2023-2024 SEPA Case Study
David Thomas, Belfast Area High School

Your Name: David Thomas

Your School: Belfast Area High School

Grade Level(s): 9 - 12

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

Number of Students Involved (Total): 70

Date: April 18, 2024

Name of your scientist partner and their institution, and any other partners:

Jane Disney, Mt. Desert Island Biological Labs

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?

I am in my twenty-third year of teaching at my third high school. I have taught for three years in Madison, Wisconsin, five years in Buchanan, Virginia, and fifteen years at Belfast Area High School in Belfast, Maine. I have a B.S. in Limnology from the university of Wisconsin-Madison and an M.S. in Science Education from Cornell University, as well as an M.S.T. for science and math teaching certification. My Master's Thesis focused on student understandings of population growth concepts.
I am interested in the AAA+ Project for several reasons, one of which is that this project allows students opportunities to collect, analyze and communicate data that is relevant to them and meaningful for the Belfast (and broader) community. The project provides access to a large dataset that can be used to increase data literacy skills for students. A large project such as this also provides professional development opportunities for teacher like myself to learn from subject matter experts and collaborate with scientists and other teachers. The project continually provides me with new ideas, technologies, and strategies to use in my teaching. I also appreciate the continued and regular feedback and updates that this project provides.

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…).

I have incorporated multiple components of the AAA+ project in my curriculum this school year, including water testing, data analysis, bioassay experiments, and communication of results with community members. Students in my advanced chemistry, fish and wildlife management, and projects in engineering class have all been involved in some aspect of the work.
I engaged my chemistry students early in September of 2023 by building their data literacy skills using Tuva online graphing software. I initially had students in my classes compile a large dataset by collecting data on their armspan, height, shoe size, favorite color, gender, etc. They added their data into a Google sheet and then we uploaded this into Tuva. After going through a graph choice chart, students were asked to write a scientific question, provide evidence using at least 2 Tuva graphs, and provide reasoning in the form of a presentation. Students then used Tuva tutorials, datasets, and other written prompts to build data literacy skills. I assigned multiple Tuva activities throughout the school year from Tuva's content library. Tuva was also used in the chemistry of the ocean class to graph and analyze chemical oceanographic data collected by the water quality monitoring team from Belfast Bay Watershed Coalition (BBWC). While the data was not drinking water data specifically, students were able to expand their computer and data literacy skills. I also included 3 assignments into my curriculum from the AAA+ program including data stories about lead in drinking water on the COA campus and arsenic and public policy. I created a set of questions that students completed from these data stories.

Students submitted water samples for testing of 14 elements at Dartmouth Trace Element Lab for 3 of the 4 testing periods during the school year. We sent in 36 samples for the Dec testing, collected from students in 2 sections of the advanced chemistry course as well as 1 section of the chemistry of the ocean course. Upon receiving our results, we used Tuva to make graphs and analyze the data. We carried out a similar sequence of activities for the Feb and March sampling deadlines. We submitted 11 samples in Feb. from students in the Fish and Wildlife Management class. Training and discussion of PBS Student Reporting Labs took place during a couple of the Tuesday U and I virtual meetings, and this inspired some of the advanced chemistry students to submit 8 water samples to consider whether the water quality varied from different faucets in different parts of the school.

Advanced chemistry students worked in groups to complete Pitch sheets to plan out videos, with topics that varied, such as how to take a water sample, and how the school can reduce plastic waste. We are still working on these videos and hope to complete them and upload them onto the school website. If not by the end of the school year, then perhaps I can work on this during the summer so we are ready to complete videos in the fall of the 2024-2025 school year. One group did some background research into water quality at various locations throughout the school and even met with the building superintendent to look at blueprints of the school piping system. A picture of this meeting is below:

We also plan to make making one or more posters (one included here) that will be presented at the World Oceans Day event in Belfast on May 16. This will involve about 120 elementary and middle school teachers, students, and community members visiting various stations, one of which will focus on drinking water quality and monitoring in Belfast and beyond. We plan to include graphs that show data from the SEPA schools as well as background information about the importance of monitoring drinking water. We also plan to write a letter for the town newspaper and/or the Belfast Bay Watershed Coalition newsletter about water testing results and need for water testing. I also hope to have students in the fish and wildlife management class to complete a Daphnia bioassay to test the effects of arsenic or other contaminants on behaviors and survival. This will be used as part of the students' final project, which will include background research, data analysis using Tuva and communication of results.

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?	X	○	_____
Conduct any experiments? - If so, what kinds of questions did students ask? How does drinking water quality vary between different drinking water sources throughout the school? How does the concentration of arsenic and other metals affect Daphnia survival and behavior?	○	X	____2__
Go on any field trips? - If so, where and why?	X	○	_____
Have any guests visit your classroom? - If so, who and why? What did the guest do? Zya Sosa, planning meeting for PBS video production	○	X	___1___

Have a Community Meeting? - If so, where was it, what did the students do, how many people attended, etc…? Presented graphs of oceanographic data from the Belfast Bay at the Belfast Free Library. These graphs were made by students from the chemistry of the ocean class.	○	X	__1____
Have other Outreach Events? - If so, where were they, what did the students do, how many people attended, etc…? World Oceans Day event on May 16 (described above)	○	X	___1___
Use your stipend to purchase anything for your classroom? - If so, what, and how did you use it? Vials, Parafilm wrap, Daphnia, aquaria, pipettes, filters, shipping costs fro water samples	○	X	$_500_____

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?

While not finished, I believe the advanced chemistry students have and will produce work that exemplifies the AAA+ project best. They have collected and submitted water samples for testing, analyzed results using Tuva, and will communicate information through videos and posters. They will also demonstrate the “data to action” theme by presenting to a broader community outside of school by making suggestions which may inspire city leaders to include free water testing and/or filters for households with high levels of drinking water contaminants.

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?

I believe they are gaining data literacy skills which includes learning a new graphing program, and other skills of collecting and importing data. They also are learning how to act as citizen scientists as well as how to use data to change policy at the community level.

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?

Yes, Tuva is the main way students analyze the arsenic data and learn about various types of graphs, how to ask scientific questions, and what conclusions can be made from data visualizations.

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

Student learning with Tuva needed to be scaffolded, especially when learning how to format and import data.

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

I was able to work with Tuva on a regular basis and learn how to import data sets into Tuva, as well as make graphs that were effective to be used in presentations. I also learned more about how to make videos as a tool for science communication.

Which aspects of this project will you repeat next year?

Water sampling, bioassays, and production of videos, as well as attendance in the U and I weekly meetings to learn more content and ask questions about my SEPA-related curriculum.

Which aspects of this project will you change next year?

I would like to conduct a project more in collaboration with a scientist partner and get feedback of student work regarding such a project or experiment. Since I teach advanced chemistry, I would like to focus on a project in this subject area.

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

Access to Tuva was very useful, as well as the opportunity to get their water tested for multiple elements. This served as a great baseline from which to cover multiple subject-area concepts, mostly in my chemistry classes. Students also benefited from having access to a large and growing dataset that included their own data.

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

1. The "lost field" notebook problem. From "Where Is the Context in Contextual Word Problems?: Mathematical Practices and Products in Grade 8 Students' Answers to Story Problems," by W.-M. Roth, 1996, *Cognition and Instruction, 14*, pp. 487-527.

   This problem was described on page 47 in Inscriptions: Toward a Theory of Representing as Social Practice, Roth and McGinn, 1998. Review of Educational Research

   Ask students to answer 3 questions as used in the article.

   Also use page 49 of Roth and McGinn article for scaling errors example.

2. Example physical features dataset that can be collected by students and graphed and analyzed using Tuva

3. Career plan and job shadow rubric that I have used in the past in conjunction with the UMaine Career Center website – as a result of students being involved in the AAA+ project, several students chose to explore careers related to water quality, toxicology, forensic chemist, etc.

4. Data Nuggets (https://datanuggets.org/) is a collection of case studies that I have used with students to practice their data literacy and quantitative reasoning skills. Each activity highlights scientific research and has data available for students to graph and analyze. Activities are available in 3 variations that differ in degree of graphing skills required. Teachers and students can even make their own data nugget. One of my plans for next year is to make a data nugget using SEPA water quality data.

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

1. Example graphs made by student conducting lettuce seed bioassay with soap at various concentrations:

https://tuva.la/4dk0dla

https://tuva.la/3UMAvF0

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

I would like to collaborate with a scientist-partner or fellow SEPA teacher next year on a project with my advanced chemistry students.

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