Project Title: All About Arsenic

School: Bow High School

Grade Level: 10-12

Your Name: Brenda Mitchell

Project Partners:
Keene State College: Priyanka Roy Chowdhury
Kearsarge High School: Mary Wright

Teacher/Scientist Partner Profile:
I have been teaching for 35 years, 23 at Bow High School. I graduated from UC Berkeley in Microbiology and Immunology --today it would be called Biochemistry. I have a Masters in Education from Antioch University. I have taught Junior High general science, Physical Science, Biology, Anatomy, Forensics and Chemistry. I am passionate about the environment so I have designed the Chemistry course to be based around environmental issues. Long before All About Arsenic I discovered that water was a unifying theme for what we cover in first year HS chemistry. The parent of a former student (who happens to work for the NH EPA) told me about the project and I wrote to Dr. Jane Disney begging to be a part of it. Bow/Dunbarton has very high arsenic and almost one hundred percent of the community is on private wells. Coupled with historically low levels of well testing, this made this project a perfect fit for us.

Summary:
The academic year of 2020-21 will forever be remembered as challenging due to Covid. Bow HS chose to have classes simultaneously taught online and in person. For several months in the middle of the year we had a hybrid model so that half of each class attended one day a week. Class time was also reduced. Due to all of this, I had to remove material from the curriculum.

Water flows through the chemistry curriculum. I use it to initiate discussions from ionic bonding, to solubility, to chemical reactions and finally to acids and bases. The development of the atom and the Periodic Table are an island in the middle. Typically, I begin with exploration of TUVA and data literacy, but not this year. I did not have time to teach TUVA (as intuitive as it is). Arsenic is a natural fit to discussions of solubility, dissolving and chemical reactions. Other water contaminants such as Lead, Uranium and salt become examples of these processes. Water purification is explored through several types of filtration and distillation. It is during this time that we collect water samples. As part of the collection process, we discuss home filtration methods (most students have no idea what they have installed at home). When the data is returned to us, the students are asked to analyze their personal data and the school data. Past year's data is also provided for analysis. In class the students analyze water pre and post filtration for pH, conductivity, turbidity and odor.

This year several families asked us if they could retest water. BHS has been part of this project for several years and families has discovered in previous testing cycles that their water was high in Arsenic. The purpose of retesting was to see if the filtration system installed was functioning. One family discovered through a previous test that their filtration system had reduced the Arsenic but not to the desired levels.

The honors Chemistry students (a self-chosen designation) met separately both online and in person. These students went through the Toxic Risk student manual (published through NSTA) which I found online. They

learned how to make and dilute solutions as a hands-on lesson. Each student designed and conducted a bioassay using duckweed or lettuce seed. They used iron to stand in for arsenic due to safety issues. This project was designed with the help of Priyanka --Keene State--who suggested iron as a good substitute. Students were able to present their findings to Kearsarge HS students in a two-way conference and to Keene State in an honors symposium. Their slides programs as well as videos of their presentations were made available online. Parents/Community members were invited through Parent Square and articles about the project and presentations were posted in our online newsletter the Falcon Flyer.

Project Details:
This project involved 5 Chemistry classes. This year it was about 60 students.
Phenomenon slides:
https://docs.google.com/presentation/d/154dgrg1OvwAnDHXAEIhiYRr6yYSBVup5PFkScau9VoA/edit

Arsenic Project: https://docs.google.com/presentation/d/1w-2knOtoWOPhH_82pDm2WwfcXF4lcAEyMAsd_mDMnOw/edit#slide=id.p

Water overview:
https://docs.google.com/presentation/d/19CV3DJ2qi2N_faGlURNbYsxB1ydv5_LSAwX6ZwvEdjw/edit#slide=id.p

Articles: https://drive.google.com/drive/folders/1uyqMSNJ2SFx5bdEFIUoU2NRLSx6v9t3F
https://www.nhpr.org/post/state-distributes-arsenic-filter-pitchers-pregnant-wic-users-unsafe-wells#stream/0
https://www.nhpr.org/post/nh-becomes-second-state-sharply-lower-arsenic-limit-drinking-water#stream/0

Book: Toxic Risk, NSTA press

You Tube or other videos: https://classroom.google.com/w/MTQ4MjQxODUyMDE4/t/all

Labs:
Build your own water filter: https://docs.google.com/document/d/1YhpLxuh6BA6-uaZcp3VNRN6WOfAz3acTiPn3LVZgZeE/edit
temperature and solubility:
https://docs.google.com/document/d/1gjHPJMgJ0kV7fItA7rKsGNCp4V8_VGy7iwfKbeE22XE/edit
chromatography https://docs.google.com/document/d/1TKk8nhCMoA9S_3KFhvC1A9AlDgp0e7PJ_1sx-BG4PAU/edit

Stipend: Purchased sample vials, envelopes, and parafilm. We also bought filtration lab supplies and plastic vials and double seal plastic bags to send labs home. Plastic pipette were also purchased. An aquarium salinity refractometer, a drinking water test kit and a reference book called the Home Chemistry Lab was also purchased.

Use of Tuva: Sadly we did not use TUVA much this year
data thinking
graphs done for data analysis, created by students

Community Outreach:

Falcon Flyer articles
Kearsarge HS conference
Keene State conference
Information from above conferences sent to local drinking water committee
Student Projects
Fox
Sage
Courtney
Vincent

Discussion:
I keep meaning to get quotes, but not this year!
I learned that students are very engaged and enthusiastic learning about things that directly impact them and their immediate environment. They are also very concerned about the environment in general. I have been searching for an honors project with some teeth in it and kept thinking that bioassays were not chemistry enough: I was totally wrong. I intend to continue the honors project and the students have generated a list of further research ideas to use: change the subject organism, study growth and not just sprouting, use other elements instead of iron, look at a greater range of concentrations. I also realized that solubility could be the theme rather than water. It fits with everything including how water or air pollution occurs!

Students really enjoy learning the how to clean it up part. They need to have some positive action possible and something that is immediate and doable by them is over the top. They know the environment has issues but feel very powerless about fixing it. I think that is why they also loved the advocacy part. I would love to pair up with a humanities class and do some letter writing or advertising for water testing and remediation options as well as legislation.

Students were more shocked than usual this year about the results in general. They commented about the "pink" results and how many there were. Color coding works! The honors students were very engaged by the presentations--both doing theirs and listening. We had good discussions after each panel.

The online panel discussions are a true keeper. Parents and community members can not usually attend student presentations: having them online and recorded really open up the possibilities.

Conclusion: Despite Covid, less contact time and less time in person, the water study was a success. Things that I never considered before, such as online recorded presentations) turned out to be a better way to do community outreach! As we move more toward using phenomenon to generate interest and genuine inquiry, this project and citizen science totally fits the bill.

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