

Empowering youth currently underrepresented in STEM through authentic science research on local environmental challenges

Margie Turrin¹, Robert Newton², Cassie Xu³, Karin Block⁴, Carrie Roble⁵, Rhea Esposito⁶, Alan Berkowitz⁷, Janice McDonnell⁸, Regina Alvarez⁹, and Steven Burns¹⁰

¹LDEO of Columbia University

²Lamont -Doherty Earth Observatory

³Lamont-Doherty Earth Observatory of Columbia University

⁴City College of New York

⁵Hudson River Park

⁶Cary Institute of Ecosystem Studies

⁷Cary Institute of Ecosystem Studies

⁸Rutgers University New Brunswick

⁹Dominican College

¹⁰St. Thomas Aquinas College

November 21, 2022

Abstract

For youth with limited role models in the STEM fields, and restricted summer research opportunities resulting from a lack of financial resources and academic connections, the opportunity to participate in academically connected, community based science research programs can be incredibly empowering. Providing these opportunities is critically important but it takes purposeful work, persistent outreach and strong community networks. We note that while providing these opportunities is incredibly rewarding, but there is a lot of work both up front and ongoing. This work is itself rewarding when networks are humming and enthusiasm for involvement is high, but it can be challenging when ceilings are hit and walls seem to arise unexpectedly. “Early Engagement in Research: Broadening participation through engagement in authentic science research” builds a regional network of summer research experiences for high school students underrepresented in STEM, starting from a successful model that has provided high school summer field research opportunities for New York City youth for over a decade (Secondary School Field Research Program). The program is developed around regional partnerships between various combinations of academic institutions and research centers, community environmental and education centers, state cooperative extensions, high schools and school networks, state and local park systems and land management groups. Each location has a unique approach, but all include some similar attributes. Each tackles an authentic science research issue that affects the local community such as microbiology in the local streams and microplastics in the local bays and biology, and each includes peer and near peer mentoring for the students along with a scientist mentor. Encouraging professional development of each student is central to the program. Technical instruction includes the use of scientific instruments and equipment, data recording and interpretation. Professional discussions include how to successfully read and dissect a science journal article, how to create and present a science poster and most importantly how build a network for themselves in STEM, and how to help us work with them to support the diversity that is needed for all of science to be inclusive and ultimately meet the needs of our future.

Empowering youth currently underrepresented in STEM through authentic science research on local environmental challenges

<https://blog.ldeo.columbia.edu/includes/>

Early Engagement in Research: Broadening participation through engagement in authentic science research

The opportunity to participate in academically connected, community based science research programs can be incredibly empowering for youth with limited role models in the STEM fields and limited research opportunities due to a lack of financial resources and academic connections. Creating these opportunities takes purposeful work.

Manhattan Cluster



“Heavy Metal Presence in Blue Mussel Shells in Hudson River Park”

Partners: The City College of New York, Hudson River Park, The River Project, The Intrepid Sea, Air & Space Museum, Young Women’s Leadership Network, Lamont-Doherty Earth Observatory

Students in the Manhattan cluster worked on the Hudson River Park waterfront assessing heavy metal presence in blue mussel shells and distance from Combined Sewage Overflows (CSOs). They collected & sieved sediment samples for blue mussel shells and completed an analysis of the shells on scanning transmission electron microscope to detect heavy metal concentrations.

Partnerships are critically important as it takes purpose work and organizational commitment

A regional network of partners were engaged in order to develop summer research experiences for high school students underrepresented in STEM. Four clusters of partners including academic partners, local environmental groups, land managers and schools were developed, which brought together local colleges with research capabilities with community groups and schools.

Mid Hudson Young Environmental Scientists



Partners: Cary Institute of Ecosystem Studies, Marist College, Poughkeepsie HS, Arlington HS, Oakwood Friends HS, Lamont-Doherty Earth Observatory

The Mid-Hudson cluster ran two projects. One group studied the effect of salt pollution on terrestrial plant growth and different soil characteristics that influence salt retention. The second group looked at the roll of aquatic vegetation in supporting fecal indicator bacteria, to examine sewage contamination in fresh water.

Thematic Working Groups Provided Consistent Design Elements Across the Clusters

Working groups that spanned the clusters addressed common elements such as a tiered mentoring structure including peer and near peer mentoring, a common assessment tool, team research design, and a whole person development focus. Additionally we held a shared panel and poster session. The groups designed and vetted programmatic elements yet each program was unique with different blends of online, lab and field work pieces.

The STEM Ambassadors Camp, New Jersey



Partners: Rutgers University New Brunswick & Newark sites, 4H STEM Ambassadors, New Jersey City College, West Orange High Schools, Lamont-Doherty Earth Observatory

The New Jersey cluster research focused on the source and fate of microplastics in the Raritan River, NJ and the on zebra fish embryos. Students worked on the estuary collecting water and sediment samples and in the lab processing their samples. This cluster blended online teaching modules with field experiences.

Developing the whole person

Encouraging whole person development of each student is central to the program. Technical instruction on the use of scientific instruments, data interpretation and discussions cover how to successfully dissect a science journal article and developing a science poster are included. More importantly we discuss how build a STEM network for themselves, and how to help us work with them to support the diversity that is needed for all of science to be inclusive, and ultimately, meet the needs of our future.

Rockland County Project: RISE



Partners: Dominican College, Cornell Cooperative Extension, Spring Valley High School, Lamont-Doherty Earth Observatory

The Rockland cluster began with using the iNaturalist app to collect data and learn about their local environment. They then worked on projects ranging from microbiology and DNA sampling of enterococcus in the local streams to soil testing for metals and other contaminants, to wildlife inventories.



Margie Turrin, Robert Newton, Cassie Xu – Lamont-Doherty Earth Observatory, Columbia University
Janice McDonnell, Rutgers University; Carrie Roble, Hudson River Park; Karen Block, City College of New York; Rhea Esposito, Alan Berkowitz, Cary Institute;
Regina Alvarez, Dominican College

Note: This project is based *Secondary School Field Research Project*, a successful project started by R. Newton (LDEO) and S. Vincent (Young Women’s Leadership Network)
This material was funded in part under NSF Grant #1649310