

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 Schaufler, University of Southern Maine

Teacher Profile: My name is Ragan Hedstrom and I have been teaching at Westbrook High School for ten 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.

I am part of the Sustainability Club here at the school, have implemented recycling and composting at the school, and have been an advocate for solar power for our school buildings. I love to teach about how humans impact our environment and help students identify solutions to environmental problems. Getting involved in the All About Arsenic program aligns with my goals of bringing real-world problems and data into my classroom.

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 class did a Tuva analysis on mercury. This was their introduction to data manipulation on Tuva, as well as the bioaccumulation of toxins in the food chain.

The students spent one class period doing a Zoom lesson with Jane Disney where they got a better understanding of the SEPA study, and focused on the analysis of data using Tuva.

During the next class period, students spent 30 minutes looking at Ludwig's case study on lead in the water at College of the Atlantic. We discussed how data was used to support a claim, and also how knowing who your audience is, and telling a story gets people to identify with it more.

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.

For a final project, the students complete an advocacy piece on a topic of their choice. The students had some examples given to them, or they could chose to focus on various topics we had discussed throughout the year. One thing I changed about this year was to make it more about data and graphs. Tuva is the top choice but they can create graphs using any format they wish. Also, there was a lot of time spent on the idea of telling a specific story. They reported that this was a very powerful experience for them that they will carry with them after graduation. It was a new experience for them to realize they actually can take action to make a difference. Without All About Arsenic, this final piece would not be centered on advocacy, or have so much student buy-in.

Project Details:

28 Environmental Science students

Funds were used to purchase:

packing tape
lab tape
falcon tubes
seeds
storage totes
scalpels
probes
paint brushes
wader boots

ice cube trays
fish nets
refractometer

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:

Every student chose a topic they wanted to advocate for. Water quality was one of the choices, but not required.

- ☰ Advocating Real World Solutions for the Environment: Final Research Project. 2024

Example pieces of work:

Lab reports

We broke the lab reports into sections that were the are of focus

- Lettuce seeds ☰ Lettuce Seed Bioassay
- Drosophila ☰ Saige 1/2 lab report

Advocacy piece

- This is a website that is to be sent out on social media. [Final project:Local food](#)
- This was sent to Sappi and Pike Industries [Final project website](#)
- This brochure is for WHS students 📄 Nyamouch Bayak the dark side of fashion.pdf
- This video explains how the brochure below was distributed, and who the main audience was. 📄 Hailey Rondeau - Final Project Presentation.mp4

GAZA CLIMATE CRISIS

POLLUTANTS

IN THE FIRST TWO MONTHS FOLLOWING THE OCTOBER 7TH ATTACK, ISRAELI MILITARY OPERATIONS EMITTED 281,000 METRIC TONS OF CARBON DIOXIDE, EQUIVALENT TO BURNING 150,000 TONS OF COAL. 95% OF THESE EMISSIONS WERE ATTRIBUTED TO ISRAEL'S AERIAL AND GROUND ATTACKS IN GAZA.

AS OF APRIL 2024, ISRAEL'S BOMBS HAVE CREATED 27 MILLION TONS OF DEBRIS THAT WOULD TAKE AN ESTIMATED 14 YEARS TO CLEAR AND HAVE INCREASED THE AMOUNT OF PARTICULATE MATTER IN PALESTINE'S AIR TO A DANGEROUSLY HIGH LEVEL. ADDITIONAL ATTACKS RELEASED WHITE PHOSPHORUS, A DANGEROUS, HIGHLY INFLAMMABLE CHEMICAL THAT COULD LINGER IN PALESTINE'S WATER AND SOIL FOR YEARS TO COME.

CEASEFIRE NOW
CALL YOUR REPRESENTATIVES
RESIDENTS OF WESTBROOK, ME

CHIELLIE PHOENIX · (202) 224-9118
SUSAN COLLINS · (202) 224-2523
ANDRU KING · (202) 224-9384

MORE INFO AVAILABLE AT SCALLS.ORG

OVERVIEW

ON OCTOBER 7TH, 2023, HAMAS LED AN ATTACK ON ISRAEL, KILLING 1,139 ISRAELIS AND TAKING OVER 200 HOSTAGES. THIS ATTACK, A RESULT OF DECADES OF TENSION AND CONFLICT BETWEEN PALESTINE AND ISRAEL, SPARKED AN UNPRECEDENTED RETALIATION FROM ISRAEL, IN WHICH OVER 35,000 PALESTINIANS HAVE BEEN KILLED AS OF MAY 18TH, 2024, WITH MORE THAN 14,000 OF THOSE BEING CHILDREN.

ISRAEL'S RESPONSE TO THE OCTOBER 7TH ATTACK HAS DAMAGED OVER HALF OF GAZA'S RESIDENTIAL BUILDINGS, LEAVING 85% OF GAZA'S 2.5 MILLION CITIZENS INTERNALLY DISPLACED WITH NO WAY OUT.

MILITARY CO2 EMISSIONS 60 DAYS AFTER OCTOBER 7TH

ENVIRONMENTAL IMPACT

CARBON DIOXIDE
GREENHOUSE GASES TRAP HEAT IN EARTH'S ATMOSPHERE. IN GAZA AND PALESTINE, TEMPERATURES HAVE RISEN BY 1.5°C (2.7°F) SINCE BEGAINING THE HOSTILITIES. RESEARCHERS AND TEMPERATURES ARE PREDICTED TO INCREASE BY 4°C (7.2°F) BY 2100.

WHITE PHOSPHORUS
WHITE PHOSPHORUS IS A CHEMICAL SUBSTANCE THAT BURNS UPON CONTACT WITH OXYGEN AND TURNS HARMLESS WITHIN MINUTES, BUT IN DEEP SOIL OR DEPOSITED INTO THE WATER WITH NO OXYGEN, WHITE PHOSPHORUS CAN LINGER FOR CENTURIES.

PALESTINIANS NEED A CEASEFIRE NOW
ISRAEL IS ON TRACK TO DESTROY GAZA IN ITS ENTIRETY. FOR A CEASEFIRE TO HAPPEN, THE UNITED STATES NEEDS TO STOP SENDING WEAPONS TO ISRAEL.

WARMING GASSES FROM REPAIRS VS. ANNUAL CO2 EMISSIONS

HUMANITARIAN IMPACT

PARTICULATE MATTER
SIDE EFFECTS OF PARTICULATE POLLUTION INCLUDE:
- EYE, THROAT, AND THORAX IRRITATION
- TROUBLE BREATHING
- CHEST PAIN
- WORSENING SYMPTOMS IN THOSE WITH ASTHMA AND HEART DISEASE

WHITE PHOSPHORUS
WHILE EFFECTS OF WHITE PHOSPHORUS EXPOSURE INCLUDE:
- SEVERAL BURNS POTENTIALLY REACHING DOWN TO AND THROUGH THE SOLE
- RESPIRATORY DAMAGE
- ORGAN FAILURE
BURNS FROM WHITE PHOSPHORUS OR AS LITTLE AS 10% OF THE BODY AFTER RESCUE IN DEATH.

Discussion:

I have been involved with this program for 4 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
- What advocacy is, and the variety of ways to get involved with topics they are passionate about

I learned:

- How to use TIVA 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 would do all of the bioassays that I know in order to get students involved and engaged. They do not all need to be formal lab reports. I would like to see more of a connection between Dr. Currie's students and my students.

Conclusion: Being part of the SEPA grant has been invaluable. It has informed my teaching throughout the course. I have learned a lot as a teacher, and it has helped me provide opportunities to my students.

It was great getting the students to engage in multiple controlled experiments, and think deeply about the procedure as well as how to utilize the results to draw conclusions. 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.

Because of my involvement in this program, I have also been made aware of the Maine Solutionaries Project, and I plan to attend one of their kick-off sessions this summer and learn how to implement that in my course.

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 hearing what other people are doing and building a network of teachers and professors.