Project Title: Water Pollution and the Impact on Human Health and Ecology

School: Westbrook High School

Grade level: 12

Teacher: Ragan Hedstrom

Partners: Partnered with Dr. Douglas Currie of the University of Southern Maine.
MDI Biological Laboratory, TUVA Labs, Molly Schauffler, University of Southern Maine

Teacher Profile: My name is Ragan Hedstrom, and I have been teaching at Westbrook High School for eleven years. Currently, I teach part-time a concurrent enrollment course called Fundamentals of Environmental Science that is only for seniors. I have taught at 3 different schools and started my career teaching in Baltimore, Maryland. I earned my BA and MA in Environmental Science and Policy at Clark University, and have been involved with environmental work in a variety of capacities ever since.

After college, I worked as an educator aboard traditional sailing vessels and as a biologist aboard scallop fishing boats and research vessels. These experiences have dramatically shaped how I teach. I love to do hands-on, and real-world studies with my students.

The All About Arsenic program has informed my teaching. I focus on bringing real-world problems and data into my classroom, determining what the story is, and how to hook people into caring in order to identify solutions to environmental problems.

Summary:
I incorporated pieces of this project throughout my Environmental Science course. I started by introducing arsenic when we discussed biogeochemical cycles and the inorganic components of ecosystems. They first learned about carbon, nitrogen, and phosphorus, then I was able to discuss other natural elements found in the ecosystem such as arsenic. When we discussed the water cycle and watershed ecology, we discussed how water is the universal solvent causing materials flow through ecosystems, and how humans have contributed to arsenic contamination. We watched "In Small Doses," and gathered information about the health implications of Arsenic in well water. Once students had a solid understanding of groundwater, arsenic, and the health implications, each student identified one location where they would be able to get a public water supply sample. We were able to obtain approximately 29 samples throughout the year.

We then did two controlled experiments that relate to this, one using lettuce seeds, and the other using fruit flies to determine the effect of ethanol on their negative geotaxis. Although none of the variables used was actually Arsenic, students were able to make the connection about ways in which controlled experiments could help to draw conclusions about the impacts of arsenic contamination, and they became aware of the use of model organisms.

The students were able to analyze their water sample results, finding trends such as the average level of lead in the public water supply. We looked at the samples using the 10 ppb limit and the 5 ppb limit as reference lines. We also used TUVA to make connections between arsenic and any other element. Students used Tuva multiple times throughout the semester for other reasons, too. We were able to discuss the value of data in graphical representation, and the diversity of ways the same data set can be represented.

The students worked for three months to perform a Solutionaries advocacy piece on a topic of their choice. They spent two different days learning about how to manipulate data using TUVA, and they spent some time learning how to use graphs as a model. There was also an emphasis on finding the advocacy piece that would have the most impact by knowing who your audience is, and telling a story gets people to identify with it more. Without All About Arsenic, this final piece would not be centered on advocacy, or have so much student buy-in.

Project Details:
21 Environmental Science students

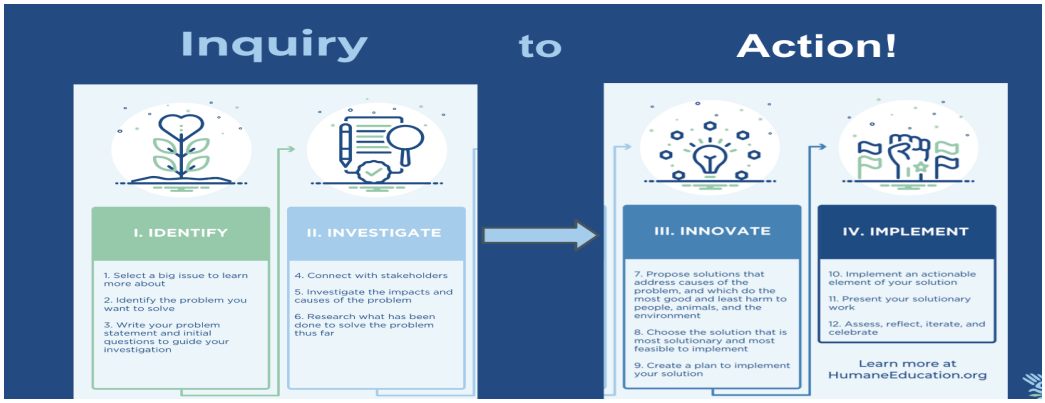
Funds were used to purchase:
Phosphate test kit
Nitrogen test kit
Dissolved oxygen test kit
Graph paper
Falcon tubes

Watershed:
Biogeochemical Cycles (group work/presentations)
[Template] Understanding the threat of mercury - Hedstrom
TUVA- mercury for lunch

Controlled experiment:
Planaria- Guidelines- how to write a lab report
[Template] Blank Lab Report- Planaria, Arsenic
Planaria basics
5 minute video- How to analyze data
WHS Lettuce Seed Bioassay
Drosophila Bioassay WHS
Blank Lab Report- Drosophila

Outreach/ Solutionary Project: Water quality was one of the choices, but not required.

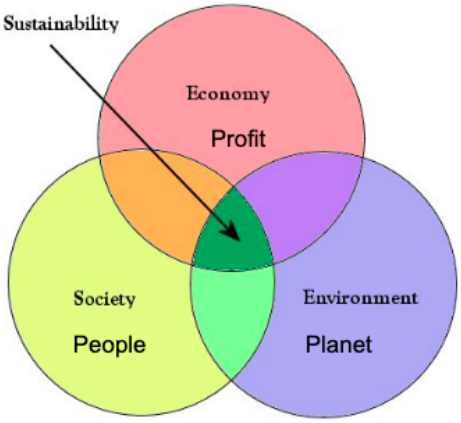
Solutionaries Project- master list 2025 This list shows
Student Solutionary Student Roadmap



[Science Communication Toolkit – All About Arsenic+]

IMPLEMENT: Final Presentation/ Celebration

Projects will be completed on April 10, and will be presented on April 30.



The Environmental Science class has spent the year learning about how environmental solutions are often more intricate and nuanced than they may appear. In addition to the environmental impact, the impact on the economy and society must also be considered.

Each person or group has been working on creating a local solution to a global problem. They have selected a topic they are particularly passionate about, performed research, spoke to stakeholders, identified possible solutions, and implemented the solution they determined to do the most good and avoid harm to people, animals and the planet.

Example pieces of work:
Lab reports

- Lettuce seeds Lettuce Seed Biassay Kylie
- Planaria Lab Reprt Planarian Mobility in Cigarette Water Concentration

Advocacy piece
The final projects are due on April 10.
There is a Celebration of Learning on April 30- stakeholders, administration, and other experts are invited.

Discussion:
I have been involved with this program for 5 years, or more.

Students learned:

- Not all drinking water is the same, even in the same building
- There are many different possible toxins
- Biomagnification, and the impact of small doses
- How to communicate effectively using data
- How to perform a bioassay
- The use of model organisms in the lab setting
- The importance of knowing the audience and telling a story
- The solutionary way to solve a problem.
- What advocacy is, and the variety of ways to get involved with topics they are passionate about

I learned:

- How to use TUVA to demonstrate different ways data can be represented
- How Drosophila can be used in class
- The importance of getting water tested, and the different types of faucets
- The Solutionaries Project exists, and it is aligned with what I want my students to do
- How to create a lesson plan devoted to advocacy

In the future, I plan to connect the Science Communications Toolkit and the Solutionaries project with more data, and have a rubric for them at the outset. This year was a great learning experience for the students, but I could streamline it better next year.

Conclusion: The SEPA grant has completely transformed how I teach my class. The first few years were more focused on incorporating higher-level data into the classroom. This last year

was about communicating data, thinking about who the audience is, and what the best course of action should be to get people inspired to take action.

The SEPA grant exposed me to multiple controlled experiments. Drinking water was a common thread, but it also allowed me to focus on several topics like writing a lab report, point and non-point pollution, watersheds, government-set limits, using graphs as a model, how to manipulate data, and more.

I love having a college professor assigned for collaboration. It helped me to raise the bar to a higher level of science and gave me the confidence to execute the labs. It has allowed me to incorporate real data into teaching and learning.

I am excited to participate in the training again this summer to build upon what I have already implemented, especially using data to tell a story, and implement solutions. One of the best parts of attending the summer workshop is making connections with other experts, and learning about programs and opportunities that others are involved in. For example: Because of my involvement in this program, I have also been made aware of the Maine Solutionaries Project.