Project Title: Introducing students to arsenic pollution

School: Mt. Blue High School

Grade Level: 10th

Your Name: Douglas Hodum

Project Partners: I worked with Terry Morrocco and Doug Reusch, both at UMF.

Teacher/Scientist Partner Profile:

I have been teaching for 20 years, nearly all at Mt. Blue High School. I was an independent major as an undergraduate, creating my own major of Environmental Technology (anthropology, environmental studies, math, physics). I went on to earn my MS in Ecology and Environmental Science. I love being outside and keeping fit all year. For the class, I love to see students making connections to the world around them and to understand how interrelated everything is. The "ah-ha" moment is the best time for a teacher. The connections that I hope to help students make are why I am interested in the All About Arsenic project. It allows students to see real issues that could affect our, or other, communities.

Summary:

I started the year off with the lettuce seed bioassay for all my students. It was a great way for me to have students DOING science and collecting data, which we later graphed and interpreted with all the classes pooling data. This was the link into data literacy. From there, my two college preparatory classes began developing investigations surrounding arsenic exposures for either *Daphnia* or duckweed. The students researched the organisms of their choice, worked through the background information, posed a question, developed hypotheses that were, admittedly, general and then wrote a protocol to follow. From there, groups did their best to collect data on growth rates of the duckweed as well as the heart rates and reproduction of the *Daphnia*. Unfortunately, with the schedule we were keeping, the only groups who truly collected any data were those working with duckweed. The *Daphnia* were dying faster than we could keep them alive, and some of the exposures were toxic very quickly.

On top of that work, all my classes were asked about testing their well water for arsenic, with some students interested. Unfortunately, the majority of the students are on town water.

Overall, the project got students thinking about the process of science, including the development of questions, hypothesis, and methods. While the data collection and interpretation were largely a bust, they did experience real problems that can arise when doing actual scientific research.

Project Details:

The initial lettuce seed bioassay involved 65 students, whereas the follow-up work involved 39 students, all of whom had a chance to work with the lettuce seeds.

My students developed protocols to test a variety of arsenic concentrations with both duckweed and *Daphnia*. Two groups asked about the effects of arsenic on reproduction in water fleas. As a back-up, they wanted to see how arsenic might affect the heart rates of the organisms. Others just asked about the effect that

prolonged exposure would have on *Daphnia*. The groups that worked with duckweed wanted to see if it affected the growth of the plants (as in the length) but also of leaf production. All the groups planned on leaving their organisms in the arsenic solutions for extended periods of time (between 2-4 weeks). Due to the limited success in maintaining the *Daphnia*, results were simply that the organisms died with extended exposure to the arsenic concentrations. One group saw elevated heart rates with the one individual that they salvaged, but it died in the higher concentration. The duckweed groups indicated that the controls survived with little growth over two to three weeks, but the arsenic solutions killed the plants. The concentrations were as follows for the duckweed and *Daphnia*:

10, 75, 100, 200, 500, 1000 ppb
1, 10, 15, 80, 100, 200, 300, 1000 ppm

Funding was used to purchase both duckweed (one-time purchase) and *Daphnia* (two rounds of purchases after the first set died due to teacher neglect and inexperience with the organisms).

With the layout of the year and only seeing students once or twice a week, we did not achieve any noteworthy results and did not do any community outreach. The results were collected at the end of May and the reports were due at the start of June, none of which allowed us to do anything with the community. Additionally, our water samples were submitted at the very last minute, meaning we did not have results during the school year.

Discussion:

"One improvement to our process could have been us being all together in school because it would have made it easier for us all to see the growth in person and not over a screen."
"They learned just how fast the heart rate was and the specific conditions needed for them to thrive."

These are two quotes from student reports. Although none of them stated this in their lab reports, they learned a couple things. First, even the best laid procedures fail sometimes for reasons outside their control. Second, teachers also have a learning curve, and sometimes that affects what students are able to learn. Mostly, though, the goal of this work was to get them to think as scientists do and to work through a process of researching and setting up questions that they could answer.

As for me, I learned that I need to know far more about the organisms before I try to use them with my students. My best intention and goals for this project were thwarted due to my own ignorance about the *Daphnia* and the duckweed. Additionally, I learned about the short-term exposure for *Daphnia*, rather than allowing the students to keep them in the polluted water for extended periods. I have a better handle on how to proceed with this next year.

Next year, I will walk the students through some options for their methods more fully. I will hopefully have students more regularly during the week, which will allow them to collect their own data and tend to their samples without relying on me. I will also start the process <u>much</u> earlier in the year to allow for data collection and interpretation.

Conclusion*:*

I have participated in this project for two years, each one bringing more learning for my students and myself. I feel as though moving into my third year, I have a much better understanding of the time needed and also the

way I can get students *doing* the science. This might be a wonderful gateway for me to introduce students to arsenic, data collection, data interpretation and also to give them initial experience with experimentation. While I have yet to yield meaningful results in the sense of arsenic-related data, my students have had an opportunity to collaborate, research and learn about organisms and how science is actually done.

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