2024-2025 SEPA Case Study Template

Date: 23 March 2025

Your Name: David Thomas

Your School: Belfast Area High School

Grade Level(s): 9-12

Course(s) Taught: Advanced Chemistry, Fish and Wildlife Management, Projects in Engineering

Number of Students Involved (Total): 70

Name of your scientist partner and their institution, and any other partners (other partners can include, but are not limited to, collaborations within the school, community groups, non-profit organizations such as the YMCA, or stand out family or friend mentors that helped your project succeed):

Jane Disney, Mt. Desert Island Biological Labs
Ramsey Steiner, Dartmouth TEAcore lab
Priyanka Roy Chowdhury, Keene State College, Keene, NH

Teacher Profile: A brief biography of yourself. How long have you been teaching? What did you study in school? What are you passionate about inside and outside the classroom? Why are you interested in the All About Arsenic+ project? How long have you been participating in SEPA and how were you recruited to participate?

I have taught high school science in New York, Wisconsin, Virginia, and Maine for 24 years. This year I am teaching 3 sections of Advanced Chemistry, a semester elective called Fish and Wildlife Management, and a 1st year engineering course called Projects in Engineering.
I studied limnology as an undergraduate at the University of Wisconsin at Madison. I later earned a Masters of Science degree in science education at Cornell University. I have worked in labs conducting aquatic research and have a keen interest in water quality research in both freshwater and marine systems.
I am interested in the All About Arsenic Project because of the project's relevance for students. I also am excited that the project engages students in areas of environmental health and water quality research, data literacy, and community outreach including civic action. I have been involved in the last year of the last round of the AllAboutArsenic project during the summer of 2022 and the 2022-2023 school year. I have also been involved in the current round of the AAA+ project during the last 2 school years. I was recruited to participate by my colleague Jon Ramgren, chemistry teacher at Waterville High School.

Abstract: Provide a 500-word summary of your project. Describe the **curriculum**. How was drinking water sampling, **data analysis**, and **science communication** integrated into that curriculum? Provide specifics (number of samples collected, what the samples were analyzed for, how Tuva was used, what opportunities students had to talk about their data through some public outreach, etc…). Did students use the **Science Communication Toolkit** and/or Solutionaries Framework to prepare for this outreach event or guide their participation in SEPA this school year? Did students participate in an **Intergenerational Learning** activity (pH exercise etc.)? Please include anecdotes or stories in this section!

My curriculum this year incorporated several components of the AAA+ curriculum. My chemistry students collected water samples from their families' private wells for the October 2024 submission deadline. I wanted to have data to analyze as soon as possible this year, unlike last year when I waited until later in the year. By the time we received our results, we had already engaged in several TUVA activities. We used the graph choice chart as well for two other datasets for which we collected data. One dataset included body measurements (height, armspan, foot size, etc.) and the other was data from our EXO2 sonde that collected aquatic data from the Belfast Bay including dissolved oxygen, conductivity, turbidity, salinity, temperature, and chlorophyll. We also used CODAP graphing program to analyze and graph data. Thirty eight student water samples were collected and sent to Dartmouth TEAcore labs to be processed and ran by Dr. Ramsey Steiner. Upon receiving the results of these water samples, we learned that nine of the thirty eight samples had exceedances in at least one of the twenty six elements tested. These exceedances included six for Mn, three for As, and two for Pb. One sample was especially worrisome, so much so that Amy Steckel sent a special note of concern. I spoke with this student and they mentioned that the sample with over 2000 ug/L of lead was taken from a "mudroom" where the water was not used for drinking. However, additional samples were sent in from this students' home. None of these secondary samples had concentrations of Pb or As greater than 1 ug/L, which was much lower than the 5 ug/L MCL for As and the 15 ug/L MCL for Pb. Interestingly, there doesn't seem to an MCL for Mn, but rather a secondary MCL of 50 ug/L (0.05 mg/L) that is based on aesthetics and clarity.
After looking through the Science Communication toolkit on the All About Arsenic website, the students in the period 3&4 chemistry class were especially motivated to share the data with the community and engage in a public information campaign regarding encouraging people to get their water tested. They even devised a survey to ask community members questions including 1) how often do you get your water tested, and 2) for what elements or compounds?, 3) have you ever tested your water for arsenic, lead, manganese, radon, mercury, or uranium?, 4) where do you send your water for testing?, and 5) would you support using public tax money for a water testing program? We thought the steps of choosing your audience, choosing your action, and framing your message provided guidance for how to conduct community outreach. Students worked through the resources to develop their plan for community outreach. I also used the rubric for posters and brochures to assess the student's posters and brochure.

We contacted the Belfast Food Coop to see if we could set up a table in the front of the store and ask customers to take the survey as well as hand out a brochure and share information on posters focused on each of 4 different elements, including As, Pb, Mn, and U. Through a series of five or so emails and phone conversations with a clerk, the financial manager, and the store manager, we were told that we would not be allowed to hold such an event at the coop. We then were thinking about using other venues, including the Belfast Free Library or Renys. We made some more progress on our brochure and posters, but have not yet used these in a community setting outside of school. We had further conversation a few weeks later about stakeholders and the target audience which might benefit from more information about drinking water testing and possible contaminants. The residents of Belfast use water from two wells in the Goose River Watershed. We learned that this water is transported to the city through one single pipe that is mounted on the side of the Route 1 bridge across the Passy River. This water eventually is distributed to residents of Belfast. We thought it would be good to test the water at its source - directly from the wells. We haven't investigated this further but hope to do so before end of the school year. Students also discussed how it might be more useful to more people if we went to individual towns outside of Belfast for a public information campaign since the vast majority of people in the rural surrounding towns use well water as their drinking source. These project ideas are still just that- ideas. Students have interest, but the chemistry curriculum limits the amount of time we can devote to AAA+ project work. I would like to develop curriculum that uses drinking water quality issues embedded in various chemistry topics.

I also worked with two other students from a different chemistry class to develop bioassay experiments that would involve using As. The U&I weekly meeting on the ME State Science Fair inspired me to pursue this with some students. I scheduled and conducted a virtual meeting with Jane Disney and Priyanka Roy Chowdhury to discuss a protocol for experiments. Unfortunately, we did not complete the work by the March 29 Science Fair date and even though Stephany from the Science Fair assured us that we could still participate and discuss the work we did, the students did not submit their work. I approached my motivated chemistry class about completing the Daphnia bioassays measuring heart rate and growth rate of neonates (juvenile Daphnia) when subjected to various As concentrations. We are planning to perform the work in April or early May of this year. We are also planning to conduct an As uptake experiment by growing algae in As-contaminated water and sending the samples to be analyzed by the Dartmouth TEAcore lab.

As part of the Intergenerational Learning Activities, I offered students extra credit for attending the community medical school presentation by Drs. Romano and Gunn on Addressing Community Cancer Concerns in Environmentally Contaminated Communities and developing the MyMammogram decision aid tool. Fifteen students attended the virtual presentation and we had a good discussion the next day in class.

As far as the Solutionaries Framework, I used the 5 whys strategy with my students on several occasions and also described the Iceberg Model and how this could apply to the complex environmental, health, social, and economic problems caused by pollution such as PFAS and other drinking water contamination.

Details

Did you…

	No	Yes	If yes, how many?
Collaborate with your Scientist Partner? - If so, how?		●	__1____
Use the Science Communication Toolkit? - If so, how? Described above		●	_____
Use the Solutionaries Framework? - If so, how? Described above		●	_____
Use any Intergenerational Activities? - If so, how? Described above		●	_____
Collaborate with any other teachers in your school? - If so, who and what do they teach? Beth Mick, AP Biology		●	1 time to show her students TUVA graphing and drinking water results
Conduct any experiments? - If so, what kinds of questions did students ask? To what degree does As enter the food web through algae? How are Daphnia affected by As?		●	
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? Members of the Belfast Bay Watershed Coalition (BBWC) discussed micorplastic pollution in Belfast Bay and a proposal for a single use plastic ban in Belfast.		●	_____
Have a Community Meeting? - If so, where was it, what did the students do, how many people attended, etc…?	●		_____
Have other Outreach Events? - If so, where were they, what did the students do, how many people attended, etc…? Still in planning for a community event. We are also planning to share posters and a brochure at the World Oceans Day		●	_____

where high school students teach elementary students about marine environmental issues and citizen science			
Use your stipend to purchase anything for your classroom? - If so, what, and how did you use it? Vials, Daphnia, algae and growth medium, petri dishes, air pumps, air stones, tubing for bioassay experiment and algae uptake experiment		●	$_____

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? Please include anecdotes and stories here.
This was largely described above, but one of my 3 advanced chemistry classes showed particular interest and ambition to engage with the community. The class is small (6 students), and students have a good work ethic, so we have more time for research and planning for public outreach and scientific research.

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? Please include anecdotes and stories here.

Students appreciated the opportunity to get their water tested and I heard several students describe that their parents and grandparents valued this opportunity.

If you are a teacher who has participated in both SEPA grants, how have you shifted your teaching to include the additional goals of science communication and intergenerational learning?

Now that I am familiar with the procedure for water testing and using TUVA as a data analysis tool, my students use TUVA to graph and analyze data from science experiments. As stated earlier, the students in one of my chemistry classes spent the most time planning for a science communication event involving the community. However, we do in-class presentations using whiteboards on a weekly basis, which requires students to present their whiteboards and explain their ideas to the rest of the class.

How did you use our Tuva drinking water dataset? 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? Please include stories that illustrate students understanding the link between data visualization and literacy and science communication. If you are a teacher who has participated in both SEPA grants, how have you shifted your data literacy focus to include this grant's science communication goal?

I am more confident in incorporating science communication into my curriculum. We did more talking about our plans for a community event than actually enacting our plan. But we still have time this year and we will conduct a public outreach activity as well as a research experiment.

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

I think time that we could devote to this project was a bit limiting, especially since we didn't devote a continual period of time to the project. Instead, we would work on the project every so often. It might be better to devote an entire unit the the AAA+ project in the future.

If you did not use Tuva this year, how did you analyze drinking water data? Please explain why you did not use Tuva. What challenges and successes did students experience with your chosen data analysis/visualization tool?

We used TUVA, but also used the CODAP online graphing program.

How did you enhance *your own* Data Visualization and Science Communication skills As an educator or scientist partner?

By attending most of the U&I weekly meetings and also giving students more opportunities to collect data, clean the data, upload the data into TUVA, and make graphs.

Science Communication Outreach

What kinds of science communication outreach products did your students produce?

Posters
Brochures

Did your students work with the Science Communication Toolkit this year? Yes X No ☐

If yes, please describe how it went. What worked best? What improvements could be made?

This is described above- we looked through the resources and used some of the information to plan a public information outreach experience

Please include anecdotes or stories here. If you did not use the Science Communication Toolkit, why not? What other resources and activities did you use to teach of facilitate science communication? Did the science communication skill building inspire outreach or build capacity in your students in ways not directly associated with the SEPA project?

I feel that the toolkit was useful to motivate my students, but again these efforts take time. Perhaps I could work with students after school in the future.

Don't forget to add all final student products to your teacher folder on the shared google folder! (Feel free to add additional products that led to the final products. Simply create a separate folder under your teacher folder.)

Intergenerational Learning

Did you send an intergenerational activity home to parents? Yes ☐ No X

If yes, please describe the activity. What are stories and anecdotes you can include about student participation in intergenerational learning activities?

If no, please describe why. What other resources or activities did you use to teach about or facilitate intergenerational learning?

Several students attended the community medical school presentations and some even watched with their parents.

What worked best? What improvements could be made?

My students and I only participated in the Community Medical Health Series presentations

Did the intergenerational activity go home at the same time as the drinking water samples? Yes ☐ No X
Please explain.

I planned to do this at a later date, but never did.

What feedback did you hear about the activity?

Interesting, but some students thought it wasn't that relevant to their lives.

Solutionaries Framework

Did you use the Solutionaries Framework in your class? Yes X No ☐

If yes, please describe.

This was described above in terms of planning a public information campaign and survey.

What worked best? What improvements could be made?

Scheduling more regular time for the project to keep the work consistent.

If no, why not? Please include other activities or resources you used to teach about or facilitate systems thinking, placed-based discovery, or project-based learning.

I incorporate many examples of environmental science and pollution into the chemistry curriculum.

Did you attend the Institute for Humane Education series on the solutionaries framework in your class?

Yes ☐ No X

Which aspects of this Communicating Data project will you repeat next year?

I plan to incorporate all the components of the program next year and want to engage other professionals in the community by having guest lectures in my classroom.

Which aspects of this project will you change next year?

I would like to plan with community stakeholders at the beginning of the year next year.

List and describe the resources that helped your students the most this year.

The extensive resources on the website and the timely feedback from Jane Disney, Amy Steckel, and Ramsey Steiner.

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

Add addendums such as stories and anecdotes, photos, student assessments, testimonials from parents/students, etc.

None available.

What were gaps or barriers you experienced this year?

None really, but some more time to plan and incorporate community outreach efforts.

What are the anticipated needs for the 2025-2026 school year?

I want to make sure that we have community partners to work with next year.

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