HIV/AIDS is not curable at this point in time. Why is this the case based on current available drugs?

Purpose:

The purpose of this activity is engage students in studying the HIV viral infection pathway in a human cell. Students will study the life cycle using scientific thought processes in small groups to determine different points where the pathway could be inhibited to prevent the spread of the infection.

Objectives:

1- Students will understand how the HIV viral pathway may be interrupted to prevent the spread of the virus in an individual
2- Students will analyze the HIV viral pathway to determine points where ARV Therapy can be used
3- Students will understand the reasoning behind the absence of a vaccine for HIV/AIDS

Suggested Time:
One and a half forty minute class periods (60 min)

Grade Level:
This activity is geared towards a high school science grade level; it is ideal for a biology or physiology class.

Prior Knowledge:
Students should have an understanding of cell structure, protein synthesis, the role of enzymes in living organisms, and molecular evolution.

Topics for Follow-up Lessons:
Possible follow-up topics to teach include enzyme structure, the role of various enzyme inhibitors, drugs as antagonistic inhibitors, more studies of evolution, and vaccine and drug development.

National Science Standards *(High School):*

- *Content Standard A* – All students should develop abilities necessary to do scientific inquiry.
- *Content Standard C* – All students should develop an understanding of the cell, molecular basis of heredity, interdependence of living organisms, biological evolution and behavior of organisms.
- *Content Standard E* – All students should develop understandings about science and technology.
- *Content Standard F* – All students should develop understanding of personal and community health, science and technology in local, national, and global challenges, and natural and human-induced hazards.

- *Content Standard G* – All students should develop understanding of nature of scientific knowledge, historical perspectives, and science as a human endeavor.

Procedure:

1. Introduce the topic by showing students the PBS video *Surviving AIDS: HIV Immunity* found at the following link: http://www.pbs.org/wgbh/evolution/library/10/4/l_104_06.html.

2. While students watch the video, they will complete viewing questions on the accompanying activity sheet.

3. Students will then read the article *Mystery of the Black Death: Clues and Evidence* on the PBS Nova Website and respond to the accompanying questions on the activity sheet: http://www.pbs.org/wnet/secrets/case_plague/clues.html.

4. Follow these questions with a class discussion reviewing the answers. Use the article questions to lead into the discussion about the group activity that follows.

5. The last question about the article should be used to highlight how scientists used the scientific process (hypothesis, experimental process, etc.) to test and study the effectiveness of the drugs and the infection pathways they inhibit.

6. Students will examine the HIV infection pathway based on their understanding of protein synthesis and molecular evolution. Using the "Studying the Lifecycle of HIV" worksheet, they will determine at least three different target points in the pathway where medication could be developed to stop the progression of the disease in the human body and defend its effectiveness.

7. Follow this portion of the activity with a class discussion about the suggested medicinal targets they determined in the infection pathway.

8. Students will then view the Koshland Science Museum video: *How do Antiretroviral Drugs Work?*

9. After viewing the video, students will return to their groups and discuss how their conclusions about effective targets for antiretroviral drugs differ from those that currently exist. They will then complete the questions about the video.

10. Once students have completed the questions, discuss their answers as a class. Be sure to emphasize the importance of scientific method in the process of drug testing and determination of effective drug targets to inhibit spread of disease. It is also important to highlight the idea of microbial evolution and how it is affecting the discovery of a vaccine for HIV.

Follow-up Questions for Classroom Discussion:

These questions suggest ways to expand on the topics discussed in the activity with your students. They focus on making connections between HIV/AIDS and other related topics.

1. Vaccines play an important role in limiting the spread of disease among populations and even in completely eradicating some diseases, like smallpox. How do vaccines control the spread of diseases in populations?

2. Through this activity, students have discovered that a change in the CCR-5 receptor on the cell's surface can lead to the inability of HIV to infect a human cell. What are some of the variations caused in an HIV-infected cell's life cycle from that of a typical cell based on this change in form?

3. How do therapeutic drugs work differently from vaccines?

4. Some communities in the world have easier access to therapeutic drugs and vaccines than others. How does access to appropriate preventative treatments for diseases affect the spread of diseases regionally and globally?

5. Vaccines work by stimulating the immune system to fight off disease. How does a vaccine create an artificial immunity to a specific disease in an individual?

6. Taxonomically, bacteria are very old and simple living organisms compared to human beings and most other living organisms. Does complexity of structure in living organisms necessarily mean they are better adapted for survival?

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