Viruses

Strand Life at the Molecular and Cellular Level

Topic Examining viruses

Primary SOL BIO.4 The student will investigate and understand life functions of Archaea, Bacteria, and Eukarya. Key concepts include
a) comparison of their metabolic activities;
d) human health issues, human anatomy, and body systems;
e) how viruses compare with organisms.

Background Information

Viruses are not considered living organisms outside their host cells. They are obligate intercellular parasites that require a host cell to reproduce. Most viruses are genetic information (DNA or RNA) surrounded by a protein coat. They do not fit into our six-kingdom system, but they do have a classification structure all their own.

Some DNA viruses that may be familiar are the adenoviruses (causes respiratory infections, such as colds), herpesviruses (herpes), papillomaviruses (HPV), polyomaviruses, parvoviruses (feline or canine parvovirus, "slapped cheek" virus), and poxviruses (chickenpox, smallpox). RNA viruses include H5NI (avian flu), coronaviruses (SARS), and retroviruses (HIV).

Viruses were not known until relatively recently because they are much smaller than the smallest prokaryote, and the scanning electron microscope was not in use until after 1965.

Materials

- The Cycles of Viruses: Two Enactments supplement (attached)
- Copies of the two attached handouts
- Presentation software (optional)
- Poster board
- Pens
- Small plastic cups
- Water
- Sodium hydroxide (NaOH)
- Phenolphthalein
- Pipette

Vocabulary

adhesion, assembly, capsid, electron microscope, envelope, host, latent, lysis, lysogenic cycle, lytic cycle, nucleic acid core, organism, parasite, penetration, replication, virulent, virus

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

1. Have students prepare and present a product that demonstrates an understanding of the viral lytic cycle and/or lysogenic cycle, using props and/or presentation software. You may choose to have them present one or both of the enactments found on the attached supplement, The Cycles of Viruses: Two Enactments. Stress that students should

demonstrate an understanding of the importance of knowing how the various phases occur and how viruses are of great concern to persons in health-related fields.

2. Direct each student to compare and contrast a virus and a living cell by drawing a Venn diagram or writing a paragraph.
3. Run a viral outbreak simulation, as follows:
   - Before class, set out cups on a tray, one per student. Add 5mL of water to all but one of the cups. In the last cup, add 5mL of a dilute solution of sodium hydroxide (NaOH). All cups should look exactly alike.
   - Distribute the cups, noting but not revealing which student receives the cup of NaOH. Tell students that the clear liquid in the cups represents their bodily fluids. One cup is "infected" with a simulated "virus," and all the others are not. We will now see how a virus can easily spread from person to person.
   - Direct each student to come in contact with three and *only* three other students and mix his/her bodily fluids with each contact person by pouring the contents of one cup into another and then pouring half of the mixed liquid back into the first cup. Have each student also make a list of the names of his/her three contacts.
   - Once all students have mixed fluids with three others, test the liquid in each cup by adding one drop of phenolphthalein to it: a bright pink color indicates a positive test for NaOH, while no color change indicates a negative test.
   - +Record the names of all the "infected people" on the board. Challenge students to use their contact lists to identify the person who was the original source of infection, giving help as needed.

   Discuss how this simulation reflects and does not reflect a real world-scenario. Include in the discussion some viruses that may fit this scenario.

Assessment

- **Questions**
  - Why did the viral DNA rip up the host cell's DNA?
  - Who produced the protein coats?
  - What happened to the original cell after the virus left?
  - What are some reasons why the viral DNA might go through the lysogenic cycle?
  - Name three ways a disease can be transmitted throughout a population.
  - What factors could influence how fast a virus spreads through a population?
  - Can you think of a way to test one of these factors? Explain.
  - Suggest a safe way to dispose of real bodily fluids (such as medical waste) that may be infected.
  - How did you feel when you found out the results of the viral outbreak simulation?
- **Journal/Writing Prompts**
  - Explain why it is essential to study viruses in a biology course even though they are not alive.
- **Other**
  - Have students demonstrate an understanding of the lytic cycle from adhesion to lysis and describe the differences between it and a lysogenic cycle.

- For a more authentic assessment, have students present their products and demonstrate their understanding to a community group or another class, using appropriate feedback procedures.

Extensions and Connections (for all students)

- For advanced discussion, you may wish to add Human Endogenous Retroviruses (HERV), which are found in 85-percent of Gulf War veterans. Have students investigate the possibility of HERV contributing to selection pressures by altering the genome.
- If possible, record the enactments for reference later in the unit. (If students are to create the enactment themselves, they will most likely try harder if they know it will be recorded. If there is a particularly good enactment, you may wish to use it to show students in future classes how it should be done.)
- Have students research a bacteria, virus, or a related advance in science that has occurred within the last five years, using print and/or nonprint resources. The finished product could be a one-page summary that cites at least two sources or a "Wanted" poster, as shown on the attached Wanted Poster handout. (You may wish to give extra credit to students who select unique subjects.)
- Have students investigate potential lysogenic viral interruption of exon functioning and resulting genetic malfunctioning.
- Have students investigate use of viral vectors in transformation technologies.

Strategies for Differentiation

- Provide in random order, illustrations of the viral lytic and lysogenic cycles and descriptions of events that occur during each type of cycle. Direct students to create a Venn diagram comparing and contrasting the lytic and lysogenic cycles, or have them sequence the events that occur during each cycle.
- Direct students to create a public service announcement about a virus of their choice and the precautions needed to avoid this virus.
- Have students discuss the main activities of this lesson in small groups prior to full class discussions in order to provide them with opportunities for potentially more inclusive discussions.

The Cycles of Viruses: Two Enactments

The focus of this drama activity[1] is for students to actually experience the different stages in the lytic cycle and to recognize the difference between it and the lysogenic cycle. You may choose to either explain the roles and scenarios to the actors (students) or have students use provided materials to create their own enactments that shows that they understand the concepts.

Materials

- A sign indicating the nucleus of the host cell
- A sign indicating the virus
- A sign to represent the host cell's DNA (held by the nucleus)
- A sign in a plastic bag to represent the virus's DNA in a membrane (held by the virus)
- Four blank signs
- A pen
- A yo-yo
- A pack of cards
- String

Lytic Cycle Enactment

1. Designate a "cell" area on the floor.
2. Choose a student to be the nucleus of the cell. Give him/her the nucleus sign, the DNA sign, the four blank signs, the pen, and string. Have the nucleus sit in the center of the "cell," and have four other students sit around the nucleus.
3. Choose a student to be the virus. Give him/her the virus sign and the yo-yo.
4. The virus comes to the cell, enters it, and has a seat beside the nucleus.
5. The virus grabs the host cell's DNA sign and rips it up.
6. The virus then pulls out the yo-yo, swinging it slowly like a pendulum to hypnotizes the nucleus into copying the viral DNA sign.
7. The nucleus starts making viral DNA signs on the blank signs, using the pen.
8. The nucleus uses the string to attach these viral DNA signs to the four other students in the cell.
9. The original virus laughs and breaks open the viral DNA membrane.
10. The original virus says, "Go, my offspring, and flourish."
11. The four students go off, and the nucleus dies.

Lysogenic Cycle Enactment

1. Repeat first two steps of lytic cycle enactment.
2. Choose a student to be the virus. Give him/her the virus sign and a pack of cards.

[1] Adapted from a skit written by faculty from Queen's University, Kingston, Ontario, Canada, and found at http://educ.queensu.ca/~science/main/concept/biol/b08/B08LAAT2.htm.

3. The virus comes to the cell, enters it, and says, “I like you; let’s play cards.”
4. The virus plays “21” with the nucleus.
5. The virus convinces the nucleus to take the viral DNA sign and attach it to the cell’s DNA sign.
6. The nucleus says, “I will now reproduce.” The nucleus writes out the entire DNA sequence, including the viral DNA part, and shows it to the class.
7. The nucleus then says, “Pretend that I have done this many times and that there are now many more cells.”
8. The nucleus and virus continue to play “21” until the teacher walks over to the nucleus and says, “I am an unknown environmental condition that has told the cell to detach the viral DNA from its own.”
9. The enactment continues from step four of the lytic cycle.

Wanted Poster

Create a "WANTED" poster for _____. Include the following:

1. Name of the infectious disease
2. Scientific and common name of the parasite that causes the disease
3. Three pictures (parasite, infected organism, vector, treatments, etc.)
4. How the parasite spreads from individual to individual (vector)
5. Incubation period for the disease
6. Symptoms of the disease
7. Whether or not immunity is built up for the disease
8. What can be done medically for infected individuals
9. What can be done to prevent the disease, if anything
10. Additional useful or interesting information about the disease or parasite