Vector-borne Diseases and Florida's Public Health

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Abstract: The goal in implementing this action proposal is to introduce the concept of vector-borne infections, the incidence of these infections in our state (specifically mosquito-borne), the importance of comprehensive mosquito control programs, and the impact that vector-borne infections can have on health and the economy in the state of Florida. Through a variety of learning opportunities, students will discover the world of microorganisms and their ability to cause disease, differentiate between bacteria and viruses, investigate different vectors and their ability to cause infections in other organisms and how to control their reproduction, and analyze and evaluate public health data concerning prevalence of specific vector-borne diseases. As an extension, students will create a public health campaign to educate the community about mosquito-borne infections and how to protect themselves.

Rationale: It is invaluable for residents of Florida to understand the prevalence of mosquito-borne infections within the state and the impact that these infections can have on health, agriculture, and tourism. By educating a sub-set of the population on prevention and symptoms, our students can then be ambassadors within their school and community.

Description of Teaching Unit: The target audience for this teaching unit will be my Health Science 2 students, which I will have during the 2nd semester. Health Science 1 and 2 are essentially dual credit courses offered on the Lemon Bay High School campus in partnership with our local Charlotte Technical Center. These students take 1 course a semester in the "block" for 90 minutes each day and earn a total of 2 credits during the school year. The majority of the students in the Health Science program are sophomores (may or may not have taken Biology) and some juniors (have completed biology). Health Science 1 students are introduced to general anatomy concepts, some basic physiology, cellular form and function, and medical abbreviations. These students then continue to Health Science 2. Health Science 2 covers a wide range of topics including but not limited to infection control, vital signs, medical terminology, medical ethics, cultural differences, and human growth and development.

Due to the varied population taking Health Science, I will begin this unit with a variety of learning activities to introduce the structure and classification of microorganisms. I will begin with a reading strategy known as an Open Word Sort. Students will be placed in groups and given a several laminated cards with the names of microorganisms (specific and nonspecific), disease states, and vectors. They will be asked to place these cards in groups according to their prior knowledge of these words. We will follow-up with a class discussion of the Word Sort made by each group. This activity can then be differentiated by giving some groups certain "headings" to drive their word sort. A lecture will then be presented to provide concrete information on microorganisms and their role(s) in our environment, both external and internal. Independent

student projects (posters) will be assigned for specific infectious diseases to include the causative agent, symptoms, treatment, and spread within a specific population. A laboratory extension from this introductory lecture will be centered around the culture and plating of environmental microorganisms, staining procedures for visualization, and microscopy for observation of different structures. Students should be able to describe the similarities and differences between bacteria and viruses, gram positive and gram negative bacteria, DNA vs. RNA viruses, and those laboratory procedures that allow for differentiation.

We will then direct our learning specifically to vector-borne diseases and their spread within a community. I think it valuable to introduce the wide variety of vectors that can spread infections and will differentiate between biological vectors and mechanical vectors. I will focus on mosquitoes and even more specifically on those mosquitoes found in Florida that are known vectors for human and zoonotic diseases. This will be a wonderful opportunity to use much of the information provided by Dr. Connelly. By retrieving water from area retention ponds, students will retrieve mosquito larvae with the BioQuip *Mini-mosquito Breeder*, observe their life cycle, and identify specific species of mosquito (following death) using the book provided by Dr. Connelly, *Common Mosquitoes of Florida*. This book provides information on known habitats and medical information, increasing the students' understanding of vector-borne infections. Students can use a variety of tools for specific identification, sketch what they observe under the dissecting scopes for comparison to the photographs in the book, and compare the information provided in the books to what we have learned in lecture. They can also make comparisons to the disease topics introduced by the various student posters. If allowed, this phenotypic identification of mosquito species can then be followed by a genotypic identification (see below in bold). Students should be able to discuss the life cycle of a mosquito, describe the importance of mosquito control mechanisms, and the incidence of disease-spreading mosquitoes in Florida.

Can I do specific DNA identification of the mosquitoes we have in our mosquito breeders? This is a possible extension of this activity that will require further investigation. If we have a known DNA sequence of specific mosquito species, can the students then grind mosquitoes, isolate the DNA and run a gel with known markers to genetically identify the mosquitoes collected from the retention ponds?

Finally, this lesson will conclude with the production of a public health education campaign on the control of mosquito-borne infections. Students will be placed in groups to select a specific infection and design a public health campaign to educate their fellow students and community members. Students will focus on the prevalence of those diseases that occur most frequently in the state of Florida. Essential is the ability to create graphics to illustrate the occurrence of disease in Charlotte County.

Lesson Extension: I am interested in collaborating with a fellow teacher at Lemon Bay High School that organizes a teacher mentoring program for high school students at our local elementary schools. High school students with an interest in Elementary education can shadow at one of three local elementary schools through our Teacher Preparation Program. These students also produce lessons for the classes that they attend daily for 1 semester. Using the

public health education campaigns created by my by Health Science students, the Teacher Prep students will design a learning module specific for the grade level they are mentoring. This will introduce the importance of mosquito control to an even younger, and more impressionable, population. For example, two fellow participants in the Summer 2010 ICORE program were natives of the Caribbean and shared their experience growing up where dengue is endemic. They are taught from a very young age to "kick over" any container with standing water to help control the mosquito population.

Data Collection Techniques/Student Assessment: This lesson offers several opportunities to assess the learning and retention of the material being presented. I love partner quizzes (formative assessments) in preparation for tests or projects which are summative assessments. Students will have the ability to demonstrate laboratory skills and the use of a variety of laboratory tools and equipment. I would make a variety of pictures (much like the pictures of equipment in the *Mission BioTech* Teacher Guide) to allow for identification of the laboratory tools and equipment used in this learning module and then can be used to assess their understanding of equipment name and function.

ICORE Elements: Several of the Summer 2010 ICORE informational and technical elements can be integrated into this learning module. First and foremost are the informational concepts of *emerging pathogens* and the impact they can have on a population. Dr. Glenn Morris' introduction to emerging pathogens from our first night, our visit to the Emerging Pathogens Institute, Dr. Connelly's presentation at the Entomology Lab concerning vectors and the diseases they carry, and finally the Rift Valley Fever outbreak simulation given by Dr. Gibbs are all great sources of information to drive initial discussion and discovery.

Technical elements can include isolation of DNA from specific mosquito species, PCR of specific sequences to allow for identification, and gel electrophoresis for the comparison of known markers for genotypic identification; this is in-addition to phenotypic ID through use of the booklet provided by Dr. Connelly.

Literature Cited:

- Summer 2010 ICORE binder elements
    - Dr. Morris Powerpoint elements: *Emerging Pathogens and Pandemics*
    - Dr. Connelly Powerpoint elements: *Insect-vectors and Florida's Public Health*
    - Dr. Gibbs Powerpoint elements and simulation: *Rift Valley Fever*
    - Lab Experiment #2: DNA Extraction, PCR, and Gel Electrophoresis
- Use of IFAS book *Common Mosquitoes of Florida*

Budget/Budget Justification:

- BioQuip Mini-mosquito breeder $9.95 each class set of 15 $149.25
- Common Mosquitoes of Florida Book $12.00 each class set of 15 $180.00
- Miscellaneous Supplies for PH Campaign $ 50.00
- Classroom set for implementation of DNA Lab(s) 8 stations $8,000 - $10,000
    - P20, P200, P1000 pipettes and pipette tips
    - 1.5 mL Eppendorf tubes
    - Micropestles
    - 0.02 mL PCR tubes
    - Thermal cycler
    - Analytical scale
    - Vortex
    - Mini centrifuge
    - DNA extraction chemicals
    - PCR chemicals
    - E-Gel Powerbase
    - E-Gels
    - UV trans-illuminator
- Visit from CPET staff for DNA Extraction, PCR, Electrophoresis PRICELESS