[FINAL CASE STUDY 2023

Project Title: All about Arsenic

School: Kearsarge Regional High School

Grade Level: Secondary (10-12)

Teacher: Mary M. Wright

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

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?I have a BS in Biology from Bates College in Lewiston, ME and a MS in zoology from the University of ME. I have been teaching for almost 30 years. I've taught various life science courses including Anatomy and physiology, Biology, Ecology, Zoology, Marine Science and Oceanography as well as Chemistry and AP Chemistry. I also teach in an evening adult education program. I have an interest in social justice work. I like that the All about Arsenic program has stressed community outreach.

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).

During the 2022-2923 school year approximately 70 students were involved in the All about Arsenic Project and associated curriculum. Forty eight students were enrolled in CP Chemistry. These students were the most involved in the arsenic project. I also had a senior project student who looked at the ability of a freshwater annelid to regenerate when living in various well water samples with various concentrations of arsenic . Thirty two water samples were returned and sent for analysis(Note: in past years Colby Sawyer sent samples that were marked as Kearsarge samples -- this year they were marked as Colby Sawyer samples. So while this is a slight drop off from previous years, it is not a huge one)

Project Details by Class or Group

CPChemistry:

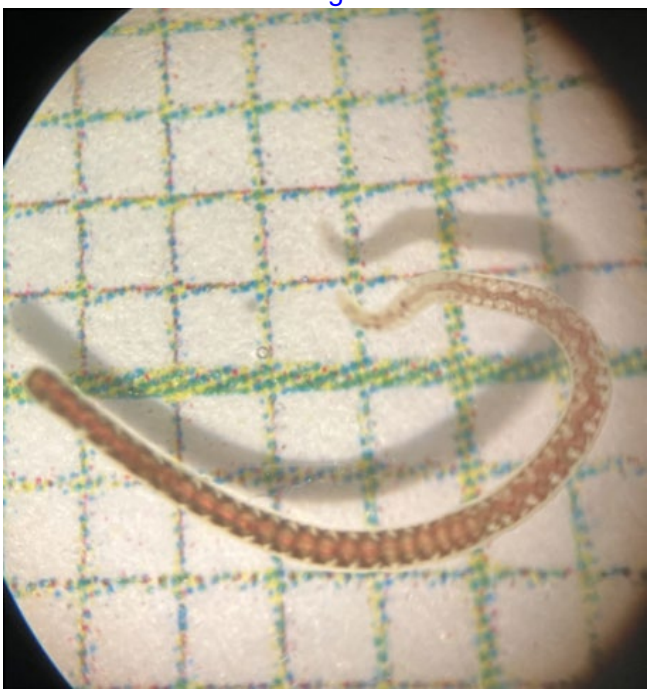
In early Sept. Students were introduced to TUVA via the activity, "The nature of the elements." This activity fit in with the traditional Chemistry curriculum, but introduced them to the skills necessary to manipulate the arsenic data set.

Next students were introduced to the "All about arsenic project." This involved sending out sampling material and looking at the arsenic data set. When looking at the data set, students formed questions about water in our district. This required the to filter data and interpret what the data means for our area. From this, students picked a water quality issue (it didn't need to be in our area), research it, wrote an annotated bibliography and created some sort of community outreach project For a summary of this and the associated projects see Use of various Tuva graphs and Community Outreach Project. Due date for these projects are May 26, 2023 (thus I don't have examples of this year's projects yet)

Senior Project Student:

MySenior project student was interested in the effects of various concentrations on the regeneration of blackworms (*Lumbriculus variegatus*). *She* took blackworms, cut them in half and then put them in either

purchased spring water, water from the school drinking fountain (double filtered well water), water from the bathroom sink at the school filtered to reduce arsenic levels to below 5 ppb) and unfiltered well water from a home that was known to be "high" in arsenic. However, it wasn't until after she had collected her data that the exact amount of arsenic was known. She then took pictures of them and used software to measure the length of the worms during regeneration (see picture below). using the one mm graph paper squares to calibrate. Unfortunately, the ability of the annelid to expand and contract their sediments made the measurements highly variable.In other words, was their actual growth or was she seeing stretching? Time didn't allow for her to restart and focus just on the cut end. However she noticed that the behavior of the worm in the various dishes differed.. She then wrote and organized a lab experiment for my non cp anatomy and physiology class (Worm Procedure please note that this was the first draft done by a student). They piloted the experiment and made suggestions (see next section). We discussed how not knowing what water the worms had been living in helped to keep them "honest."



The student presented her project on May 16, 2023. It was attended by approximately 20 people

Anatomy and physiology (non-cp):
This is a science elective for students with an interest in human biology, but who may not be at grade level for basic skills. We started the year using a TUVA lesson called "Body Temperature by Sex: Comparing Groups with dot plots and box plots. We also used a TUVA lesson as part of our unit on infection and infectious disease (Contagiousness of Viruses and Bacteria).
This is the group that performed the behavioral experiments with the worms raised in different water samples. While the data they collected was suggestive that arsenic affected their ability to move quickly, they noticed that the worms raised in a particular sample were VERY hard to catch and transfer to their small petri dishes. In our discussion of the data, they wondered if the act of transferring them to the dishes used for the experiment could have tired them out. Their suggestion was to raise them in the small dishes from the start OR transfer them to the disses the day before the class experiment. They were very intrigued by the experimental design where they didn't know which worms were raised in arsenic until AFTER they had done their tests. We discussed blind,and double blind experiments.

Night School: This class is an adult education program for young people who were unsuccessful in traditional public school yet want to pursue an adult diploma. We meet once a week for two hours for 16 weeks each semester. It was the second semester group who collected water samples. Due to snow days around the sample due date, problems with missing permissions and only seeing them once a week, only a few samples were returned and/or sent out. However we explored the data set created by the program and researched

water contaminants that could impact health. They were particularly interested in Manganese, Arsenic, and Uranium in samples from our area (oh, and they liked the way the data points in TUVA moved around!)

ANSWERS to other questions:

- Stipend money was used to buy materials for the senior project, mailing samples, parafilm, and some project presentation materials. Student are deciding if they want to spend money to by filter pitchers for the school (we have a newly discovered lead problem in school sinks) or make hold a raffel for all participants.
- Student's projects will be displayed at school (and perhaps at the SAU office) after May 26. Presentations will also be done at that time. Unfortunately, we could not coordinate with Bow this year for a joint presentation.
- We have had a number of positive comments from parents. We had one family with high levels of uranium in the water which was used to make formula for a baby. They are looking into mitigation now.
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Conclusion: While we had few students return samples this year, many aspects of the project went better. For example, we explained our use of TUVA and have had more in depth discussions of experimental design. Due to learning loss during covid, this project was the first and may be the only time this cohort has searched for peer reviewed articles. It is also one of the few places outside a statistics elective where statistics is discussed. While students are currently working on their community outreach projects, I look forward to seeing them after Memorial Day.

References: If you used any references with your students or other readings, list them here. Again, provide links where possible.

Toxic Risk: NSTA Press

Link to "Global solution to a silent poison." https://science.sciencemag.org/content/368/6493/818.full

Pre-discussion questions for article:
https://docs.google.com/document/d/1FxaChv5LORfFLoe4XgI2IhBOfqp0BUScK5WdNLfKN0Q/edit

Annotated bibliography template:
https://docs.google.com/document/d/1HwchNF9KDcOxBjeyuhqJH2CUu5ml5UYV8OLq0aHyXKc/edit

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