NSF GK-12: Environmental Science to Promote Sustainable Urban, Rural, and Indigenous Communities

ESF
State University of New York
College of Environmental Science and Forestry

Enriching K-12 Education through *ESF in the High School*

Integrating Scientific Research Into the High School Classroom

The world of the 21st century is at a major crossroads. Never in the six billion years of earth's history has one organism dominated the landscape so completely. The human species now directly utilizes over 25-40% of the net primary production of the earth's biosphere (Vitousek et al. 1986). Humankind is confronted by a variety of seemingly unsolvable environmental dilemmas such as overpopulation, the depletion of natural resources including fossil fuels and soils, global climate change, and the loss of biodiversity. What can institutions of higher learning do to prepare society to face these challenges?

Our project's focus is two-fold. First, through our graduate education program, we seek to produce environmental science leaders who will be able to meet the extraordinary environmental challenges of the 21st century. Our project offers transformational opportunities for graduate students to become environmental scientists who possess the skills required to meet society's immediate and future challenges. We enhance their effectiveness as environmental science communicators and as research scientists who can actively engage and make a positive difference in their own communities through *Service-Research*, a variant of the *Service-Learning* concept.

"We have become the central organizing reality around which non-human life will evolve."

— **Cincotta and Engelman (2000)**

Second, we seek to increase the environmental knowledge and science literacy of today's high school and middle school students to produce citizens who will be able to make informed decisions regarding the environment. *Environmental Science to Promote Sustainable Urban, Rural, and Indigenous Communities* builds upon and extends two of our well-established college/school partnerships (*ESF in the High School* and the *ESF Science Corps*). These programs deepen student knowledge of science and develop young citizens who will contribute to a healthy environment and sustainable future. Using the environmental science theme of *Sustainable Communities*, we engage traditionally underrepresented and financially disadvantaged youth from our urban, rural, and indigenous educational partners.

ESF in the High School

Road Shows: Graduate Student Research in the Classroom

"Road Shows" are a major component of the program that promote inquiry learning and hands-on experiences for the students in *The Global Environment* class. From January 2008 to December 2008 Fellows provided 81 road shows in 19 schools.

These traveling lessons are often based on topics having roots in the graduate Fellows' research area of expertise. Graduate Fellows perform research in diverse areas such as winter ecology of migratory birds, evolutionary responses of mammals to climate change, and health in Ecuador. Topics that Fellows present include stream bio-assessment, energy of flight, nitrogen cycling,

How can we help to develop participatory citizens who understand the complex scientific and social issues behind the headlines, make informed decisions, and meet these environmental challenges?

"I enjoy collaborating with my Fellow, and the students are learning much from him. It has been an asset to my teaching and the benefits are enormous for my students."

— Lisa Lowenberg
Chittenango High School

"The Fellows bring the latest and greatest ideas and techniques in the field. The fact that they are fresh in the field adds quality to their visits. They have great and ideas and captivating experiences."

— Dean Cirilla,
Clyde-Savannah High School

"Having a Fellow has expanded my scientific literacy and, consequently, that of my students. These very accomplished individuals serve as tangible role models, and they exhibit a high degree of competence, openness and willingness to go far beyond what is required."

— Myriam Ibarra
Nottingham High School

Keith Bowman

Degree Program: Ph.D. Ecology

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Keith is studying the bryophyte communities of northern white-cedar swamps in Central New York. Specifically he is interested in how the bryophyte communities are affected by their distance from agricultural edges. His work includes floristic and ecological sampling and also examines how the propagule bank and the propagule rain relate to the observed bryophyte community structure.

Keith views teaching as a dynamic and iterative process. In the high school classroom he uses those techniques that he and others have found to be successful, but he constantly looking for and trying new techniques. It is Keith's goal that the students will learn to ask good questions, pursue answers, and follow-through with appropriate responses in all aspects of their lives.

Road Shows
The relationship between income levels and ecological footprints

Consumer Packaging and its Consequences

Student Projects
Peat: A Sustainable Alternative Energy Source for New York State

Anatomy of an Ecosystem Engineer

Shannon Buckley

Degree Program: Ph.D. Ecology

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Shannon's research is looking at levels of CO_2 within the city of Syracuse, focusing on two sampling sites in a residential and a commercial neighborhoods. She eventually plans to explore relationships with local urban forests and impacts on city planning and forest management recommendations.

Shannon uses her research as an example for the students to refer to when beginning their projects. She finds that students tend to respond better knowing that she is currently going through a similar process. What she finds most rewarding are the moments when you see the students become excited about a topic.

Road Shows
The Air you Breathe: Understanding Air Quality Locally and Nationally

Climate Change: Past, Present and Future

Student Projects
Is Destiny USA as Green as it can be? Environmental Implications of Construction

Urban Children and their Perspectives on the Environment

Lindsay Cray

Degree Program: Masters Environmental Management and Risk Assessment

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Lindsay's research focuses on Promoting Ecosystem Sustainability through Renewed Forest Management Frameworks and Community Integration. Over the last four years she has worked on the island of Puerto Rico as a research assistant for the US Forest Service.

Lindsay brings world perspectives into the classroom by combining social and ecological sciences. She teaches students the importance of realizing their personal impact on the global community, as well as how to integrate multicultural aspects into research methods and inquiry.

Road Shows
Empire State Environmental Management

Acid Rain in the Adirondacks

Student Projects
Ground a phosphorous models in owasco inet, Auburn New York

Seasonal Accumulation of Similar Non-Migratory Songbirds

Mitchell Graves

Degree Program: Ph.D. Bioprocess Eng.

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Mitchell's research looks at the use of Enzymatic Hydrolysis of woody extracts in the production of bio-based fuels. His research emphasizes the process's potential for industrial applications.

Mitchell uses his experience in the pharmaceutical industry, as well as his experiences studying abroad in China, to teach students about the importance of effective experimental design and use of the scientific method. It is his goal to use student research to create an environment in the class room that fosters creativity and critical thinking.

Road Shows
Forests Full of Fuels

The Ins and Outs of China

Student Projects
The environmental impact of students choosing to drive to school over use of the provided bus transportation

Exploring the possibilities of using alternative fuels in today's commercial airlines

Catherine Landis

Degree Program: Ph.D. Ecology

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Catherine's research focused on restoration of riparian plant communities along an urban stream, Onondaga Creek, flowing through Syracuse, NY. In particular she looked at riparian woody plant recruitment and potential for "passive restoration" relying on propagules generated in the more natural parts of the watershed

Catherine's research has taught her how the research process works, and gave her the tools and concepts she now shares with her students. Catherine and her students discuss restoration and the various ways that, through their own scientific understanding and research efforts, they can make a difference in the wider community.

Road Shows
The Streamside Connection: Riparian Ecology

This is Your Watershed

Student Projects
Environmental Impact of Foods Served at Corcoran High School

Effects of Deicing Agents on Roadside Plants

Neil Patterson Jr.

Degree Program: Masters Natural Resource Management

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Neil's research looks at how traditional knowledge and criteria are used in community energy decisions. He is measuring how much electricity could be produced on an Indian reservation in comparison to their total residential demand. Development scenarios are then assessed under traditional criteria identified by the tribe, called the Haudenosaunee Environmental Protection Process.

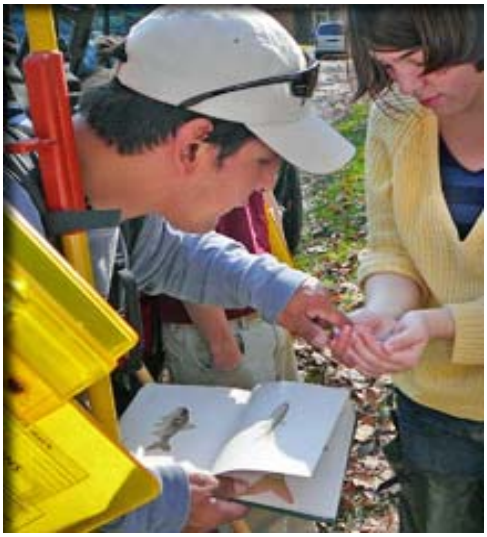
Comparing energy flows in human and natural systems is the foundation of Neil's NSF GK-12 school activities. Students are challenged to explain how aquatic and terrestrial organisms maximize net energy ratios, and why this concept is becoming more important to human energy systems in the face of fossil fuel shortages.

Road Shows
Haudenosaunee Traditional Ecological Knowledge

Your Biomass Economy

Student Projects
Killer Chemicals: Allelopathy in Buckthorn

Renewable Energy Production, Town of Lafayette, NY



Yazmín Rivera

Degree Program: Ph.D. Forest Pathology and Mycology

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Yazmín's research interests are forest fragmentation, disturbance, and how this affects population structure and genetic diversity of organisms, specifically fungal associations. Currently, she is studying the changes in genetic structure of an introduced mycorrhizal species in Puerto Rico, and its association with introduced species of pines. Yazmín is also studying the effects of forest fragmentation in the genetic structure of the ectomycorrhizal fungus *Suillus pictus* in the Adirondacks using molecular markers.

Yazmín's research experiences in Puerto Rico and New York helps her bring a different perspective on environmental sciences to the classroom. In addition, she uses her expertise with the scientific method, statistics, and mycology to help the students carry out research at an advanced level.

Road Shows
Between two worlds: Puerto Rico as a Case Study on Environmental Issues

Data Statistical Analysis

Student Projects
Human activities effect on rural and urban soil chemistry

Macroinvertebrates population diversity in Meadowbrook as a gauge of water pollution in Syracuse, New York

Anna Stewart

Degree Program: Ph.D. Ecology
Masters of Public Administration

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Anna's doctoral research is focused on exploring the climatic and socioeconomic drivers of dengue fever transmission in Ecuador to identify effective public health policy interventions to prevent transmission of the disease.

As someone who has conducted research in the U.S. and abroad at the interface of the natural and social sciences, Anna encourages her students to venture beyond the typical boundaries of environmental science to conduct relevant, transdisciplinary research and incorporate an international perspective into their research.

Road Shows
Environmental Justice: A closer look at Hurricane Katrina

The Nitrogen Cycle and Human Population Growth

Student Projects
Assessing the land area required to replace the entire world's current and future oil consumption using corn-based ethanol

The ecological footprint of the East Syracuse-Minoa High School food service department

Nicole Werner

Degree Program: Ph.D. Ecology

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Nicole's research looks at the ecological effects of invasive forest insects. Nicole is developing a spatial analysis of the effect of native parasitoids on the European wood wasp in a fragmented landscape.

Prior to returning to graduate school, Nicole was a research plant pathologist at Cornell University. She uses her professional experience to assist students in designing experiments to successfully address research questions and to perform statistical analysis on their data.

Road Shows
Food Miles: What a long strange trip its been

Genetically modified crops: Frankenfood or a safer environment

Student Projects
Effect of nutrient amendments to waste bed soil on the growth of crops

Correlations of sea surface temperatures on the frequency and intensity of hurricanes in the Gulf of Mexico

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SUNY-ESF resides in a unique region where urban, rural, and indigenous communities are all located within a 10 mile radius of the campus. ESF is leading research that directly touches local students' lives such as land reclamation and restoration projects including urban "brown field" sites, as well as socially, historically, and culturally important sites such as Onondaga Lake and Creek. ESF is a leader in future energy sustainability and is the *SUNY Center for Sustainable and Renewable Energy*. Our theme of "*Sustainable Communities"* focuses our training of Fellows into environmental professionals who can affect real change in their own communities. Our project's innovation stems from both its *Sustainable Communities* theme and its goals in producing environmentally literate citizens and environmental change-agents.

Located in Syracuse, New York, ESF is one of only nine doctoral-granting institutions in the 64 campus State University of New York (SUNY) system. ESF is an urban campus with eight regional campuses and field stations distributed across 25,000 acres in Central and Northern New York, ranging from the Appalachian highlands and Great Lakes basin to the St. Lawrence River and the Adirondack mountains. As a result, ESF is one of the largest campuses in the U.S. dedicated to education, outreach, and research related to environmental science and natural resources.

For more information on the NSF GK-12 Program at SUNY-ESF please visit our website:

www.esf.edu/outreach

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