

EXTER HIGH SCHOOL

Exeter High School Arsenic & Water Testing Project Summary

School: Exeter High School

Grade Level: High Schools

Teacher: Debra Kimball

Overview:

Exeter High School was one of 7 school in New Hampshire and Maine to be involved in the *All About Arsenic EPA Environmental Education Models Grant, NE 83592001-0*. A team of four physical science teachers developed an intensive water chemistry unit through the “What’s in Your Water?” theme.

June 2016:

I worked with colleagues to modify the Exeter HS Physical Science Curriculum where we worked to change our chemistry unit to incorporate the importance of drinking water and to understand how common compounds such as arsenic get into our water. A new unit was developed to better reflect the NGSS standards for science. It was agreed that not all of the 6 physical science teachers would incorporate all of the activities that were created over the course of a semester, but many of the activities would be utilized by the entire team, in particular, the ground water treatment plant visit and the making of water filters. As a team, we discovered along with our students how contaminants get into the water, as well as how to get contaminants out of water on a large scale for the town of Exeter, NH and for each individual home. Hopefully students have a better respect and understanding of groundwater resources and the importance in testing their well water to find out if they have high levels of arsenic and other contaminants.

September 2016:

Exeter High School Physical Science classes began the year covering the properties of matter through water by introducing of the importance and behavior of water. Students did activities on the specific heat capacity, dissolving abilities and other properties of water.

October- November 2016: Water chemistry unit activities

The water chemistry unit began with the understanding of how elements and compounds interact and why. The key theme was understanding that water, as the universal solvent, makes it easy for many compounds to dissolve. The groundwater model activity involved students building sample groundwater tubes and to test to see how water filters through their layers of soil, gravel and rock and how that influences the quality of water at the bottom- the reservoir. We next investigated arsenic, manganese, and other common contaminants that got into the supply both naturally and unnaturally. A research paper covering common contaminants in Northern New England drinking water was assigned. One piece we have been working on with 9th graders is critical reading and writing.

During this time, we coordinated a visit to the Town of Exeter Groundwater treatment plant- where we used funds from the grant to have all the students – (approximately 400) tour the plant with their booklets and ask questions along the tour of the facility managers and engineers. We

were able to do this during student block periods. It was nice to not have to worry over bus costs or ask students to pay for this special lab day. The groundwater treatment plant was a perfect learning tool for all as the plant treats water both through physical and chemical means. Students viewed the water testing lab, special towers of gravel and greensand and viewed the source wells. It was also explained to the students that the town had exceeded the arsenic limit in one of the wells on site, and thus added greensand and other filtration means along with dilution from other wells to get the level of arsenic down to below 5-8 ppb.

December 2016: Water testing at the high school for students and staff and performance task projects – Water Filtration Devices

Water sample submission: In December, 80 test kits were given out to students and staff. Students and staff submitted 59 samples for testing. Three of these samples were rejected due to insufficient information on the form. Due to the holiday vacation the following week, late samples were not accepted. Of the 56 samples submitted to the Dartmouth Metals Lab, several were lacking information on types of wells and if they had a filter system, making some of the data analysis difficult to do. Debra Kimball sorted and relabeled and even entered some of the data into the online form. Not all samples were entered online, and those samples held up the data analysis process on the Dartmouth and MDI end. If I had known this would be a major issue I would have made those submitting to enter online at the school to be sure. Some individuals had difficulty with the online system- and were not sure if data had gone through properly online. We received the data spread sheets in February (see data analysis in next section).

Water filtration performance tasks (PT):

The team developed the water filtration PT as we were implementing the activity. The task was to clean up the dirty water (coffee grounds, iron, soil, and NaCl) by developing a filter system to get the water as clean as possible. We stressed this was not drinking water quality but the water was tested before and after filtration for pH, metals, conductivity, and turbidity. We tweaked the task to the classes involved- honors level, College prep, and academic—all levels were able to have successes- some better than others. Students at all levels were able to develop their water filters with our supplies as well as supplies they brought in from home. Students were asked to do their research on how a water filter works and report out on how their filter performed. See attached document on water filtration PT. We got this idea from many sources online- all of which added food coloring, which we felt was not our goal – thus we came up with our own recipe that kept getting adjusted as the testing began. (*Source for idea: Classroom Water Projects, Secondwind Environmental, Manchester NH, www.secondwind.com*)

March- April 2017: Data analysis and community awareness posters and pamphlets

Students began by analyzing the data from the spreadsheets supplied by MDI. We were unable to access this data from the website. Students had to decide if a particular variable of their choosing affected another variable and explain if there was indeed a correlation between these variables. Since we only looked at our data and not other NH or Maine schools our sample size was limited. It was limited further if a group choose to only select drilled wells or filtered samples, or drilled wells that were filtered. Given that data analysis is still a skill we are working

towards some groups made conclusions based on limited data, while others who kept to the basics were able to make viable conclusions based on their data.

On March 10th, the period 4 class entertained a visit by Kathrin Lawler and Paula Smith. They helped us develop a community awareness plan to try to get the word out to the community. We had acknowledged that we were not going to do a presentation nor host an event- that time had passed and we could not think of any opportunity to do so with in our community nor the time to coordinate such an event. Thus, we decided the final product would be a pamphlet informing the communities in which we live of the importance of water testing. The best pamphlets shared a bit of their data analysis of our samples from the 6 plus towns. I ended up doing this piece with two of my classes who took several days to look over their data results and craft pamphlets that might get the attention of our community- the goal was getting someone to pick up and look at what they had produced. We knew the weakness of our community as shared by Paula Smith on her visit. These weaknesses included a community not well informed, the resistance of not wanting to know more about their water, and how to get this information to the folks that needed to be informed the most- households drinking well water that had not been tested. The last piece was what to say. I gave the students a wide berth to decide what information to include and how to do it. The pamphlets with accurate, convincing, and local information were chosen, and a decision was made to combine the best of these pamphlets and puts out several, not just one. These pamphlets will go out to libraries in the area, as well as town offices. Lastly, Exeter has a special day in the late spring devoted to the Alewives and focused on the Exeter River water quality- perhaps getting these pamphlets out to a table for folks to see might be a good way to get others to understand the importance of water testing. The festival is mentioned in this dated source (https://www.des.nh.gov/media/pr/documents/070509_erf.pdf), however, there are local folks to contact to see if and when in June it might run.

Overall, this was an intensive year of learning about water quality and the importance of water testing. Had it not been for the grant we would not have explored nor shared this topic with students. Many students were very involved and grew to understand this life sustaining resource that we often take for granted or just simply do not understand how important it is to have good quality drinking water. We will continue to do many of these activities in future years including the water treatment plant visits- a thumbs up from our principal who was impressed we brought every student- not just select a few classes- 4 days of busloads of kids touring a small facility- we appreciated the time the Exeter Water Works Employees gave us. All these activities give a reason for understanding chemistry and how water connects us to our community.

All resources to be attached in a separate emailed file.