

Title: Studying Retroviruses across Species using Biotechnology

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Abstract

This action plan will take students on a journey that will animate the world of the retrovirus and its impact on its host. Taking a route less traveled students will study retroviruses using both human and nonhuman models. The retrovirus host and disease they will study are: humans-HIV, nonhuman primates-SIV, felines-FIV and horses-equine infectious anemia. They will utilize a variety of methods to study retroviruses including an ELISA test simulation to diagnose hypothetical veterinary patients and view demonstrations of HIV and FIV diagnostic exams.

Rationale

Retroviruses have been around for thousands of years in a variety of vertebrate hosts recently through the emergence of HIV into the human population these viruses have gained popularity and research scientist have begun studying them in depth. Viruses that do not commonly affect humans are often overlooked in high school sciences and this is a disadvantage to our students since many emerging pathogens have evolved from strains that commonly affect other animals. These viruses are great platforms in achieving deeper understanding of evolutionary biology and modern methods in biotechnology.

Unit 1

Introduction to the retrovirus

Pre- study survey- this will serve to gauge the students' knowledge of HIV and retroviruses in general.

Watching and answering questions on excerpt from HHMI DVD "AIDS Evolution of an Epidemic". Students will learn what a retrovirus is and how it infects cells within the host, basic immunology and the anatomy of the virus.

Excursions in Science: students will watch "Structural Virology" with Dr. Mavis Agbandje- Mc Kenna

Students will build a retrovirus model with labels and descriptions of all the parts.

Unit 2

HIV and SIV

PowerPoint presentation and fill in the blank notes about the history and evolution of HIV from SIV.

Geography activity students will utilize a map of the world to show the spread of HIV using known dates and number of those infected.

Using Genbank the students will create a phylogenetic tree that shows the relationship of HIV to SIV. A special emphasis will be placed on the many different subtypes of both HIV and SIV.

Activity: The spread of a Virus through Sexual contact (phenolphthalein and sodium hydroxide).

Students will read journal article “Simian Immunodeficiency Virus infection of Chimpanzees” about the different subspecies of African chimpanzees and the corresponding strains of SIV. A focus will be made on understanding that all strands of SIV are not pathogenic to all species of non-human primates. Geographic regions will be highlighted.

Unit 3

FIV, SIV, and Equine Infectious Anemia

Web quest activity in which students will utilize various website to answer questions that will lead to the understanding of FIV, SIV, and Equine Infectious Anemia.

The diagnostic test utilized in veterinary hospitals to diagnose FIV will be demonstrated and antigens and antibodies will be explained in great detail.

Pipetting by coordinates activity- students will learn how to properly use a micropipetter and this will serve as preparation for ELISA testing simulation. ELISA test will be explained in great detail to the students.

Excursion in Science: Students will watch “ELISA Testing” with Linda Green.

Lab: ELISA test simulation- students will be given animal patient background information and will fill out paperwork and conduct the ELISA test simulation. The students will then type up an official report on the results of the test.

Unit 4

Vaccines and Research

PowerPoint presentation on different treatments, vaccines, and medicines associated with FIV, BIV, HIV, SIV, and Equine Infectious Anemia.

Show and explain to the research that Dr. J.K. Yamamoto has done in FIV and where her research is heading currently.

Discussion students will read excerpt from the book “The Octopus and the Orangutan” about the ethics related to utilizing primates for HIV research.

Excursion in Science: students will watch “Careers in Biotechnology”

Post study survey will be given to the students in order gauge learning gains.

ICORE

Locker Usage: Pipetting Stations (action proposal); Giant microbes with question cards (other); Introduction to gel electrophoresis (other).

HHMI DVD “AIDS Evolution of an Epidemic”

CPET website- Excursion in Science

Literature cited

Sharp, Paul et al. 2005. Simian Immunodeficiency Virus Infection of Chimpanzee. Journal of Virology

Gao, Feng et al. 1999. Origin of HIV-1 in the chimpanzee Pan troglodytes troglodytes . Nature

Budget

BioRad ELISA Immuno Explorer Kit	Wards Scientific Supplier 36v5206	2 kits at \$103 each total \$206
Phenolphthalein	Wards Scientific supplier 946v5302	\$8.95
Sodium Hydroxide	Wards Scientific Supplier 970v7907	\$6.95
Pipetters	Carolina Biological Supplier	4 sets at \$189 each total \$756 (borrow from ICORE-equipment locker)
		Total: \$962.00

Exploring SIV, FIV and EIA LESSON PLAN

KEY QUESTION(S): How are retroviruses identified in animal hosts? How does the ELISA test work in identifying retroviruses?

SCIENCE SUBJECT: Zoology and Biology

GRADE AND ABILITY LEVEL: High School Honors

SCIENCE CONCEPTS: Biotechnology, ELISA testing, Retroviruses, HIV, SIV, EIA, antibody, antigen

OVERALL TIME ESTIMATE: 6 – 60minute periods

VOCABULARY: retrovirus, lentivirus, ELISA test, EIA, HIV, SIV antigen, antibody,

LESSON SUMMARY: Students will carry out a simulation ELISA test while taking on the role primary investigator in a veterinary laboratory scenario. Through the use of animations and demonstrations the student will gain a thorough understanding of retroviruses and how they affect different mammals.

STUDENT LEARNING OBJECTIVES:

1. Student will demonstrate the ability to carry out an ELISA test and understand the mechanism behind this biotechnology.
2. Student will survey the impact that biotechnology has on the field of veterinary medicine.
3. Student will obtain specific knowledge of retroviruses and their impact on human and animal hosts.

Standards:

SC.912.L.16.70 Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology.

SC.912.L.16.10 Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

MATERIALS:

Day 1: Computer Lab Access (1 computer per student)

Day 2: LCD projector /computer for power point presentation; markers, glue, cardboard paper and pipecleaners.

Day 3: Micropipettors 1 set for every 4 students and activity "Micropipetting by Coordinates"

Day 4: FIV lab test (1 per class) and a blood sample to run the test. LCD projector / computer with internet access to play the ELISA test animation. One patient background/ scenario for every 2 students.

Day 5: BioRad ELISA Immuno Explorer Kit (1 kit for every 32 students); "Official" Diagnostic lab paperwork (1 set for every 2 students).

Day 6: Computer Lab access (1 computer for every 2 students).

BACKGROUND INFORMATION: Retroviruses are RNA viruses that utilize reverse transcriptase to produce DNA from its RNA. In this lesson students will compare retroviruses specifically lentiviruses in different animal hosts; equine infectious disease (EIA) in horses, feline immunodeficiency virus (FIV) in cats and simian immunodeficiency virus (SIV) in nonhuman primates.

The enzyme linked immunosorbent assay (ELISA) is a diagnostic laboratory test that is used to detect the presence of antibodies or antigens in a sample. An antigen is any molecule that causes the immune system to produce antibodies against it and an antibody is a protein produced by B lymphocytes that have been activated by the binding of an antigen to a cell surface receptor. This test is often used to detect HIV in humans and can also be used to detect SIV, FIV and EIA.

In horses retroviruses cause EIA and can be spread from one horse to another through mosquito bites and through bodily fluids. Horses exposed to EIA typically develop detectable immune responses to antigens of EIA within 45 days. A diagnosis is usually accomplished by using a Coggins test but can also be diagnosed using the ELISA test; results are often confirmed using the western blot method.

FIV is caused by a lentivirus and is found in many felines but immune system responses to the virus are usually seen in domesticated house cats. Big cats with FIV live for many years without showing any symptoms. The diagnostic test for FIV starts with a snap test which is a rapid immunoassay which detects antibodies for FIV in feline blood, serum or plasma. The presence of specific antibodies to FIV indicates the cat has been exposed to the virus; further testing utilizing the western blot method is employed.

SIV is able to infect at least 33 species of African primates but infections in the natural host of the virus appear to be nonpathogenic. Diagnosing SIV can be accomplished through the use of the ELISA test and confirmed using the western blot system.

PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES

Day 1- Take students to the computer lab and give them a 3 part webquest activity (give them specific websites in order to answer specific questions). The first part of the webquest should be on SIV, the second part of FIV and the third part on EIA. The webquest should answer the following questions: 1) which animal does this virus affect? How does it affect the animal? How is it transmitted? How is it diagnosed? How can it be prevented?

Day 2- Use a power point presentation and printed out fill in the blank notes to explain how antibodies and antigens work. Have students get into groups of two and make antibody and antigen models in order to illustrate the concept; use cardboard paper, pipe cleaners and markers.

Day 3- First 30 minutes of period have students use micropipettes to practice using these tools utilize the ICORE micropipetting by coordinates. Second 30 minutes play the "Science Excursion" video on ELISA testing using the LCD projector and computer.

Day 4- Demonstrate a real life FIV snap test and explain each step to the students. Play the ELISA test animation and quiz found at:

http://highered.mcgrawhill.com/sites/0072556781/student_view0/chapter33/animation_quiz_1.html discuss the correct answers to the quiz. Handout veterinary lab scenarios and animal patient background information and have students read the storylines and start the "official" lab paperwork.

Day 5- Utilize BioRad ELISA Immuno Explorer Kit and have students in groups run the lab tests for their patients; at the end of the lab the students should know which of their patients tested positive and be ready to type up an official lab report.

Day 6- Take students back to the computer have them type up their lab findings in an official lab report format; make sure to have samples of what they should include.

ASSESSMENT SUGGESTIONS:

Objective 1- The animation used in day 4 has a quiz that can be utilized for assessment purpose. Students carrying out the ELISA simulation will show if the student understands the concept of the ELISA test.

Objective 2- Student/ teacher discussion of laboratory test utilization in veterinary medicine will gauge student understanding of this objective.

Objective 3- The webquest utilized in day 1 of lesson assess this objective.

EXTENSIONS: Have students present their scenarios and results to the class. Confirm results of the ELISA testing using the western blot method and explain that this method is how positive results are confirmed in real veterinary diagnostic laboratories.

RESOURCES/REFERENCES:

<http://www.vet.cornell.edu/fhc/brochures/fiv.html> -FIV information

http://www.curtitsyacres.com/Education/Coggins/body_coggins.html - Equine Infectious Anemia information

<http://journals.usamvcj.ro/veterinary/article/viewFile/1697/1665> - relationship between the coggins and ELISA test.

<http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/60218.htm> -general information on lentiviruses