



2023-2024 SEPA Case Study Template

Your Name: Janet Holden, Kaleigh Martins

Your School: Pelham High School, Pelham, New Hampshire

Grade Level(s): Grades 10-12

Course(s) Taught: Anatomy & Physiology, AP Biology, AP Environmental Science, College Preparatory Biology

Number of Students Involved (Total): 80 students

Date: 3/13/2024

Name of your scientist partner and their institution, and any other partners: Dr. Flor Fahenstock, University of New Hampshire, Geology

Teacher Profile:

Janet Holden: I have been teaching for 31 years. My original field of study was Biochemistry with a focus on Food Science and Nutrition and later education. Inside the classroom my favorite class to teach is Anatomy and Physiology. Outside of the classroom I love watching pond life in Maine. I became interested in arsenic in the mid-1980's when I was offered a position going to farms and collecting water samples for arsenic testing. I hadn't known it was a drinking well water issue until then.

Kaleigh Martins: I have been teaching for 7 years. My original field of study was Forensic Science with my concentration in Biology, later my Masters of Science in Secondary Science Education. My favorite classes to teach are Biology and Forensic Science, recently becoming certified to teach AP Environmental Science in addition to my regular course load. Outside of the classroom, I enjoy traveling and taking in nature with my family. I became interested in the toxic metals in water during an internship between my junior and senior years of college, where I worked testing water samples from bodies of water in the state for various contaminants. The Arsenic Project has piqued my interest while working with Janet Holden and hearing the unsafe levels of toxic metals in the Pelham community after considering moving to the town.

Abstract: Water analysis is part of Pelham High School's curriculum, it is included in both Anatomy and College Prep Biology classes. In Anatomy it is included in the Nervous System with students researching the health risks of the common toxic metals in the Pelham area. The metals include arsenic, uranium, manganese, and lead. The College Prep Biology classes include water analysis during the Environmental Science Unit in the Fall or Spring depending on the class. The AP Environmental class completed bioassays using algae and water with arsenic contamination. Brine shrimp were also used in a bioassay grown in the established algae water with arsenic. Students measured the growth of algae (*Nannochloropsis*) using a Secchi stick for optical density prior to the addition of the toxic metal contaminated water. Once a significant amount of algae growth had been grown, the arsenic contaminated water was added. At this point, there was no additional growth of the brine shrimp, but the algae growth has continued to flourish. Weekly density readings were recorded and graphed over the course of the AP Environmental class period.

In the Fall students were offered water test kits after completing the curriculum on toxic metals in the anatomy, biology, and AP Environmental classes. A total of twenty-eight vials were returned and sent to Dartmouth. Sampling occurred in two different community events. The first event was during the evening when parents and students from the middle school were invited for an open house. A table was set up with toxic metal in well water literature from Dartmouth College and the N.H. Department of Environmental Science. Students had prepared fifty water sample kits that included a water vial, instructions, and the registration forms. The second event was during the January Primary Voting Day, permission had been granted by the Pelham Town Moderator to set up a table with the literature, a tri-board showing previous years results and the water test kits results from previous tests were discussed. Fifty kits were handed out and twenty-six were returned. When the results from each round were shown to students. A third event will be held April 6th at the first annual "Protect Our Ponds" at the Pelham Town Hall where a poster session will be held. Students were invited to participate presenting to interested townspeople the dangers of toxic metals in well water.

TUVA was introduced to the Fall semester students with them logging in and completing the basic tutorials. When the first data arrived students then went into TUVA again with their goal to make a pie chart of whatever metal they had first been assigned during the Fall class curriculum. Students were able to create pie charts of all the metals assigned except for arsenic. The TUVA program is set up for the arsenic limits in Maine not N.H. which are lower. When students tried to create the pie chart they needed to add an attribute provided through TUVA but it is computer coding and students had issues with mistakes.

Details

	No	Yes	If yes, how many?
Collaborate with any other teachers in your school? - If so, who and what do they teach?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	English Department for editing of write ups to be published by the town newspaper; Administration for approval of informational posters to be shared with the town.
Conduct any experiments? - If so, what kinds of questions did students ask?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Bioassay (brine shrimp) with toxic water from a sample sent for analysis.

<p>Go on any field trips? - If so, where and why?</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>_____</p>
<p>Have any guests visited your classroom? - If so, who and why? What did the guest do?</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>Dr. Flor Fahenstock, presentation on the geology of New Hampshire and where the toxic metals come from.</p>
<p>Have a Community Meeting? - If so, where was it, what did the students do, how many people attended, etc...?</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>11/16/2024 - 8th Grade Night: students offered literature provided from Dartmouth College on arsenic and results of previous SEPA Grant tests. Water test kits were provided to families.</p> <p>1/23/2024 - Town Voting Day: water test kits and information were available to interested families</p> <p>4/6/2024 - Pelham N.H. Town Hall 8:30 am - 12:00 pm students participated in the town "Protect Our Ponds." A table with literature on well water issues, and information on well water results from several grants testing over four hundred homes in Pelham.</p>

<p>Have other Outreach Events? - If so, where were they, what did the students do, how many people attended, etc...?</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>A newspaper article written by students on the SEPA project ran in the local paper, The Evergreen (local newspaper) ran in the February edition.</p>
<p>Use your stipend to purchase anything for your classroom? - If so, what, and how did you use it?</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>\$238.52 Purchased vials, water filters, and shipping costs for 3 rounds of water testing</p>

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?

The AP Environmental students gained a great deal of knowledge through this project, and through the curriculum of the course. Students were engaged in this project, while investigating topics surrounding: watersheds, the water cycle, the rock cycle, pollution, and global impact. As juniors and seniors in high school, the students were shocked, and in some cases disturbed, to know how much of a negative impact toxic metals have on the environment, their town, the ecosystems in which they live, and the human body. Students became more aware of the dangers of arsenic in their well water, and were advocating to friends and neighbors to have their well water tested for toxic metals. Through this round of testing, students were able to identify that not only are arsenic levels unsafe in the well water in Pelham, but there were also elevated levels of uranium and manganese. Students became more aware and invested in the metals that are in their water, and what can be done to reduce those substances.

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?

Through the identification of unsafe levels of uranium and manganese, the AP Environmental students helped create and test run a project for the Biology students on pollutants in the environment. The pollutants, identified through the current SEPA grant and the curriculum of AP Environmental Science, are communicated in the College Preparatory Biology courses, where students get to investigate the sources, causes and environmental effects of the pollutant of a students choosing to the environment and the human body. Additionally, AP Environmental students helped analyze the current and historical data, retrieved from Tuva, to create visualizations of the dangerous levels of toxic metals in the town wells. The visual created has helped students share the dangers of the arsenic, uranium and manganese at unsafe levels with

members of the greater Pelham community at events such as the schools 8th Grade Showcase Night in November, the Presidential Primary Election Day in January, the Town of Pelham's Town Hall on Protecting the Ponds in town in April.

How did you use Tuva, for the arsenic data?

Students used Tuva to review and analyze the data from the SEPA grant in both the current year of data and the historical data for the town of Pelham. Students were able to make graphs showing trends, increases in certain toxic metals, and determining the percentage of tested homes with unsafe levels of arsenic, uranium and manganese. Students were able to create pie charts to show this data, with some limitations due to the attribute for Arsenic reflecting that of Maine and not that of New Hampshire.

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?

Students were encouraged to use Tuva to analyze the data released from the current SEPA Grant. To practice with the software, students were asked to work together on a laptop, not a Chromebook, on the projector to manipulate graphs and data from preloaded activities. Students were able to follow the instructions and walkthrough on activities inside of Tuva, however, struggled with the arsenic data taking a deal of time to load, and writing code to add the attributes for New Hampshire arsenic levels. Students were able, at times, to work with the software system, while also making and manipulating graphs through the use of Excel and Google Sheets. The graph created for the poster on Toxic Metals in the well water in Pelham was made in both Tuva and Google Sheets. The poster created by the students was made using Canva, and printed by the school on the poster printer.

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

The biggest challenge the students faced with the Tuva program was first learning how to use and write code to add the attribute for the New Hampshire threshold for arsenic. Due to being in New Hampshire, and the threshold for arsenic being lower than in Maine, students had to learn how to use and write code to add the attributes for New Hampshire. While performing this task, students struggled to then apply the attribute to the data to further manipulate it to show them what they want. Additionally, we are a 1-to-1 school with Chromebooks. Tuva was not entirely user friendly, often taking a while to load through the browser for the students. These two challenges combined made the use of the tool more challenging for students.

How did you enhance *your own* Data Visualization and Science Communication skills? Which aspects of this project will you repeat next year?

With the inclusion of the town utilizing the town voting days, it is planned to continue to communicate with the town the toxic metals that are found in the well water. There has been an increase in demand for water testing

throughout this academic year. By creating cleaner visuals that express the concern for the toxic metals in water, we were able to communicate with the community in a much larger way. It is imperative that we continue to communicate with the community in this way to help the townspeople better understand what is in their water.

Which aspects of this project will you change next year?

Next year we have a connection with the local newspaper that only prints monthly. In the Fall we will be able to have an article on the dangers of toxic metals the month prior to the National Voting Day, which will be in November 2024 versus January this year. The bioassay experiment did not go as anticipated this year, as the Brainy Briney shrimp were unable to fully develop and reproduce. A change to the curriculum to allow these bioassays to repopulate at least one time before the addition of the toxic metal containing water.

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

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

Videos- PUR Water Bar commercial

https://video.search.yahoo.com/search/video;_ylt=AwrEm5k8kPBlagQAQfJXNyoA;_ylu=Y29sbwNiZjEEcG9zAzEEdnRpZAMec2VjA3BpdnM-?p=PUR+water+bar+commercial&fr2=piv-web&type=E210US714G0&fr=mcafee#id=2&vid=c7ba6f94aab3fb2a6882bf838aa1b85a&action=view

Curriculum:

Bioassay: Algae Research Company Brainy Briney Lab Activities

<https://algaeresearchsupply.com/pages/projects-and-lessons>)

Population Sampling

https://drive.google.com/file/d/1YX03FDYw_DjqmS_mc7AJCStA0yJ2l5P8/view?usp=sharing)

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

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

November 16, 2023 8th Grade Step Up Night Students Abigail Sullivan and Emma Sullivan



Sarah Bellahrossi, student helper with the collection and communication of water samples in town. Her work through this grant has spiked her interest in creating an independent research project for her senior year.

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