

**Project Title:** All About Arsenic

**School:** Kearsarge Regional High School

**Grade Level:** 10 -12

**Your Name:** Mary M. Wright

**Project Partners:**

Nick Baer: Colby College.

Brenda Mitchell: Bow High School

**Teacher Profile:** I have been teaching in public and private schools for over 20 years. The last 13 I've been teaching at Kearsarge Regional High School in N. Sutton, NH. I have a BS in Biology from Bates College in Lewiston, ME and a MS in Zoology from the University of ME (Orono). Outside of school, I have been involved in various social justice projects and I'm a former local president of the teacher's union.

I had the pleasure of having two of Dr. Baer's children as students when he recruited me to be part of the All About Arsenic Project. I'm so glad that he did! Projects like this increase student engagement which leads to in depth learning. Students have felt empowered when explaining the importance of the project to their families and community members.

**Summary:** This year's (2020-2021 covid year) All about Arsenic Project involved primarily 62 College Preparatory chemistry students, 1 senior project student, and to a much lesser extent, 22 Biology students. While in many ways this year's project (second year) was more successful than the first year, laboratory work was severely curtailed due to covid restrictions imposed by the school. Also, time with students was curtailed negatively impacting the number of lessons dedicated to the project. That being said, there were many positives; these include: increase use of Tuva, better integration of the project into the curriculum, and good alternatives to a traditional community meeting.

**CP Biology class:** These students performed a seed germination experiment looking at the impact of various concentrations of copper and iron nitrate on the rate of germination (lab modified from Toxic Risk, NSTA Press). Students designed and carried out their own experiment, graphed results, and discussed their conclusions.

**CP Chemistry class:** In September students were asked to read the article "Global solutions to a silent problem" and answer questions in preparation for a class discussion. It was during this discussion that the water testing protocol was introduced. I ran through the goals of the project as well as the various data points that would be collected. Collection tubes were distributed to students whose parents expressed an interest in having their water tested. The collection and registration process took longer than normal (covid schedule). During this time students were introduced to peer reviewed journal data bases and were asked to find three articles related to water contamination and submit an annotated bibliography (due in Nov). This became the first step in a research paper (or presentation) on drinking water contaminants. (Jan). In March, Nick Bear and I presented at a Water Sustainability conference at the University of Main. In the April/ May my students had to complete a separate community outreach project. They could do any of the following: a) participate in an online conference with Bow High School on a water contamination issue (slide presentation and videos were the two mediums students selected), b) create an informational pamphlet such as might be useful in a library or pediatrician's office to educate the public c) create an informational hyperdoc d) create an online

pictographic. I did require students to include some sort of graph (to integrate what they had learned from Tuva – see below). Of these projects (not the conference), only the video was ever “made public” beyond the school setting (we ran out of time for student to re-edit their pamphlets after I graded them). However 5 students participated in the on line conference with Bow high school and over 20 students attended either one or both of the meetings.

While the above was going on, Tuva was introduced to students using one of their pre-written lessons, “Meet the elements” which fit right into a unit on the periodic table. This lesson was a very nice introduction to the Tuva platform and basic graph manipulation. Later in the year, students also used “Ask Questions about the chemistry of well water.” This was in preparation an examining our well water data which was available in Feb. Students used the complete data set to answer such questions as “What types of wells have the greatest issue with ... (various metal contaminates)?, Is arsenic contamination correlated with any other contaminate? What zip codes have the greatest problem? What percentage of the wells tested in our region have high levels of arsenic (or other contaminate). Are the filtration systems (if present) working?”

The project also had tie ins to our solutions unit (includes how metal ions form (redox) as well as single and double replacement reactions).

**Senior Project student:** This student also learned to use Tuva and completed a research paper and created a informational poster. She helped put together the sampling packets and helped register samples. She also solicited additional samples from the faculty and staff not only at the high school, but at other schools in the district. She gave a presentation of her project to a group of students as part of the senior project requirements (Normally, there is a public Senior project night – this was cancelled because of covid restrictions)

**Additional Details (not addressed above):**

- Did you:
  - Collaborate with any other teachers in your school? I tried to interest the GIS teacher in using the data, but this course runs during the fall semester the teacher in question was not prepared add something new this year.
  - Go on any field trips? Why and where? No (not allowed due to Covid)
  - Use your stipend to purchase anything for your classroom? If so, what, and how did you use it? Yes. I still had funds left over from year one, so did not request additional monies. I used money to buy seeds and some materials for the biology class to do their experiments remotely. I had already purchased tubes and parafilm and envelopes.
  - Invite any guests to visit your classroom? I set up two students to interview a Dartmouth professor. This interview became part of their community outreach video. This was shown to all students, and I plan to use it to introduce the project next year.

**Discussion:** I think that year two was far more successful than year one of the project. Students used Tuva more and developed more skills in manipulating large data sets to answer particular questions. That being said, I think there is room for more growth in this area. I hope that next year a more “normal” schedule will allow students to take better advantage of all that Tuva offers.

I was pleased that all of the chemistry students were introduced to data bases for peer reviewed articles. Because of the various choices students have, they might not have been exposed to this until their senior year (and perhaps not then) in their English classes.

Many students did a good job with their pamphlets and pictographs that they developed for their community outreach project. However, even the best of them would have required editing before they could be actually

released in a public setting (I have also noted that MDI review is now required for this sort of thing) . The most common errors I saw were a) misleading or mislabeled graphs b) Misrepresenting the scope of the problem of the contaminate (not all did arsenic) in our area – for example, many included pictures or stories from Bangladesh when the target audience was supposed to be people in Maine or New Hampshire, c) Stating correlations that were not supported by the data. I think more work with TUVA exercises would help with some of this – as more instruction in basic statistics – would help address this problem. Quite frankly I ran out of time with the project this year.

My students were also concerned about what are our responsibilities are to study participants who have high levels of various metal ions. I may integrate more bioethics into next year's class (the summer 2021 session provided some excellent guidance – thanks Jane!).

Speaking of next year, my course assignment is changing a bit. I will be teaching human anatomy and physiology and more biology (fewer chemistry sections), so while I will continue to integrate the project in my chemistry class, I will now have an opportunity to look at the physiology of arsenic (and other contaminants). I'm also looking forward to renewing the in person collaboration with Dr. Baer and his students once covid restrictions are reduced!

**Conclusion:** Overall, it was a good year and I'm looking forward to continuing to perfect the integration of the project in chemistry and also into Anatomy and Physiology.

#### **References:**

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/1FxaChv5LORfFLoe4Xgl2lhBOfq0BUScK5WdNLfKN0Q/edit>

Annotated bibliography template:

<https://docs.google.com/document/d/1HwchNF9KDcOxBjeyuhqJH2CUu5ml5UYV8OLq0aHyXKc/edit>

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