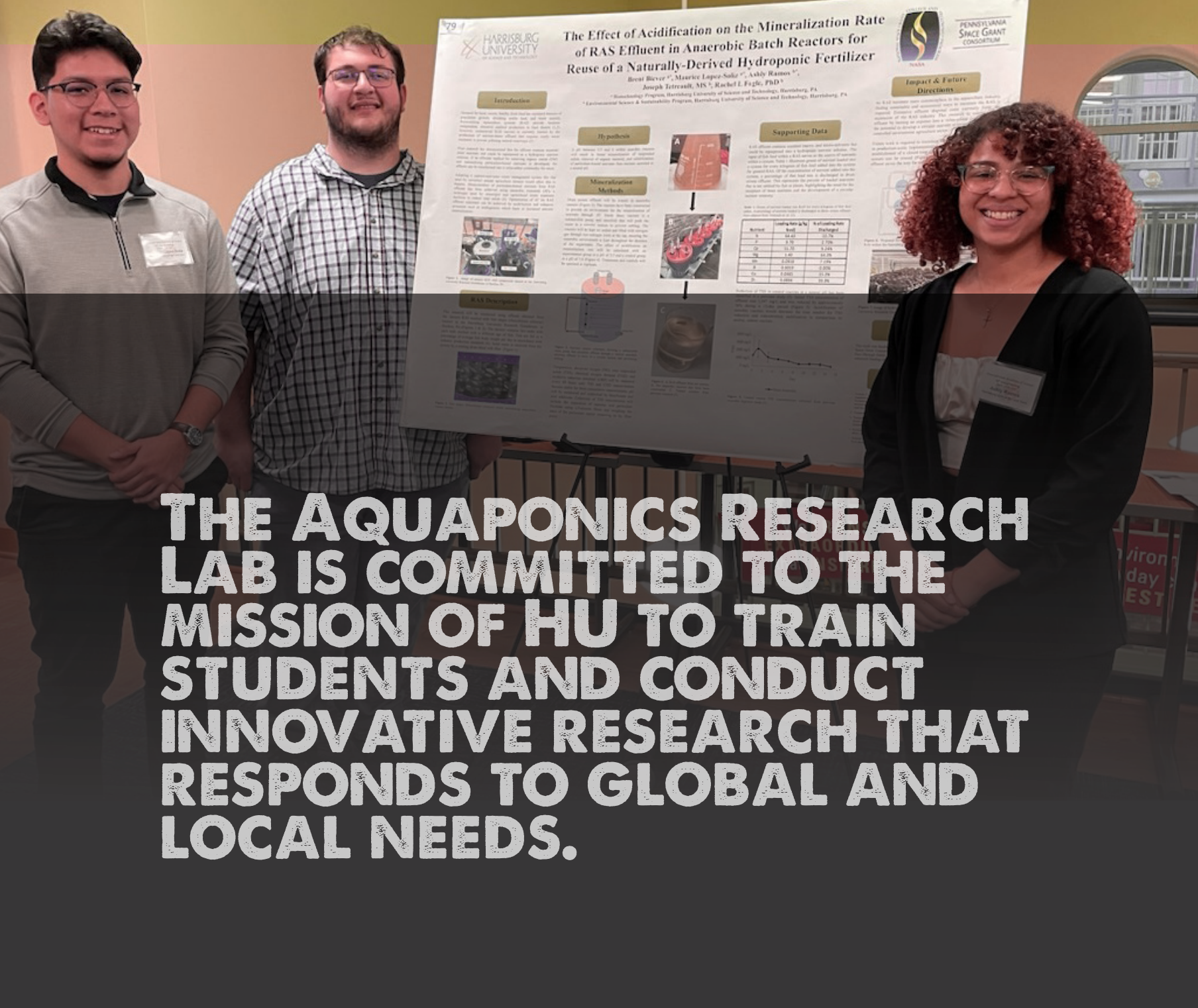


Aquaponics



HARRISBURG
UNIVERSITY
OF SCIENCE AND TECHNOLOGY



THE AQUAPONICS RESEARCH LAB IS COMMITTED TO THE MISSION OF HU TO TRAIN STUDENTS AND CONDUCT INNOVATIVE RESEARCH THAT RESPONDS TO GLOBAL AND LOCAL NEEDS.

Aquaponics Research Lab

We engage with HU students, local primary and secondary school students, international universities, community organizations, and agricultural professionals. Our mission is to provide experiential learning opportunities to prepare students for careers in the rapidly growing controlled environment agriculture (CEA) sector, conduct research in coordination with leading CEA businesses, and provide fresh produce to alleviate regional food insecurity throughout Dauphin County.

Four CEA-related HU courses have been approved in the Environmental Science and Sustainability Program and designed through communication with CEA businesses to make sure that students gain experience in the exact competencies identified by employers. Summer camps for middle and high school students relating to CEA are offered jointly with Commonwealth Charter Academy. Junior Girl Scout Troops have been hosted to work towards earning gardening and PA horticulture badges and lifelong learners from the Pathways Institute for Lifelong Learning have participated in greenhouse tours and hands-on workshops.

CURRENT FACILITY AND COMMUNITY SUPPORT

The 3,000 ft² research greenhouse is located on the Steelton-Highspire School District (SHSD) property and was extensively renovated in 2021, partially funded through a generous donation from the GIANT company, to align with industry standards established through communications with aquaculture and hydroponic professionals. The greenhouse is now operating with equipment, growing practices, and production rates commensurate with leading businesses. This ensures that our students are prepared to enter the workforce and that our research is relevant and scalable to make an impact on commercial production.

Donations of produce are made to Downtown Daily Bread, Susquehanna Township, and the HU undergraduate student population. Approximately 450 leafy greens, including butterhead lettuces and Bok choy, can be harvested and donated weekly. A variety of herbs, such as basil, parsley, and oregano are also provided. Most recently, tomatoes and peppers have been added to the mix!

EXPANDING OUR IMPACT WITH AN EXPANDED RESEARCH FARM

We are currently fundraising for the construction of an expanded CEA research farm. This new 5,600 ft² facility will integrate innovative aquaculture and hydroponic practices. It will be fundamental in training a skilled workforce in the growing CEA industry, alleviating food insecurity, and conducting foundational operating research to de-risk new technologies, all within Dauphin County. The construction and operating plan of this farm is supported by industry leaders and employers seeking research support and a pipeline for skilled workers, area restaurants desiring local and year-round fresh ingredients, and schools and community support organizations seeking to improve food security for vulnerable Dauphin County residents.



SEPARATED FISH BARN

Pennsylvania is the third largest trout producer in the United States and aquaculture is one of the fastest growing commercial sectors in agriculture. This 2,600 ft² facility is designed to operate with equipment, growth rates, and production standards commensurate with leading industry standards. Six identical grow-out systems for replication and scalable research informed by industry will allow students to gain experience only available at HU. A classroom adjacent to the aquaculture center will allow on-site instruction for the diverse array of learners using the site. Irrigation from the fish barn to the new greenhouse described below will allow the reutilization of treated fish culture water for hydroponic growth while permitting the fish and plants to be maintained at their differing ideal environmental conditions.

Vision for the Future

5,600 ft² greenhouse for research and undergraduate training

- Research supported by industry leaders

Experiential learning courses

- Growing practices adopted from farmers
- Students use the same equipment as future employers

Actively addressing local food insecurity

- Partner with community aid organizations
- Early discussions with restaurants

INTEGRATED GREENHOUSE

The new ~3,000 ft² greenhouse will utilize the three most common hydroponic grow methods to produce a wide variety of commercial crops. Replication of each grow method will allow students to gain valuable research and management experience. Comparison of crop growth using traditional hydroponic fertilizers and nutrient-rich treated fish culture water will provide support for the growing CEA industry. The new greenhouse will focus on experiential learning and industry-informed research opportunities to prepare undergraduates for CEA careers. The existing greenhouse will be used for K-12 education and enrichment opportunities. Produce grown within both greenhouse will be used to support Central Pennsylvania food security.



PROVIDING WORKFORCE DEVELOPMENT AND FOOD SECURITY

Training Pathways for Growing Industries

One of the chief goals of HU is to reach a diverse group of learners by providing academic research programs that are student-centered, technologically advanced, and experiential learning focused. Aligning with the mission of HU, we provide authentic experiential learning opportunities through internships and applied practical research projects. Student success

is achieved through an emphasis on purposeful interdisciplinary competencies and career development pathways.

Four undergraduate CEA courses have been integrated into the plans for the proposed new facility to provide students hands-on training not possible on this scale at any other PA universities.

Positively Impacting Dauphin County

Much of Dauphin County is classified as a food desert with median household incomes below the poverty line according to the United States Department of Agriculture Economic Research Services. Expansion of CEA infrastructure at SHSD would have an immediate positive affect on the community, as 82% of SHSD families meet low-income classifications and 47% of SHSD sixth-graders reported worry that their home would run out of food before parents were paid next in

an anonymous 2019 poll conducted by the Pennsylvania Youth Survey. Since the COVID-19 pandemic, Harrisburg City has also seen an increase in numbers of the unhoused and other vulnerable communities. The proposed new facility will have the capacity to produce 28,000 heads of leafy green vegetables and over 2,800 lbs of trout each year that can be put back into local schools, community aid organizations, and businesses.

Model for State-Wide Application

The food insecurity in Dauphin County serves as an appropriate example for many low-income urban centers. Robust research has demonstrated the positive affect that healthy food access has on emotional and behavioral health as well as academic and job performance. A research farm located on SHSD and

dedicated to enhancing the growing CEA industry, training students for skilled careers, and providing year-round healthy food has the potential to transform community health and become a model for state and country-wide adoption of innovative food production technologies.

Our Team and Research Interests



Rachel Fogle, PhD

Dr. Fogle is an Associate Professor of Biological Sciences, Program Lead for Environmental Science & Sustainability, and Director of Aquaponics & Hydroponics Initiatives. She is interested in providing HU students authentic learning opportunities, including participation in interdisciplinary research and internships.



Joe Tetreault, MS

Joe is a Research Scientist and serves on the Board of Directors for the Aquacultural Engineering Society. His research focuses on developing aquaponic production models for sustainable business development in food deserts and organic waste-to-reuse treatment systems for a circular nutrient economy.

Current Research and Recent Publications

Project Title | Valorization of organic waste streams to develop naturally derived hydroponic nutrient solutions using anaerobic batch reactors

Project Summary | This project seeks to utilize anaerobic microbial treatment to remove organic carbon, mineralize solids, and solubilize nutrients in aquaculture waste for reuse as a fertilizer in hydroponic farming. Anaerobic treatment processes have the potential to reduce the pollution of aquaculture production, convert a waste source into a value-added product, and reduce the reliance of the hydroponic industry on inorganic and finite fertilizer salts.

This work is funded through the Pennsylvania Space Grant Consortium supported by NASA.

Peer-reviewed Publications since 2021

Tetreault J, Fogle RL, Ramos A*, and Timmons MB. A predictive model of nutrient recovery from RAS drum screen effluent for reuse in aquaponics. *Horticulturae* 2023, 9, 403. <https://doi.org/10.3390/horticulturae9030403>

**Ramos A is a 2023 ENVS HU Graduate*

Tetreault J, Fogle RL, Fogarty S, and Guerdat T. Coupled aquaponics: Optimizing hydraulic retention times using a parallel unit process water treatment approach. *Frontiers in Horticulture* 2023, 9, 1140998. <https://doi.org/10.3389/fhort.2023.1140998>

Tetreault J, Fogle RL, and Guerdat T. Scalable coupled aquaponics design: Lettuce and tilapia production using a parallel unit process approach. *Frontiers in Sustainable Food Systems* 2023, 7, 1059066. <https://doi.org/10.3389/fsufs.2023.1059066>

Tetreault J, Fogle RL, and Guerdat T. Towards a capture and reuse model for aquaculture effluent as a hydroponic nutrient solution using aerobic microbial reactors. *Horticulturae* 2021, 7, 334. <https://doi.org/10.3390/horticulturae7100334>

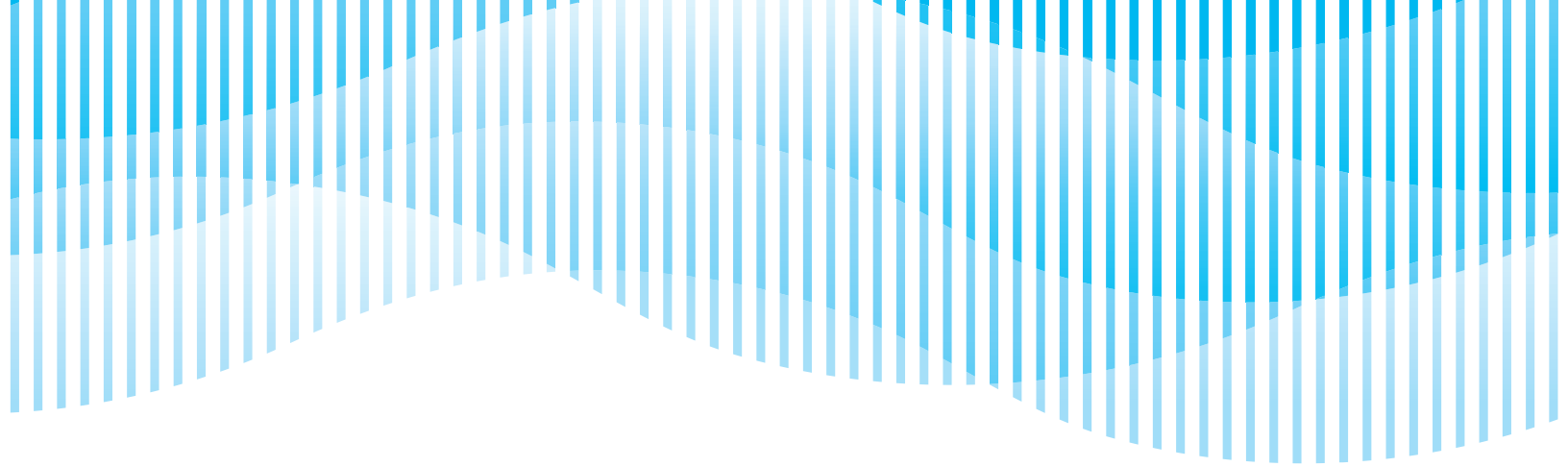
Tetreault J, Fogle RL, and Guerdat T. Anaerobic mineralization of recirculating aquaculture drum screen effluent for use as a naturally-derived nutrient solution in hydroponic cropping systems. *Conservation* 2021, 1, 151. <https://doi.org/10.3390/conservation1030013>

Want to Get Involved?



Please email us at Aquaponics@HarrisburgU.edu and check out our website at <https://centers.HarrisburgU.edu/aquaponics/>

A Leader in Aquaponics Research



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A copy of HU's Annual Security Report, which reflects the current status and historical data of campus security and safety, is available at:

<http://HarrisburgU.edu/lib/pdf/annual-security-report-clery-report.pdf>. You may request a paper copy of this report by contacting HU at Connect@HarrisburgU.edu

Academic programs, admission and matriculation requirements, and student eligibilities are subject to change.

The Harrisburg University of Science and Technology is accredited by the Middle States Commission on Higher Education, 3624 Market Street, Philadelphia, PA 19104. (267-284-5000) The Middle States Commission on Higher Education is an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.



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