SCHOOL NAME: Mount Desert Island High School

Project Title: Arsenic Mini-Unit

School: Mount Desert Island High School

Grade Level: 10-12

Teacher: Ruth Poland

Project Partners: Who did you work with for this project? Name your mentor and their institution and any other partners.

Sarah Hall @ College of the Atlantic
Anna Farrell & Jane Disney @ MDIBL

Teacher Profile: A brief biography of yourself. How long have you been teaching? What did you study in school? What are you passionate about inside and outside the classroom? Why are you interested in the All About Arsenic project?

This is my 3rd year teaching biology at MDIHS and I taught middle school math and physical science for three years prior to this. I have a variety of experience in experiential and alternative education as well. I studied environmental science with a focus in ecology in college and got a masters in education a few years after graduating. I am passionate about environmental issues in and out of the classroom and I love offering students opportunities to participate in real-world science through citizen science projects.

Summary: Provide a 500-word summary of your project. Describe the curriculum. How were arsenic monitoring and data literacy integrated into that curriculum? Provide specifics (# samples collected, what the samples were analyzed for, etc).

I ran a project on arsenic in my AP Environmental Science class this fall. It was integrated as a "mini-unit" between our Earth Systems and Life Systems units. I specifically introduced the project as a way for the students to make a positive impact in the community. I introduced students to arsenic issues by having them do some primary research on arsenic for homework and discussing their prior knowledge. I then shared the powerpoint that Bruce Stanton gave to teachers during our summer workshop to give the students more background. The next day I introduced the Anecdata website and citizen science project. I told students that my goal was to collect well water samples from all the freshmen science classes this semester and to help them understand their results when they were returned. We brainstormed a list of tasks we needed to accomplish and distributed roles. Students created their presentation and practiced it the next day. Students also developed a pre-presentation questionnaire to help students gather information from their families before the presentation. That way we could help students register the day of our presentation. My students put together the sample test kits and submitted their own sample data on Anecdata the next day so they could go through the process before teaching it. Students presented to the freshmen classes the next day.

When we got the data back, about 3-4 weeks later, my students printed out the EPA limits for each of the contaminants listed in the data and I wrote a letter with resources and advice on what to do about high levels of arsenic. Students went back to the freshmen classes and helped them get back on Anecdata to view their results. They had students write their own contaminant levels next to the EPA limits and explained the resources in the letter, then asked students to bring

the information home to their families. The information was also disseminated via the weekly newsletter from the high school that goes out to families. We gathered about 75 samples. I did not have the students work with TUVA during the arsenic mini-unit, but I did have them do a bioassay with Daphnia during our Pollution unit and we used TUVA to graph our data and make LD50 determinations.

I also began a very short unit with my Island Pathways class around the arsenic project. Similar to my AP class, I taught students the basics of arsenic and had them help put sample kits together, but I passed the kits out to the spring freshmen science classes due to time constraints. I intended for my students to present to freshmen classes once the data came back, but the project was cut short by the end of the year, so I had my students create informative posters about arsenic to hang in the school instead.

Project Details:

- Detail specific curricular items such as questions, articles, books, YouTube videos, and labs. It's helpful if you provide links.

Below is the day-by-day curriculum with links that I used with my AP Environmental Science students. I also have a GoogleFolder with all my documents, etc, which can be accessed via the link.

Day 1

Review homework questions on Arsenic:

- What is Arsenic?
- Why is Arsenic a health risk?
- Where in the world is Arsenic a problem and why? Why are we concerned about it in Maine?
- Have you tested? You don't need to share your results...
- Make an account on AnecData & join "All About Arsenic" project

4) Begin Arsenic basics slideshow (Dr. Stanton)

Day 2

1) Introduce AnecData projects & "add observations"

2) Arsenic project tasks:

- Schedule presentations
- Brainstorm what we want to include in our presentations
- Make a presentation to share with the IPS classes, including how to make an account on AnecData
- Hold presentations *make sure to record who gets what sample #!
- Collect samples from IPS students & send out to Dartmouth!
- How can we help notify students & parents when the samples are available? How can we help them to act?

Day 3

1) Data collection of Eco-Columns!

2) Presentation practice & revisions
3) Develop pre-presentation questionnaire
HW: Practice presentation

Day 4
1) Make test kits
    - cut parafilm, put stickers on tubes, fold papers, record sample # in spreadsheet,
2) Final run-through of the presentations!
3) Plan all steps of class "curriculum"
4) Sign up for TUVA:
  - Go to link: https://tuvalabs.com/join/pujdv/
  - Use class code: **pujdv**
5) Practice using TUVA with Lynx/Hare activity
HW: Explore past well data on TUVA!
  - Can you find any patterns? What graphs can you make that give "meaning"?
Also, Test your own water & add an observation on AnecData!

Day 5
1) How did presentations go?!
2) Begin populations unit!
3) Explore Lemna data on TUVA - make your own graphs; what does each one highlight? Which are most informative?

- Did you:
    - Collaborate with any other teachers in your school?
        - I worked with the freshmen science teachers to coordinate our presentations and collecting samples from students. The curriculum was not integrated, but there are lots of future possibilities for this.
    - Go on any field trips? Why and where?
        - No field trips
    - Conduct any experiments? What kinds of questions did students ask?
        - We did the LD50 lab with Daphnia using a provided toxin, but students asked that we use arsenic next time, which I would like to offer.
    - Use your stipend to purchase anything for your classroom? If so, what, and how did you use it?
        - I used it for the Daphnia assay lab kit, some aquarium accessories,
    - Invite any guests to visit your classroom?
        - Sarah Hall visited along with Jane Disney & Anna Farrell to give us feedback on our presentation. Before the arsenic project, we had done a mini-unit on sea level rise and prepared a presentation for Janet Mills on the issue. We had Steve Katona, the retired president of the College of the Atlantic, visit us for a practice run of that presentation. I think he provided valuable feedback to the students on the importance of not just listing data, but also in expressing

emotional appeals when you are trying to get someone to change behavior or believe in the importance of something. I think this interaction helped students to prepare more meaningful and impactful presentations on arsenic and the importance of addressing it.

- How did you use Tuva, both for the arsenic data and for other datasets?
    - See above for the arsenic project. I also integrated TUVA into my honors biology class by having students use it to make graphs for two lab reports. I had students familiarize themselves with TUVA by having them make 2 very prescribed graphs for an Osmosis lab write-up. One goal I had with this was that you could make multiple graphs to answer a variety of questions about even a simple data set. I then had students work with a graph dichotomous key to think about what graph types fit with which sorts of questions. We then ran a "pulse" lab where students took their pulse under a number of different scenarios and also recorded categorical information such as gender and athleticism. I then asked students to come up with 3 questions about this data and make the appropriate graphs using TUVA, which I think was a really great way to drive home the importance of looking at data in multiple ways and thinking about causation/correlation and best ways of visualizing information, etc. I think this was the most impactful use of TUVA that I deployed.
- How did you plan your community meeting?
    - We used our presentations to the freshmen classes as our form of the community meeting. I believe it was much more effective, in many ways, as it got many more people involved in testing their water and because students are a great way to access a wide swath of community members (their parents). It is difficult to tell how many families read the information I sent home, but I heard anecdotally that a number of families either installed whole-house filters or purchased pitcher filters after receiving their test results.
- Include any data analyses your students did.
    - This was a major gap in the curriculum, but I do think TUVA has been a great resource for my teaching generally and I am pleased with the data literacy that students have built in other labs, etc. through the use of the platform. I would like to add more data analysis of the actual arsenic data in the future, although logistics are quite tricky with the gap between sample collection and data availability.

Discussion:

- What did students learn? It's great to include quotes if you have them.
- What did you learn?
- What would you do differently?

I think students learned about arsenic content, presentation and group-work skills, etc. but the biggest benefit for students was that they got excited about participating in citizen science work and activism work - they identified an issue and then got to act on making things better for their community. I find this is a really important and surprisingly rare opportunity for students. Especially in an environmental science class, it can feel simply depressing to learn about one after another of the ways in which we are over-using resources, or about the disparity of life quality, etc. Without offering a way for students to make a difference, this just leads to total apathy, which is the opposite of any teachers' goal for their students. Kids were really excited about going through their own sample test data and then offering other students ways to remediate their own water quality.

As far as what I learned, I feel much more comfortable with TUVA after this year of practice with it and I can see some good specific uses for it. I also learned (for the 100th time??) that the more prior thought you put into how a project will unfold, the better it goes. I put some good time

thinking through the first iteration of the project both on my own and with my students during the first semester (AP En Sci), but thought I could wing it more in the second semester, with much poorer results!

Conclusion: A few sentences to bring everything together.
I really liked the way this project came together for my AP En. Sci. students and it was discrete and easy to manage to boot. I also felt like we made a real impact on the community by educating the students and hopefully their parents via the sample kits, presentations and handouts. I also really like the way I integrated TUVA in my spring honors bio classes. In the future, I'd like to combine these two pieces to make a really hardy unit, although I think that it would probably fit best in our chemistry classes, where they might be able to devote more time to the unit and make more interesting and relevant connections to the rest of their content.

References: