The student is expected to:

4C Compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza.
KEY CONCEPT
Viruses exist in a variety of shapes and sizes.
Viruses differ in shape and in ways of entering host cells.

- Viruses have a simple structure.
  - genetic material
  - capsid, a protein shell
  - sometimes a lipid envelope, a protective outer coat
• Viruses enter cells in various ways.
  – viruses of eukaryotes can enter by endocytosis
  – newly assembled viruses then exit via exocytosis, gaining their lipid envelope from the membrane of the host cell
• Viruses enter cells in various ways.
  – viruses of eukaryotes can also fuse with the cell membrane
  – DNA (or RNA) are released into the cytoplasm of the host, while the viral envelope remains as part of the cellular membrane
  – newly assembled viruses then fuse with sections of viral membrane in the host membrane to exit, or bud out
• Bacteriophages are viruses that infect bacteria.
• Viruses enter cells in various ways.
  – bacteriophages pierce host cells to inject their genetic material
Viruses cause two types of infections.

- A lytic infection causes the host cell to burst.

The viral DNA forms a circle.

The virus may enter the lysogenic cycle, in which the host cell is not destroyed.

The host bacterium breaks apart, or lyses. Bacteriophages are able to infect new host cells.

The viral DNA directs the host cell to produce new viral parts. The parts assemble into new bacteriophages.

The bacterophage attaches and injects its DNA into a host bacterium.
• A lysogenic infection does no immediate harm.

The prophage may leave the host’s DNA and enter the lytic cycle.

The viral DNA is called a prophage when it combines with the host cell’s DNA.

Many cell divisions produce a colony of bacteria infected with prophage.

Although the prophage is not active, it replicates along with the host cell’s DNA.
KEY CONCEPT

Some viral diseases can be prevented with vaccines.
Viruses cause many infectious diseases

- There are many examples of viral infections.
  - common cold
Viruses cause many infectious diseases

- There are many examples of viral infections.
  - common cold
  - influenza
Viruses cause many infectious diseases

- There are many examples of viral infections.
  - common cold
  - influenza
  - SARS
Viruses cause many infectious diseases

- There are many examples of viral infections.
  - common cold
  - influenza
  - SARS
  - HIV

- The body has natural defenses against many viruses.
Vaccines are made from weakened pathogens.

- A vaccine stimulates the body’s own immune response.
- Vaccines prepare the immune system for a future attack.

<table>
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<tr>
<th>VIRAL INFECTION</th>
<th>SYMPTOMS OF DISEASE</th>
<th>TRANSMISSION OF DISEASE</th>
<th>U.S. VACCINE RECOMMENDATION</th>
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<tr>
<td>Chickenpox</td>
<td>rash, itchy skin, fever, fatigue</td>
<td>contact with rash, droplet inhalation</td>
<td>for children between 12 and 18 months</td>
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<tr>
<td>Hepatitis A</td>
<td>yellow skin, fatigue, abdominal pain</td>
<td>contact with contaminated feces</td>
<td>for people traveling to infected locations and protection during outbreaks</td>
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<tr>
<td>Mumps</td>
<td>painful swelling in salivary glands, fever</td>
<td>droplet inhalation</td>
<td>for children between 12 and 15 months and again at 4 to 6 years</td>
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<tr>
<td>Rabies</td>
<td>anxiety, paralysis, fear of water</td>
<td>bite from infected animal</td>
<td>for veterinarians and biologists in contact with wildlife</td>
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<tr>
<td>West Nile</td>
<td>fever, headache, body ache</td>
<td>bite from infected mosquito</td>
<td>no available vaccine</td>
</tr>
</tbody>
</table>

- Vaccines are currently the only way to control the spread of viral disease.
HIV Infection

- HIV has RNA as its genetic material.
- Glycoproteins on the envelope cause human cells to allow it to enter.
- The HIV virus also has a copy of an enzyme called reverse transcriptase which is used to make a complementary DNA copy of the virus RNA.
- The complementary DNA is inserted into the cell's genomic DNA, where it can lie dormant, sometimes for years.
- When activated, the viral DNA serves as a template for production of viral RNA, which is then used as a template for viral proteins.
Influenza Infection

- the flu virus has eight RNA segments in a capsid, surrounded by an envelope studded with two types of glycoproteins, Hemaglutinin (H) and Neuraminidase (N)
- the virus has a specific RNA polymerase which transcribes m-RNAs from each of the viral RNA’s
- the H glycoproteins on the virus surface attaches to receptors on the host cell, allowing the virus to enter the host cell
- N glycoproteins are thought to deform the membrane from inside allowing newly assembled viruses to leave the cell during virion budding
- antibodies against flu are mainly directed against H and N, but these are different in different strains of flu, making vaccines hard to make