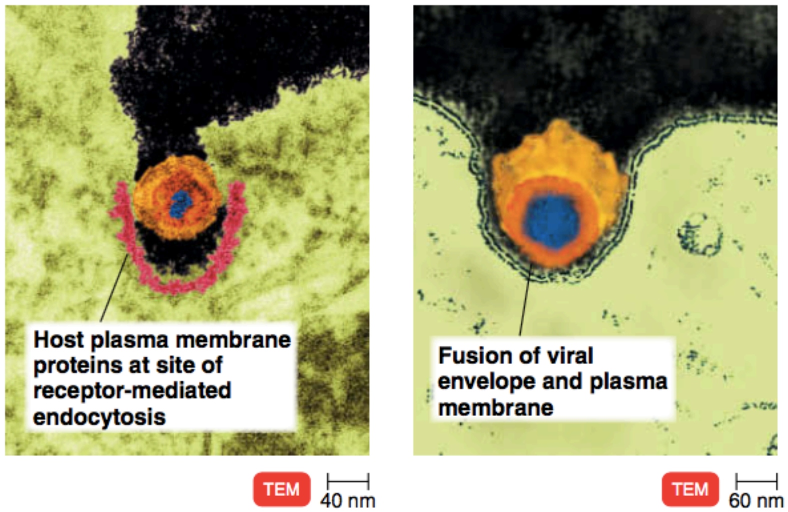


Figure 13.13 Specialized transduction. When a prophage is excised from its host chromosome, it can take with it a bit of the adjacent DNA from the bacterial chromosome.

Q How does specialized transduction differ from the lytic cycle?

TABLE 13.3 Bacteriophage and Animal Viral Multiplication Compared

Stage	Bacteriophages	Animal Viruses
Attachment	Tail fibers attach to cell wall proteins	Attachment sites are plasma membrane proteins and glycoproteins.
Entry	Viral DNA is injected into host cell	Capsid enters by receptor-mediated endocytosis or fusion.
Uncoating	Not required	Enzymatic removal of capsid proteins.
Biosynthesis	In cytoplasm	In nucleus (DNA viruses) or cytoplasm (RNA viruses).
Chronic infection	Lysogeny	Latency; slow viral infections; cancer.
Release	Host cell is lysed	Enveloped viruses bud out; nonenveloped viruses rupture plasma membrane.



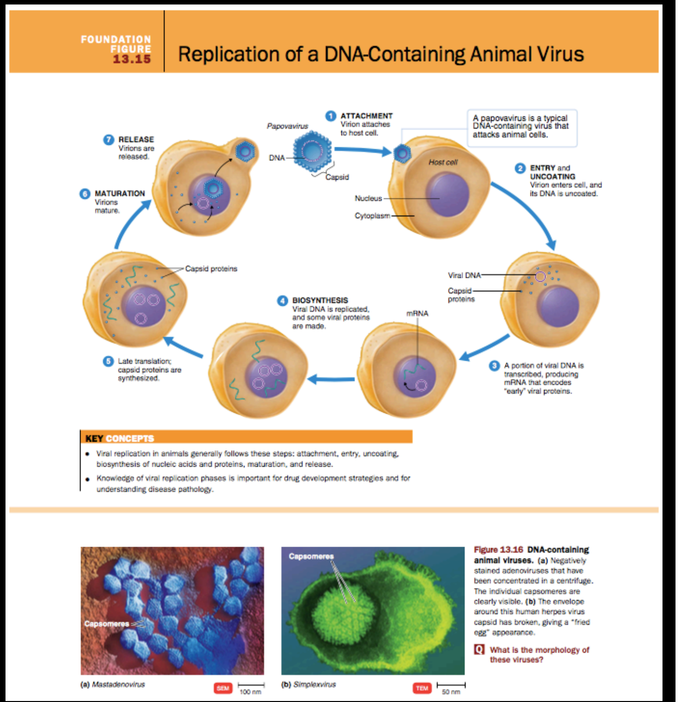
(a) Entry of pig retrovirus by receptor-mediated endocytosis

(b) Entry of herpesvirus by fusion

Figure 13.14 The entry of viruses into host cells. After attachment, viruses enter host cells by **(a)** receptor-mediated endocytosis or **(b)** fusion of the viral envelope and cell membrane.

Q In which process is the cell actively taking in the virus?

Multiplikasi Virus



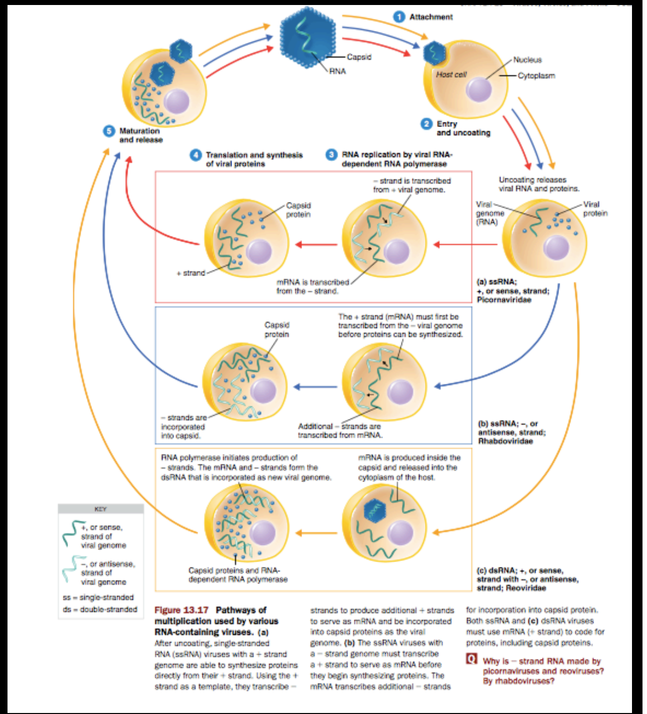
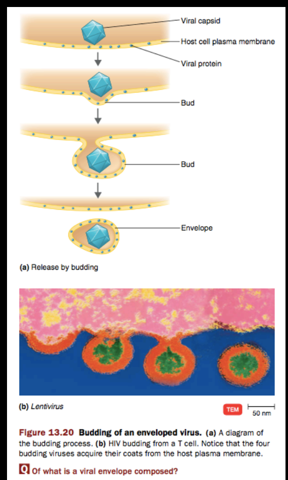
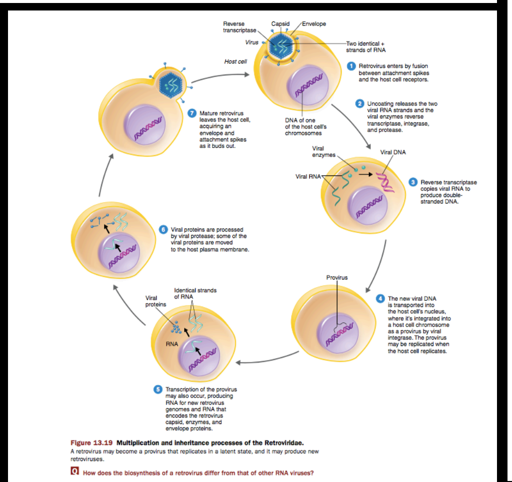


Figure 13.18 RNA-containing animal viruses. **(a)** Vesicular stomatitis viruses, a member of the family Rhabdoviridae. **(b)** Marburg virus, found in African cave bats, causes hemorrhagic fever in humans.

Q Why do viruses with a + strand of RNA make a – strand of RNA?





Virus & Kangker

- Transformasi Sel Normal menjadi Sel Tumor
- Virus DNA Onkogen
- Virus RNA Onkogen
- Virus yang Mengobati Kangker

Infeksi Virus Laten & Persisten

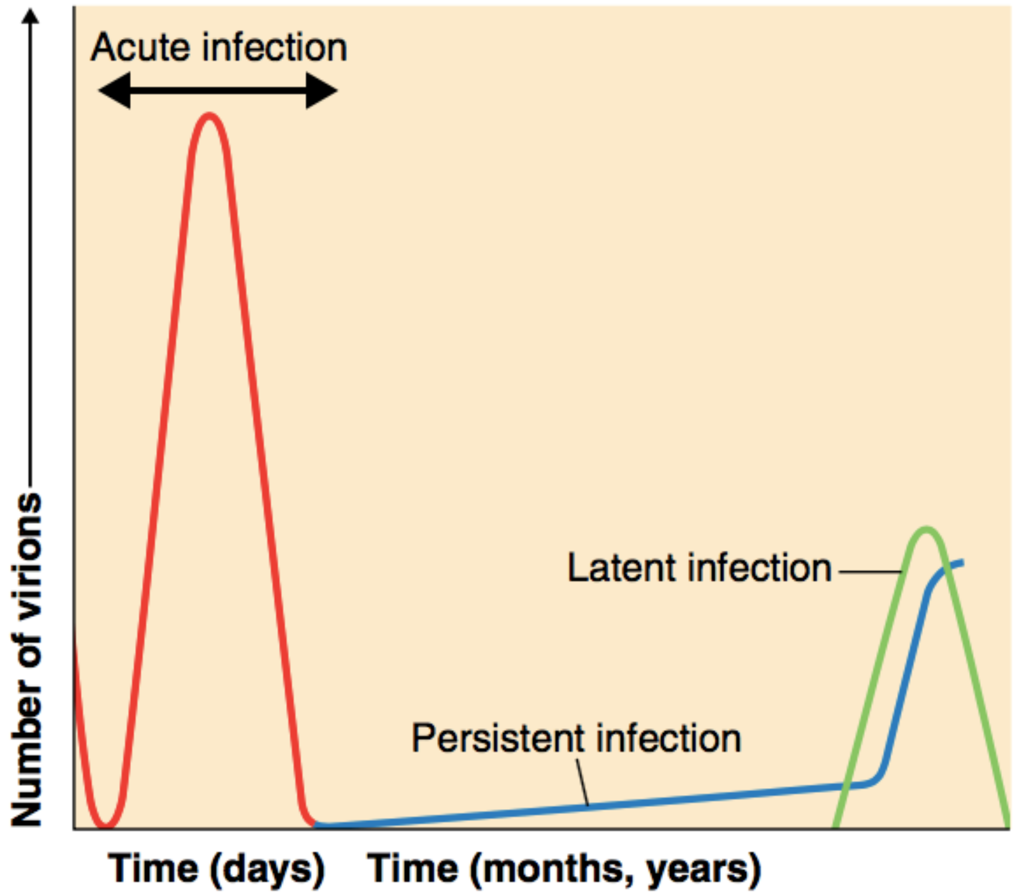


Figure 13.21 **Latent and persistent viral infections.**

Q How do latent and persistent infections differ?

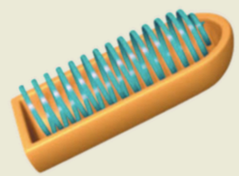
Virus Tanaman & Viroid

- Perbedaan virus, viroid dan prion
- siklus litik pada virus tanaman

TABLE 13.5 Examples of Latent and Persistent Viral Infections in Humans

Disease	Primary Effect	Causative Virus
Latent	**No symptoms during latency; viruses not usually released**	
Cold sores	Skin and mucous membrane lesions; genital lesions	HHV-1 and HHV-2
Leukemia	Increased white blood cell growth	HTLV-1 and -2
Shingles	Skin lesions	*Varicellovirus* (Herpesvirus)
Persistent	**Viruses continuously released**	
Cervical cancer	Increased cell growth	Human papillomavirus
HIV/AIDS	Decreased $CD4^{+}$ T cells	HIV-1 and -2 (*Lentivirus*)
Liver cancer	Increased cell growth	Hepatitis B virus
Persistent enterovirus infection	Mental deterioration associated with AIDS	Echoviruses
Progressive encephalitis	Rapid mental deterioration	Rubella virus
Subacute sclerosing panencephalitis (SSPE)	Mental deterioration	Measles virus

TABLE 13.6 Classification of Some Major Plant Viruses

Characteristic	Viral Family	Viral Genus or Unclassified Members	Morphology	Method of Transmission
Double-stranded DNA, nonenveloped	Caulimoviridae	Cauliflower mosaic virus		Aphids
Single-stranded RNA, + strand, nonenveloped	Bunyaviridae	Watermelon wilt		Whiteflies
	Virgaviridae	*Tobamovirus*		Wounds
Single-stranded RNA, – strand, enveloped	Rhabdoviridae	Potato yellow dwarf virus		Leafhoppers and aphids
Double-stranded RNA, nonenveloped	Reoviridae	Wound tumor virus		Leafhoppers

Prion

- Bagaimana protein dapat menginfeksi

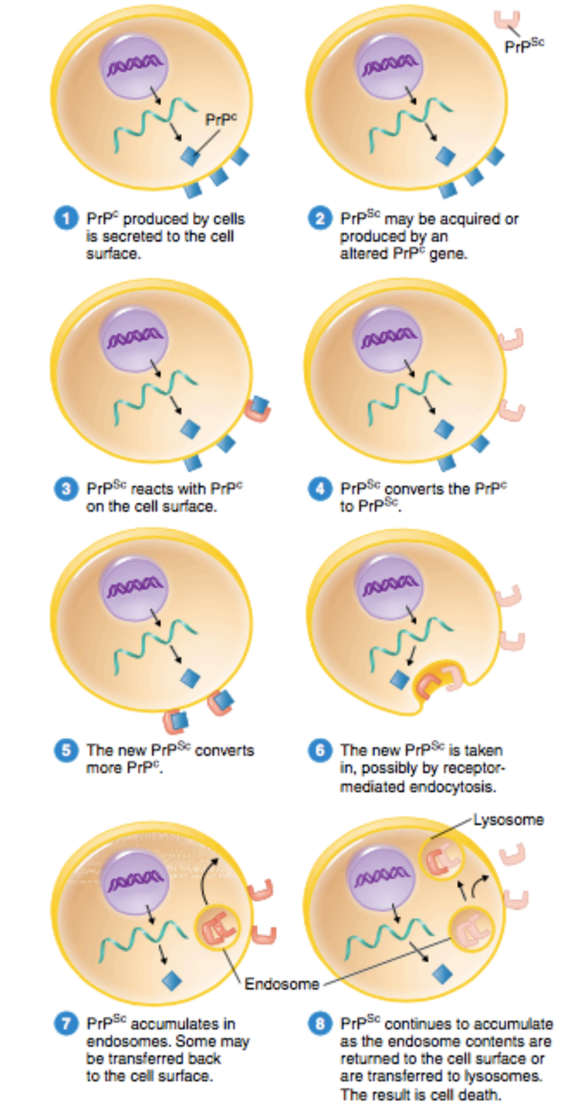


Figure 13.23 How a protein can be infectious. If an abnormal prion protein (PrP^{Sc}) enters a cell, it changes a normal prion protein PrP^{C} to PrP^{Sc}, which now can change another normal PrP^{C}, resulting in an accumulation of the abnormal PrP^{Sc} in the cell and on the cell surface.

Q How do prions differ from viruses?

DAFTAR PUSTAKA

1. Tortora GJ, Funke BR, Case CL, 2007, Microbiology an Introduction, 13th edition, Benjamin Cummings, Animprint of Addison Wesley, Longman Inc., USA