

Environmental Research puts



Science into Action

— Lori Zaikowski and Paul Lichtman —

Students carry out research projects to improve the environment in their communities



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The new paradigm for student research should be articulations and collaborations with local governmental, academic, and civic entities. This will enable students to make lasting contributions to bettering their communities through scientific research, and to better understand the practical relevance of science. This article presents two such programs—Chemistry in Action Research (CiA) and the South Shore Estuary Watch (SSEW)—which allow students from Long Island, New York, to participate in a variety of projects of importance to and in partnership with the community. Examples of projects include reduction of storm water runoff contaminants, bioremediation, wetland restoration, elimination or minimization of eutrophic conditions, and invasive species studies.

CiA was founded at Dowling College in 1997. In the program, Dowling undergraduates and faculty serve as mentors to selected high school students who develop their own research projects on the South Shore Estuary. To further extend and complement existing knowledge about the South Shore Estuary, SSEW began in 1999 as an in-house high school program. Its initial purpose was to provide real-time water quality monitoring data for certain aspects of a New York State estuary program. However, over the years, the mission evolved into a much larger picture. In addition to monitoring water quality, current projects include remediating eutrophication, contaminants, and salt water intrusion; developing halophyte plants to act as marshland buffers; and investigating problems of hy-

poxia in the Long Island Sound. SSEW still functions as a precollege program with a continued mission to recruit community partners.

CiA and SSEW

CiA—initiated by Program Director Lori Zaikowski with funding from the Dorr Foundation—is a research program designed to bring chemistry to life for high school students and their Dowling College student mentors. Initial projects focused on local estuarine investigations on the South Shore Estuary; the program has now expanded to include other areas of research [Editor’s Note: For a list of projects, see the March 2007 issue of *The Science Teacher*, p. 32]. Under the mentorship of the Program Director, Dowling undergraduate science majors and

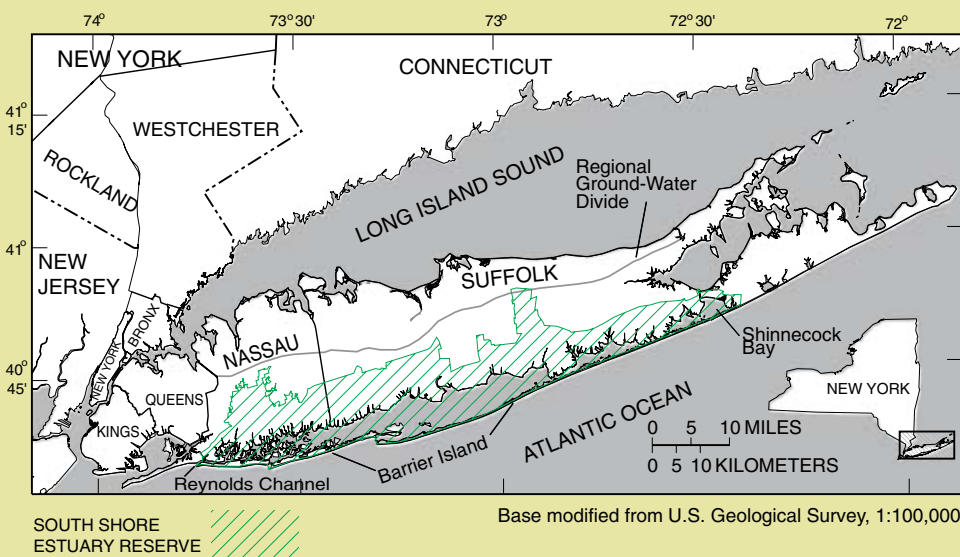
graduate students in the teacher education program involve high school students to initiate, develop, and carry out research projects that contribute to the base of knowledge for the South Shore Estuary, its tributaries, and parts of the Long Island Sound. College and high school students are selected for CiA through a competitive application process in which transcripts, letters of recommendation, and essays on research intent are considered. College students are funded through work-study programs and fellowships from the Idle Hour Flyfishers Association. Most high school students receive one academic credit in science research at their high schools, and their letter grade is determined by their high school cooperating teacher based on the quality of a required research paper, an oral presentation, and poster presentations.

SSEW was founded by the authors to increase the scope and geographical reach of research on the South Shore Estuary by engaging high school students and citizens across Long Island in water-quality monitoring and activities

FIGURE 1

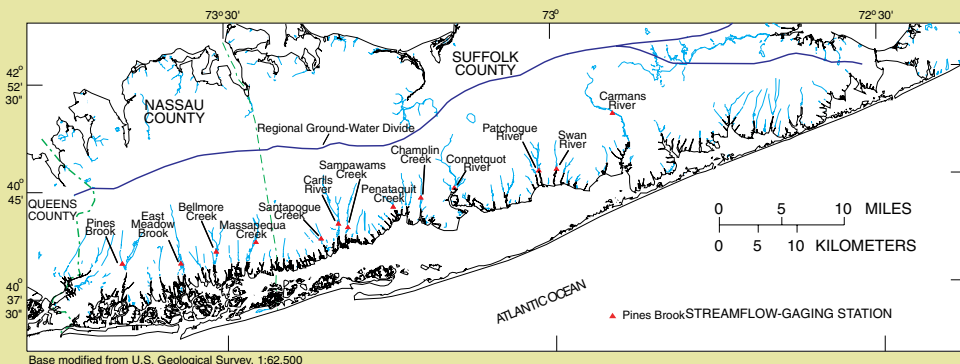
a. The Long Island South Shore Estuary.

[MODIFIED WITH PERMISSION FROM MONTI (2003).]



b. Locations of 13 selected streams that discharge to the South Shore Estuary Reserve from Nassau and Suffolk Counties, N.Y.

[MODIFIED WITH PERMISSION FROM MONTI (2003).]



that enhance the quality of the estuary. Because most schools south of the Long Island groundwater divide are located near a tributary or bay of the South Shore Estuary (Figures 1a and 1b), students can conduct estuarine research year-round in their school districts, and contribute data and observations to expand the base of knowledge along the 120 km length of the estuary. Students in the SSEW program can receive high school academic credit and are eligible for college credit through articulation agreements with various colleges when the activities are research-based.

SSEW students also have scholarship opportunities through the United States Department of Agriculture and the National FFA Organization (www.ffa.org). At Uniondale High School, for instance, the SSEW program is developed through a supervised agricultural experience (SAE)—a project format developed by the National FFA Organization, which includes environmental issues in its programming. The SAE is a major part of the National FFA Organization's standards that enables students to develop specific proficiencies in their research-based projects. Students who meet these proficiencies are eligible for both state and national recognition through the National FFA Organization's extensive scholarship programs and agriscience fair. A fully developed SAE not only enables the student to obtain real-world experience, but also allows the student to receive recognition in the form of public acknowledgment and potential monetary rewards.

Selected projects and collaborators of both programs

The South Shore Estuary has a long history of economic and cultural importance to Long Island, and today over 1.5 million people live in its drainage basin. It has the most extensive tidal wetlands in New York and is home to a great diversity of species. Land use and associated storm water runoff pose the most pressing threat to water quality, and local towns and villages require data upon which to base decisions that may affect the estuary.

The South Shore Estuary Reserve (SSER) Comprehensive Management Plan calls for water-quality monitoring that includes identifying and assessing trends, and evaluating the extent to which desired uses of the Reserve's water resources are met. One of the goals of the SSER Program is to "achieve and maintain the water quality necessary to preserve and rehabilitate resources of the estuary" (Pataki and Daniels 2001). Attaining this ambitious water-quality goal depends on the cooperative efforts of many players—federal, state, and local governments; nongovernmental organizations; resource users; and residents.

This is where both CiA and SSEW students have been able to play an important role by contributing scientific data regarding water quality, remediation,

and restoration. While data are available from local governmental agencies for the open bay and from U.S. Geological Survey for the freshwater reaches of tributaries, there is a dearth of data for the tidal sections of tributaries. CiA and SSEW are filling that gap as student researchers have been a valuable asset in providing baseline and new-source data for the SSER by complementing research done by governmental entities. With proper supervision and strict adherence to experimental protocols and Quality Assurance/Quality Control (Hauer and Lamberti 2006; Clesceri, Greenberg, and Eaton 2005; Behar, Dates, and Byrne 1997), the student researcher, a traditionally untapped resource, is an important component in achieving one of the primary objectives of the SSER Comprehensive Management Plan—a healthy and thriving ecosystem, resulting in both ecological and economic benefits for all Long Island citizens.

Figure 2 (p. 50) describes projects conducted in the field and lab by students in the CiA program and from SSEW member schools. Projects focus on biological, chemical, and physical estuarine studies; remediation and water purification; development of natural fertilizers and pesticides; wetland restoration; invasive species; and land stabilization. The South Shore Estuary Watch Manual was developed by the authors to establish common protocol and procedures for studies carried out across the estuary (Zaikowski and Lichtman 2003).

Benefits to students and society

Students present their work to local governmental and civic entities through written and oral reports for use in planning, land use, and remediation projects. For example, the Village of Patchogue submitted student-generated CiA data collected on the Patchogue River over a four-year period to the New York State Department of Environmental Conservation (NYSDEC), resulting in designation of Patchogue River as a Priority Waterbody by NYSDEC. Priority Waterbody classification made the Village of Patchogue eligible for governmental funding to improve water quality on the Patchogue River and for waterfront revitalization funding.

To showcase CiA projects to the local and scientific communities, the Dowling College Annual Symposium on the Banks of the South Shore Estuary was founded in 1997, and has expanded to feature the best high school environmental science research projects on Long Island, including SSEW projects. It provides a connection for the community between research done in high schools and its relevance to issues of local importance. In a forum where students hear presentations by practicing scientists and where students can educate the public about their research, students better understand the role of science in society and better realize the significance of their work. The symposium

FIGURE 2

Selected CiA and SSEW Projects and Cooperating Entities.

Participating High Schools and Cooperators	Projects
Idle Hour Flyfishers Village of Patchogue Commack HS Bellport HS Central Islip HS	“A Comparative Study of Dissolved Oxygen and Nutrients on Patchogue and Carmans Rivers” “Assessment of Water Quality in Tributary Rivers of New York’s South Shore Estuary Using Organic and Inorganic Indicators” “Sediment Analysis of PAH, PCB, and Organochlorines by Infrared, UV, and Gas Chromatography/Mass Spectrometry” “Toxicity Studies of Pesticides and Copper on Aquatic Crustaceans Utilizing a Fluorescent Marker to Monitor Metabolism” “Effects of Pesticides on the Aquatic Plant <i>Lemna minor</i> ”
Idle Hour Flyfishers Town of Brookhaven U.S. Geological Survey Sachem HS Southold HS	“Swan River Cooperative Educational Project: Assessment of Biological, Chemical, and Physical Factors”
Town of Brookhaven Bellport HS	“Bioremediation of Storm Water Runoff at Beaverdam Road”
Nassau Soil and Water Conservation Massapequa HS	“Remediation of Runoff from Massapequa HS Parking Lot”
Post-Morrow Foundation U.S. Fish and Wildlife Service NY State Dept. of Environmental Conservation Suffolk County Dept. of Public Works Ducks Unlimited Bellport HS Sayville HS	Various wetland restoration projects in Brookhaven and Islip Townships Biological, chemical, and physical studies of Green Creek Invasive species assessments
Long Island Maritime Museum Bluepoints Oyster Company Bellport Bay Sailing Foundation East Islip HS	South Shore Estuary Informational Video Environmental science programs for both summer and academic year
Nassau County Dept. of Parks New York State Dept. of Parks Suffolk County Dept. of Parks Sayville HS Uniondale HS	“Greener Than Green: A Novel Approach to the Use of Natural Substances as Plant Growth Regulators in the Family Poaceae” (Hildebrand 2003) “A Multivariate Statistical Analysis of Soil and Water Contamination Due to <i>Branta canadensis</i> Droppings” “A Comparative Analysis of Soil Chemistry Between Areas of the 2003 Connetquot River State Park Fire and Areas of the 1995 Westhampton Pine Barrens Fire” “Analysis of Cryptobiotic Soil in a Glacial Outwash Valley” “Land Stabilization: Utilization of Cryptobiotic Soil to Revitalize Sensitive Ecosystem Integrity” “Remediation of Eutrophic Conditions Using Sustainable Low-voltage Buoys” “Using Multivariate Phytoremediation Techniques to Remove Heavy Metals”
Brookhaven National Laboratory Suffolk Community College Center for Community Research (Black 2000) Bellport HS Smithtown HS	“Geobotanical Analysis of Invasive Species in the Pine Barrens” “The Study of Water Milfoil (<i>Myriophyllum heterophyllum</i>) and Its Potential Threat to the Environment as Invasive Species”

also serves as an inspiration to scientists and the community to see the worthwhile scientific efforts young people are making, and has forged connections that have opened up student opportunities for internships and employment.

CiA and SSEW projects have won numerous awards at national science competitions such as Intel, Siemens Westinghouse, International Science and Engineering Fairs, and the National FFA Agriscience Fair, as well as at local science fairs (Cassese 2005; Hildebrand 2003, 2006). Presentations at national meetings of professional scientific societies, such as the American Chemical Society, get student research results out to the scientific community and have been well received (Wilkinson 2003). Furthermore, through FFA Career Development Events that focus on the ability of students to communicate, high schools such as Uniondale sponsor events that enable students to present the significance of their research to local PTA chapters and other concerned community groups. In this way, not only do students gain an understanding of local environmental concerns, but the relevance of their research is transmitted to the community that supports them.

A fundamental role of modern science is to advance society, and the most valuable contributions we can make as scientists are those that provide direct benefits to society. Engaging students in the collection, analysis, and presentation of scientific data that is needed by local governmental and civic entities is truly science in action. Students experience the excitement of making new discoveries; learn about the applications of science in understanding and solving important problems; gain training in laboratory skills, instrumentation, and experimental design; and learn about career and college opportunities. Based on the positive responses we have had from students, teachers, citizens, and governmental entities involved in CiA and SSEW, we encourage the establishment of more college/high school/community partnerships that focus on local issues of importance. ■

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