Project Title: Monitoring for Arsenic and Other Pollutants in Drinking Water

School: Hinsdale High School. SAU 92

Grade Level: 11th

Teacher: Teresa L. Chirichella

Project Partners: Professor Verna DeLauer, Franklin Pierce University (FPU)

Teacher Profile: I teach Biology, Human Anatomy and Physiology, and Environmental Science at Hinsdale High School. Hinsdale is a very small rural school district in southern New Hampshire. I started teaching 15 years ago after working as an adjunct at Franklin Pierce University and in an Environmental Consulting firm. I did not major in teaching - I hold a BS in Hydrobiology from Universidad metropolitan in Mexico and a master's in Environmental Coastal and Ocean Sciences from U-Mass Boston. I got certified to teach via an Alternative IV certification pathway.

I was invited to the arsenic project by professor Verna DeLauer from FPU. I thought it would be a great opportunity to involve the students in real data analysis and that the fact that they were gathering data from their own community would bring interest and ownership to their learning.

Summary: The class "in charge" of the arsenic project was my Environmental Science class. The class is a combination of 11th and 12th grade students. Initially the students became acquainted with the project by studying the SEPA website and viewing some available videos and activities presented to us in the summer workshop. After this, they prepared presentations to invite other students to contribute with samples from their homes. They presented to my Human Anatomy class, 3 Biology classes and one 7th grade class. The presentation included instructions on how to take a clean sample, instructions on how to fill out the paperwork and general information on health issues associated with arsenic contamination in well water. Overall, 50 sampling kits went out. It was hard to get all of the sampling kits back from the students that took them home. By the end, we collected 37 samples back that were sent to Dartmouth for analysis.

Students from FPU and professor Verna DeLauer visited Hinsdale to work with the students on data analysis using Tuva; they did a presentation on arsenic and helped the students develop questions to answer using the data available in Tuva. The high school students enjoyed the collaboration with the older students. We were planning a visit to the chemistry department to do some bioassay work with Daphnia since I did not feel comfortable working with arsenic in the high school lab. Unfortunately, that was not possible due to the cancellation of classes because of Covid-19. Though the FPU student involvement was cut short, the two participating college students gained experience in creating educational curricula for high school students. Professor DeLauer worked with them to better understand the intended audience and to adapt SEPA materials accordingly. The students saw themselves as temporary mentors to encourage the high school students to not only participate in the arsenic study but to also consider studying health or environmental science in college.

The students analyzed the results for Hinsdale and compared our results with other NH schools. Since we had no samples with arsenic over 10 ppb, they looked at all the other factors analyzed. Some of the samples from drilled wells showed elevated levels of manganese, so they did some research on the health effects of manganese in drinking water. Students explored the differences between the samples that came from households with drilled wells, dug wells and town water; they discussed the reasons why some schools in the

state had elevated arsenic and Hinsdale had no positive samples and they researched other parameters measured in the samples.

A presentation of the results was scheduled to be presented to the school board on April 7th. Unfortunately, school was cancelled and the school board meetings were cancelled as well. Overall the experience was a positive one for the students and they seemed to enjoy the project. The students learned about all the possible contaminants that can be present in drinking water and that arsenic contamination is a concern in the state of New Hampshire. They learned to analyze data and create graphs to present the data to the public and raised awareness on the importance of analyzing drinking water by presenting to other classes.

Project Details:

- 50 students collected samples and 9 students were involved in planning and managing.
- Mostly we used the materials shared with us at last years' training available on the SEPA All about Arsenic page and from Dartmouth:
    - https://news.dartmouth.edu/news/2019/07/dartmouth-research-informs-nh-action-arsenic-drinking-water
    - https://www.dartmouth.edu/~childrenshealth/arsenic/
    - We also explored what the units PPB mean: http://www.nesc.wvu.edu/ndwc/articles/OT/FA04/Q&A.pdf
    - And what permitted levels of Arsenic in NH were and currently are: https://www.nhpr.org/post/nh-becomes-second-state-sharply-lower-arsenic-limit-drinking-water#stream/0
- I collaborated with Kristina Raymond, the 7th grade science teacher. My student did a lesson and presentation to her class and her students took some additional samples
- We were planning on going to FPC to work with a chemistry professor and develop an arsenic bioassay with Daphnia. The trip was not possible.
- We were planning to conduct experiments but got cut short with COVID-19.
- Kinds of questions students asked:
    - Does Hinsdale have an arsenic problem in drinking water supplies?
    - What are the differences in pollutant levels from samples from different types of wells?
    - What areas of NH seem to have higher levels of Arsenic?
- I spent some of the $500 stipend for the tubes, parafilm, envelopes and a Daphnia culture. Since that was less than the $500, I took the balance and wrote it for transportation to visit FPU with my students since Verna and I had discussed this possibility. This money has not been spent.
- Professor Verna DeLauer and two of her students visited my classroom three times.
- We used Tuva to analyze the Hinsdale data and to compare it with the rest of NH and Maine
- I asked my building principal for suggestions on planning the community meeting and she decided we should present to the school board. Our presentation was scheduled for April 7th but unfortunately it was cancelled. Students were in the process of preparing a presentation to the school board when the school year was moved to remote learning
- Data analyses included: students comparing values from Hinsdale to permitted levels in the state and to other NH schools for arsenic, manganese, lead etc.

Discussion:

- Students learned:

    - That drinking water quality is an issue and that it is important for homeowners to know what they are being exposed to.
    - That even very small amounts of a contaminant can have an effect on public health in the long run.
    - That collecting enough data to get the "big picture" requires the effort of not only scientists but also communities and regular citizens.
    - They practiced data analysis and graphing.
- I learned to use Tuva as a tool for data analysis
- Next time, I would try to involve the community earlier and not wait for the final presentation of data

Conclusion: Overall, participating in this project was a positive experience for my students and I; the students seemed enthusiastic to analyze data from their own community. Many of them kept asking "when are the arsenic results coming?" The fact that the samples were from their own households or from the neighbors and classmates made it real to them and gave them ownership. They enjoyed working with the students from FPC.

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