

**Title:** HIV-1: A Model of Evolutionary Genetics

**Principle Investigator:**

Carla Dee Reedy

**Abstract:** Evolutionary biology is often a difficult concept for students to understand and accept. Philosophical, cultural, or religious views often cloud the issue and make teaching controversial. Allowing students to discover the obvious changes in HIV-1 over time teaches evolutionary principal. Students can learn about how the RNA of HIV-1 changes through mutation and that these mutations allow different subtypes to appear. Students will be able to explore how the different subtypes have different physical and chemical characteristics. Students can then plug in the information back into Genbank to create a phylogenetic tree of HIV-1. The basis of evolutionary biology will become more obvious through the work of the student rather than the words of a teacher.

**Mission Statement:** The purpose of this project is to use HIV-1 as a model emerging pathogen for study in evolutionary genetics. The unit will include a reading component, ELISA lab, molecular modeling, looking up genetic sequences to create phylogenetic trees and the production of an imovie explaining HIV-1 as an emerging pathogen.

**Description of teaching unit or module, including expected outcome:** This module will require four weeks to complete beginning with a pretest followed by teacher-directed instruction about emerging pathogens and HIV-1. Students will then complete a series of activities that will allow them to visualize nucleic acids using computer programs, compare viral RNA using Genbank, create a phylogenetic tree for HIV-1 using Genbank, and simulate testing for HIV using an ELISA. During this time, students will be reading the book My Own Country: A Doctor's Story and will discuss how HIV-1 has impacted both individuals and society. Near the end of the unit, students will create an iMovie revealing HIV-1 as an emerging pathogen. At the end of the unit, students will take a post-test.

When this unit is complete, the student will be able to:

- Illustrate the parts of HIV-1 in a cartoon-type model and complete a flow chart of its life cycle.
- Use Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb) to look at 3-d images of the subtypes of the HIV-1 molecule and describe any differences they see.
- Use Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi> to find the various subtypes of HIV-1 and create a phylogenetic tree for these subtypes.
- Carry out a simulated ELISA on HIV-1 and describe the purpose of each step.
- Discuss some of the ramifications of HIV-1 on various individuals and society after reading the book My Own Country: A Doctor's Story.
- Identify the way in which HIV spread in the United States and its prevalence in the state of Florida.
- Create an imovie that explains how HIV-1 is an emerging pathogen.
- Demonstrate learning by completing a pretest and posttest on emerging pathogens, HIV-1, the use of phylogenetic trees, HIV-1 impact on individuals, and ELISA testing.

**Expertise of the PI:**

Education:

- B.A. Biology Harding University
- Biotechnology Boot camp, Madison Community College, Iowa, 2005

- Biotechnology Training through CPET 2005 and 2006
- Biotechnology Training through UF Center of Excellence for Health and Regenerative Biotechnology 2007 and 2008
- ICORE Emerging Pathogens 2009

Certificates:

- Professional Teacher Certification in Biology and Chemistry
- Industrial Biotechnology Certification through Marion County, FL

Experience:

- North Marion High, Citra, FL - chemistry & biotechnology, 1995-2008
- Sonrise, Covina, CA – Life & Physical Science, 1985-1995

Awards and Presentations:

- Member of the team that drafted the curriculum framework for Biotechnology 1, 2, and 3 for the State of Florida, approved for adoption in 2006
- Biotechnology presenter, October 2007 FAST conference
- Grants for Great Ideas Recipient, Marion County Public School Foundation
  - 2006-2007 Yes! This Is Rocket Science
  - 2007-2008 Science Under the Stars
- School Advisory Committee (SAC) Mini Grants
  - 2005-2006 Science Quest
  - 2006-2007 CSI Night

**Budget and Budget Justification:**

ELISA ImmunoExplorer from BioRad	\$150.00 + shipping
30 Copies of <u>My Own Country: A Doctor's Story</u> , Amazon 30 x 10.88	\$326.40 + shipping
25 SanDisk Cruzer 4GB USB flash, drive Staples 25 x 19.99	<u>\$476.50</u>

**Total: \$952.90 + shipping**

The ELISA will be used to simulate detection of an HIV infection. My Own Country: A Doctor's Story will allow students to see HIV-1 as an emerging pathogen and how this pathogen changes the lives of the people it afflicts. The SanDisk Cruzer will allow the computer work to be downloaded for safe storage, presentation, sharing, and grading.

**Resources available from North Marion & Marion County:**

- 1) Classroom set of EETT Grant apple book computers that can be utilized for viewing molecules and making the imovie.
- 2) \$500 award from Grants for Great Ideas to purchase the 25 SanDisk Cruzers.

**Theme: Emerging Pathogens**

<b>Lesson Title</b>	HIV-1: A Model of Evolutionary Genetics
<b>Grade Span</b>	10th-12th grade
<b>Content Emphasis (Mathematics or Science)</b>	Science
<b>Targeted Benchmark(s)</b>	SC. F. 2. 4. 3 understand the mechanisms of change (e.g., mutation and natural selection) that lead to adaptations in a species and their ability to survive naturally in changing conditions and to increase species diversity.
<b>Author(s)</b>	Carla Dee Reedy
<b>School</b>	North Marion High School
<b>District</b>	Marion County
<b>Lesson Preparation</b>	
<p><b><u>Learning goals:</u> What will students be able to do as the result of this lesson?</b></p> <p>When this unit is complete, the student will be able to:</p> <ul style="list-style-type: none"> <li>• Illustrate the parts of HIV-1 in a cartoon-type model and complete a flow chart of its life cycle.</li> <li>• Use Jmol on <a href="http://www.rcsb.org/pdb">www.rcsb.org/pdb</a> to look at 3-d images of the subtypes of the HIV-1 molecule and describe any differences they see.</li> <li>• Use Genbank at <a href="http://blast.ncbi.nlm.nih.gov/Blast.cgi">http://blast.ncbi.nlm.nih.gov/Blast.cgi</a> to find the various subtypes of HIV-1 and create a phylogenetic tree for these subtypes.</li> <li>• Carry out a simulated ELISA on HIV-1 and describe the purpose of each step.</li> <li>• Discuss some of the ramifications of HIV-1 on various individuals and society after reading the book <u>My Own Country: A Doctor's Story</u>.</li> <li>• Identify the way in which HIV spread in the United States and its prevalence in the state of Florida.</li> <li>• Create an imovie that explains how HIV-1 is an emerging pathogen and save their presentations to a thumbdrive.</li> </ul>	
<p><b><u>Estimated time:</u> Please indicate whether this is a stand-alone lesson or a series of lessons.</b></p> <p>This teaching module will require four weeks to complete beginning with a pretest followed by teacher-directed instruction about emerging pathogens and HIV-1. Students will then complete a series of activities that will allow them to visualize nucleic acids using computer programs, compare viral RNA using Genbank, create a phylogenetic tree for HIV-1 using Genbank, and simulate testing for HIV using an ELISA. During this time, students will be reading the book <u>My Own Country: A Doctor's Story</u> and will discuss how HIV-1 has impacted both individuals and society. Near the end of the unit, students will create an iMovie revealing HIV-1 as an emerging pathogen. At the end of the unit, students will take a post-test.</p>	

**Materials/Resources: Please list any materials or resources related to this lesson.**

1. Classroom set of apple book computers
2. 25 SanDisk Cruzers
3. Websites: Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb), Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi>
4. ELISA ImmunoExplorer from BioRad
5. 30 Copies of My Own Country: A Doctor's Story
6. Butcher paper, drawing paper, markers

**Teacher Preparation: What do you need to do to prepare for this lesson?**

1. Devise protocols and grading rubric for the cartoon illustration of HIV-1 and the flow chart of its life cycle.
2. Prepare discussion questions for each reading section of My Own Country: A Doctor's Story.
3. Devise protocols and grading rubric for HIV-1 model comparisons.
4. Devise protocols and rubric for developing phylogenetic tree of HIV-1.
5. Copy protocols & questions for lab on the Spread of a Pathogen in a Community.
6. Preview directions and materials for lab on ELISA ImmunoExplorer from BioRad .
7. Prepare pre and post test for the HIV unit.
8. Prepare the grading rubric and preplanning sheet for the imovie on HIV-1.

**Lesson Procedure and Evaluation**

**Introduction: Describe how you will make connections to prior knowledge and experiences and how you will uncover misconceptions.**

I will introduce the lesson with a KWL on HIV-1 using butcher paper. I will address experiences and misconceptions most strongly in the discussions from the book My Own Country: A Doctor's Story. Additionally, we will explore the spread of HIV-1 through the use of the CDC website.

**Exploration:** Describe in detail the activity or investigation the students will be engaged in and how you will facilitate the inquiry process to lead to student-developed conclusions.

Evolutionary biology is often a difficult concept for students to understand and accept. Philosophical, cultural, or religious views often cloud the issue and make teaching controversial. Allowing students to discover the obvious changes in HIV-1 over time teaches evolutionary principal. Student will use resources on government websites and exploration to discover how viruses evolve. Students will discuss emerging pathogens and their ramifications as the read the book My Own Country: A Doctor's Story. Most of the activities of this unit are guided exploration.

**Application:** Describe how students will be able to apply what they have learned to other situations.

Students will know how to use web sites that model molecules, produce phylogenic trees, and give the history of the spread of disease. Students will know how to use an apple book computer for imovie presentation and will have other basic computer skills. They will also know how to use a thumb drive. All of these can be used in other courses and learning situations.

**Assessment:** Describe how student knowledge is being assessed at the appropriate cognitive level for the targeted benchmarks.

Student knowledge is being assessed using a post test appropriate to high school aged students. Questions will be similar to those type used on a school-wide exam generator that uses level 2 and 3 type FCAT questions. Other assesments will be generated from project rubrics for each hand-on lessons.

**Teacher Self-Reflection:** Record your thoughts on the lesson and describe any modifications you would recommend based on the outcomes.  
**Not applicable yet.**

**SCIENCE LESSON PLAN FORMAT Sample**

Adapted from UF course SCE 6338 taught by Dr. Linda Jones

**\*TITLE:** HIV-1: A Model of Evolutionary Genetics

**KEY QUESTION(S):** What is the structure and life cycle of HIV-1? How do shapes of the different subtypes of HIV-1 compare? Has the HIV-1 molecule mutated over time? Can an ELISA test be used to indicate the presence of HIV-1? How does HIV-1 and other emerging pathogens affect the lives of those it infects? How did HIV-1 spread in the United States and in the state of Florida?

**\*SCIENCE SUBJECT:** Biology & Genetics

**\*GRADE AND ABILITY LEVEL:** 10th to 11th grade average to above average

**SCIENCE CONCEPTS:** DNA & RNA replication, mutation, emerging pathogens, spread of pathogens in a community

**OVERALL TIME ESTIMATE:** four weeks

**LEARNING STYLES:** Over the course of 4 weeks, all learning styles, but an emphasis on kinesthetic.

**VOCABULARY:** model, nucleic acid, DNA, RNA, gene, replication, enzyme, mutation, retrovirus, phylogeny, ELISA, pathogen

**LESSON SUMMARY:**

Week 1) Complete a KWL on HIV-1. Record on butcher paper to review at the end of the project. Begin reading the book *My Own Country: A Doctor's Story*. Illustrate the parts of HIV-1 in a cartoon-type model and complete a flow chart of its life cycle. Use Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb) to look at 3-d images of the subtypes of the HIV-1 molecule and describe any differences they see. Model the spread of HIV in a community during lab. Preview the imovie rubric and have students begin collecting materials for their presentation.

Week 2) Identify the way in which HIV spread in the United States and its prevalence in the state of Florida. Discuss the initial chapters of *My Own Country: A Doctor's Story*. Use Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi> to find the various subtypes of HIV-1 and create a phylogenetic tree for these subtypes.

Week 3) Discuss some of the individuals in *My Own Country: A Doctor's Story*. Complete a preplanning sheet for imovie. Learn how to use the imovie basic settings. Carry out a simulated ELISA on HIV-1 and describe the purpose of each step.

Week 4) Discuss and document some of the ramifications of HIV-1 on various individuals and society after reading the book *My Own Country: A Doctor's Story*. Create an imovie that explains how HIV-1 is an emerging pathogen and save to thumbdrive.

Wrap-up: Demonstrate learning by completing a posttest on emerging pathogens, HIV-1, the use of phylogenetic trees, HIV-1 impact on individuals, and ELISA testing. Present imovies.

**\*STUDENT LEARNING OBJECTIVES WITH STANDARDS:**

1. Illustrate the parts of HIV-1 in a cartoon-type model and complete a flow chart of its life cycle.

SC.912.N.3.5:

2. Use Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb) to look at 3-d images of the subtypes of the HIV-1 molecule and describe any differences they see. SC.912.N.3.5
3. Use Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi> to find the various subtypes of HIV-1 and create a phylogenetic tree for these subtypes. SC.912.N.3.5
4. Model the spread of HIV-1 through a community SC.912.L.16.7
5. Carry out a simulated ELISA on HIV-1 and describe the purpose of each step. SC.912.L.16.7:
6. Discuss some of the ramifications of HIV-1 on various individuals and society after reading the book My Own Country: A Doctor's Story. SC.912.L.16.7
7. Identify the way in which HIV spread in the United States and its prevalence in the state of Florida. SC.912.L.14.6:
8. Create an imovie that explains how HIV-1 is an emerging pathogen. SC.912.L.14.6, SC.912.L.16.7:

**\*MATERIALS:**

1. Cartoon illustration of HIV-1 and the flow chart of its life cycle- paper, markers, color pencils
2. Discussion My Own Country: A Doctor's Story, one book per student
3. HIV-1 model comparisons apple book for every student & a thumb drive per student
4. phylogenetic tree of HIV-1-apple book for every student & a thumb drive per student
5. Copy of protocols & questions for lab on the Spread of a Pathogen in a Community, 5 ml of 1 M NaOH, 20 ml. phenothalein, 200 ml of dH<sub>2</sub>O character cards- 1 per student
6. Directions and materials for lab on ELISA ImmunoExplorer from BioRad
7. imovie on HIV-1 - apple book for every student & a thumb drive per student

**\*PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES:**

Week 1-

- Complete a KWL on HIV-1. Record on butcher paper to review at the end of the project.
- Begin reading the book My Own Country: A Doctor's Story.
- Illustrate the parts of HIV-1 in a cartoon-type model and complete a flow chart of its life cycle.
- Use Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb) to look at 3-d images of the subtypes of the HIV-1 molecule and describe any differences they see.
- Model the spread of HIV in a community during lab.
- Preview the imovie rubric and have students begin collecting materials for their presentation.

Week 2-

- Identify the way in which HIV spread in the United States and its prevalence in the state of Florida.
- Discuss the initial chapters of My Own Country: A Doctor's Story.
- Use Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi> to find the various subtypes of HIV-1 and create a phylogenetic tree for these subtypes.

Week 3-

- Discuss some of the individuals in My Own Country: A Doctor's Story.

- Complete a preplanning sheet for imovie.
- Learn how to use the imovie basic settings.
- Carry out a simulated ELISA on HIV-1 and describe the purpose of each step.

#### Week 4-

- Discuss and document some of the ramifications of HIV-1 on various individuals and society after reading the book My Own Country: A Doctor's Story.
- Create an imovie that explains how HIV-1 is an emerging pathogen.

#### Wrap-up

- Demonstrate learning by completing a posttest on emerging pathogens, HIV-1, the use of phylogenetic trees, HIV-1 impact on individuals, and ELISA testing.
- Present imovies.

#### **\*ASSESSMENT SUGGESTION:**

1. Illustrate the parts of HIV-1 in a cartoon-type model and complete a flow chart of its life cycle - pass out a rubric for completing assignment and use to grade.
2. Use Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb) to look at 3-d images of the subtypes of the HIV-1 molecule and describe any differences they see- pass out a rubric for completing assignment and use to grade.
3. Use Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi> to find the various subtypes of HIV-1 and create a phylogenetic tree for these subtypes-pass out a rubric for completing assignment and use to grade.
4. Model the spread of HIV-1 through a community- Students track their "interactions" on a data table over the period of 30 seconds, record whether or not they are infected after 30 seconds, copy a table detailing everyone's interactions, try to determine "patient 0" in this community, calculate the percent infected, & analyze the number of partners verses the chance of infection.
5. Carry out a simulated ELISA on HIV-1 and describe the purpose of each step - complete data section and questions provided by the kit.
6. Discuss some of the ramifications of HIV-1 on various individuals and society after reading the book My Own Country: A Doctor's Story, participation in discussions using a participation sheet & answer questions for each chapter.
7. Identify the way in which HIV spread in the United States and its prevalence in the state of Florida- Student access the CDC site and fill out a US map showing the movement of HIV-1 in the U.S., then they complete a map for the state of Florida showing current infection rates by county, students will also document the subtype move of HIV-1 and complete a data table on this information.
8. Create an imovie that explains how HIV-1 is an emerging pathogen -pass out a rubric for completing assignment and use to grade.
9. Pretest and Posttest with a review.

#### **\*RESOURCES/REFERENCES:**

1. Jmol on [www.rcsb.org/pdb](http://www.rcsb.org/pdb)
2. Genbank at <http://blast.ncbi.nlm.nih.gov/Blast.cgi>