The Impact of Septic Systems on Long Island's Aquifer: A Citizen Science Interdisciplinary Study

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Suffolk County Community College

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2018 NCSCE Science & Engineering for Social Good

February 9-11, 2018 - Georgia Tech University

Partnerships and Collaborations via Grant-Funded Initiatives

- *National Science Foundation Scholarships for Science, Technology, Engineering, and Mathematics (NSF-S-STEM)*
- *National Science Foundation SF Louis Stokes Alliances for Minority Participation (NSF-LSAMP)*
- *Harry and Leona Helmsley Charitable Trust NYProject*
- *Science Education for New Civic Engagements and Responsibilities (NSF-SENCER) and the National Center for Science and Civic Engagement (NCSCE)*
- *Institutional Research and Academic Career Development Awards-New York Consortium for the Advancement of Postdoctoral Scholars (NIH IRACDA-NYCAPS)*
- *National Science Foundation Advanced Technological Education (NSF-ATE)*
- *National Science Foundation Improving Undergraduate STEM Education (NSF i-USE)*

SENCER - NYP Helmsley Project at Suffolk County Community College

- Focus: Issues affecting Long Island's water supply and quality.
  - Drinking water is drawn from a sole-source aquifer
  - Primary means of waste disposal is through individual cesspools/septic tanks particularly in Suffolk County

- Formed interdisciplinary citizen science learning community.
  - Charged with exploring and investigating the impact of septic systems on our LI water supply through the lens of four courses: chemistry, journalism, engineering science and construction technology.
  - Classes explored the issue within each of their classes and exchange, share resources, and aggregate this information utilizing Blackboard as a central communications tool.

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- Groundwater experts, local politicians and community leaders as well as our IRACDA post-doctoral Teaching Scholar were scheduled to lead online discussions.
- Discussions examined new septic systems currently being piloted which reduce Nitrogen loading.
- Students synthesized scientific information along with economic, societal and renewable energy implications to arrive at a recommendation.
- Recommendations disseminated to inform the college and regional community via capstone presentations at the Student Undergraduate Research Conference on April 21, 2017 (sponsored by SUNY), SENCER SSI, SUNY Applied Learning
- Other NY Project Helmsley partner institutions will share their SENCER-themed interdisciplinary projects.

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Chemistry students

demystifying the chemical reactions of septic tanks and water supply. What is happening and why? Develop understanding of how crucial the situation is and what is the action that must take place.

Journalism

Create writings to educate, disseminate to the public and discuss the pros and cons of the implementation of system. With over a million homes and vital water supply at stake, what does this mean? Water vs cost?

Blackboard as central communication link with possible social media . Experts in local ground water present to students, regular student planning/exchange meetings. Dissemination of information to the community, an informed community.

Construction Technology

Develop drawing and descriptive diagrams demonstrating how the system operates. Generate descriptive diagrams demonstrating how our underground water supply operates. How can we design informative information for the public?

Engineering Science

What is the problem, how do we implement a solution, and what are the tradeoffs.

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Selected Student Thoughts to Discussion Prompt: "What Do You Think is the Primary Threat to our Drinking Water?"

- Potable vs "wild water"
- Patterns in posts- sewage and fertilizers
- Sewage –data on geology, cost, construction issues
- Fertilizers vs herbicides vs pesticides; overuse and costs to consumers
- Fertilizers – no permits
- EPA fines
- Unlicensed and uninsured business– avoids taxes to Government
- Suffolk County Fertilizer Reduction Act

Student response to Discussion Question “What do you think is the Primary Threat to our drinking water?”

“…….As regards the drinking water threats for Long Island, I don't think we can separate threats to our potable water from the issues with all of the 'wild' water surrounding the Island (the Sound, the Ocean, the bays and inlets; saltwater and fresh). After reading many of the posts I am beginning to see a pattern. Many of the posts are focus on two main issues: sewage and fertilizers.”

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Excerpts: Student Comments

"….I think most people informed of the issue will agree that given Long Island's unique geological characteristics, given the fact that Long Island's population is currently almost eight million (three million of whom live in Suffolk and Nassau counties), given the fact that we retain all of our potable water from aquifers under the island, it is income-prehensible that we continue to use cesspools for holding sewage. When there is the very clear possibility that what is in those cesspools will eventually contaminate the fresh water supply, it is incumbent on us to find an alternative way for dealing with our waste. One possible solution would be to create a sewer system that would drain to the ocean. One obvious problem with that is cost. The cost of switching every neighborhood in Suffolk and Nassau alone would be astronomical. The work required is highly invasive. …... Also, there is the very unfortunate possibility that by the time such a project was approved, funded, and completed, damage to our aquifer will have already begun and continuing for many years."

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Excerpts: Student Comments

"…..fertilizer- is also a more complex problem... I am actually very familiar with this issue because I owned and operated a small landscaping business for the past ten years with my brother…..First, it is important to keep in mind the differences among fertilizers, herbicides, and pesticides…..

Fertilizers are used to feed a lawn. Homeowners apply fertilizers to their lawns mainly because of poor decision-making with their landscaper. Also, landscapers will apply fertilizers to make money, and I assure you there is no easier money to be made by a landscaper than to apply fertilizers. The profit margin is enormous and there is an incentive to applying it because there are essentially no rules regulating its application. State and local governments do not require special permits. to apply fertilizers, and they are very often applied incorrectly and unnecessarily. One way to prevent the overuse of fertilizers is for a homeowner to ask that his or her landscaper leave behind the clippings,…..making fertilizer applications all but unnecessary."

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ESRI Mapping of Chemistry Student Water Sample Data

- A story map of the data collected was prepared and these maps are interactive The link to maps can be manipulated by the user to turn on and off layers and to see the table data associated with each point, those links are within the story map.

- Within Blackboard we added a quick link to a map app, so that students could see their data graphically and also have the ability for turning on and off layers.

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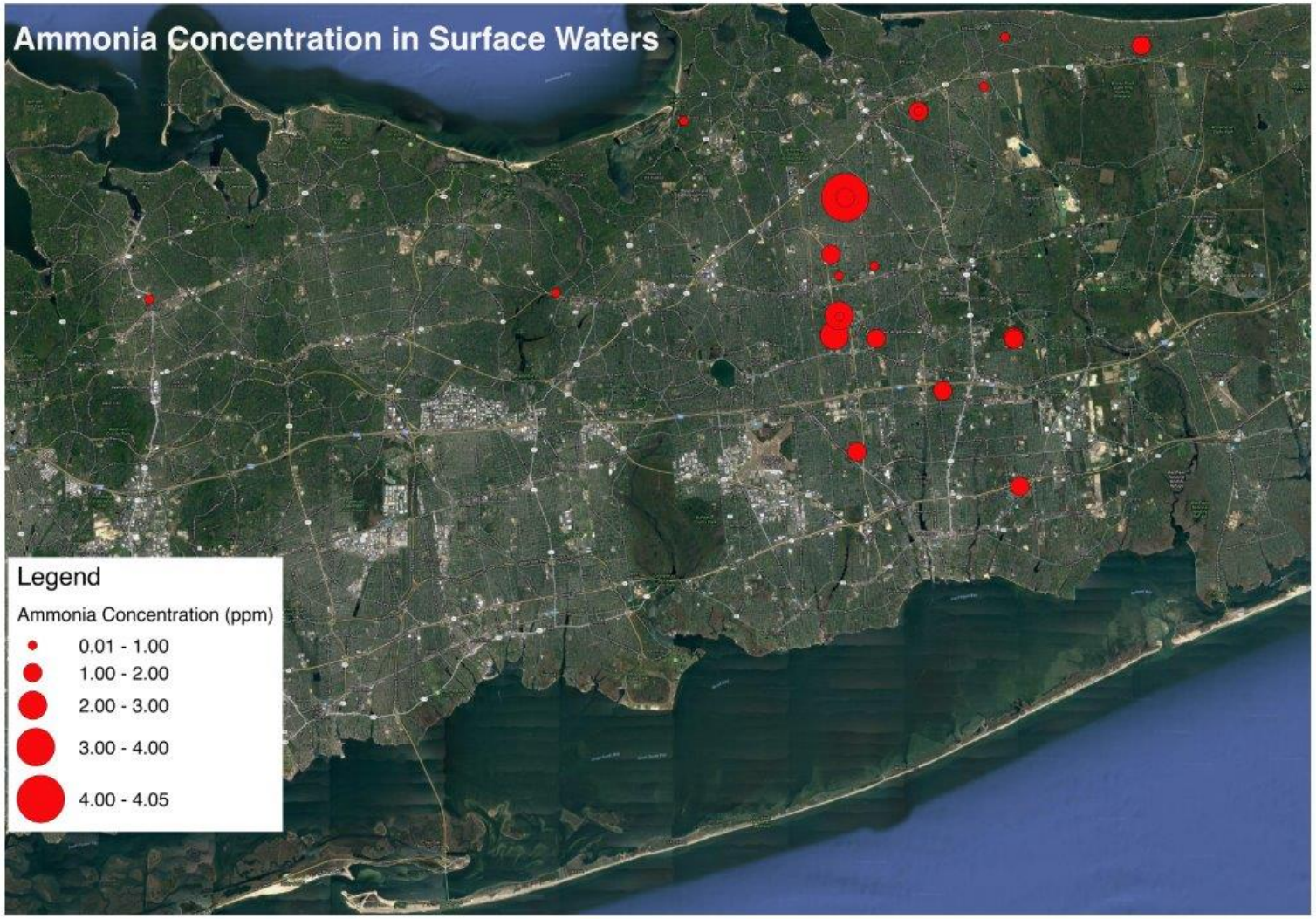
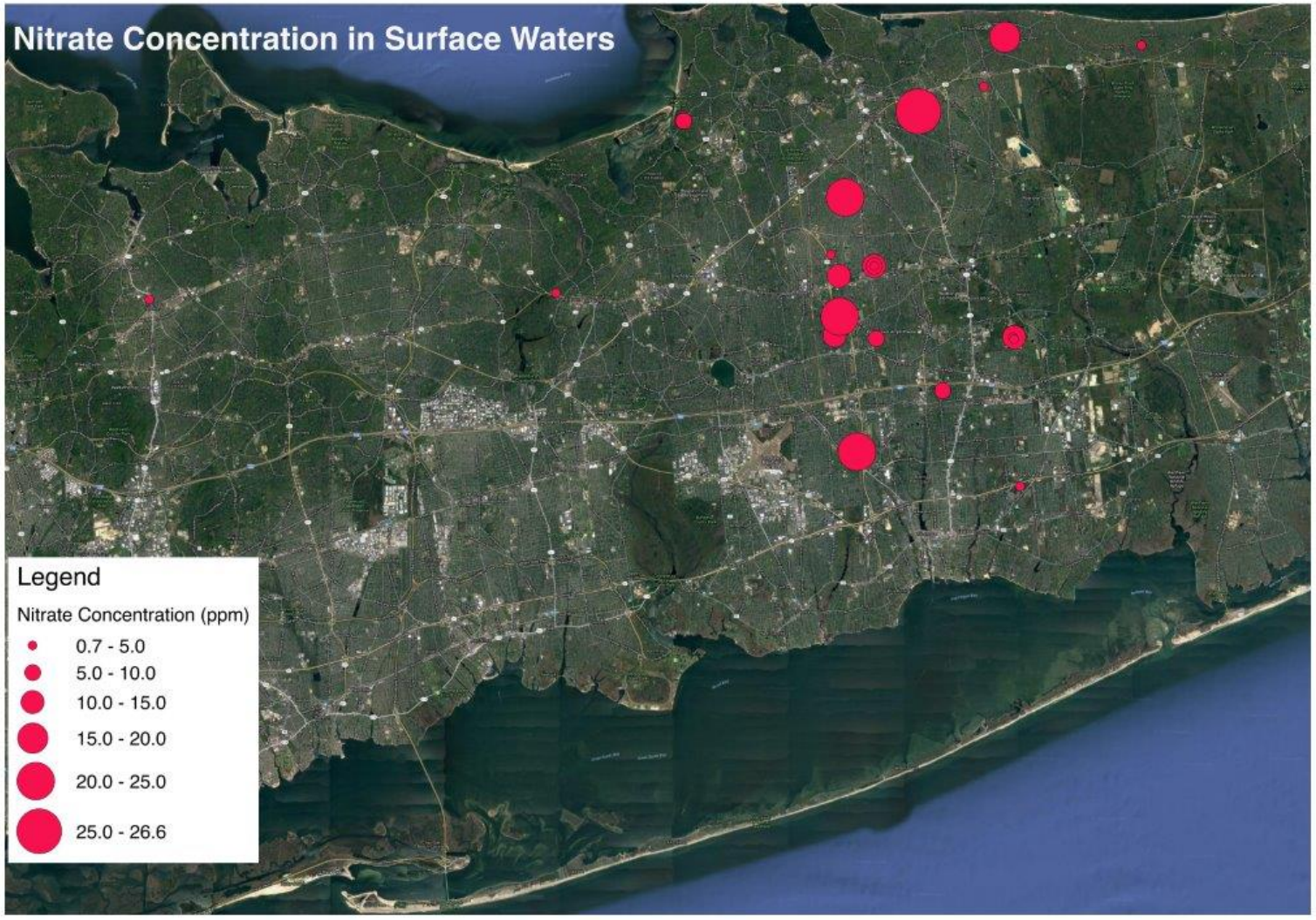
Student Collected Data, Fall 2016



Plotted on Google Earth Map of Suffolk County (Western and Middle Sections)

Student Collected Data, Fall 2016



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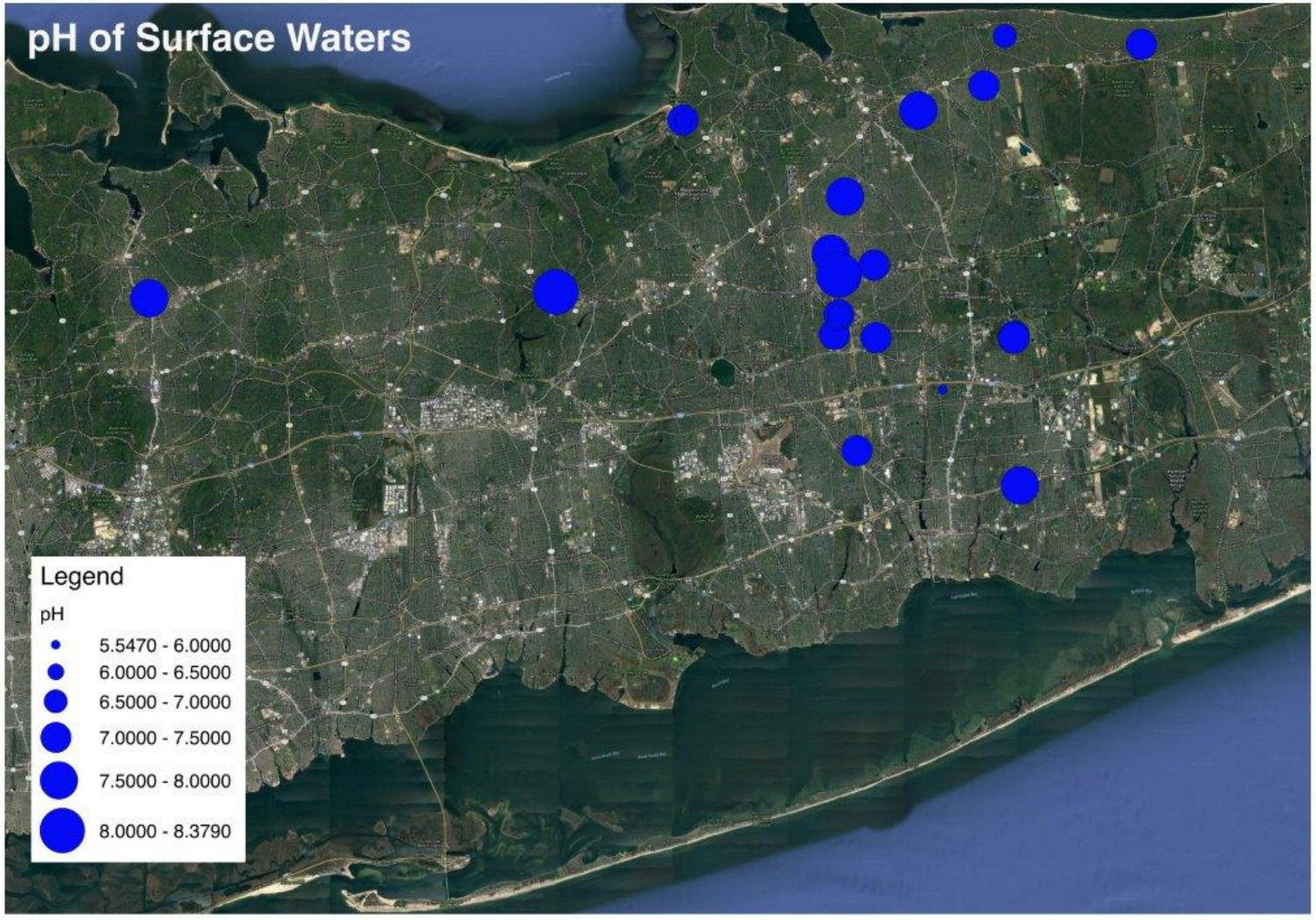
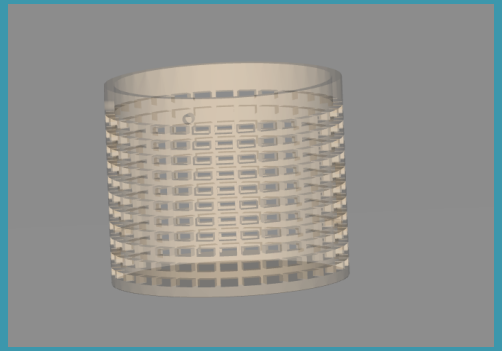


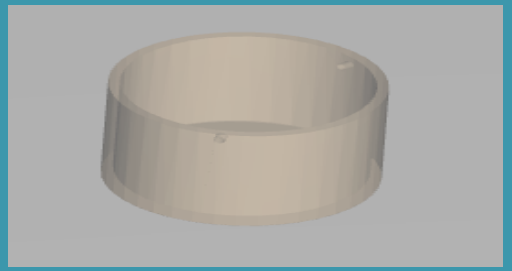
Plotted on Google Earth Map of Suffolk County (Western and Middle Sections)

Model Designed by Engineering and Construction Technology Students

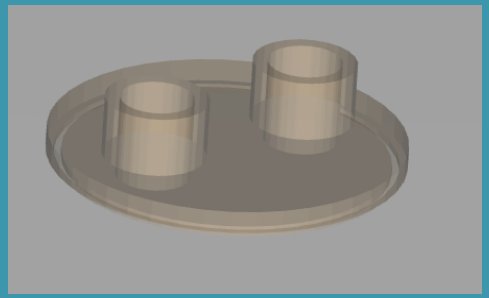


Liquid waste recovery

An alternative septic system is installed in front of a home on Laura Court in Nesconset on Aug. 20, 2015. Suffolk wants to change the sanitary code to legalize such systems countywide. Photo Credit: James Carbone



Solid waste model



Liquid and solid waste caps

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Excerpts from a Journalism Paper: Septic System Upgrades

Septic systems are failing to meet standards and regulation put in place today. It is important for these systems to work properly to ensure that the water quality of these areas do not become contaminated by harmful chemicals. The state should require all personnel who either need repairs for their systems or need a completely new system to get an upgraded septic system for their home.

Many systems in homes today were built before new, necessary regulations were put in place. They are outdated to today's standards. These old systems do not properly work in order to remove contaminates contained in sewage. Repaired systems also lack reliability to perform this task and are not up to new code (Unknown).

"My septic system is about 20 years old, has never exhibited any problems, there are absolutely no signs of any problems outside (no smells, no damp areas, no excessive vegetation growth), and I have had it pumped out approximately every 5 years" according to Septic Health Resources.

Excerpts from a Journalism Paper: Septic System Upgrades

A twenty-year-old system, pumped every five years, with no signs of any problems could still be polluting water supply. The problem with this specific system was that it was leaking through soil, down to bedrock, and downhill to a nearby lake. This contamination showed no signs near the home in which it was built for yet it still managed to covertly cause contamination ("Health Resources").

The issue many find with upgrading the systems is the ability to regulate them and the costs. It may be hard to require everyone to update their systems and keep track of who did and who did not. Anyone who needs repairs or a new system could simply be required to get a new system which is up to current codes. This could be costly.

All current septic systems will fail or need repairs at one point. Systems will always require a great cost in order to work properly. Paying to upgrade these systems will only ensure a better quality and lasting system. This will also be beneficial to keeping drinking water cleaner.

Dr. Alison Branco; Director Peconic Estuary Foundation

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Lessons Learned and Future Plans

- Interdepartmental work with an online component requires some adjustment for faculty and students unfamiliar with the process.
- Interdisciplinary student-centered projects facilitate learning.
  - Students remained engaged. Fewer than usual dropped out of their courses and there were fewer “F” and “D” grades (journalism course)
  - Students took charge of their learning.
  - Program continued 2017 semester. Students and IRACDA Post Doc collaborated in an Introduction to Research course as related to their fall work.

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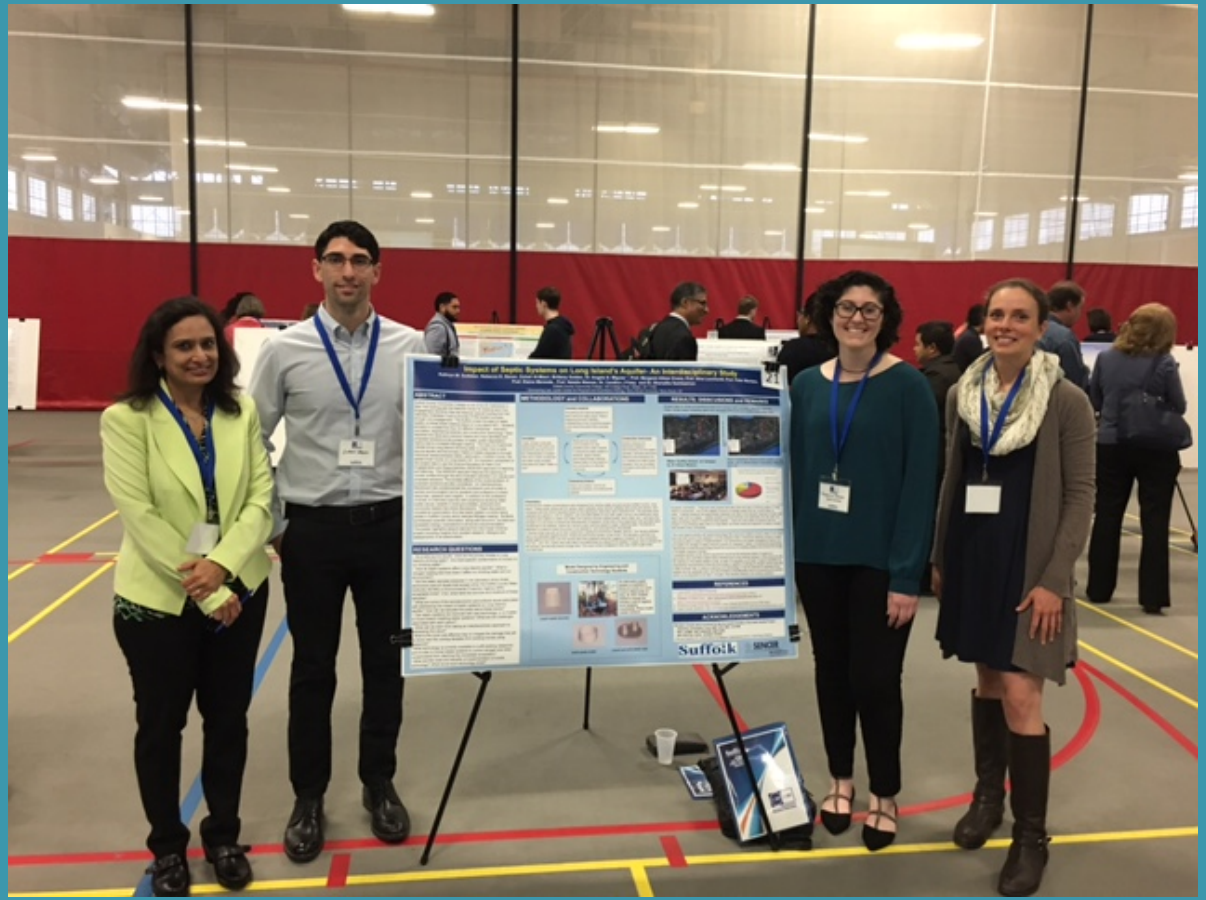
Research Methods Course , IRACDA, SUNY Undergraduate Research Conference Presentation



Broader Impacts

- NSF ATE complementary project to develop a green energy option in engineering science and electrical technology and to infuse understanding of energy in general education courses
- Institutionalization: CHE 134 Program Learning objective: Evaluate and discuss contemporary science-related social and ethical issues, both locally and globally, using scientific knowledge and reasoning
  - Assessed a written formal report based on quality of drinking water analysis using a standardized rubric (attached at the end of the report).
  - Students studied water quality from publicly available Suffolk county water authority data (SCWA). This assignment is based on the 5E learning model, which includes five phases: engage, explore, explain, elaborate, and evaluate.
  - Spring 2017 assessment data results from 6 of 9 CHE 134 courses taught on all 3 SCCC campuses including day and evening classes of our major's level second semester chemistry CHE 134 courses

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Broader Impacts

- The incorporation of the Helmsley Water Quality project elements institutionally led to over 90% of students met or exceeded standards and less than 10% of students were seen to approach standards and none fell below standards.
- Students reports were evaluated based upon rubric which includes Contaminants Analysis, Contaminant Impact, and Ethical Issues and Remediation
- Results indicate that students are interested to learn about water quality and other environmental /ethical issues surrounding them.

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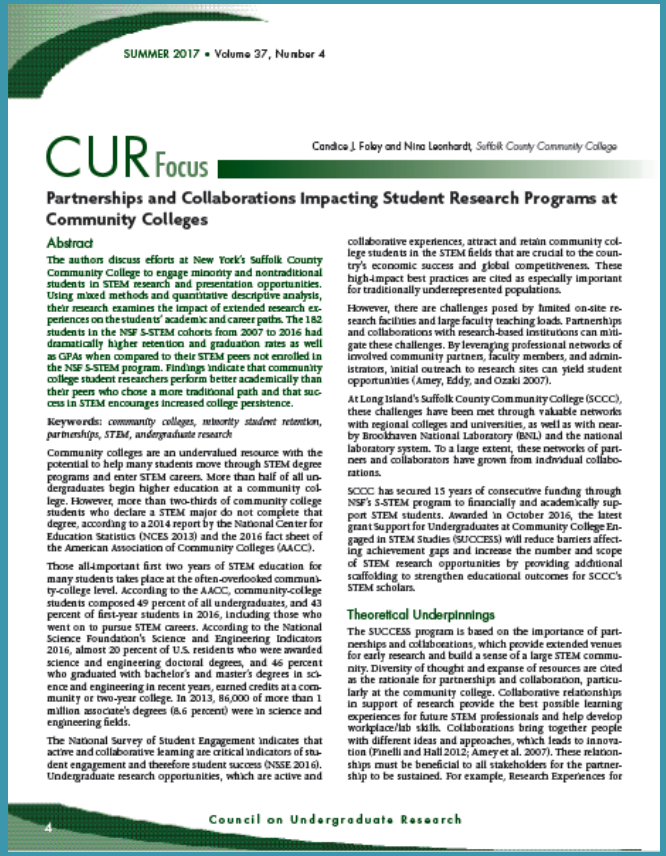
Publication:



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CUR Focus

Candice J. Foley and Nina Leonhardt, *Suffolk County Community College*

Partnerships and Collaborations Impacting Student Research Programs at Community Colleges

Abstract

The authors discuss efforts at New York's Suffolk County Community College to engage minority and nontraditional students in STEM research and presentation opportunities. Using mixed methods and quantitative descriptive analysis, their research examines the impact of extended research experiences on the students' academic and career paths. The 182 students in the NSF S-STEM cohorts from 2007 to 2016 had dramatically higher retention and graduation rates as well as GPAs when compared to their STEM peers not enrolled in the NSF S-STEM program. Findings indicate that community college student researchers perform better academically than their peers who chose a more traditional path and that success in STEM encourages increased college persistence.

Keywords: *community colleges, minority student retention, partnerships, STEM, undergraduate research*

Community colleges are an undervalued resource with the potential to help many students move through STEM degree programs and enter STEM careers. More than half of all undergraduates begin higher education at a community college. However, more than two-thirds of community college students who declare a STEM major do not complete that degree, according to a 2014 report by the National Center for Education Statistics (NCES 2013) and the 2016 fact sheet of the American Association of Community Colleges (AACC).

Those all-important first two years of STEM education for many students takes place at the often-overlooked community-college level. According to the AACC, community-college students composed 49 percent of all undergraduates, and 43 percent of first-year students in 2016, including those who went on to pursue STEM careers. According to the National Science Foundation's Science and Engineering Indicators 2016, almost 20 percent of U.S. residents who were awarded science and engineering doctoral degrees, and 46 percent who graduated with bachelor's and master's degrees in science and engineering in recent years, earned credits at a community or two-year college. In 2013, 86,000 of more than 1 million associate's degrees (8.6 percent) were in science and engineering fields.

The National Survey of Student Engagement indicates that active and collaborative learning are critical indicators of student engagement and therefore student success (NSSE 2016). Undergraduate research opportunities, which are active and collaborative experiences, attract and retain community college students in the STEM fields that are crucial to the country's economic success and global competitiveness. These high-impact best practices are cited as especially important for traditionally underrepresented populations.

However, there are challenges posed by limited on-site research facilities and large faculty teaching loads. Partnerships and collaborations with research-based institutions can mitigate these challenges. By leveraging professional networks of involved community partners, faculty members, and administrators, initial outreach to research sites can yield student opportunities (Amey, Eddy, and Ozaki 2007).

At Long Island's Suffolk County Community College (SCCC), these challenges have been met through valuable networks with regional colleges and universities, as well as with nearby Brookhaven National Laboratory (BNL) and the national laboratory system. To a large extent, these networks of partners and collaborators have grown from individual collaborations.

SCCC has secured 15 years of consecutive funding through NSF's S-STEM program to financially and academically support STEM students. Awarded in October 2016, the latest grant Support for Undergraduates at Community College Engaged in STEM Studies (SUCCESS) will reduce barriers affecting achievement gaps and increase the number and scope of STEM research opportunities by providing additional scaffolding to strengthen educational outcomes for SCCC's STEM scholars.

Theoretical Underpinnings

The SUCCESS program is based on the importance of partnerships and collaborations, which provide extended venues for early research and build a sense of a large STEM community. Diversity of thought and expanse of resources are cited as the rationale for partnerships and collaboration, particularly at the community college. Collaborative relationships in support of research provide the best possible learning experiences for future STEM professionals and help develop workplace/lab skills. Collaborations bring together people with different ideas and approaches, which leads to innovation (Pinelli and Hall 2012; Amey et al. 2007). These relationships must be beneficial to all stakeholders for the partnership to be sustained. For example, Research Experiences for

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