Project Title: Arsenic Project

School: Rivendell Academy

Grade Level: 11th

Your Name: Rachel Sanders

Project Partners: I did not really collaborate for this project this year.

Teacher/Scientist Partner Profile: I am a biology and chemistry teacher and have been working at Rivendell Academy for 11 years. My background is in biological oceanography. Prior to working at Rivendell, I taught biology in Ghana for two years as part of the Peace Corps and worked as an adjunct instructor at Dickinson College. I love finding ways to help students connect classroom materials to their own lives and make meaning from the material we study. I also love to find ways to have student construct or interact with models in the classroom. I joined the All About Arsenic project to help students increase the use of authentic data in my classroom and to connect the ideas of toxicity that we study in class to applications in their community.

Summary:
My goal this year was to integrate the arsenic project into my chemistry curriculum. I use the Living by Chemistry curriculum, which begins in the fall with a unit looking at periodic trends and properties of elements, which was where I introduced the idea of heavy metals. We discussed the ideas of the arsenic project and introduced the concept of filtration to create clean water. We also discussed the idea the water that looks or smells clean is not necessarily safe to drink. To cement this idea and open the project, I provided students with some "dirty" water and asked students if they would drink it. Students then used materials such as sand, activated charcoal, filter paper, cotton, gravel, and baking soda to create a filtration system in a used water bottle to "clean" this sludgy water. We discussed the idea that we could not test this water on humans, so used lettuce seed bioassays to determine if the student's filters improved the water quality. Due to COVID, all of this work was done from home.

Students returned to school in person part time in November. At this time I assigned them to collect water samples from their families. I had very few students return samples, but managed to collect samples from staff members and older students for a total of 22 samples. Unfortunately, I did not send the samples in to be analyzed in a timely fashion, and did not get data back until late May. At that time, our school was winding up for the year, so I did not have time to dig into the data with my students. I was disappointed that I did not get the samples in earlier.

The final unit of my chemistry curriculum is designed around toxins, and we did a number of toxicity calculations with arsenic, and used the different forms of arsenic to consider how much elemental arsenic you would get from different number of moles of different arsenic compounds. Thus, the ideas of arsenic as a toxin were integrated into the unit even though we did not get to look at the data. I was also very far behind on my curriculum due to COVID, so this unit was later in the spring that I would have hoped. I will not be teaching chemistry next year, but hope to bring the project back for the 2022-2023 school year, and have some ideas about how to fully integrate the community outreach part of the project in to the toxins unit in my chemistry class.

Project Details:

- How many students were in the class that was involved in this project?
    - There were 14 students in my class this year. This was unusually small.
- Detail specific curricular items such as questions, articles, books, YouTube videos, and labs. It's helpful if you provide links.
    - **I did a filtration lab that I created and used a basic method for a lettuce seed bioassay. Students read an article about studies from Dartmouth Hitchcock encouraging arsenic sampling in our local area. This is the article.**
- Did you:
    - Collaborate with any other teachers in your school? **No, only for collecting well samples.**
    - Go on any field trips? Why and where? **No.**
    - Conduct any experiments? What kinds of questions did students ask? **We conducted filtration experiments and lettuce seed bioassays. Students mostly designed their own bioassay experiments but because they were working from home I did not have much ability to ensure quality control. They did the bioassay comparing water they had filtered with basic filters they designed to water they had not filtered. Some also used their tap water.**
    - Use your stipend to purchase anything for your classroom? **If so, what, and how did you use it? I purchased the materials for the project. I still have some money that I could use for my classroom.**
    - Invite any guests to visit your classroom?
- How did you use Tuva, both for the arsenic data and for other datasets? **I did use Tuva a little bit. I would like to use it more next year.**
- How did you plan your community outreach**? I didn't get to this part this year.**
    - What did the students do?
    - What was the impact?
- Include any data analyses your students did.

Discussion:

I think that students learned that there are toxins that can be in their water, but I don't have any data to support this. Honestly, I did not bring this project to fruition this year. I wish I had been able to pull it off! I learned that brining a new project online during COVID is probably more that I can pull off. However, I learned where the connections between my chemistry curriculum and this project are. I also had several students' state that they were excited about the project because it did connect to their community, so I know that given the time and a normal school year, this could be a meaningful project. Overall, this was very much an idea building year for me. Next time I would start in a similar fashion but get the samples in much much earlier. I would then use the data during the toxins unit, completing analysis and calculations that could help students apply the chemistry we are doing to the question of appropriate limits of arsenic. We could then do the data analysis of the project data and bring that together in the spring for community outreach. I would really like another shot at this project in a more typical school year.

Conclusion: Overall, there is a huge opportunity for my students with the project. Due to COVID, I was not able to bring this together this year, but I can't wait to try again. There are strong connections between this project and my chemistry curriculum.

References:

Acknowledgement: The work reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number R25GM129796. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.