

Project Title: Elevated Groundwater Arsenic Concentrations In Private Wells in Central

Maine **School:** Waterville Senior High School

Grade Level:10-12

Your Name: Jon Ramgren and Justin Giroux

Project Partners: Dr. Juyoung K. Shim, University of Maine Augusta, was the scientist partner for this project. Justin Giroux and Jon Ramgren, the chemistry teachers at Waterville Senior High School, collaborated on the implementation of this project.

Teacher/Scientist Partner Profile:

Jon Ramgren has been teaching for 32 years. He has a Bachelor of Science in chemistry from North Park College and a Masters in Secondary Science Education from The Ohio State University. Over the last 12 years he has involved students in research opportunities at the Mount Desert Biological Laboratory during April vacations and summers. He coaches the Science Olympiad Team. He enjoys seeing students get involved in new experiences that lead them to engage in further learning about - and exploration of - their world.

Justin Giroux has been teaching for 10 years. He has a biochemistry degree from Bates College with a focus on environmental chemistry. His undergraduate research focused on improving the efficiency of CdSe based photovoltaics. Justin is interested in bringing real life problems to his classroom to allow his students the chance to work on something meaningful to their community. To achieve this, his chemistry classes have a focus on energy and water.

Summary:

Collecting samples done in the early fall with the idea that students could sample water at their camps before they were winterized. Obtaining samples was difficult since many of the students live on public water supplies. Obtaining a sample was worth a grade in each class. Adults in the building were able to help out students who could not find a well to sample.

Justin's classes had a broad choice for their community project. Their varying projects includes: a blog, an art project, brochures, a Tik Tok video, slide show, and posters. Jon's class worked on a brochure to offer at community medical practices.

Project Details:

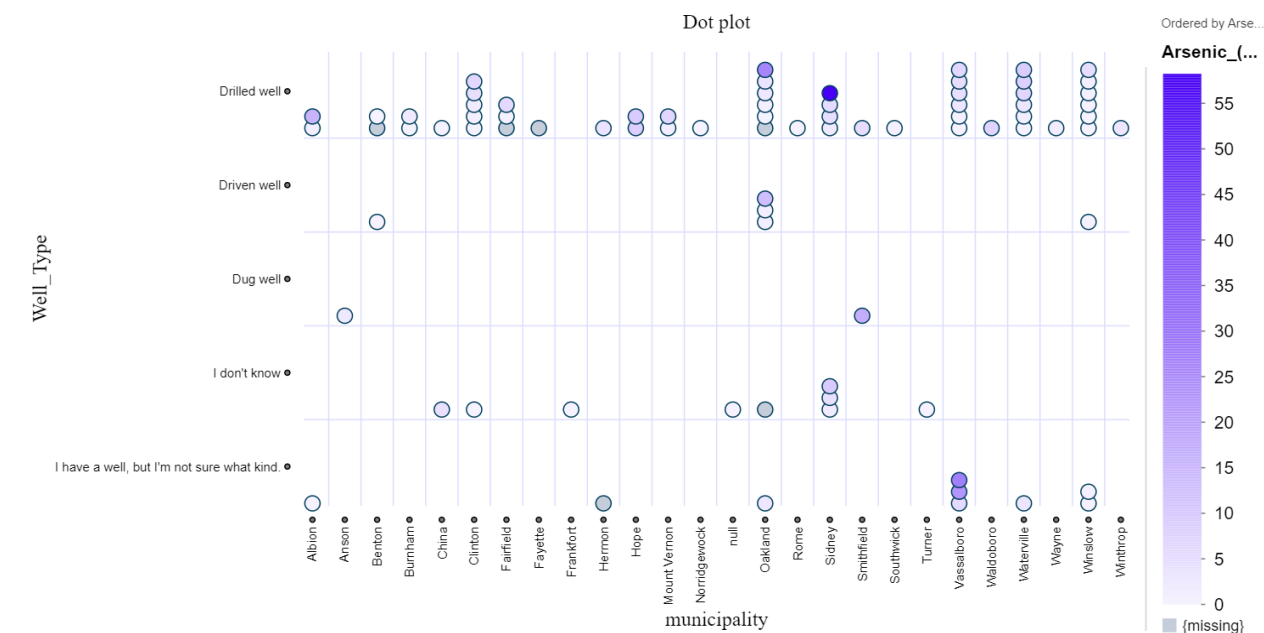
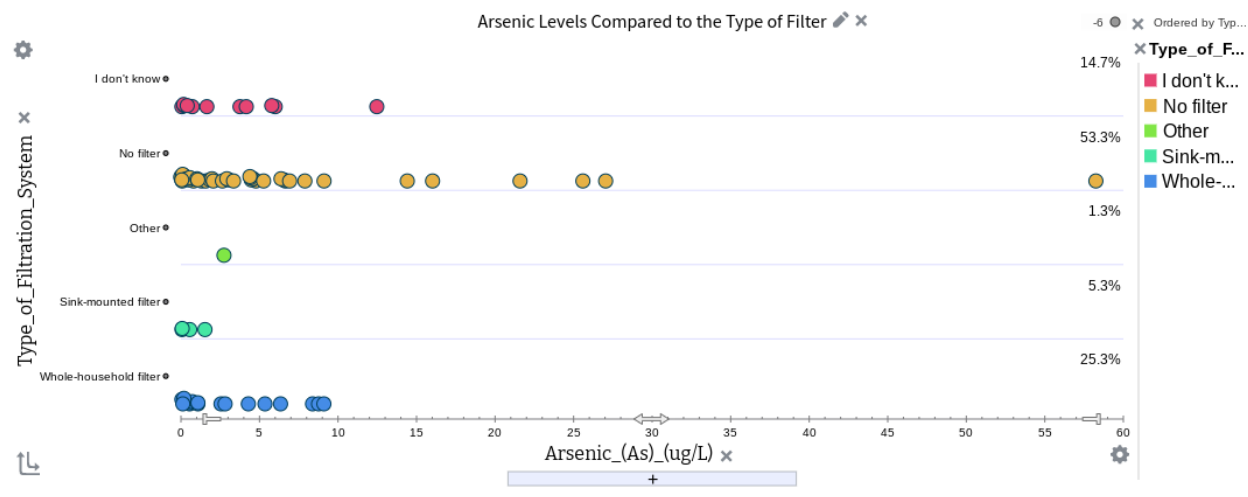
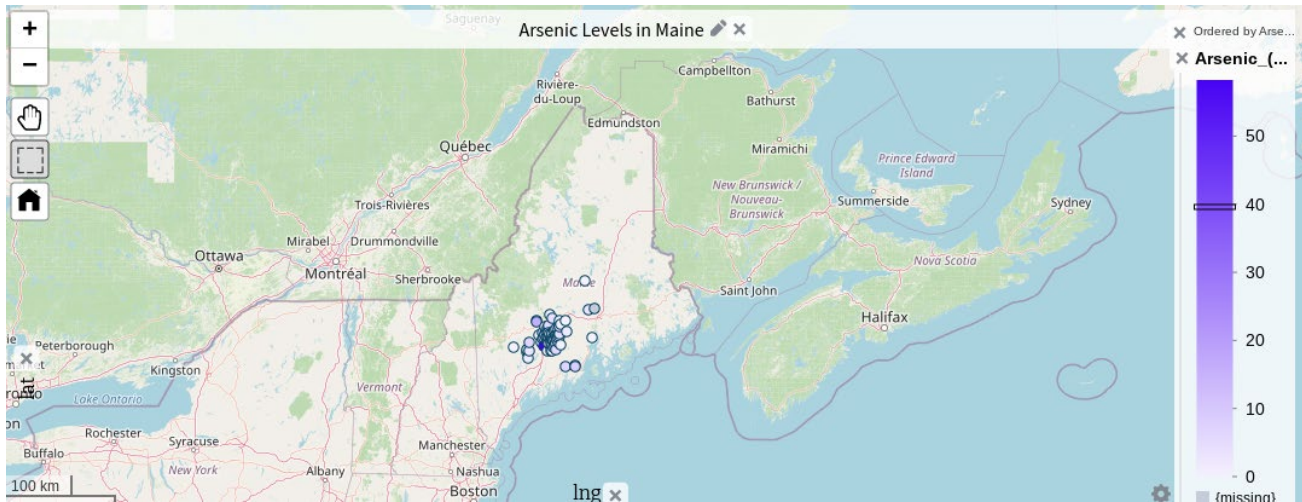
- How many students were in the class that was involved in this project? Justin had 17 students work on this project. Jon had 64 students.

- Detail specific curricular items such as questions, articles, books, YouTube videos, and labs. It's helpful if you provide links.
 - "The Quest for a Clean Drink"
<https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/gcquest-for-a-clean-drink.pdf>

- “The Flint Water Crisis: What's Really Going On?”
<https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/pastissues/2016-2017/december-2016/flint-water-crisis.html>
- Maine Geological Survey Bedrock Geology Maps
<https://www.maine.gov/dacf/mgs/pubs/online/bedrock/state.htm>
- “How Much Arsenic is in Rice” <https://www.youtube.com/watch?v=9XK66S50oas>
- Tuva Video tutorials <https://tuvalabs.com/resources/videos/>
- Tuva pre-made data sets and activities
https://tuvalabs.com/content/?show=all&view=block&type=datasets&order_by=-last_modified
- “Assessment of Arsenic Concentrations in Domestic Well Water, by Town, in Maine, 2005–09”
<https://pubs.usgs.gov/sir/2010/5199/>
- Questions for “All About Arsenic - Data to Action: A Secondary School-Based...”,
<http://www.allaboutarsenic.org/>
- Jon and Justin used Tuva activities to teach students how to use the program. Jon also put the data from the class penny density lab into Tuva and had students make graphs of the data. Justin and Jon used Tuva with their periodic table unit. Students also made various graphs of the Arsenic Data Set.
- Essential question: How is the water quality of Messalonskee Stream?
- Essential question: How widespread is the PFOA contamination in Central Maine?
- Essential question: How widespread is arsenic in Maine’s well water?

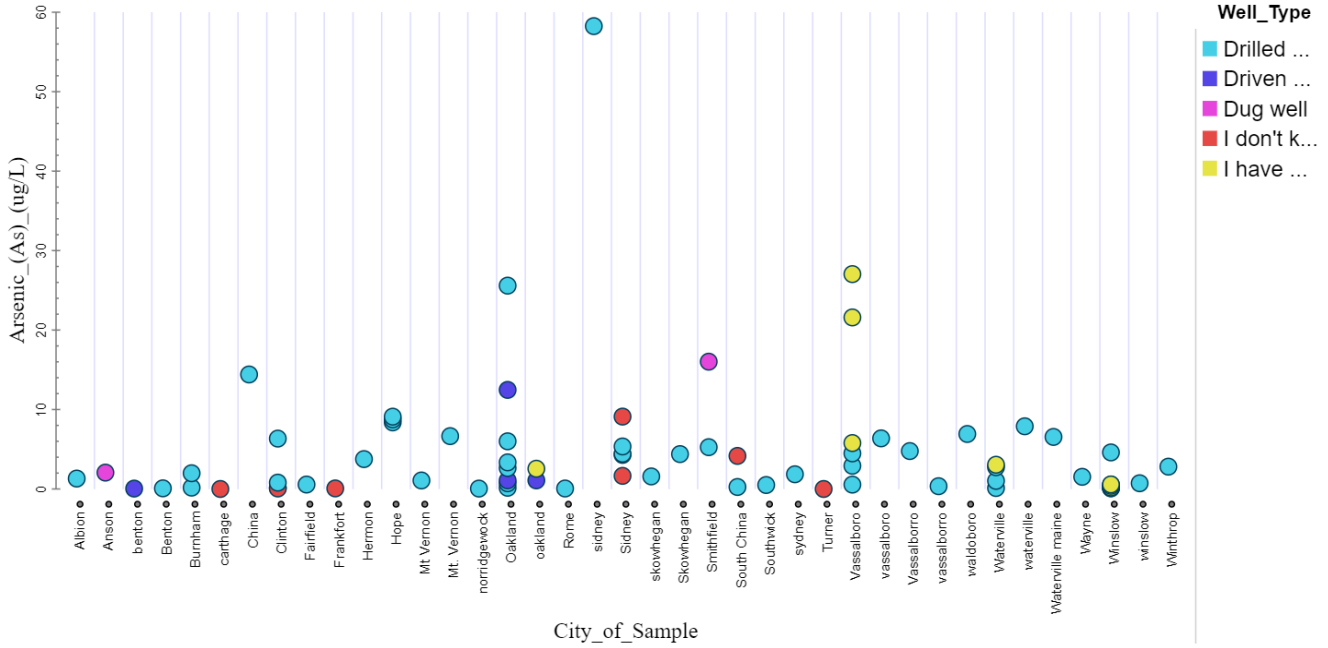
● Did you:

- Collaborate with any other teachers in your school? Besides Justin and Jon working together, a teacher new to our school, Andrea Tardif, also had her Applied Chemistry students collect water-samples and work with Tuva to carry out many of the activities in this case study.
- Go on any field trips? Why and where? No.
- Conduct any experiments? What kinds of questions did students ask? Did water testing of our local stream. Did bioassays with planaria. Students did both movement and regeneration experiments.
- Use your stipend to purchase anything for your classroom? If so, what, and how did you use it?
Jon ordered planaria and the printing of 1000 brochures.
- Invite any guests to visit your classroom? *No*
- How did you use Tuva, both for the arsenic data and for other datasets? Students used the periodic table dataset as the introduction to Tuva. Once the arsenic data was produced students used Tuva to explore the dataset to explore associations between the different attributes. We also used Bill Zooellick’s pre-test and used specific lessons on TUVa to target our students’ misconceptions. Used a Tuva activity as a part of the mid-year exam for the Applied Chemistry classes.
- How did you plan your community outreach?
 - What did the students do?
 - Justin’s students did a plethora of different project types as mentioned in the summary.
 - Jon’s students produced brochures.
 - What was the impact? We had no way of assessing the impact on our community.
- Include any data analyzes your students did.



Arsenic in maine towns

-6 Ordered by Well...



2022/2023 Drinking Water Data | How to Select Data in TuvaLab

arsenicdata.tuvalabs.com/dataset/385/

Tuva Datasets Help Sign Up Sign In

CASE CARD < 1 of 423 >

- Longitude: 70.214133
- Sample collection date: 2022-12-19
- Year: 2022
- Month: 2022-12
- State: Maine
- County: Hancock County
- City: Mount Desert
- Sample number: 2223-758
- SEPA School Name: Mt. Desert Elementary

As in Waterville well water samples 22-23

7 (9.3%)

54 (72%) 14 (18.7%)

Arsenic (ug/l)

Table View Summary View v2.160

2022/2023 Drinking Water Data About Tutorials

Mar 6 11:44 US

2022/2023 Drinking Water Data | Classwork for Applied Chem W... | Drinking Water Data (All Years) | Ava Bash - Copy of Block 3: 1st

arsenicdata.tuvalabs.com/dataset/244/

Tuva Datasets Help Sign Up Sign In

CASE CARD < 1 of 3405 >

Name High School

ZIP zip: 03221

Well type Drilled well

Previous arsenic test I don't know

Type of filtration system No filter

Sample location Kitchen

Arsenic (ug/l) 0.408

Antimony (ug/l) 0

Barium (ug/l) 0.037

Beryllium (ug/l) 0

Ar years for waterville

Table View Summary View v2.16.0

Drinking Water Data (All Years) About Tutorials

Mar 6 12:01 US

2022/2023 Drinking Water Data | Classwork for Applied Chem W... | Ava Bash - Copy of Block 3: 1st

arsenicdata.tuvalabs.com/dataset/385/

Tuva Datasets Help Sign Up Sign In

CASE CARD < 1 of 423 >

ZIP zip: 04679

Well type Drilled well

Previous arsenic test Yes

Type of filtration system No filter

Sample location Kitchen

Arsenic (ug/l) 0.385

Antimony (ug/l) 0.034

Barium (ug/l) 1.512

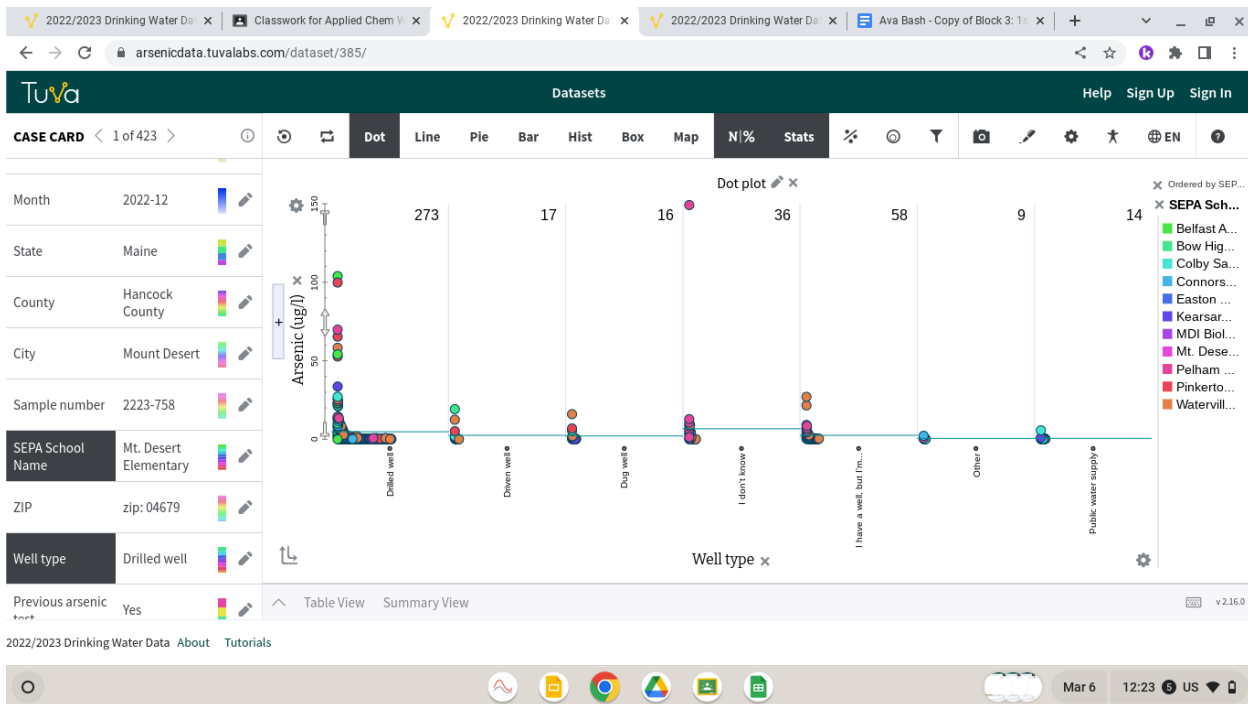
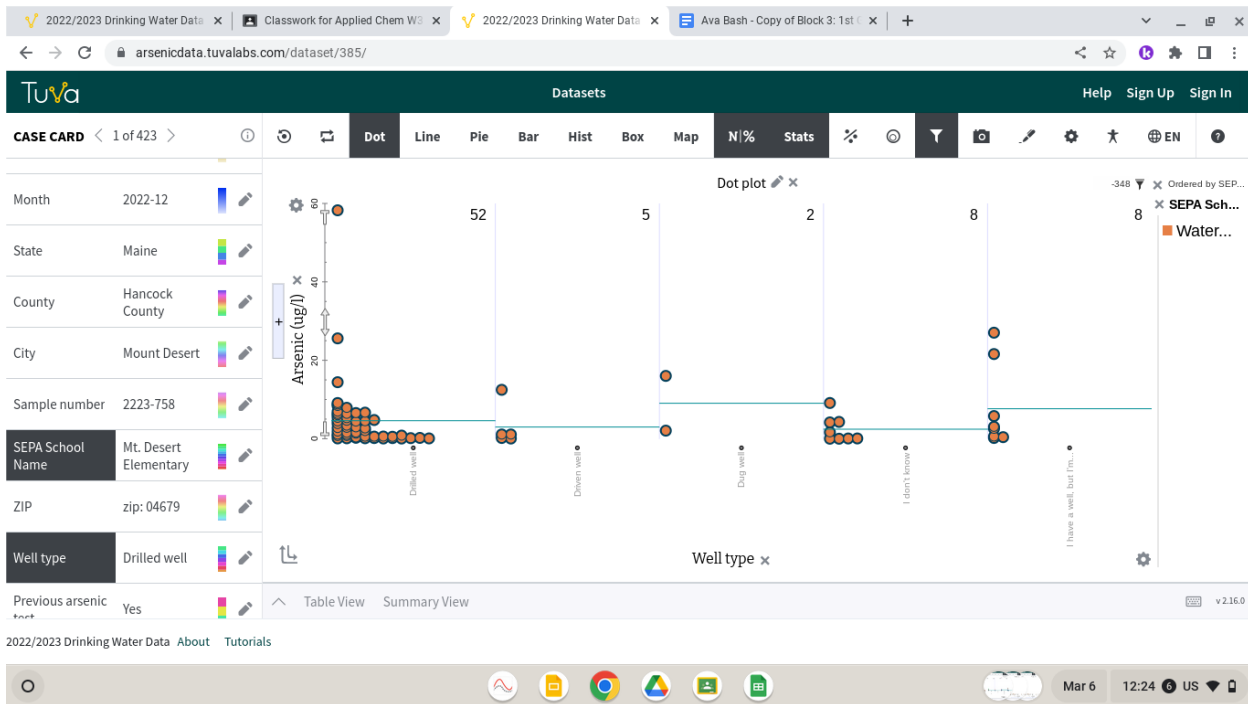
Beryllium (ug/l) 0.011

All data of Ar 22-23

Table View Summary View v2.16.0

2022/2023 Drinking Water Data About Tutorials

Mar 6 11:48 US



Discussion:

- What did students learn? It's great to include quotes if you have them.
 - Students learned that arsenic is a problem in wells in our area and it's a good idea to test them.
 - Students learned that arsenic can be filtered out with some types of water filters.
 - Students gained data literacy skills working with raw data.

- What did you learn?

- Justin and Jon learned about our student's misconceptions surrounding data literacy with the help of the pre-test developed by [Bill Zoellick](#).
- Jon Learned that he needed better equipment to get usable pictures of the planaria in the regeneration experiment and that observing every other day did not allow students to see the types of subtle differences in regeneration time for planaria in different treatments.
- What would you do differently?
 - Justin got a late start on the data literacy portion of the curriculum this year. He wishes he had started this component sooner.
 - Jon would work to keep the activities more tightly grouped together. I would order the planaria from a supplier that could deliver when ordered instead of waiting only to find out that they were on backorder.
 - Jon would look for a better camera setup for the planaria experiment.

Conclusion: The arsenic project was once again well received by students. Again we did find several families have high levels of arsenic in their well water. We found the percent of wells tested with elevated arsenic was similar this year to the previous years' results. We were able to teach about what things can be done if there is a high level of arsenic in a given water supply. Making water quality the central theme of our chemistry classes, especially the Applied level classes, has been helpful at engaging students. We will continue to work at refining curriculum and activities to improve student outcomes.

References:

<https://www.allaboutarsenic.org/>

Poster "Assessing effects of arsenic on behavior and regeneration on Planarian Bioassay" Gregory Spencer¹, Valerie Erhardt¹, Collin Frangos¹, Perla Moguel¹, Carmen Lopez¹, Jane Disney², Juyoung Shim¹.
University of Maine at Augusta¹, Mount Desert Island Biological Laboratory²

Acknowledgement: The work reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number R25GM129796. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.