Your Name: Lucy Koup

Your School: Bow High School

Grade Level(s): 10-12

Course(s) Taught: Integrated Life Science, Environmental Science

Number of Students Involved (Total): 100

Date: 5/6/24

Name of your scientist partner and their institution, and any other partners:
Priyanka Roy; Keene State College, the Bow Committee on Drinking Water Quality

Teacher Profile:
I have been teaching high school science since 2021. Prior to that I coordinated and taught science to middle and high school students in an adventure-based environmental education program with the Appalachian Mountain Club. I hold a B.S. in Environmental Science from Villanova University and an M.S. in Environmental Studies from Antioch University New England.

I am passionate about helping others foster their relationship with the natural world, and about connecting students to real world experiences doing science field work in their communities - this made the All About Arsenic project a natural fit!

Summary:
During the 23-24 school year, about 100 students were involved in the water collection. Collection began in December of 2023. The project is set up to integrate with topics in the Chemistry and Environmental Science curriculum throughout the school year. Data literacy curriculum begins in September and is a continuous strand that students come back to over the year. Incorporating data literacy skills in a scaffolded and meaningful way into science curriculum at BHS has been an area of focus for the last few years. The Chemistry curriculum is based around water and water contaminants and the removal of such is integral to the course. The Environmental Science curriculum covers a broad range of topics including water quality and watersheds. Science communication is the big component of this curriculum as students are learning about environmental issues impacting their communities. More work is planned in the future to work alongside the Bow Drinking Water Committee in collaborating on community outreach projects related to drinking water quality in Bow and Dunbarton, NH.

Details

Did you…

	No	Yes	If yes, how many?

Collaborate with any other teachers in your school?
  - If so, who and what do they teach?
 	
    Brenda Mitchell: Chemistry, AP Chemistry
    Bethany McKilen: Chemistry
    Sean Carroll: Engineering
	○	○	3 additional teachers

Conduct any experiments? - If so, what kinds of questions did students ask? See description of lab assignments completed below, with linked documents.	○	○	_____
Go on any field trips? - If so, where and why?	○	○	_____
Have any guests visit your classroom? - If so, who and why? What did the guest do? Cindy Klevens, of NHDES participated in our Career Day at BHS. She is also a member of the Bow Drinking Water Committee. Her visit with students was about drinking water quality monitoring in NH more broadly, but her visit sparked conversation regarding further collaboration..	○	○	Once
Have a Community Meeting? - If so, where was it, what did the students do, how many people attended, etc…? This is something we hope to incorporate in the future.	○	○	_____
Have other Outreach Events? - If so, where were they, what did the students do, how many people attended, etc…? This is something we plan to work on in the future in collaboration with the Bow Drinking Water Committee	○	○	_____
Use your stipend to purchase anything for your classroom? - If so, what, and how did you use it? Not yet, but I am working on it.	○	○	$_____

Describe the student, or group of students, whose work most exemplified the All About Arsenic+ project this school year. What were they excited about? How did that facilitate their learning?

Environmental Science students this Fall did an in depth study into watersheds and water quality. Students collected physical, chemical and biological data in order to comment on the water quality at Black Brook, and were able to connect that water quality assessment to land use and recreational activity in the surrounding area. Students were particularly excited about getting outside to do field work, and to collect data that supported their communities' understanding of their waterways. While there was no direct data collection related to heavy metal contamination, I would like to find ways to tie drinking water contamination in our communities into this larger unit on watersheds and water quality. We do a lot of work with ArcGIS in this unit - and I wonder if there is a way to incorporate this information into our spatial understanding of what influences water quality.

Reflect on your students' primary learning outcomes/gains with reference to data literacy, science communication, and using data visualizations in communication. What are they getting out of their involvement in this project?

As in previous years, students were able to personalize their Chemistry and Environmental Science learning by applying the information to their wells at their homes and their own health. The value of this cannot be overstated. Through engaging with the project and the associated curriculum, students gain valuable data literacy skills such as formulating scientific questions and analyzing data for trends. Learning how to fix the problem is also such valuable learning!

How did you use Tuva, for the arsenic data?? Did you use the software for teaching, was it a tool students used to create data visualizations? What about other Tuva data activities? Did you use them in your teaching? Did students build skills using those activities?

In Chemistry classes, Tuva was introduced early as a tool for data analysis, and was used regularly in the practicing of these skills. In addition to data analysis, TUVA was used in some cases for the delivery of content.

In Environmental Science, TUVA was used after data was received from our water samples. Students completed two TUVA data activities - "Well Should We Question the Water" and "Can Arsenic be Filtered Out." Students practiced skills of formulating experimental questions and evaluating/analyzing data.

What challenges did your students have with Tuva, the website, the datasheet, Anecdata, anything related to the project process.

Overall, the process was very smooth, especially considering the volume of water samples collected. Issues arose when entering student data into Anecdata - particularly regarding students gathering data about their particular water filtration system at home, and entering data accurately and completely. Collaborating teachers and I have discussed how this process might be done differently in the future to ensure fewer errors.

How did you enhance *your own* Data Visualization and Science Communication skills?

Participation in the SEPA DataCom, as well as work with the project over the course of the last school year contributed greatly to my own data visualization and science communication skills. As a new teacher partner, gaining familiarity with TUVA through DataCom training was incredibly helpful. Additionally, the sessions related to Science Communication in the workshop contributed to my skills set. I can design lessons targeted to helping students gain these skills, and that will become very helpful as we increase our community outreach regarding the project.

Which aspects of this project will you repeat next year?

Chemistry and Environmental Science curricular tie-ins into the project will continue.

Which aspects of this project will you change next year?

Next year, myself and other teachers at Bow High School hope to streamline the sample collection and data entry portion of the project, given that we are collecting such a large number of samples. Additionally, we would like to work more closely with Priya, our scientist partner, to allow for opportunities for our students to engage with her work and research. We would like to have Priya and her lab students visit Bow High School for demonstrations into their research with Daphnia. We would also love to bring back Bow High School students' participation in the Student Research Conference at Keene State College.

List and describe the resources that helped your students the most this year.
TUVA - "Well Should We Test the Water" and "Can Arsenic Be Filtered Out" provided a structured way for students to build familiarity with TUVA, and to develop their data analysis skills. Other data sets were used for the delivery of content, and prior arsenic data sets were used for analysis practice.

Equipment: colorimeter, spectrometer, etc.

Provide a list, and links, if applicable, to specific curricular items such as online worksheets, articles, books, YouTube videos, and labs.

Fall
Chemistry:
Introduction to Data Literacy - students look at TUVA files and generate graphs. They also use the data to generate their own questions.
Thinking about Water and Penny Data - review of central tendency, variability, and types of graphs.
Lab: Chem is Try - students conduct a lab that generates many (conflicting) data points. They design their own questions and procedures and then graph the data in Google Sheets.
Love that Dirty Water - students are introduced to the properties of water: polarity, electromagnetic forces, ionic bonds, solubility. The following labs are conducted - solubility races, paper chromatography, micro column chromatography, water filtration lab
Particle Diagrams are revisited and refined
Water Collection is done and arsenic and other contaminants are introduced as soluble. Dangers of arsenic and other contaminants that are common in Bow and Dunbarton are discussed. Previous years' data is analyzed.

Environmental Science:
How clean is your watershed? - students use ArcGIS to create maps that pull together many data attributes related to water quality in their community

Black Brook Water Quality Formal Lab Report - students write a formal lab report on their in depth study into water quality at Black Brook in Dunbarton NH

Winter
Chemistry:
Students look at results from water collection and generate questions to ask as well as graphs to support their answers to the questions.
Reactions Lab - solubility is looked at and particle diagrams are refined. Students must predict the solubility of the particles and divide the soluble ones into ions and show their interactions with water. The reactions lab is based on compounds that are water contaminants or can be models for water contaminants. Students examine this years' water data as part of their analysis.

Spring
<u>Chemistry:</u>
Honors Bioassay (lentil seeds): Honors students conduct a bioassay using contaminants chosen from results of the water collection or that model Arsenic as a contaminant. (Honors students are self-selected and the number ranges from 4 to 20. Honors students meet as a group in our FLEX period once a month.) We used the booklet Toxic Risk to help plan the projects.

Add addendums such as curriculum, photos, student assessments, testimonials from parents/students, etc.

The Bow Drinking Water Committee continues to use our data to support their outreach work related to drinking water quality in Bow. We are working on a few collaborative efforts for next year - the creation of an outreach video designed to inform residents about how to install a point-of-use filter on their sink, and also the outreach for water test drives that the Bow Drinking Water Committee puts on every year. We have also discussed the potential for long term projects related to community outreach and point-of-use filter lifespan. The idea would be for these project ideas to be taken on by interested students working on Senior Projects. We are hoping to get more involved with similar efforts in Dunbarton NH, as many of our students reside there as well. Meetings with the Bow Drinking Water Committee and NH DES have been helpful in brainstorming and collaborating towards these efforts.

[Link to the Drinking Water Committee Website](#)

What are anticipated needs for the 2024-2025 school year?

There are no specific anticipated needs outside of normal project logistics (test kits, classroom stipend, etc). Support would be appreciated in thinking through the transfer of student information into Anecdata accurately when the volume of samples taken is so high.