Environmentally-conscious scientists, engineers and entrepreneurs of the future: A City College of New York Collaborative.

Federica Raia, Kevin Foster Jonathan Jelen, Anasa Scott
City College of New York

Students learn best when engaged in studies of content that directly relate to their interests and the environment they live in. Our job, as geoscience faculty, is to develop courses and programs that support and sustain students' interests while promoting sound content learning. Based on the knowledge that the generation of students entering college today is particularly sensible and interested to environmental issues, relevant to both the global as well as local context, we developed a program to support development of environmentally-conscious scientists, engineers and entrepreneurs of the future.

GREEPROOFING – program overview

This program is a collaborative among the Departments of Earth and Atmospheric Science, Civil Engineering and Economics. The Program's mission statement, articulated by the current group of Earth Science, Civil Engineering and Economics students and faculty, reflects the clear parallel between our programs a the City College of New York and NOAA's Environmental Entrepreneurship Program (NOAA EEP/MSI: 4811013): the practice of creating a healthier environment by making wise business choices. With the firm conviction that the process of minimizing pollution and protecting ecosystems starts with individual awareness, we support the establishment of for non-profit or capital endeavors that focus on enhancing the environment through all or most of their activities, directly or indirectly. This can be done by 1) recognizing problems that face our environment, improving or creating innovative ideas that address these problems, and building successful business ventures to realize these ideas; or 2) integrating environmental concerns into any business plan. In addition to coursework and site visits, which provide opportunities for applied research, the focus is the development of a small business targeting environmental issues in the NOAA sciences directly relevant to New York City: the GreenProofing Consultancy. We realize our mission--integrating resources for sustainable choices, responsible technology, and healthy living spaces—through four arenas: an interactive virtual platform, GreenProofing.org; consulting services for businesses; the bi-annual GreenProofing Symposium; and GreenProofing

Offline, a series of outreach activities, including curriculum development for CCNY courses and city school classrooms. GreenProofing has already begun to strengthen the capacity of The City College of New York to foster student careers, entrepreneurship opportunities, and advanced degrees in NOAA sciences.

Students become empowered to not only mechanically fill in a business plan template, but to creatively and innovatively construct a new business model that will allow them to adequately address the identified social and environmental issues. A major addition to the consultancy under the support of the NOAA is the targeting of four NOAA line offices engaged in activities directly related to the primary environmental issues of New York City and the interests and backgrounds of the CCNY faculty. Groups of two or three students become "experts" in one of these areas (Oceans, Satellites, Fisheries and Research) to identify specific problems or projects that overlap between NOAA's work and the concerns of the New York City area. The students visit NOAA's office in DC and conduct interviews, produce interactive modules for the GreenProofing.org website to publicize these areas to New York City and the greater virtual community, and develop ideas for and "pitch" potential businesses in these areas. Through these and other activities, the participating students become a much-requested group of young people with both the understanding and skills needed to start the businesses that will offer environmental solutions as well as to populate our universities, government agencies, and private businesses.

This five-year program, currently ongoing, is supported by NOAA *(* NOAA EEP/MSI: 4811013). Below we report part of the work and program developed by the participant students

PRIMARY OBJECTIVES OF EEP AT THE CITY COLLEGE OF NEW YORK

- To support development of environmentally-conscious engineers and entrepreneurs of the future.
- To engage local community residents and stakeholders by creating jobs and wealth in the sustainable production industry.

GREENPROOFING

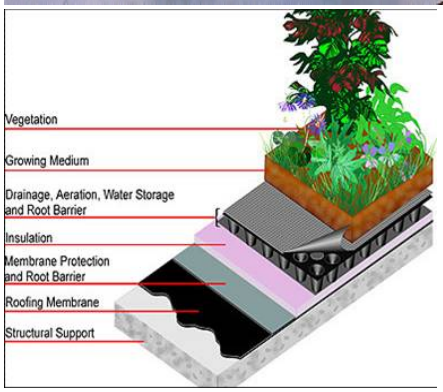
- Recognizing problems that face our environment;
- Improves or creates innovative ideas that address these problems;
- Builds successful community based enterprises and ventures to realize these ideas;
- Integrates local environmental concerns into new and existing business plans.

GREENPROOFING is especially focused on the environmental health of marine systems, especially the NY/NJ Harbor Estuary which surrounds New York City.

This focus has lead the group to green-roofing research and implementation. As green-roofs have been found to play a role in reducing pollutant run off into our marine systems.

Greenproofing group is studying water retention rates, moisture levels and temperatures of different types of plants, soils and modules.

The group is laying out a design for a module that can be easily manufactured locally by residents and High School students



Green roof cross-section
(Source: American Wick Drain Corp.)

GREENPROOFING OUTREACH TO NYC SCHOOLS

Greenproofing students team engage the local community residents and stakeholders and support environmental awareness and scientific interest in younger students through local Public School partnership.

The team:
helps the school to install a native plant garden on school building by:

a) assisting in fundraising and grant writing,
b) making structural assessments, and finding approvals from the School Construction Authority
c) assisting in the designing and construction of the roof

Sustain the teaching and learning of Earth Systems Science by

a) collaborating with treachers in Curriculum Development and
b) Student-Based Science Inquiry (Grades 5-12)

<u>Students based inquiry environmental projects and curriculum development activities:</u>
The study of green roofs and how they work spans many fields of science. In middle school and high school classrooms Life Sciences-Biology, Physical Sciences and Earth Sciences are particularly emphasized. Greenproofing has developed curriculum and

activities that teach students about green roofs while supplementing classroom and textbook learning.


Green roof installed at the School of the Future. NY, NY:

Greenproof members decided to modify the GLOBE and the Environmental Protection Agency (EPA) curricula, and adapting them to the study of greenroofs. Discussions and activities are designed to enhance the NYC Department of Education Science Scope and Sequence for middle school requirements as well as the High School regents.

General Topic	**Required Focus (NYC Standards)**	**Greenproofing Green Roof Topics**
Earth Sciences	Requires all of the Spheres	soil composition and properties, urban heat island effect
Physical Sciences	Energy, Properties of Matter	properties of water; thermal expansion/ contraction; urban heat island effect
Life Sciences	Ecology	botany; ecosystems; green roofs as tools for bioremediation; nutrients and eutrophication

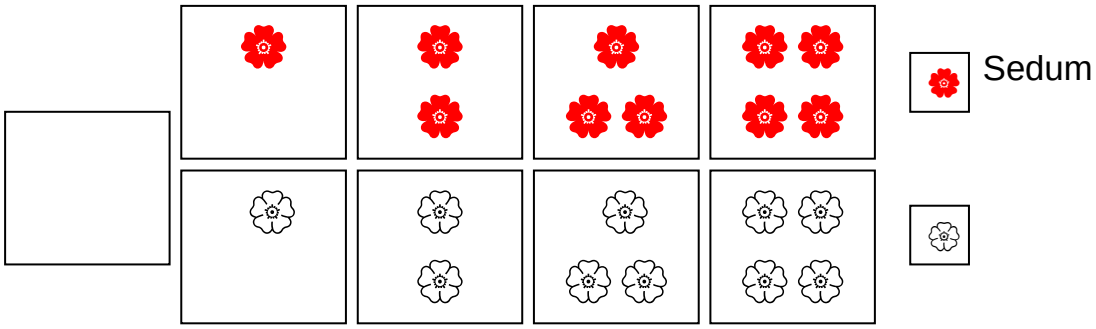
During the 2005- 2006 school year, High School students, guided by a landscape architect, designed the landscape of their roof. The Greenproofing team completed the installation and initial maintenance of the greenroof at School of the Future during the Summer 2006.

Example Student Projects at the School of the Future

Green roof installed at the School of the Future. NY, NY

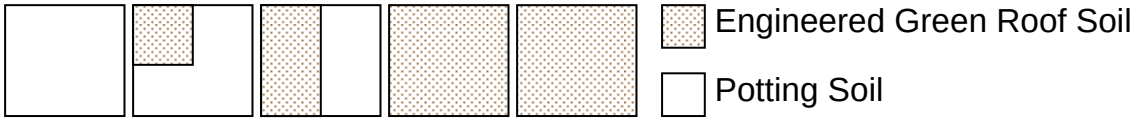
One of Greenproofing's main initiatives is to get New York City high and middles school students involved in scientific research pertaining to green roofs. Students at the School of the Future are currently conducting research experiments on their green roof, focusing on how different variables affect water retention.
The Greeproofing team worked with school teachers and students to develop research questions to be addressed by the school students:

1) How does plant density affect water retention in soils on green roofs?



Two different species of plants are being used in this experiment to examine how plant density affects water retention in soils on green roofs. Of a total of nine planter boxes, four are planted with a common green roof plant, a sedum, four are planted with a native plant, and one, the control, contains only soil

2) How does soil composition affect water retention on green roofs?



In this project, students are observing the effect of soil composition on water retention. Two different types of soil, engineered green roof soil and standard potting soil, were mixed in different percentages to monitor this effect. Of a total of five planter boxes, one contains only the potting soil, one contains only the engineered soil, and the other three contain varying percentages of the two soils . All planter boxes are unplanted.

Greenproof students team designs an outdoor classroom at Manhattan Hunter Science High School NY NY

The objective of the outdoor classroom is to encourage a holistic understanding of the environment which can be extended to

Plans at Manhattan Hunter Science High School
Campus High School.
housed at Martin Luther King Jr. Campus High

other areas of thought. In accordance with this objective, there are two overarching focuses which apply to all grade levels. The first is the interaction of the natural and urban environments, and the second is the study and restoration of native New York plant species. Students will study the benefits of planted areas and plant processes such as photosynthesis and evapotranspiration for urban environmental problems such as air pollution, the urban heat island effect, and stormwater runoff. The outdoor classroom will be the sitez of a series of experiments focusing on these phenomena. Students will also investigate the role of native New York plants and organic compost in improving urban environmental conditions.

School, NY, NY