

Beware! Hidden Pathogen Exposed!

Correspondence Information:

David S. Fenster
Coconut Creek High School

Abstract: Avian Flu Virus, Type H5N1 is the most virulent form of this “Emerging Pathogen.” A total of 15 subtypes of influenza virus are known to infect birds, with the result that an extensive reservoir is circulating in bird populations. After circulating for short periods of time in a poultry population, viruses of low pathogenicity can mutate to highly pathogenic viruses. H5N1 mutates rapidly and has a propensity to acquire genes infecting other animal species. Its ability to cause severe death and disease in humans has been documented. The increasing incidence of H5N1 in birds and the accompanying increase in opportunities for direct infection of humans pose the likelihood that humans concurrently infected with human and avian influenza strains could become “mixing vessels” for the emergence of a new subtype with sufficient human genes to be transmitted easily from person to person. This proposal will engage students in a comprehensive exploration of the history, structure, and function of the H5N1 and other subtypes, and a comprehensive exercise in how to distinguish science fact from science fiction in the context of the history of journalism surrounding the “Bird Flu Scare.”

Mission Statement: My Mission, in keeping with the Mission of Coconut Creek High School , is to deliver to my students a rigorous science education which engages critical thinking skills by requiring a high degree of literacy in reading, writing, and mathematics, while exposing students to the most current biotechnological concepts.

Description of Teaching Unit:

Part A

This Unit must appeal to a diversity of students. This Unit must teach content rigorously, in an engaging way, and appeal to a diversity of learning styles. Students will research the original vector and history of transfer of Avian Influenza A H5N1, and the proliferation of its subtypes. We will try to understand *why* the H5N1 type is the most virulent of the species. Next, we will dig deeper to probe the nucleotide sequence. Students will cleave a known DNA sequence with at least two restriction enzymes, amplify the resulting fragments via the Polymerase Chain Reaction (PCR), then use gel electrophoresis to confirm the existence of, and visualize these fragments. Finally, we will model the crystallization of a portion of the peptide sequence of the hemagglutinin residue by crystallizing a known portion of the peptide sequence of lysozyme.

Part B

Most of my students are television hogs. If it’s a “current event,” especially a “sensationalized” current event, chances are my students know about it even before I do. South Florida Residents know about WSVN—Channel 7—known for their ability to contaminate a forecast for April

showers such that it is perceived as one for a Category-5 Hurricane. I have actually been to their studio offices—their “Reporter’s Floor” wall banner states: “If it bleeds, it leads!” So much is known about this pathogen that is true, and so much has been reported that is false. Enabling my students to separate science fact from science fiction is a must. Therefore, my students will be required to prepare a rubric-based research assignment. I may have access to a public speaker in this area via contacts through our Journalism teacher!

Description of target audience: Most of my students are “in-need.” More than 80% are of Caribbean extraction. Many come from nontraditional families, and have not been fortunate to have been raised by Parents or Guardians who were positive role models to reinforce either the priceless value of an education, or the habits of mind which a young person must practice to be successful in the pursuit of an education.

Expected Outcomes:

- 1) Use the Avian Flu Virus as our Model Emerging Pathogen.
- 2) Define “Emerging Pathogen.”
- 3) Develop opinions on media coverage of edpiemics.
- 4) Understand how the function of the H5N1 and each subtype depends on the structure of each subtype.
- 5) Define Polymerase Chain Reaction (PCR).
- 6) Carry out the complete amplification of a DNA fragment of known sequence.
- 7) Define DNA, DNA polymerase, denature, anneal, template, primer, dideoxynucleotide, taq polymerase, oligonucleotide
- 8) Explain the function of each step and component of the PCR process.
- 9) Explain what can be learned from protein crystallization.
- 10) Crystallize lysozyme, we know its primary structure.
- 11) Explain the purpose of every step of the protein crystallization procedure.
- 12) Explain how this protein crystallization is a model for the structure and function of the avian flu virus.
- 13) Compare and contrast the structure and function of each of the subtypes of the avian flu virus.

Competency of the Principal Investigator to Carry Out this Investigation: I will start my six year teaching the biological sciences in August, 2008. My B.A. is in Biochemistry, and my M.S. Ed. is in Secondary Education. I am conversationally fluent in Haitian-Creole. Therefore, I can engage and parents who are unable to communicate effectively in English, and I will do so with pleasure even for the parents of students who are not my own. Per my Principal, Mr. Eugene Butler, Jr., “Teamwork makes the Dream work.” For my Undergraduate Senior Thesis, I developed a original procedure to purify dihydrofolate reductase from *Drosophila melanogaster* larvae. From 1990-1993, I was a Graduate Student in the Department of Biochemistry at the University of Illinois at Urbana-Champaign in the Laboratory of Dr. Richard Gumport, one of the co-Authors of the classic text “Biochemistry” by Lubert Stryer of Stamford University. From July 3-8 I will make my second trip to Haiti (my first trip occurred from January 2-7, 2008; my visit is cited in the fifth paragraph on <http://www.konpay.org/crp/node/167>) during which I will solidify the partnership between CCHS and three schools near Jacmel, the largest city in southeastern Haiti. I will interview all students and teachers, and deliver a curriculum, which

these teachers will implement in the context of their immediate environment near Jacmel. I will maintain routine contact with all teachers and students, and assess all results using the techniques of Action Research, with which I have prior experience.

I have already completed the Official College Board Advanced Placement Biology Summer Institute. Additionally, I have twice completed the similar Summer Institute offered by the School Board of Broward County's Department of Advanced Academics. I am also endorsed to teach Gifted Students. Finally, I am a Candidate for National Board Certification. What does all this mean? This means that I am high qualified to successfully expedite to fruition all facets of this Minigrant. Period!

Feasibility: This proposal works because all steps have been carefully and systemically performed in advance by me and my colleagues. Additionally, these procedures will be performed by Advanced Placement Biology Students who have been personally preselected by me based upon their academic records, recommendations from other science and nonscience teachers, and upon their GPAs. Even the most self-disciplined students are human, and should unexpected, negative results occur, we will apply the scientific method in our best effort to determine the cause of the error. No matter how positive the results may seem, my students will empirically suggest means for new research using these experiences as their quantitative and qualitative inspiration.

✓ Finally, this Proposal will be the foundation for my submissions for these Grants:

- 1) Bingham
- 2) others publicized through the NSTA
- 3) others publicized through the NBTA

Literature Cited:

Charles D. Lawrence, Drs. Mavis and Rob McKenna

Budget: \$200

Budget Justification:

Supplies to help students construct 3D models of what they see at the microscopic scale:

Foam balls: \$50

Colored plastic toothpicks: 25

Popsicle sticks: \$10

Paint: \$15

Artistic plastic: \$50

Artistic wire: \$50

Lesson Plan:

- 1) Though this lesson plan is presented in a stand-alone format, it is open-ended to the extent that there is no tight timeline. We will probably cover total content during approximately one month.
- 2) Students will perform background research on the topic of “Emerging Pathogens.” They will do this to propose answers to these questions: a) “What is an emerging pathogen?” b) How does the “Bird Flu” fit the definition of an “emerging pathogen” that may be potentially harmful to the human population of South Florida? c) To what extent have South Florida newspapers thoroughly covered the topic of emerging pathogens since 1998?
- 3) Students will then prepare to, and engage in a formal, parliamentary-style open debate on this topic:
“ARE SOUTH FLORIDA HEALTHCARE EXPERTS PREPARED TO HANDLE A BIRD-FLU PANDEMIC, OR ANY PANDEMIC?”
- 4) Following this debate, or in-line with this debate, we also will have addressed these topics: replication, transcription, translation, PCR, virus morphology and reproduction, and the history and technology of protein crystallization.
- 5) Resources used include these DNA Dolan Learning Center Biology Animation Library lessons completed in teams of two: Cloning 101, Cycle Sequencing, DNA Arrays, DNA Restriction, DNA Transformation 1, DNA Transformation 2, Gel Electrophoresis, Model Organisms, Polymerase Chain Reaction.
- 6) and these HHMI Biointeractive Virtual Labs done in teams of two: The Bacterial Identification Lab, The Immunology Lab, and the The Transgenic Fly Virtual Lab.
- 7) The Drs’. McKenna ICORE Powerpoint is an invaluable information resource on the history of H5N1, and technology of protein crystallization.
- 8) Websites and journal articles to help visualize the H5N1 residue of the Avian Flu Virus are: <http://www.scienceonline.org/cgi/content/full/312/5772/404>
The structure of H5N1 avian influenza neuraminidase suggests new opportunities for drug design. [Nature. 2006 Sep 7;443\(7107\):37-8.](#)
- 9) Dr. McKenna generously donated supplies to enable my entire AP Biology class to model the crystallization of the H5N1 hemagglutinin residue using lysozyme. Following the completion of this protocol, students will construct 3D models of what they view using ordinary art supplies purchased with the assistance of the ICORE minigrant. They will also be allowed to refer to online websites and journal articles. Examples of appropriate websites and journal articles are listed above.
- 10) ASSESSMENT:
Because this is AP Biology, I will test all content use conventional assessment which replicates the conditions and difficulty of the AP exam. For the PCR and protein crystallization labs, students will prepare formal lab reports using prepared data-collection handouts. For the 3D model, I am preparing a special rubric based on the nine Multiple Intelligences.