

An Epidemic of Disease and Chemistry

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Abstract:

As part of the chemistry benchmarks, a unit on biotechnology and human impact on the environment is included but rarely highlighted. I will place an emphasis on the environmental component by teaching students about the spread of pathogens while incorporating various biotechnology skills. I will begin by using some basic lab procedures and continue with my bigger focus during the unit on acids and bases in the fourth quarter. I will teach the benchmarks about human effects on the environment using the simulation kit for Medical Mystery of Epidemic Proportions because it shows how humans are involved in the spread of disease while being based on an understanding of neutralization reactions, buffers, and indicators. By the end of the unit, students will understand how water quality is affected by human activities and pathogens while also gaining an understanding of how chemistry is applied outside of classroom settings.

Rationale:

In the benchmarks for chemistry, a unit on environmental impact is included but rarely highlighted. I will place an emphasis on the environmental component through the use of biotechnology in the field of emerging pathogens.

As I have one other colleagues from my school here at ICORE, we will be implementing some common activities that will incorporate the information on emerging pathogens and biotechnology presented. One of the common activities will be a pre and post test on general biotechnology skills and pathogen information. We will each have a non-ICORE teacher to serve as a control to our ICORE-information-exposed students. A second common component will be teaching kids about the spread of pathogens using glo germ at the beginning of the year. This will be done with, hopefully, everyone in our science department on the same day. Each teacher will be told to greet his/her students with a handshake to "contaminate" each student with glo germ lotion. Next, each student will be instructed to thoroughly wash his/her hands as the first step in the Following Directions lab they will be doing. This will teach students briefly about how germs are spread while also emphasizing an issue we all have in our classrooms: students need to pay better attention to procedures and directions during labs. The third component that will be shared within our action protocols will be a Designer Plates lab. I will use this to show students the difference between different volumetric units as well significant figures. I will modify this lab so that the designs students create are chemistry based while also adding a portion in which students design their own protocols for someone else to follow. The latter part of the lab will reinforce the importance of writing out detailed procedures and following them when doing activities.

Once the three shared components are complete, my main ICORE-inspired focus will occur during the unit on acids and bases in the fourth quarter - this is where the district has placed this component of the chemistry curriculum. I will be reintroducing the benchmarks about the human activities and their effects on the environment using the simulation kit for

Medical Mystery. The reason this simulation-style lab fits well with ICORE and chemistry is because it discusses emerging pathogens while using chemistry knowledge of neutralization reactions, buffers, and indicators. Additionally, information will be included in the lab that will extend into how the non-simulation tests for water quality rely on the use of chemistry topics taught in the course. The end result will be that students understand how water quality is affected by human activities while also gaining an understanding of how chemistry is applied outside of classroom settings.

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

This teaching unit, which will span 3 days, will focus on the following Physical and Life Science NGSSS:

- MACC.912.N-Q.1.3 Choose a level of accuracy appropriate to limitations on measurement when reporting.
- SC.912.L.17.15 Discuss the effects of technology on environmental quality.
- SC.912.P.8.11 Relate acidity and basicity to hydronium and hydroxyl ion concentration and pH.
- SC.912.N.4.2 Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental.

The learning outcomes are as follows:

1. Students will illustrate how accuracy and precision affect measurements.
2. Students will be able to explain how cholera affects humans and how drinking bottled water negatively impacts the environment.
3. Students will use technology to evaluate the quality of water for the presence of pathogens.
4. Students will describe how acids and bases react to form salt and water.
5. Students will present information about the importance of safe drinking water and the unnecessary use of bottled water in most American homes.

The student learning outcomes will be achieved through the completion of the following activities:

- Following directions lab with glogerm
- Designer Plates with Chemistry-related designs and student-produced protocols
- Case Study: "But it's just a bottle of water..."
- Case Study on cholera: The Mystery of the Blue Death: A Case Study in Epidemiology and the History of Science
- Medical Mystery of Epidemic Proportions - modified for state of FL or Orange County, FL

Data collection techniques and/or student assessments:

- Pretest
- Student-originated Designer Plates lab protocols
- Follow-up questions to bottled water case study

- Follow-up questions to The Mystery of the Blue Death case study
- Mini poster on safe drinking water and the overuse of bottled water in American homes
- Lab report on Medical Mystery of Epidemic Proportions
- Posttest

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

- Pipetting stations locker

ICORE summer institute elements specifically included (UF connections):

- Designer Plates
- Glo germ (discussed during best practices session)
- Medical Mystery of Epidemic Proportions - This lab will be modified so that the epidemic is localized to common theme parks in Central Florida near my school. Additionally, there will be followup questions about acids, bases, neutralization reactions, and buffers to tie in the ICORE lab to the chemistry curriculum. The equipment locker will not be used due to the changes being made.

How your proposal differs from what you normally teach, new pedagogies; how you previously taught this lesson or topic versus how you plan to teach it under your Action Proposal:

Previously, I have used the "But it's just a bottle of water..." to emphasize how human behaviors affect our environment. My students really enjoyed giving their opinion on this issue and some even switched over to a reusable water container. The ideas presented in my action proposal will help students understand these concepts in a more technologically advanced format that will hopefully stay with them for years to come.

Literature cited:

- May, Lindsey , Jessica Kotke, and Charles R. Bomar. "But It's Just a Bottle of Water...". National Center for Case Study Teaching in Science (2006). http://sciencecases.lib.buffalo.edu/cs/files/bottled_water.pdf
- Muench, Susan Bandoni. The Mystery of the Blue Death. National Center for Case Study Teaching in Science (2009). http://sciencecases.lib.buffalo.edu/cs/files/blue_death.pdf

Budget and budget justification: \$200

| Item | Vendor | Cost |
|--|------------------------|------------|
| Glo germ 36V9900 (Glo Germ™, Gel, 8oz.) | Ward's Natural Science | \$18.50 |
| Micropipets 15V1733 (WARD'S Micropipette, 20–200 µL) | Ward's Natural Science | \$140 x3** |
| pH indicator strips 21V9040 (WARD'S Instant Water Quality Test Kit) | Ward's Natural Science | \$24.95 |
| Microcentrifuge tubes 18V1361 (package of 500) | Ward's Natural Science | \$18.50 |

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| TOTAL | | \$481.95* |
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*Additional costs will be covered by lab donations beyond the \$200 minigrant

**Micropipets are to be purchased this year so as to be used in the future when equipment lockers are not an option