SCHOOL NAME: Maine Academy of Natural Sciences

Project Title: Watersheds of Maine

School: **Maine Academy of Natural Sciences**

Grade Level: 9-12

Teacher: Kenlyn Clark

Project Partners: My partners in this project were the other Threshold teachers: Ana Rothschild, Grace Hilmer, and Mahlon Bickford, and Susie Bright on the MeANS in-school staff.

Teacher Profile: I have taught in K-12 schools for four years, and on the college level for 11 years. I have a master's degree in soil chemistry, so I think of myself as a scientist first and a teacher second. I like teaching because I care about our youth. They must deal with the effects of the burning of fossil fuels, which began in earnest with the Industrial Age. They will be the ones to develop solutions to mitigate and hopefully recover from climate change. Educating them to understand how nature works and to care about the world they live in motivates me.
I am an environmentalist and a weather geek. I am a hiker and maintain a section of the Appalachian Trail for the Maine Appalachian Trail Club.
I heard about the All About Arsenic Project from another teacher who I had asked about water-testing equipment. The Threshold program, which I teach for, was planning for a yearlong theme of Watersheds for our Threshold Mondays. The All About Arsenic Project seemed a perfect fit for our theme. I knew that finding out that there are naturally occurring contaminants in their drinking water would grab the attention of our students.

Summary: The arsenic project was incorporated into the Threshold Mondays Watersheds theme. The Threshold program is a home-visiting teacher model where each teacher provides a holistic curriculum covering all academic areas. The Threshold Mondays are once-a-month on-campus meetings where the students in the Threshold program get together to work on projects as a group. We chose watersheds as a theme because we could incorporate geography, history, earth science, mathematics, government and economics into that theme. Arsenic was the major focus of the November Threshold Monday, where we focused on science.
The Threshold students returned 10 samples, and the school group returned 16 for a total of 26 samples. The samples were sent to Dartmouth Laboratories and analyzed for beryllium, chromium, manganese, iron, nickel, copper, arsenic, selenium, cadmium, antimony, barium, thallium, lead, and uranium.

Project Details:
The Kennebec River can be seen from the campus, and most of our students are within the Kennebec watershed, so that was a natural place to start. During our September meeting we introduced the watersheds theme. We had asked students to collect water samples from natural sources to bring in. We asked them to create an hypothesis about if the water sample contained living organisms or not. We also took the students out to pick up trash along a nearby waterway.
In October we took a field trip to see the middens in Damariscotta to learn how Native Americans had used the waterways and visited an oyster farm and found out how water quality and climate change were affecting their business.
In November we dove into the arsenic project. We had the students assemble the testing kits and take one or more home to sample their wells and offer their neighbors the opportunity to have their water tested. We

taught them about how arsenic can get into ground and surface waters. We explained what citizen science is and how the samples they were gathering would contribute to a larger study of arsenic levels in Maine wells. We also introduced them to Tuvalabs and had them do some activities in Tuvalabs (like Man's Best Friend) to learn about how to view and change the data. We also took some time to look for signs of life in the natural waters that they had gathered in September. We had them look at prepared slides of bacteria first, so they would know what they were looking for. This was also an introduction to the use of microscopes for many students.

December's Monday was snowed out, so we next met in January. We had a guest speaker who had been a student at the former incarnation of the school, when it was Goodwill-Hinckley back in the 1920s. He told the students about how they harvested ice from the Kennebec in the winter, so they could have ice year-round for the iceboxes. He told them that all that work came to an end with the introduction of electric refrigerators. Students were challenged to build insulated boxes to hold 9 ice cubes. The goal was to keep the most ice in solid form for the longest period. We had a control of 9 ice cubes left at room temperature to melt. We gathered data on the mass of each ice cube set before and after being in the student boxes. Students had cardboard, Styrofoam, and straw (a nod to the old way of insulating ice) from which to construct their boxes. We also tracked time, so we could calculate the melting rate of the ice in each box. Students put the data into a Google spreadsheet and set up the column calculations to find the melt rate for all the student boxes. They then had to write their conclusions about which box design was most effective, and how they could improve their own design.

In February we used Tuvalabs and ice-out data from New England lakes to talk about climate change and the variability in data. One goal was to help students understand the difference between climate and weather. Students looked at the overall data for all lakes over a short time period, and then over the total span of data to see how short-term trends differed from long-term trends. They also chose one lake and repeated the comparison of short- and long-term trends.

In March we used graphs and data from NASA to continue to look at climate change from a global point of view. Students studied graphs that showed global precipitation patterns, vegetative growth, aerosols, and other data. They make inferences about the significance of the same data over a year, then compared all the data for a given month. Students summarized their findings and shared it with the class throughout the entire exercise.

In April we focused on students' genealogy as a link to geography targets about immigration and the global movement of people. In May we built plant boxes and had students start little gardens. In June we started a nutrition and cooking focus with SNAP-Ed.

Our samples did not go in until later in the year, and we just got the data back a week or so ago, so we have not had time to incorporate it into our work. I plan to have students who have samples in the study look at the data and create a report or brochure to share the information they have learned with their family and/or neighbors, depending on where the sample came from. I also have a student who is committed to create an arsenic education video. Susie Bright and I are planning on having information on arsenic and the project at the end-of-the-year open house where students in the school show the results of their individual projects.

The stipend money was used to purchase the sample bottles and envelopes and to cover shipping costs. I also spent money on a set of prepared bacteria slides for the microscope work.

Curricular items:

- Microscope Introduction and cells lab (attached)
- Close reading of arsenic articles in Bangor paper (Ana)
- Arsenic fact sheet (Mahlon)

- Community meeting
    - Planned for open house night near the end of July when students present their individual projects.

- Also planning to have a display about arsenic at Threshold New Family Orientation July 24th.

Discussion:

- Students learned that there are naturally occurring toxins in Maine groundwater, and that research suggests that the areas of highest contamination are linked to fault lines. Understanding the relationship between the naturally occurring deposits of metals and tectonic activity is one of the NGSS learning standards. Those who submitted samples also learned what is in their well water.
- I learned that it is hard to keep the momentum and student interest for a project when there is a large lag time from the first introduction to the assessment phase, and when students do not meet and work together daily or even weekly.
- If I did this again I would get the water samples collected earlier so we would have more time to look at the data. I think this would also be better as a community-focused activity: select a rural community with many residents on well-water and start by engaging with local officials to gauge community interest in participating in the project. The arsenic testing could be built into a more comprehensive project that would have a civic, community service, and educational components. I think if students could see themselves making an impact on others' lives and well-being, that they would be more motivated to do the work and follow-through. That would take more planning and more buy-in by other teachers. Our Threshold model is not a good fit for this because the students do not meet often, and attendance varies. Each Monday tends to be a one-and-done event.

Conclusion: The arsenic project was a natural fit for the Threshold Monday them of Watersheds. Incorporating the arsenic project into the Threshold learning model was a challenge. Individual student participation varied widely, and the time from sampling to results was too long to sustain student interest.

References:

Articles below were used for close-reading ELA exercise
https://bangordailynews.com/2012/06/26/news/state/arsenic-belt-through-eastern-maine-means-high-rate-of-the-poison-in-well-water-study-finds/
https://bangordailynews.com/.../**arsenic**-in-well-water-is-a-silent-epidemic-too -few-maine-families-can-afford-to-treat-their-wells/

Microscope Investigations **Name_____**

Back in September you brought in a water sample. At that time you made an hypothesis about whether or not it would have living things in it later. Recall your hypothesis now and mark below:

▢ My sample WILL have living things in it

▢ My sample WILL NOT have living things in it

Next step: following the guidelines for the proper use of a microscope, examine one of the prepared slides of bacteria. Draw what you see below.

Name of specimen: _____

Magnification:_____

Now that you have practiced using the microscope and successfully focused on a specimen, get a concave slide and place a drop of water from your sample in the concave depression. Look for signs of life. Draw what you see below.

Magnification: _____

Review the types of common water microorganisms:
https://docs.google.com/presentation/d/1YLhIHdXzpGtXCWzPp3www3J-HspJWhc_JJRON_CGWMA/edit#slide=id.p

What do you think is in your water sample? _____

What makes you think that? What characteristics does it have? _____

_____

Conclusion:

□ My sample DID have living things in it

□ My sample DID NOT have living things in it

What does this tell you about the conditions for life in you water sample?

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