

Vampire and Zombie Forensics – Analysis of Pathogens in the Water Around You

Inga Pinnix
Sandalwood High School
2750 John Prom Blvd.
Jacksonville, FL 32246
pinnixi@duvalschools.org

Abstract:

AVID Biology students at Sandalwood High School will become members of a forensics team charged with learning about the pathogens found in water. An overall goal is initial student engagement and improved student attention and performance. Biotechnology lab activities and subsequent analysis will support practical, real-world applications for measurement, using the scientific method, examining genetic variation, characterizing proteins, and monitoring environmental factors. Each type of information will be applied to understanding the mechanism, transmission, and therapeutic intervention for several diseases caused by emerging pathogens. By the end of the forensic investigation, students should be equipped to solve scientific problems with greater confidence and a greater awareness of connections between Biology learned in class and real-world applications. Assessments will include pre- and post-test data, grading of an AVID Interactive notebook, accurate completion of lab workpages, item analysis of test questions, and adequate progress on an individually chosen project.

Rationale:

Teaching Biology during high school involves the usual challenges that all science teachers face, which includes keeping students of various levels engaged during the course of the year. Biology has a large number of facts, vocabulary, and processes that students need to understand, and students can struggle with connecting what they are learning to the real world. In addition, some students enter class with a neutral to poor attitude about their analytical problem solving skills and scientific abilities. Also, struggling students are at various stages of defeat with regards to their scholastic potential by the time that they reach high school.

Biology teachers are therefore faced with the challenge of maintaining student engagement throughout the school year. The goals of this proposal, which will be taught to 10th grade AVID and other standard level students, are:

- to add an ongoing Emerging Pathogens unit as an immediate engagement tool
- to show students a real world relevance Biology concepts
- to create connections to the district curriculum and state and national Science standards throughout the year
- to use the proposal and created scenarios and activities to further develop the analytical skills required for the scientific method
- to provide fresh ideas for Science Fair projects, and
- to support service learning opportunities for 1 or more school Science Clubs

In addition, the Emerging Pathogens materials will be useful for innovative Girl Scout camping ideas as well as other community and after school groups for Science workshops.

Teaching Unit and Expected Outcomes:

The unit will be intermingled with the upcoming revised district curriculum at points which are correlated to Biology content and NGSSS:

- **SC.912.N.1.4** Identify sources of information and assess their reliability according to the strict standards of scientific investigation.
- **SC.912.L.17.16** Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.
- **SC.912.L.18.12** Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.
- **SC.912.L.16.10** Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

This proposal will include the following student outcomes (most of the final two outcomes will take place during the optional UF Field trip described later in this proposal):

- Students will test environmental water samples of their choice for *E. coli* and coliforms.
- Students will learn about water borne vectors, pathogens, and chemical contaminants such as coliforms and *E. coli*, mosquitos, and endocrine disruptors as well as the associated diseases that result from exposure to these components.
- Students will maintain an Interactive lab notebook (AVID) and enhance their analysis and problem solving skills as applied to laboratory research, and
- Students will connect Biology theory to real-world problems and complete a project illustrating their understanding of pathogens.
- Students will learn microscale measurement techniques using micropipettors and should better understand significant figures and the importance of appropriate measurement size.
- Students will learn the mechanisms of biotechnology techniques including DNA and gel electrophoresis, DNA microarrays, and PCR.

Data Collection:

- Emerging Pathogens Pre-test
- Emerging Pathogens Interactive Journal Pre-Entries
- Item Analysis on Selected Test questions
- Final product for each activity (*i.e.*, lab reports and completed workpages)
- Emerging Pathogens Post-test
- Emerging Pathogens Interactive Journal Post-Entries
- Student Evaluation of Emerging Pathogen Activities
- Interactive Biology notebook grading
- Final Project Grade

Use of UF Equipment Lockers:

- Viral, Water Pathogen and Environmental Microarrays Simulations
- Mosquito Hatchery and Identification Kit
- Medical Mystery and Outbreak at Sandalwood Scenarios

UF Field Trip (optional if school funds are available):

PCR/DNA gel electrophoresis - protocols for mosquito extraction followed by PCR of mosquito DNA or Outbreak PCR and DNA Fingerprinting labs (methods chosen will depend on successful interaction with UF faculty or on kits available in the CPET labs).

ICORE Summer Institute Elements:

- Equipment Lockers listed above
- Elements of the Dengue Curriculum
- E. coli colorimetric activity DNA gel electrophoresis with dyes
- DNA gel electrophoresis with dyes
- Faculty presentations by Drs. Gabriel, Connelly, Teplitski, Clark, Johnson, and Kane – selected slides
- Student reading: “The Bug Spit Guy”; Dengue scitable

New Additions to the Curriculum:

Each of these elements is new to the curriculum. The engagement part will start by introducing a daily fact or question starting with the fourth week of school, displaying wiggling water for the students, inviting students to contribute to an art banner, and placing some special theme effects (zombie fingers, fake blood, etc.) in the classroom. Students will be invited to join the Vampire, and Zombie Forensics Team. They will test local water samples for E. coli and coliforms as discussion begins about emerging pathogens. The Medical Mystery will be conducted a couple of weeks later as students learn about the requirements for Science Fair.

Students will use microarrays and learn about environmental agents after they work on chemical reactions and organic molecules. Details about the Deep Horizon oil spill will be discussed. An extension of this work will be the UF field trip with pipetting, PCR, and DNA gels; and the students will tour Dr. Kane’s lab (if available and time permits) and the UF campus. At least one movie will be shown and discussed (Contagion). Each student will be responsible for producing a book study report, general paper, brochure, PSA, or Webquest report on a disease caused by an emerging pathogen.

There will also be several extracurricular components that will not be tracked within the data analysis of this proposal but which utilize ICORE elements. Members of the Junior Academy of Sciences will learn more about each technique to share with students at area middle schools as part of the club demonstration team. Girl Scouts will work with the forestry activities from Project Learning Tree, and selected labs will be chosen for community science workshops and after school programs.

Literature cited:

- Dr. Conley’s papers
- Dr. Johnson’s papers
- Dr. Kane’s papers
- Benskin, Jon and Chen, Sixue; Proteomics in the Classroom: An Investigative Study of Proteins in Microorganisms; *The American Biology Teacher* 74: 237-243; 2012.
- Cushman, Kathleen; Fires in the Bathroom: Advice for Teachers from High School Students, The New Press, New York, 2003.
- Interdisciplinary Science references

Budget and budget justification (\$230):

The goal of the proposal will be to enrich the curriculum for the current school year while laying the foundation for creating a sustainable system that can be used in future years.

Contagion and Food Inc movies (\$20)
Mosquito posters and resources from IFAS (\$20)
Mosquito breeders from Bioquip (\$50)
E. coli detection reagent kit (\$50)
Black lights and black light pens(\$60)
Books for book study (\$30)

**Additional funds will be supplied by school science funds