PROPOSED LESSON

to fulfill the requirement for

The UF HHMI Interdisciplinary Center for Ongoing Research / Education Program

Title: The Role of Microorganisms in Research, Medicine and Biotechnology

Name and correspondence information for PI:

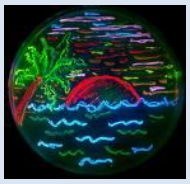
Kathryn Kehoe
Ponte Vedra High School
460 Davis Park Road
Ponte Vedra, FL 32082

Abstract: While an important tool in molecular biology and biotechnology is the model organism E. coli, certain strains of this microbe have the ability to sicken and kill. This proposal details a unit of study focusing on the dichotomy that exists for microbes in general. Third year biotechnology students will learn of the" good and bad "of microorganisms. An important goal is to provide open ended activities that are considered authentic research. The central experiment will be to study the effect of mutagenic UV exposure on a *Serratia marcescens* electrophoretic protein profile by the sequencing of differential peptides. As a class project this should be interesting, but also demonstrates a technique that could be applied in individual student projects. Students will be assessed using traditional pre and post tests and guided lab reporting. The ultimate assessment is the number of students returning for a fourth year research experience.

Rationale:

This unit is designed to introduce third year biotechnology students to the use of microorganisms as tools to study topics of importance to human health, safety and the development of products, while also providing an appreciation for the potential of these to do harm. Students in Biotechnology III are familiar with many of the important techniques used in biotechnology, including PCR, electrophoresis, proteins assays and recombinant DNA technology. The goal of this third year is to continue the development of these skills and to combine the use of these tools with exposure to important model organisms used in biotechnology research. While popular model organisms to be studied in the third year include *Drosophila, C. elegans* and Arabidopsis, this unit will focus on the biotech workhorse, *E. coli* and other microbes, while also noting the pathogenic strains of these tools. Students are exposed to several genetic disorders in the first two years of biotechnology. The secondary goal of this unit is to provide exposure to disease that occurs due to pathogenic organisms. The rationale is that project based studies to be undertaken, will assist the students in the development of a research topic commissioned during the fourth year of study.






Description of teaching unit or module(s), including expected outcomes

This unit will focus on the Florida Department of Education CTE Performance standard 21, 44 and 57.

Students will utilize basic knowledge of microbiology and blood-borne diseases, including AIDS

The activities of this unit will first concentrate on the use of microorganisms in biotechnology and research, focusing on the skills necessary for the propagation, manipulation and study of bacteria. The focus will subsequently consider the reciprocal concept--how biotechnology tools are used to study, detect and characterize microorganisms as pathogens and pests.

Individual lessons will include the following topics and concepts:

- Bacterial genetics including transformation and conjugation
- Testing for bacteria
  - Oral microbes using Metagenomics (PCR based)
    - Bioinformatics using primers. Experiment has been performed previously. PCR primers and reagents are available
  - *Water-borne pathogens using a variety of methods
  - *Cholera (Medical Mystery of Epidemic Proportions)
  - *Mosquito borne pathogens-Dengue Fever Case Study
  - Career Focus-Epidemiology
- Other viral pathogens and viral tools
  - HIV and AIDS (HHMI tools)
  - AAV and gene therapy
- Genotypic/phenotypic variation and the role of mutations in phenotype
  - *Proteomics (protein sequencing and identification)
  - Cancer biology
  - *Oncolytic Virotherapy

The full lesson plan to be submitted with the final draft will include the genotypic/phenotypic variation lab using *Serratia marcescens.* Students will grow cultures under different temperature conditions to confirm environmental phenotypic variation. After confirmation of response (temperature dependent pigment production) cultures will be exposed to different levels (time of exposure) of ultra-violet radiation to produce mutant forms incapable of pigment production. Proteins will be prepared and run on SDS-PAGE to observe differences in protein profiles between control, UV exposed pigmented and UV exposed un-pigmented bacteria. Protein bands of significance will be cut from gels and sent to Dr. Chen's lab for protein fingerprinting in advance of a scheduled field trip to the University of Florida for a data analysis session with the goal of identifying proteins showing differential expression.

The final lesson will provide a lead into the next unit which will focus on human cancer biology and then plants in biotechnology. Elements of the ICORE experience (*TSWV and citrus greening) will be used in the subsequent unit.

Data collection techniques and/or student assessments

Students will be given a pre-test to determine baseline information. As third year biotechnology students they will have knowledge of the use of microorganisms in biotechnology and their general education should have provided basic knowledge on pathogenic forms. We have not, however, formally addressed disease causing organisms. A pre-test will identify any misconceptions that may be present and instruction should emphasize dispelling these, as well as providing an introduction to emerging pathogens.

Students will be given lab summary sheets that will be graded. These will serve to organize the results of the lab activities into a standard reporting format of data presentation, results and conclusion.

Students will be asked to provide a student self-assessment sheet indicating their perceived level of mastery for objectives presented for each activity. This is a self-monitoring tool.
Students will be given a post-exam and a post-exam reflection sheet.
Students will be given a pre- and post-survey on attitude toward research and topic selection.

If applicable, use of equipment lockers and/or UF visit (either in the classroom or UF campus)

As stated above, I would like to schedule a field trip to the University of Florida so that students can be introduced to mass spectrometry and peptide identification

ICORE summer institute elements specifically included (UF connections)

Items identified by (*) on page two are ICORE elements that will be used to implement the activities described in this action proposal.

Literature cited

Proteomics in the Classroom: An Investigative Study of Proteins in Microorganisms, Jon Benskin and Sixue Chen The American Biology Teacher, Vol. 74, No. 4 (April 2012), pp. 237-243

Self-Monitoring Tools and Student Academic Success, Debra A. Bercher, Journal of College Science Teaching, Vol. 41, No.5 (May/June 2012), pp 26-32.

Budget and budget justification for Serriatia marcescens and proteomics lab.

Transportation to Gainesville	$1000 (Charter bus and teacher substitute)	Student funded Alternatively grant funding will be sought (previously awarded in 2009) http://sites.target.com/site/en/company/page.jsp?contentId=WCMP04-031880
SDS-Page gels	$114	Novex® 4-12% Tris-Glycine Mini Gels 1.5 mm, 15 Well Invitrogen EC60385BOX (PVHS uses Invitrogen products)
Serratia marcescens	$14.95	Serratia marcescens, MicroKwik Culture®, Vial Carolina Biological 155450A
Protein Standard	$85.43	**SeeBlue® Pre-Stained Protein Standard** **Invitrogen LC5625**
Running Buffer	$23.82	Novex® Tris-Glycine SDS Running Buffer (10X) Invitrogen LC2675
Sample buffer	$16.83	Invitrogen LC2676
Acetonitrile	$24.98	Fisher Scientific AA42311AK
Acteonitrile with 1% formic acid	$119	Fisher Scientific LS120-500