

Title: Biotechnology Identifying Bioterrorism

A study on the effects of performing bioterrorism-based biotechnology labs with high school Forensic Science students and their knowledge of current protocols and techniques on detecting biological warfare agents.

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Abstract: The purpose of this study is to analyze the effects of performing bioterrorism-based biotechnology labs with high school Forensic Science students and their knowledge of current protocols and techniques on detecting biological warfare agents. All students will perform an Ebola ELISA simulation in class while the UF field trip participants will perform a Dengue ELISA and analyze the results using gel electrophoresis. Data collection will occur through pre and post quizzes as well as a questionnaire for the field trip participants. Informal data collection will occur throughout the unit through discussions, activities, and lab reports.

Rationale:

This action research will target high school students in several Forensic Science classes. This class was chosen because of the lack of curriculum which allows for innovative ideas to be implemented. This action research is tied with my best practice submission dealing with biological and chemical weapons. My current unit on WMD and bioterrorism has some gaps. I would like to fill these gaps with more plausible real world scenarios that involve the use of biotechnology labs.

By coming to ICORE I've gained more knowledge about salmonella and botulism in food through Dr. Simonne's lecture. This can be connected to the real world through food borne illnesses and the possibility of weaponizing these pathogens. Many students have heard their parents talk about salmonella. Those who are involved in canning should definitely be made aware of the dangers of botulism. There are several examples of how these pathogens have been used in a bioterrorism attack in the past. In addition to this knowledge, I have gained more knowledge about how mosquitoes are vectors for several diseases that can be used as a biological weapon through Dr. Connelly's lecture and activities. Through a PowerPoint presentation I can convey this knowledge onto my students. Through a research project and hands-on lab activities, the students will be able to utilize this knowledge to successfully perform the activities and labs. The bioterrorism unit is completed after the interview/interrogation and ethics units. Typically students think of Forensic Science being mainly about murders and analyzing DNA and fingerprint evidence. It is unfortunate, but forensic science is often used in mass deaths. Forensic science can be used not just for DNA analysis of bodies, but to determine if a pathogen was used in a terrorist attack. To start, students

will take a pre-quiz about bioterrorism and the use of pathogens. This will determine their initial level of knowledge about the topic. Then we will discuss WMD and a few aspects of how pathogens can be used as a weapon. Students will then be assigned a biological or chemical weapon. They will research this topic and then create a PowerPoint or Prezi and present their material to the class. We will then discuss detection methods such as ELISA and gel electrophoresis. "We successfully developed antigen-detection ELISAs for nearly 40 different biological agents and antibody-detection ELISAs for nearly 90 different agents" (Lindler). Lindler has a section titled "Department of Defense Capabilities Supporting Bioterrorism Response" where the students can understand the 7 basic steps in a terrorist attack and how the DOD responds to each step. This will prepare those students who are going on the field trip to be able to understand and perform the ELISA for the Dengue curriculum. After the field trip, all students will perform the ELISA simulation in my class using my adapted Ebola lab. This is based on the dengue protocol, so the students who went on the field trip can then become student leaders during the lab. My goal is to make sure each class is represented on the field trip to succeed in this goal. Cunha has written an article discussing how emergency rooms recognize threats of bioterrorism. This will connect with the Ebola ELISA as well. As an extension, students can stay after school to watch "Outbreak". They will have guided questions to answer during the film.

Unit Plan: Bioterrorism

- Pre Quiz- analyzing student's initial level of knowledge
- PowerPoint on Bioterrorism- direct teacher-led lecture providing knowledge to students
 - o Include points from ICORE lectures
- Bioterrorism Student Research and Presentation- students gain specific knowledge on a particular topic and present their knowledge to their class
 - o (2) 90-minute class periods for research and formation of PowerPoint presentation or Prezi presentation
 - o Presentations will be done half periods at a time so the students don't become bored. The other half of the period will show videos regarding particular topics and will involve articles of prior attacks which will lead to class discussion. WMD's will also be discussed.
 - o One half period will involve discussion of biotech detection capabilities and vectors
 - ELISA
 - Gel electrophoresis
 - Vectors- explaining how different types can be spread
 - Mosquitoes and dengue
- Field trip to UF- up to 30 students- the ability to perform college-level labs on a real college campus will excite the students about science and the prospect of college. Students will gain skills using biotechnology apparatus
 - o Pipette by design- learn and practice micropipetting skills

- Dengue Activity describing how an ELISA works
- Dengue Lab- ELISA (actual)
- Dengue Lab- gel electrophoresis (dye simulation)
- Field trip questionnaire- analyze how the field trip impacted their knowledge and excitement levels
- Ebola Lab- ELISA (revised from Dengue Curriculum- Julie Bokor)- students will connect the knowledge base to skills/performance based
 - Students who went on the field trip can help lead this reaction
 - Simulation using invisible UV for positive tests
- Ebola article discussion- ER detection of bio agents- reading connected to science
- Post Quiz- analyze to show students have gained knowledge about bioterrorism

Data Collection: Pre and post-quizzes will be used for comparative data. Instead of having every student in my Forensic Science classes taking the quizzes, I will only collect from those students who want to participate so the data will be more truthful. CPS clickers will be used so the quantitative data can be analyzed later. A questionnaire will be given to those students attending the field trip and will be analyzed qualitatively. Informal assessments will occur during classroom discussions, debates, and lab reports.

ICORE Connections:

1. Dengue Curriculum- Julie Bokor
2. Adapted Dengue ELISA simulation- Chuck Lawrence and Julie Bokor
3. Food borne pathogen lecture- Dr. Simonne
4. Mosquitoes as vectors lecture- Dr. Connelly

New pedagogies: The lab simulations and activities will allow the students to perform the tests and recognize how real forensic scientists might be involved in determining whether a pathogen was used in a particular case. This hands-on approach is different than my usual lecture and research project. I believe that this will allow more students to understand the protocols and be more engaged in discussions. When students are engaged they are better able to retain information. This will better prepare students for college science classes by being exposed to biotechnology techniques.

Resources:

Cunha, B. A. "Anthrax, tularemia, plague, ebola or smallpox as agents of bioterrorism: recognition in the emergency room" *Clinical Microbiology and Infection*, Volume 8, Issue 8, 28 AUG 2002. < <http://onlinelibrary.wiley.com/doi/10.1046/j.1469-0691.2002.00496.x/pdf>>

Lindler, Luther E., Lebeda, Frank J., Korch, George Ed. "Biological Weapons Defense: Infectious Disease and Counter Bioterrorism (Infectious Disease)." Humana Press, 2005.

Budget: The following items are needed to support the adapted lab simulation for Ebola in my classroom.

-Yellow centrifuge tubes (with 5 samples and 8 groups= ~40 tubes needed) packs of 500 for ~\$20

-(3) invisible UV Blacklight Reactive 3 color marker. Order code RSINVP3. \$2.49 each at <http://www.blacklight.com/items/RSINVP3>