Chapter 24 – Pathogenic DNA Viruses

NIMESH PATEL| HLSC 2400

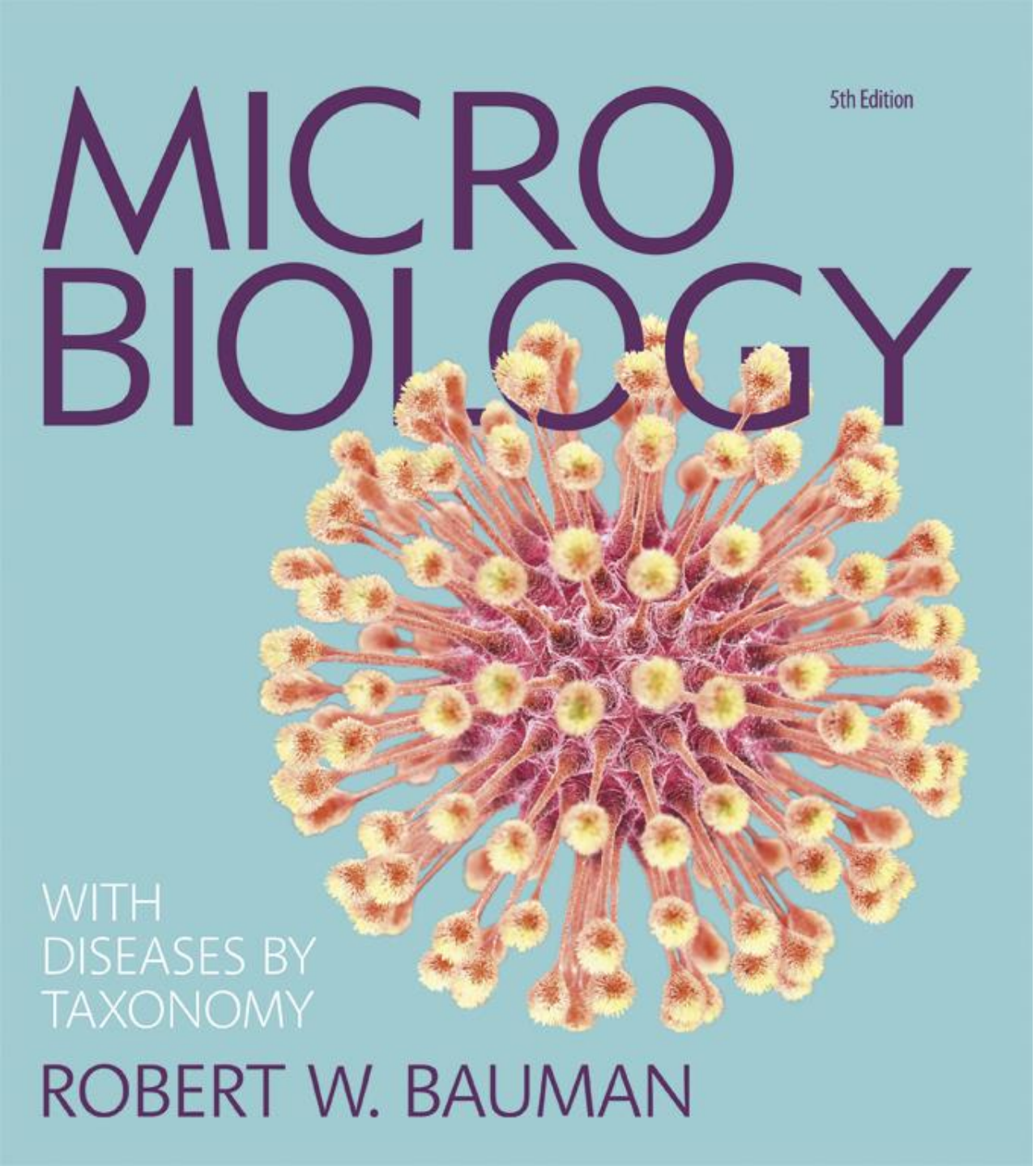
NOVEMBER 21, 2017

How to better prepare for the final test

- Study in groups
- Prepare multiple choice questions as a part of your practice for the test
- **Students will receive 1 bonus mark (max 4 bonus marks) for each 10 multiple choice questions they email to TA and Cc your instructor**
  - Means submit 40 MCQs and earn 4 bonus marks!
  - Submit the questions in one PDF file – will be posted on Moodle with your name on it
  - Answer key should be at the end of the document
- Do **NOT** copy questions from online sources or your classmates
- MCQs must be from the materials to be tested in the final test
- Deadline: December 1, 2017 (11:59pm)

Students' Question Bank

- Files are being posted on Moodle as we receive them
- Make sure to create high-quality MCQs in the same format as your test questions
- Cover all the material – see the announcement on Moodle
- Focus: Lecture slides, textbook chapters, classroom discussion (including students' presentations)
- **5 questions in the test will be from students' Q bank –** only *selective* high quality questions will be included in the test Qbank



PowerPoint® Lecture Presentations prepared by Mindy Miller-Kittrell, North Carolina State University

CHAPTER **24**

Pathogenic DNA Viruses

Cervical Cancer – Screening Guidelines

Canadian Task Force on Preventive Health Care

Recommendations

- For women aged < 20 we recommend not routinely screening for cervical cancer
  (Strong recommendation; high quality evidence)
- For women aged 20 to 24 we recommend not routinely screening for cervical cancer.
  (Weak recommendation; moderate quality evidence)
- For women aged 25 to 29 we recommend routine screening for cervical cancer every 3 years.
  (Weak recommendation; moderate quality evidence)
- For women aged 30 to 69 we recommend routine screening for cervical cancer every 3 years.
  (Strong recommendation; high quality evidence)
- For women aged ≥ 70 who have been adequately screened (i.e., 3 successive negative Pap tests in the last 10 years), we recommend that routine screening may cease. For women aged 70 or over who have not been adequately screened we recommend continued screening until 3 negative test results have been obtained.
  (Weak recommendation; low quality evidence)

Summary of recommendations for clinicians and policy-makers

Recommendations are presented for screening asymptomatic women who are or have been sexually active. They do not apply to women with symptoms of cervical cancer, previous abnormal screening results (until they have been cleared to resume normal screening), those who do not have a cervix (due to hysterectomy), or who are immunosuppressed.

Papillomaviridae and *Polyomaviridae*

- **Polyomavirus Infections**
  - *Poly*=“many”, *Oma*=‘tumor”
  - Capable of causing tumors in animals and humans
  - Can cause other diseases
  - BK and JC viruses are endemic worldwide
  - Initial infection = affects lymphocytes
  - Infection outcome depends on the individual's immune system
    - Normal immune systems tend to prevent latent infections
    - Compromised immune systems allow latent infections to become established in the kidneys where reactivation occurs later

Papillomaviridae and *Polyomaviridae*

- **Polyomavirus Infections**
  - Reactivation events are different between the BK and JC viruses
    - BK virus
      - Potentially severe urinary tract infections can develop
    - JC virus
      - Can cause progressive multifocal leukoencephalopathy
        - Viruses infect and kill the white matter of the CNS
      - Paralysis and death eventually result
  - Beta interferon can prevent kidney damage by BK virus
  - Diagnosis of JC virus infections often made too late to treat

Adenoviridae

- Contain single, linear dsDNA genome
- Have naked polyhedral capsid with spikes
- **One of many causative agents of the common cold**
- At least 30 respiratory adenoviruses cause the “common cold” and are spread through respiratory droplets
- Spread via respiratory droplets
- Can survive on fomites and in improperly chlorinated water
- Respiratory infections
  - Viruses taken into cells lining the respiratory tract via endocytosis
  - Cause sneezing, sore throat, cough, headache, and malaise
- Infection of the intestinal tract can produce mild diarrhea in children
- Infection of the conjunctiva can result in pinkeye
- Treat early stages of infection with gamma interferon
- Attenuated vaccine is available only for military personnel

Catch a cold and catch obesity?

- Human adenovirus 36 (Adv36) began infecting humans in 1980 – beginning of the obesity pandemic the same year
- Directly affects adipocytes (fat cells) in animals and humans – more body fat if infected
- Regulates a gene responsible for fat production
- Also, enhances a cell's ability to take up glucose, which can be metabolized into fat and stored
- Perhaps someday soon, more effective anti-cold remedies may also help you lose weight!

Figure 24.16 Adenovirus.

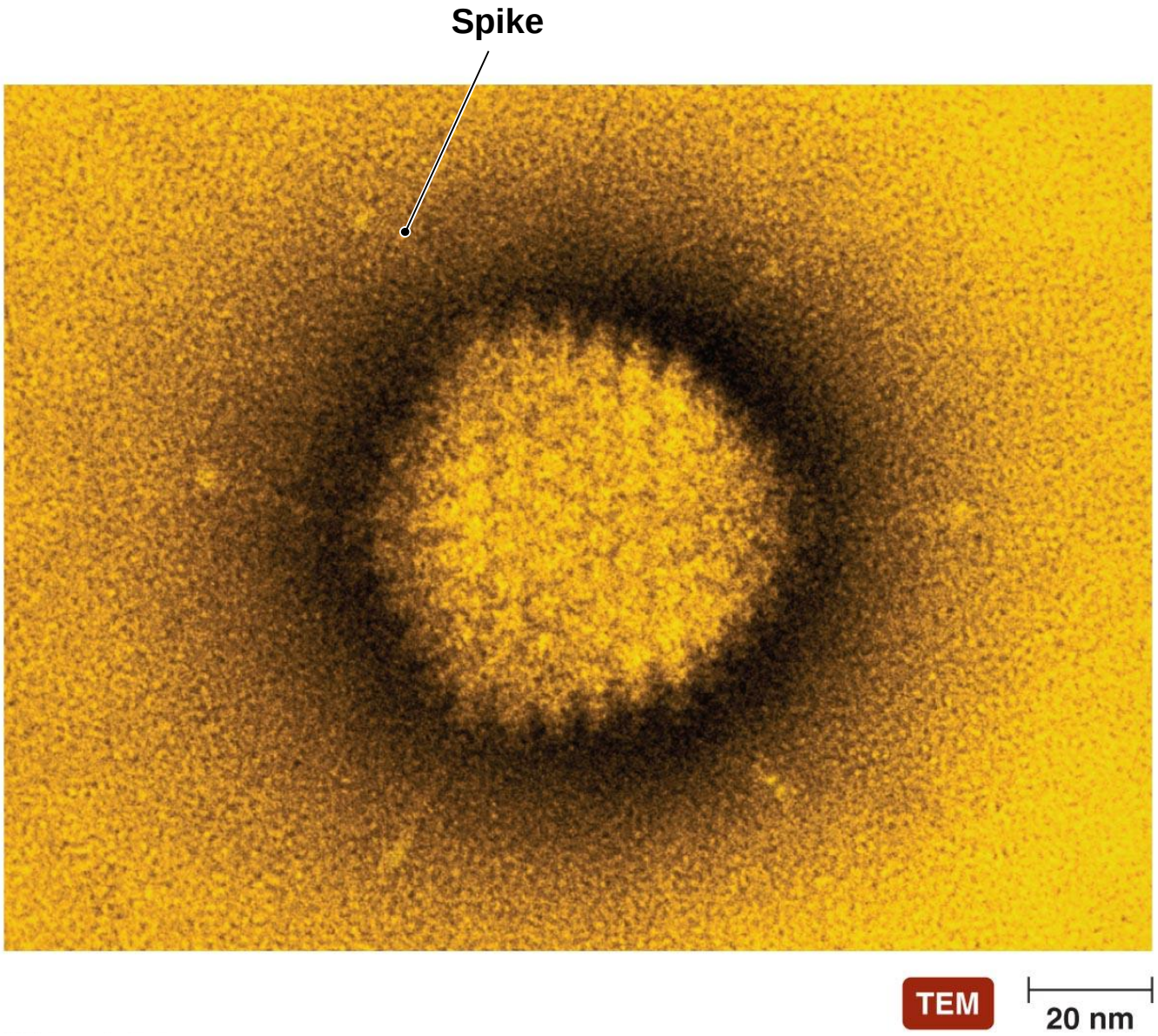
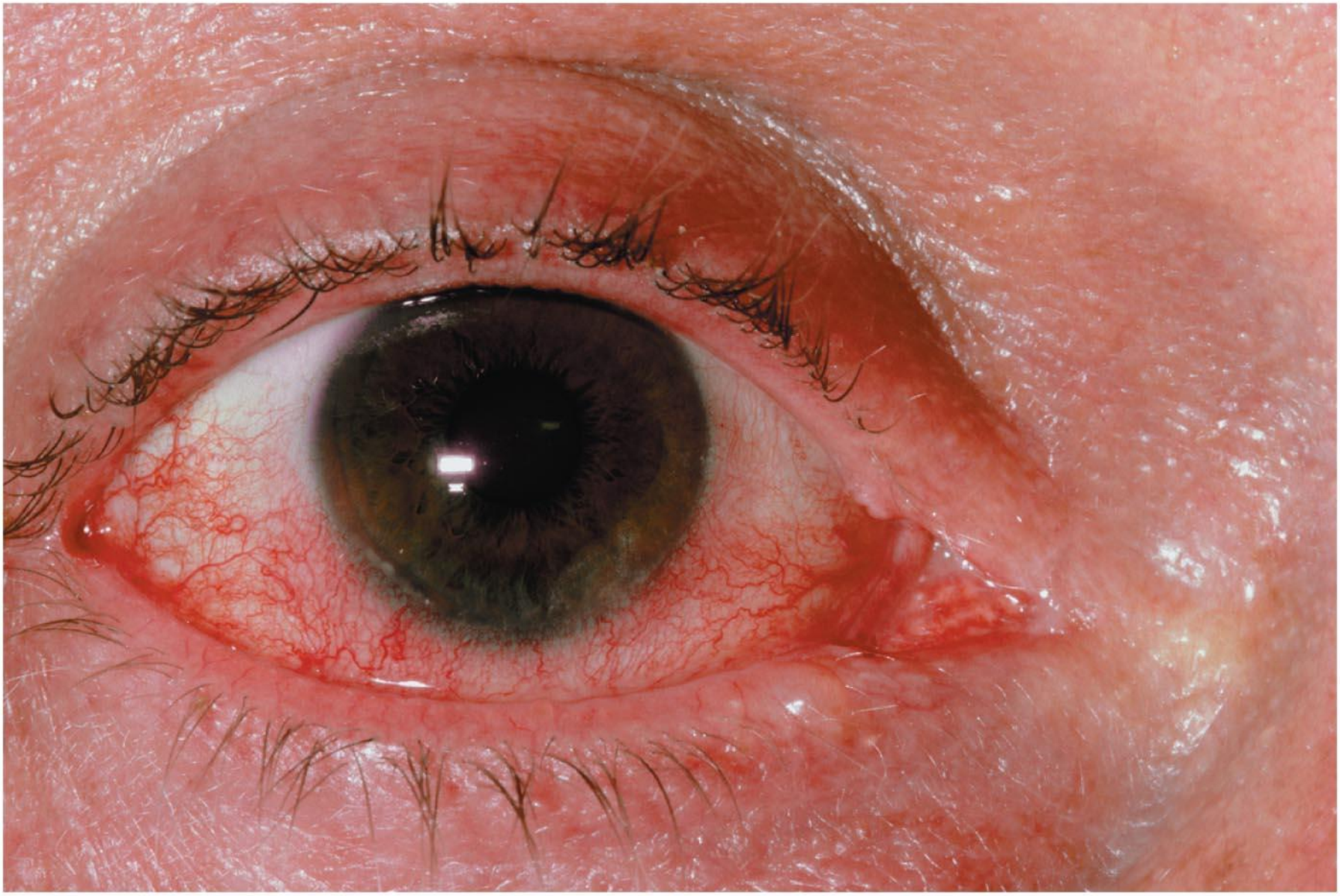


Figure 24.17 Adenoviral conjunctivitis (pinkeye).



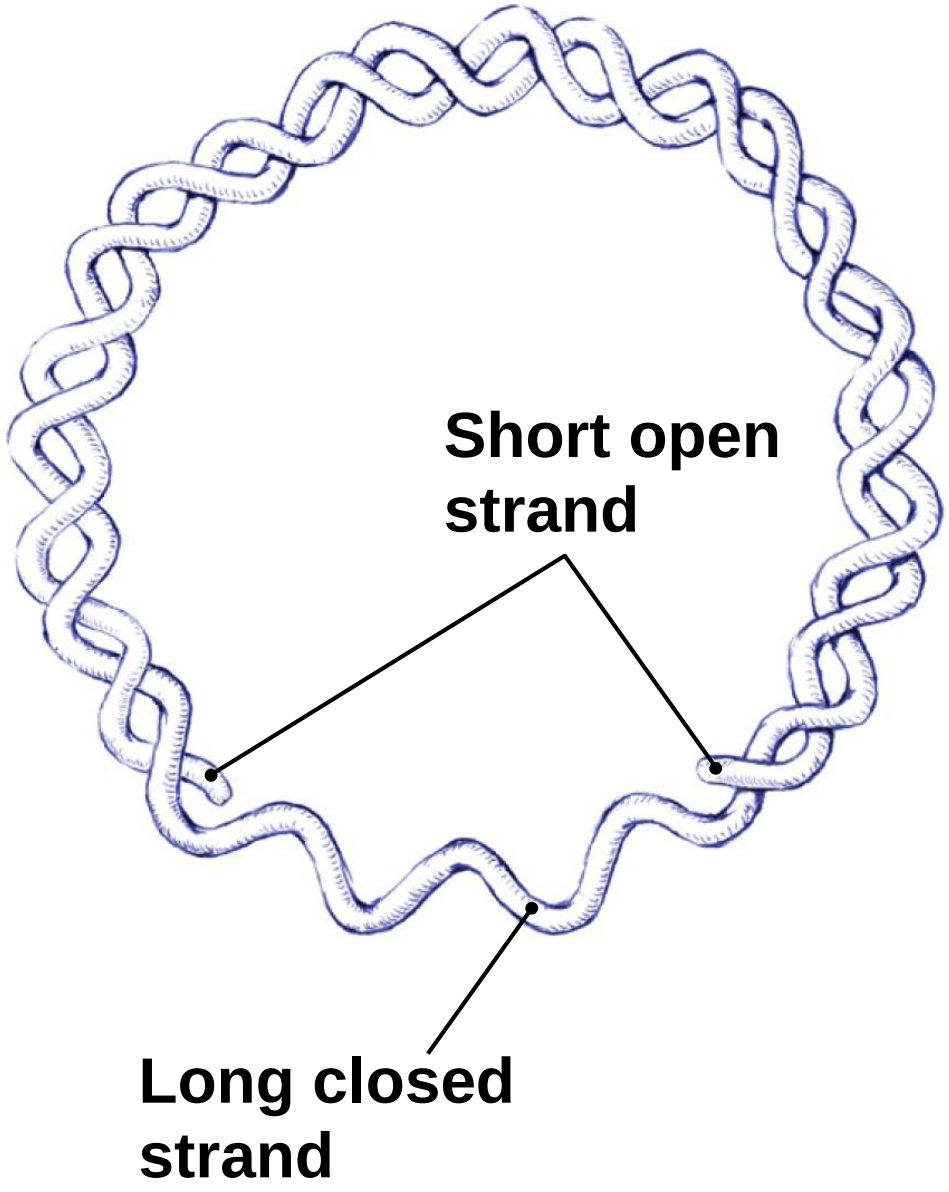
Hepadnaviridae

- Enveloped DNA viruses
- Have icosahedral capsids
- Invade and replicate in liver cells
- The genome includes both double-stranded and single-stranded DNA, with the proportion of ssDNA to dsDNA varying between virions

Hepadnaviridae

- Include hepatitis B virus (HBV), in the genus *Orthohepadnavirus*
- Unique genome is composed of both single- and double-stranded DNA
- HBV replicates through an RNA intermediary
  - Unique among DNA viruses
  - Reverse transcriptase transcribes DNA genome into RNA

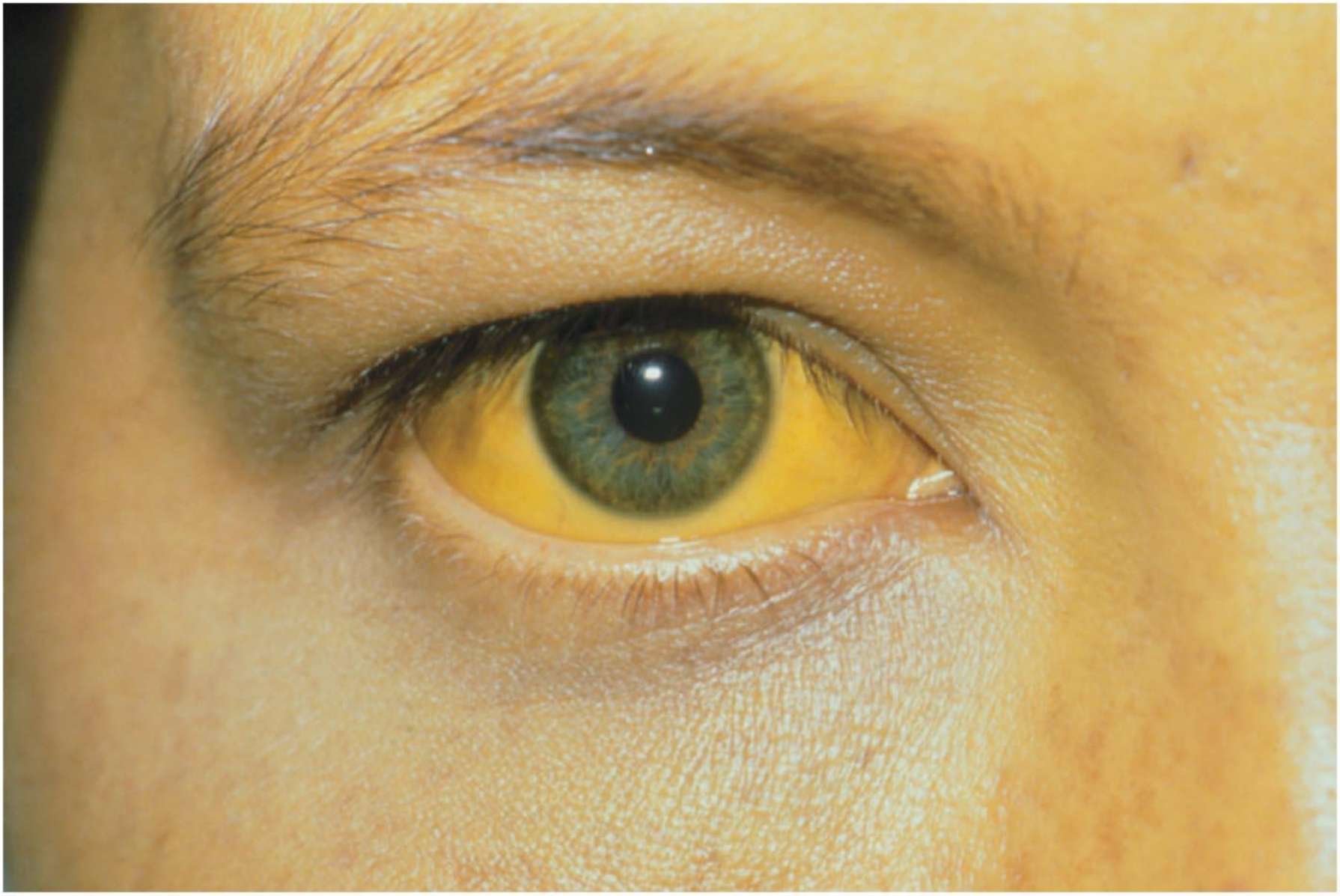
Figure 24.18 The genome of a hepadnavirus.



Hepadnaviridae

- **Hepatitis B Infections**
  - Cause hepatitis
    - Inflammation of the liver
  - **HBV is the only DNA virus that causes hepatitis**
  - Viral infection can cause severe liver damage
  - Various symptoms
    - Jaundice (a yellowing of the skin and eyes that occurs when *bilirubin* accumulates in the blood), liver enlargement, abdominal distress, and bleeding into the skin and internal organs
  - Co-infection with hepatitis D virus increases risk of permanent liver damage

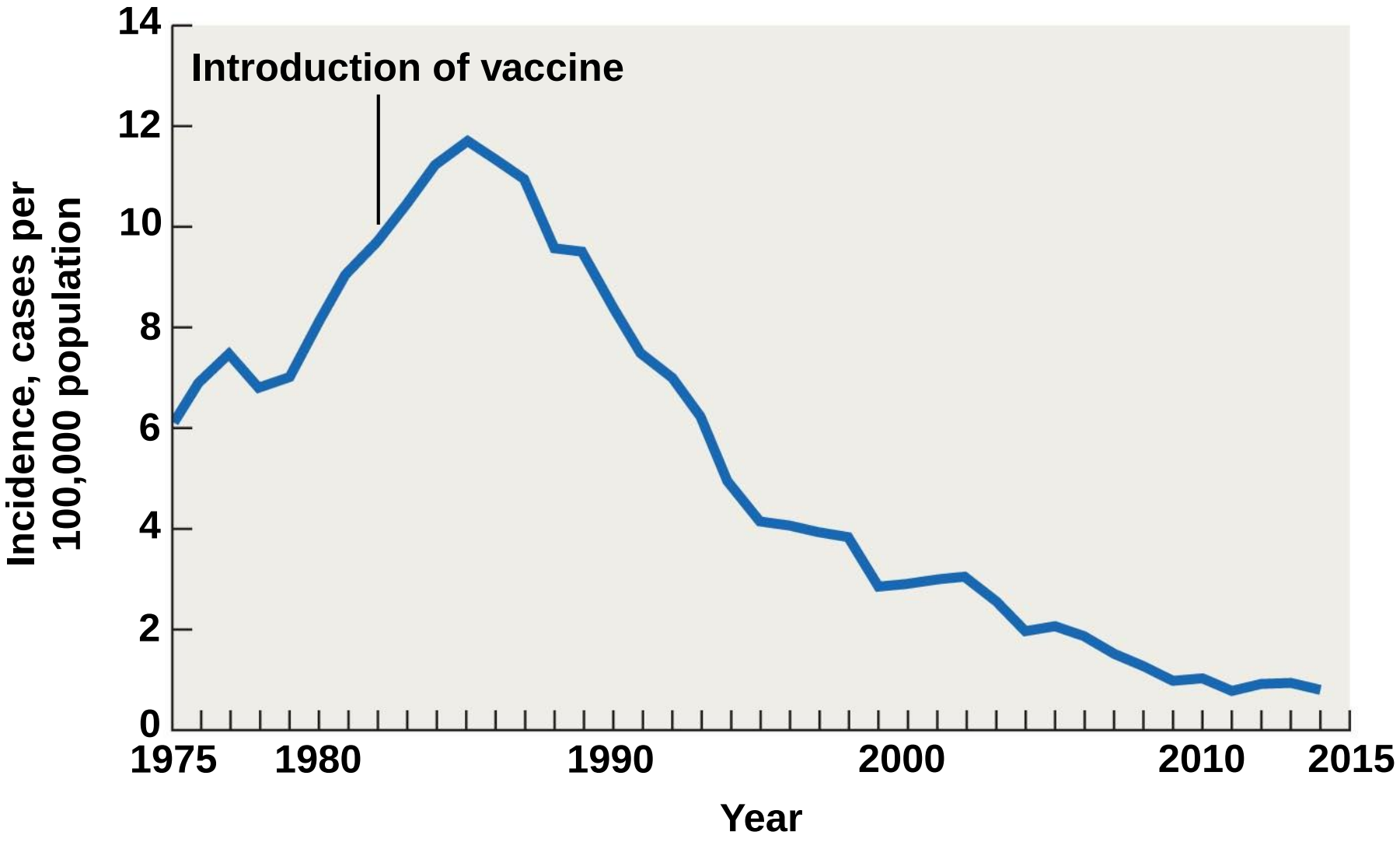
Figure 24.19 Jaundice.



Hepadnaviridae

- **Hepatitis B Infections**
  - Epidemiology and Pathogenesis
    - Liver cells continually release virions into the blood (exocytosis)
    - Virions are shed into saliva, semen, blood, and vaginal secretions – requires only a low infective dose
    - Transmitted when infected body fluids contact breaks in the skin or mucous membranes
    - Virus spread through infected needles, sexual intercourse, and passage to babies during childbirth
    - Many individuals are asymptomatic or have mild symptoms
    - Vaccination has reduced the cases of HBV in the U.S.

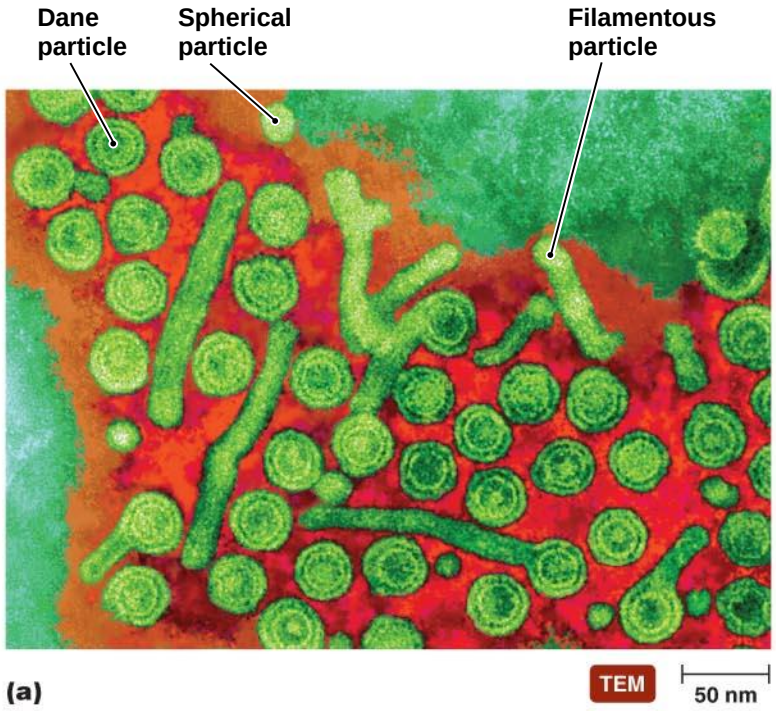
Figure 24.20 Estimated incidence of acute hepatitis B in the United States.

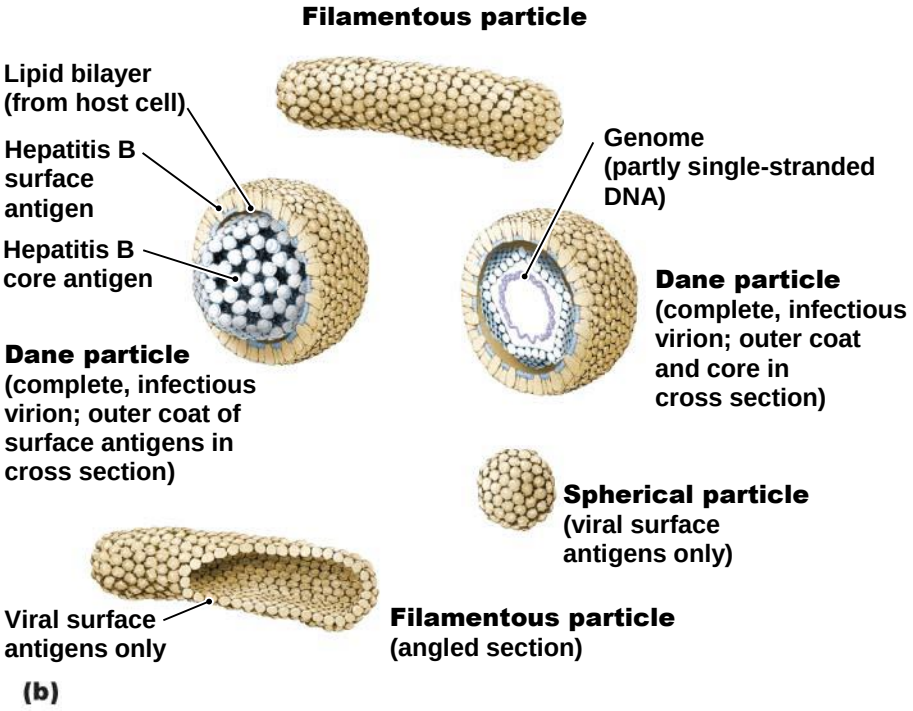


Hepadnaviridae

- **Hepatitis B Infections**
  - Diagnosis, Treatment, and Prevention
    - Diagnosis
      - Diagnose by detecting presence of viral antigens
        - Body fluids contain three types of virus particles: *Dane particles, spherical particles,* and *filamentous particles*
    - Treatment
      - No universally effective treatment
    - Prevention
      - Vaccination offers long-term protection against HBV
      - Abstinence and monogamy protect against sexually transmitted infection
      - Care with needles and sharp instruments, disinfection with 10% bleach solutions

Figure 24.21 The three types of viral particles produced by hepatitis B viruses.





14.0 INTERPRETATION OF TESTING RESULTS

Factor to be tested	Term	Use
HBsAg	Hepatitis B surface antigen	Detection of acutely or chronically infected person
Anti-HBs	Antibody to HBsAg	Identification of resolved infection with HBV; determination of immunity after hepatitis B vaccination
Anti-HBc	Antibody to core antigen (HBcAg)	Identification of individuals with prior infection with HBV (not present after immunization).
Anti-HBc IgM	IgM class antibody to HBcAg	Indicates acute or recent infection with HBV; detectable for 4-6 months after infection.
HBeAg	Hepatitis B e Antigen	Identification of infected individuals at increased risk of transmitting HBV.
Anti-HBe	Antibody to HBeAg	Identification of infected individuals at lower risk for transmitting HBV.

http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Epid/CD%20Manual/Chapter%201%20-%20CDC/HepatitisB_Sept_2009.pdf

Interpretation of test results

HBsAg anti-HBc anti-HBs	negative negative negative	susceptible
HBsAg anti-HBc anti-HBs	negative negative positive (≥ 10 IU/L)	immune due to vaccination
HBsAg anti-HBc anti-HBs	negative positive positive (≥ 10 IU/L)	immune due to natural infection
HBsAg anti-HBc IgM anti-HBs	positive positive negative	acute infection
HBsAg anti-HBc anti-HBs	positive positive negative	chronic infection
HBsAg anti-HBc anti-HBs	negative positive negative	"isolated anti-core positive" four interpretations possible Interpretation unclear; four possibilities: 1. Resolved infection (most common) 2. False-positive anti-HBc, thus susceptible 3. "Low level" chronic infection 4. Resolving acute infection

http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Epid/CD%20Manual/Chapter%201%20-%20CDC/HepatitisB_Sept_2009.pdf

https://www.cdc.gov/hepatitis/HBV/PDFs/SerologicChartv8.pdf

Hepadnaviridae

- **The Role of Hepatitis B Virus in Hepatic Cancer**
  - Evidence shows HBV associated with hepatic cancer
    - Hepatic cancer occurs in areas with high prevalence of HBV
    - HBV genome integrated into hepatic cancer cells
    - Hepatic cancer cells express HBV antigen
    - Chronic HBV carriers more likely to develop hepatic cancer
  - Hepatic cancer may be the first cancer eliminated by vaccination

Parvoviridae

- Only human pathogen with a ssDNA genome
- Have icosahedral capsid
- Smallest of the DNA viruses
- Cause a number of diseases in animals
- B19 virus is the primary parvovirus of humans
  - Causes erythema infectiosum
    - Also called fifth disease
  - Infection results in a reddening of the skin
  - Sunlight aggravates the condition

Figure 24.22 A case of erythema infectiosum (fifth disease).

TABLE 24.2 Taxonomy and Characteristics of DNA Viruses of Humans

Family	Strand Type	Enveloped or Naked	Capsid Symmetry	Size (diameter, nm)	Representative Genera (disease)
Poxviridae	Double	Enveloped	Complex	200–300	*Orthopoxvirus* (smallpox, cowpox), *Molluscipoxvirus* (molluscum contagiosum)
Herpesviridae	Double	Enveloped	Icosahedral	150–200	*Simplexvirus*—type 1 herpes (fever blisters, respiratory infections, encephalitis), type 2 herpes (genital infections), *Varicellovirus* (chickenpox), *Lymphocryptovirus* Epstein-Barr virus (infectious mononucleosis, Burkitt's lymphoma), *Cytomegalovirus* (birth defects), *Roseolovirus* (roseola)
Papillomaviridae	Double	Naked	Icosahedral	45–55	*Papillomavirus* (benign tumors, warts, cervical and penile cancers)
Polyomaviridae	Double	Naked	Icosahedral	45–55	*Polyomavirus* (progressive multifocal leukoencephalopathy)
Adenoviridae	Double	Naked	Icosahedral	60–90	*Mastadenovirus* (conjunctivitis, respiratory infections)
Hepadnaviridae	Partial single and partial double	Enveloped	Icosahedral	42	*Orthohepadnavirus* (hepatitis B)
Parvoviridae	Single	Naked	Icosahedral	18–26	*Erythrovirus* (fifth disease)