

Project Title: Integrating Arsenic Wellwater Citizen Science Project in Water Resources Course.

School: Colby-Sawyer College

Grade Level: 200 Level Water Resources Course and 200 Level Geographic Information Systems Course

Teacher: Mary Wright (Kearsarge High School)

Project Partner: Nick Baer (Colby-Sawyer College)

Partner Profile:

I am in my 16th year at Colby-Sawyer College and I continue to seek applied science projects to integrate into course curriculum to engage students in the course material and give them a 'real' project to contribute to over throughout the semester. I teach a broad range of courses from introductory ecology and environmental science courses to upper level aquatic ecology, conservation biology and field courses in Colorado and in the White Mountains. My research interests include assessing the effects of water chemistry and its impacts on aquatic biota and human health.

Summary:

In our Environmental Science program we are interested in scaffolding applied projects in our 200 level courses in preparation for the students' 300 series Community-Based Research project courses usually taken in their junior year. The goals of integrating this arsenic in wellwater project in the Water Resources course are to: 1. Learn about groundwater contaminants, 2. Introduce skills to manage and coordinate research projects, 3. Develop data management and analytical skills, 4. Expose students to citizen science projects and get students to engage in working with the public, and 5. Develop communication skills through research papers and presentations.

Project Details:

The Water Resource class was assigned a research paper early in the semester with the goal of doing a literature review of what is known about a specific groundwater contaminant. There were a few students who focused on arsenic while others chose a variety of other water contaminants including MtBE, Uranium, Radon, and PFOAs. The student papers focused on reporting about the specific contaminant, its origin, use, human and ecological health concerns, regulation, management and mitigation. All students were asked to contribute to a presentation for the high school students focused on arsenic. The class developed the presentation outline, and in small groups students were responsible for contributing specific slides to the overall presentation including a script with the key points to be presented.

The arsenic project was described to the class and an advertisement was placed in the local paper to make the community aware of the project and how to get a sample kit to have their

well tested. The goal was to augment the number of wells tested in the region to add to the data collected by Mary Wright's high school students. Students organized and put together the wellwater sampling kits. Once samples were returned, the students entered the data into the anecdata.org portal through the All About Arsenic website. The class discussed the importance of quality control and quality assurance and students were encouraged to have one person enter the data and a second student check the entries before submitting to reduce errors in the data. The class examined the data from previous years to explore the larger data set from Maine and New Hampshire and to look at arsenic levels within Merrimack county.

The final component of this project was integrated in the spring semester Geographic Information System (GIS) course where students learn spatial mapping skills using the GIS software. The wellwater sample data collected with citizen science partners in the fall semester was used along with the rest of the data to get students to look at the data spatially and analyze patterns. Students created maps looking at arsenic concentrations while learning the functionality of GIS and the tools within the software. Because there are multiple levels of GIS courses, we even had one student who participated in the arsenic study two years ago, go on to develop a series of maps that included arsenic levels in wellwater and historical arsenic pesticide use.

Discussion:

Overall the arsenic wellwater project worked well to engage students in groundwater contaminants and fit well within the course curriculum. The research paper was an effective way for students to learn quite a lot about specific contaminants and to share what they learned with their peers. Due to COVID-19, this past year the students didn't complete the final arsenic presentation and talk with Mary Wright's students. I would like to try another presentation or student collaboration with the high school next year to see if it might get the students collaborating. Perhaps trying a blog where both groups of students can contribute will be an engaging activity.

Getting students involved in the citizen science wellwater sampling was an excellent part of the project that gave the students an appreciation for the level of organization and work needed to successfully collect data. I would like to spend more time with the data exploration so students can have multiple opportunities to see and ask questions about the data they are gathering. Integrating the data into the GIS course has been well received by students who helped to collect the data. It was also a great way for instructors to collaborate. Harvey Pine, who teaches the GIS course, welcomed the opportunity to use the data in his course. We conducted student surveys to assess the effectiveness of using the arsenic wellwater project in our course curriculum. Students rated it high for learning about data management and analysis and for engaging with the course content more deeply. We plan to expand our assessment in the coming year.

Conclusion:

Getting our students engaged in environmental research projects and developing collaborative work skills are key pieces we wanted to scaffold in our curriculum, so students are better prepared for their junior year when they are managing a year-long community research project. This project provides a wonderful opportunity for our college students to dive deeper into a water resource issue and contribute to ongoing research in the region. This collaboration fits well within our course and curricular outcomes for the Environmental Science and Studies program here at Colby-Sawyer College.

Acknowledgements:

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