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Title:

“From Mother Nature’s Cookbook comes a Recipe for Disaster”

Abstract:

Many students are not mastering scientific thinking before moving on to the many other benchmarks within their science classes. It is important that students have a strong foundation on which to build their science knowledge for success on state tests and also to be successful in future endeavors. By walking students through this mini-unit using real-world scenarios the students can make observations, formulate questions, review what is already known, assess reliability from sources of information, carry out investigation and scientific practices which will help them pose answers and explanations, describe natural phenomena and use appropriate evidence to justify explanations to others. The labs activities and comprehensive instructional sequences (CIS) will also help students better communicate results and evaluate the merits of explanations that are produced by others. Through a pre- and post-test the students’ understanding of scientific thinking can be assessed giving the teacher a better picture of prior knowledge and knowledge gained from the mini-unit. A better understanding of scientific thinking will help students to pose more scientific questions about the natural world around them. It will also exercise their critical thinking skills, help with designing investigations to answer defined problems, and become more efficient problem solvers.

Rationale:

This mini-unit is being developed to be implemented in any science class, but will be piloted in Environmental Science (11th and 12th graders) and in Biology I (9th and 10th graders) classes. Since the mini-unit encompasses a variety of activities the manner in which the activity will be delivered will vary. For the article reading piece using CIS a whole-group approach will be used through the gradual release model (I do, We do, You do). For the lab activities (Menacing Microbes, Dengue Dilemma, and the Western Blot), along with the times the students study the life cycle of the mosquito, the students will be broken up in to 12 groups of 2 students. For the photo journaling activity the students will work independently.

The mini-unit is designed to support the benchmark dealing with scientific thinking, which falls at the beginning of the school year. This is an area of weakness recognized from both the state data and our district’s diagnostic data for Palm Beach Lakes High School (PBLHS). By starting off with a real-world view of a scientific investigation under the umbrella of emerging pathogens, the students will see how scientific thinking can be used to meet the 11 major areas of the Florida State Standard devoted to scientific thinking, which are: 1) define a problem based on a specific body of knowledge and further investigate to pose questions, 2) make observations, 3) examine literature on the subject, 4) review what is known in light of empirical evidence, 5) plan investigations, 6) use tools to gather, analyze, and interpret data, 7) pose answers, explanations, or descriptions of events, 8) generate explanations that explicate or describe natural phenomena (inferences), 9) use appropriate evidence and reasoning to

justify these explanations to others, 10) communicate results of scientific investigations, and 11) evaluate the merits of the explanations produced by others. These 11 skills of scientific thinking lay the foundation for which all science investigation, theory, and processes are built. Having this mini-unit constructed and taking place at the beginning of the school year will ensure the students practice using scientific thinking to build that strong foundation early as well as how it ties in to a real-world scenario and can be used in their everyday lives, and have impact on their future achievement in their science classes.

The mini-unit will have the student get the macroscopic view of disease in general and front load the vocabulary necessary to understand disease. Continuing to reveal the ingredients in Mother Nature's cookbook that are necessary to have disaster, the students will focus in on hosts, pathogens, and vectors which all must be present for a problem to develop, which will bring on the Dengue Dilemma scenario. Once the dilemma brings the view down to a much more personal level (Key West...very close to West Palm Beach), the students will then run a western blot to test "patients" for Dengue, which will then take us to the ELISA assay for testing antibodies and serotyping which form of Dengue the patients express. During these lab experiments, the students will also be observing the life-cycle of mosquitos via the breeding chambers, reviewing articles from the CDC about the data of mosquito-vectored diseases, and will culminate the mini-unit with a photo journal where the students will take photographs around their home and surrounding community of potential "breeding chambers."

With the mini-unit taking the students through a scenario of a Dengue outbreak in Key West, and just living a short drive from that area, it will culturally fit and be significant to the students at PBLHS. In the fall, an extension activity could be funded via the BEEF grant to have the students visit the Florida Medical Entomology Laboratory extension of the University of Florida. During the visit, the students could then spend the day learning about the work performed in mosquito control and the two forms of mosquito larva control (copepods and bacteria toxin). The grant can help supplant the expense of transportation cost along with any consumables needed for activities performed during the field trip.

For the mini-unit, there will be little need for overhead costs and each lab activity is easy to conduct with the students using the materials that are provided in lockers from the ICORE/UF equipment lockers. With the field trip being contingent upon the BEEF grant approval, it will not impact the success of the other activities should it not be funded. There is already commitment at the school for an Environmental Science and Biology I teachers to use the mini-unit during the suggested time slot. They have even suggested that this be used as a lesson study in the science department with a possibility of it being conducted later in the year with other teachers during applicable places in the pacing guides for Environmental Science and Biology I.

The resources for the materials mostly come from the ICORE/CPET website and include the article entitled "The Ecology of Disease" by Jim Robbins from the New York Times. The CDC website will be utilized to give up-to-the-minute data on Dengue disease outbreaks as well as a section on mosquito vectored pathogens. The laboratory activities for "Dengue Dilemma" and "Western Blot" are already provided by ICORE/CPET. Time will need to be spent with Dr. Connelly to help prepare for the potential field trip later in the first semester of school.

Timeline Overview:

The length of time needed for this proposal is over a two-week period to begin on the 2nd day of school for 7 school days (not necessarily consecutive days).

Student Outcomes:

Standard	The student will be able to ...
SC.912.N.1.1	<p>Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and Earth/space science, and do the following:</p> <ol style="list-style-type: none">1. Pose questions about the natural world;2. Conduct systematic observations;3. Examine books and other sources of information to see what is already known;4. Review what is known in light of empirical evidence;5. Plan investigations;6. Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs);7. Pose answers, explanations, or descriptions of events;8. Generate explanations that explicate or describe natural phenomena (inferences);9. Use appropriate evidence and reasoning to justify these explanations to others;10. Communicate results of scientific investigations; and11. Evaluate the merits of the explanations produced by others. <p>(Also assesses SC.912.N.1.4, SC.912.N.1.6, SC.912.L.14.4)</p>

Lessons:

- “The Ecology of Disease” article by Jim Robbins from the New York Times (Comprehensive Instructional Sequence Delivery of this article – will read the article 3 times)
 - Menacing Microbes Activity (30 minutes)
- Palm Beach County Mosquito Control Programs website (<http://www.pbcgov.com/erm/mosquito/health.htm>) (CIS Day 2 reading)
 - Mosquito breeding chambers (life cycle of mosquito, two controls of mosquito larva via copepods and bacteria toxins)
- CDC website on mosquitos as vectors for pathogens, with a focus on Dengue (<http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-3-infectious-diseases-related-to-travel/dengue-fever-and-dengue-hemorrhagic-fever>)
 - Introduce the Photo Journal activity to the students
- The Dengue Dilemma starting with the Western Blot activity.
 - Interactive CDC Dengue Map (<http://www.healthmap.org/dengue/index.php>)
- The ELISA assay to test proteins and serotype the type of Dengue from the Dengue Dilemma
- Are you contributing to Mother Nature’s Recipe? (Student reports out regarding their photo journal activity)

Data Collection Techniques:

- Pre-test/Post-test
- Formal Assessment
- Lab Report
- Photo journal

Use of Equipment Lockers/Field Trip to UF:

- Giant Microbes for the Menacing Microbes activity (that have the pathogens related to mosquito-vectored diseases included)
- Mosquito breeding chambers with mosquito eggs to hatch
- The Dengue Dilemma Lab w/ELISA simulation kit
- Western Blot Lab
- Possible trip to Vero Beach to the UF IFAS Extension Office (Florida Medical Entomology Laboratory)

Connections to ICORE Summer Institute:

- Article - "Ecology of Disease"
- Activities – Menacing Microbes; The Dengue Dilemma (Western Blot, and ELISA activity)
- Potential Field Trip (if BEEF grant goes through for funding)

Improvement on Traditional Teaching Techniques:

Scientific thinking has been taught in a variety of ways in the past and not with much success. Mostly power-point presentations and verbal examples have been given to present students with all of the 11 skills listed in the benchmark that focuses on scientific thinking. It is my hope that with the pre- and post-test being conducted, the use of a real-world scenario, having it brought "home" for the students by making them aware of how close this pathogen has come to being a problem in Palm Beach County, and ultimately how their actions impact the mosquito populations will be a huge improvement to the way this has been approached in the past.

Budget and Budget Justification:

Item	Cost	Vendor
Mosquito Breeding Chambers	15 @ 9.45	BioQuip
This item is essential to my module because... ...students will be able to study the life cycle of the mosquito during the mini-unit and even conduct future work during the school year.		
Invisible UV markers	Order code: RSINVP3 1@2.45	Blacklight.com
This item is essential to my module because... ...to create the ELISA trays to run the lab to serotype in the Dengue Dilemma scenario.		
Giant Microbes plush doll	15 @ ~8.95	Giantmicrobes.com
This item is essential to my module because... ...to create a set of microbes to use with the students and conduct future activities throughout the year.		

Literature Cited: (YES! THIS NEEDS HELP!!)

"Ecology of Disease" article
 Florida Sunshine State Standards in Science
 CDC website