NATURE is the Classroom for Marine Education
From the EDITOR

“SEA” WHAT’S NEW!

In this issue of Wrack Lines, we depart from our usual potpourri format to instead offer a single theme, marine education. We have highlighted in these pages not only the worthy efforts that our own program leads, but a look at marine education efforts by a variety of Connecticut educators and partners who all have the same goal: bring the ocean and coast to life for this generation of students. We couldn’t include everything going on in these 24 pages, but you’ll find some inspiring examples.

When I look through the articles submitted, I find a common thread throughout: the educators we talked with all agree that nature makes the best classroom, and hands-on activities are the ones young people will remember. Did I mention the sense of stewardship that can develop when students are exposed to natural environments?

By bringing observations, data, or specimens back to the classroom or laboratory, the learning continues indoors with the tangible real-world connection still fresh in students’ and teachers’ minds.

For all of us, it’s important to understand the importance of the ocean. A good place to start: The Ocean Literacy Campaign is a wide-ranging, collaborative effort by hundreds of scientists and educators to create a society with greater ocean knowledge. One of its key efforts was to develop seven basic key principles of Ocean Literacy that we should all know and appreciate.

Here they are—see how many you knew!

- The Earth has one big ocean with many features.
- The ocean and life in the ocean shape the features of Earth.
- The ocean is a major influence on weather and climate.
- The ocean made Earth habitable.
- The ocean supports a great diversity of life and ecosystems.
- The ocean and humans are inextricably interconnected.
- The ocean is largely unexplored.

Peg Van Patten

About our cover:
The Charles W. Morgan, last wooden whaleship in the world, sails on its 38th voyage to New England ports of call in 2014. The voyage was not only about history, but also science and ocean sustainability. NOAA’s Office of National Marine Sanctuaries partnered with Mystic Seaport for a visit to Stellwagen Bank National Marine Sanctuary. Story on page 7. Photo: © Mystic Seaport, DA Murphy
Features

**THERE’S STILL TIME TO GET YOUR FEET WET!**

Marine and aquatic field experiences provide a rich context for inquiry-based teaching and learning designed around standards.

**TEACHING ABOARD THE CHARLES W. MORGAN**

The oldest commercial sailing ship in the U.S. teaches history but also makes a great classroom for science experiments.

**MENTORING WORKSHOPS HELP TEACHERS EXPLORE THE SOUND**

Top-notch educators hold workshops for their peers, bringing Long Island Sound into curricula and linking activities to state education standards.

**NOAA-B WET PROJECTS**

An environmental education grant program provides hands-on learning for students to discover and analyze local watersheds.

**TECHNOLOGIES BRING UNDERWATER SOUNDS TO LIFE FOR DEAF STUDENTS**

Deaf students worked with university researchers and technicians to build hydrophones and used acoustic software to visualize the sounds as waveforms and sonograms.

**THE COSEE-TEK AND LSAMP PARTNERSHIP**

Opportunities for underrepresented students to experience hands-on ocean science and technology, acquiring skills and learning about careers.

**QUAHOG BOWL**

Each year, high school teams compete against each other to beat the competition at the Quahog Bowl. It’s the CT/RI regional competition for the National Ocean Sciences Bowl, hosted by Project Oceanology and Connecticut Sea Grant.

**HELPING STUDENTS BECOME SEA STARS**

Marine educators adapt innovative ideas to meet the needs of local students. Even underperforming students can have life-altering experiences in the natural world.

*Of Interest*

*Influence of Major Ecosystems on Literacy*
There’s still time to get your feet wet!

by Valerie Cournoyer

The Importance of Marine and Aquatic Field Studies for Students-An Essential Tool for Inquiry-based Instruction Designed around Standards.
Developing Environmental Stewardship

Marine and aquatic educators embrace field experiences. Many of us are drawn to the water like a high school student to their cell phone. You can’t drag us away. How did we develop this affinity for water? Some say we are physiologically drawn to water since we are basically bodies of water ourselves. That may be part of it, but from my experience, I have observed that an appreciation for aquatic environments comes from familiarity with the place, whether it is a beach, rocky shore, open water, estuary, river or stream. Many of our students do not have the opportunity or inclination to visit Long Island Sound or their local body of water. Providing educational field study experiences through a school or non-profit educational program can make the difference between a conservation minded, science literate adult that takes action to remediate and preserve aquatic environments and one that skips the science news when they surf through their cell phone.

The Current State of Science Education Standards

In Connecticut, we are in a transitional phase in education with uncertain but imminent change in science educational standards and practices. Will we adopt the Next Generation Science Standards (NGSS), modify the current Connecticut Framework for Science Education or embrace a regional version of the science standards? This decision will be made by the Connecticut Education Department and its constituents soon.

While there is uncertainty about the exact science standards we will have, there is consensus that science literacy and inquiry must be part of the instructional equation. Science literacy means the student has developed skills to acquire scientific knowledge and apply it to a larger context in everyday life. This embodies not only core science knowledge but also the skills needed to obtain that knowledge which have been described in the Common Core State Standards (CCSS) for reading, writing and math.

Science inquiry is viewed in two ways. Traditionally, we think of inquiry as a set of science process skills used by scientists using experimentation around a testable question. Additionally, however, science educators are now integrating inquiry into instruction. In an inquiry based classroom, student questions drive instruction. Students are directing their learning with peers and community partners. The instructor facilitates and supports students in gathering information, analyzing data and understanding key science concepts.

Field study experiences not only support students in their goals to meet both common core and science standards through inquiry, but also increase student engagement. Let’s look at a few examples.

The Coastal Connecticut Connections Program

Long Island Sound and its rivers were the focus for this field study combining students from High School in the Community in New Haven and Amity Regional High School students from the towns of Woodbridge, Orange and Bethany. Designed and implemented by Project Oceanology in Groton, Connecticut and funded by the Connecticut State Department of Education, urban and suburban students visited each other’s schools and worked in mixed teams for classroom, laboratory and field investigations. Students used sophisticated oceanographic technology onboard the research vessel R/V Envirolab to collect, identify, and measure marine life and water conditions of Long Island Sound at three sites. The comparison of three locations at the culmination of the project allowed students to compare and contrast the biotic and abiotic characteristics and overall health of three major river systems that empty into the Sound including the Thames River (Groton, New London), the Connecticut River (Old Saybrook, Old Lyme) and the Quinnipiac River (East Haven, New Haven). This program was simultaneously conducted with many urban/suburban school pairings throughout the state. Students were able to work with peers and community partners, ask and investigate their own questions, collect and analyze data and use the knowledge gained to make sense of the overall health of Long Island Sound in the study areas. These field experiences support current Connecticut state science standards in the conceptual themes of inquiry, matter and energy in ecosystems and structure and function. Using the proposed NGSS standards they fall under the Core Ideas in Life Science, specifically LS2: Ecosystems: interactions, energy and dynamics.

Inquiry at Bermuda Institute for Ocean Science (BIOS)

Imagine this scene: students are huddled around a bonfire at midnight on the shore of Whalebone Bay in Bermuda. One pair of students is returning from the water, hands their underwater clipboard with octopus sighting data to another student and excitedly turns to their partner and says, “Did you see the color of the octopus when we swam close to it?” “It was bright red with white spots”.

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“Yes” says the other student, “I saw two more just before I got out.” Another pair of students prepare to enter the water, clipboards in hand, to snorkel a transect that was set up earlier in the day by students with support from James Wood, a cephalopod expert, studying squid and octopus at the BIOS facility. Fueled by student interest and curiosity, the 24-hour octopus study was born through collaboration with the scientist, support from Amity teachers and a desire to contribute data to an authentic question being pursued by Wood.

Amity High School has been partnered with the Bermuda Institute for Ocean Sciences for 25 years, providing students the opportunity to explore and ask questions about subtropical environments in Bermuda. For example, other student projects include an investigation of the distribution of the endangered snail known as the West Indian Top Snail in the intertidal zone, and collection and analysis of coral reef fish type and abundance on Bermuda reefs in conjunction with the international data base Reef.org. Another includes conservation efforts to restore Cooper’s Island, former locations for the US Navy and most recently a NASA outpost, to its endemic state by planting buttonwood trees and collecting floatable debris data to add to an ongoing BIOS research project. In addition to life science standards, these projects support earth science standards including NGSS standard ESS3: Earth and Human Activity.

Community Partners

An important part of designing relevant field study is the development of community partners. These partners provide support, tools and materials and authentic scientific investigations that are connected to real world issues. While developing a marine biology and oceanography course for Amity High School, I relied heavily on partnerships developed through past employment, professional development opportunities and professional organizations.

In addition to Project Oceanology and BIOS, Connecticut Sea Grant supplied classroom materials and professional development opportunities including support for our Hammonasset Intertidal Zone field study. The Long Island Sound Mentor Program (LISMT) was developed by Connecticut Sea Grant in 2002 and is funded by the Environmental Protection Agency (EPA) through the Long Island Sound Study (LISS). Facilitated by Diana Payne in Connecticut, certified teachers become mentors for their peers by creating professional development workshops focused on the Long Island Sound watershed. Donna Rand, a teacher from the Glastonbury-East Hartford Elementary Magnet School has mentored teachers through her workshops “Seine the Sound” and “Teach at the Beach.” At one workshop at Hammonasset State Park in Madison, Connecticut. Donna modeled the questioning techniques she employs at each interdisciplinary station. Students were given context for the task that had been provided, such as collecting and sorting Japanese shore crabs or using a seine net to collect intertidal organisms. Student questions were elicited, recorded on a flipchart and used to guide the investigations about population growth and interdependent relationships in ecosystems.

Other community partners providing support for my marine biology course include The Maritime Aquarium at Norwalk. Students gave jellyfish culturing a try with two different jellyfish species provided by the aquarium. Classroom investigations prepared them for a visit with the aquarists in the jellyfish culturing area where they asked questions to guide their study. Individual scientists are also interested in working with students. Sheila Stiles from the NOAA National Marine Fisheries Service (NMFS) in Milford, Connecticut mentored my students in the art of scallop culture and restoration in Long Island Sound providing background resources and scallops. An open house is available to teachers and students at NMFS every October.

The field experiences I have just described have added so much to my classes, providing rich context for learning, opportunity to engage with community partners and model authentic inquiry. The excitement of visiting a new place and meeting new people allows students to engage and develop compelling questions. Each experience explicitly used as a method to reach understanding of disciplinary core ideas in science is relevant and valuable. Do we have time to be out of the classroom and get our feet wet? I’d say it’s a waste of time not to!

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Valerie Cournoyer is a science teacher and Bermuda Studies director at Amity High School in Woodbridge.
Ishmael’s Plankton Net: Teaching Marine Science Aboard the Historic Charles W. Morgan

by Alexandra McInturf

On a humid morning last July, 20-year-old Molly Weiner stands at the pier of Boston’s National Historical Park, unfazed by the juxtaposition of the historical vessels and the modern instruments before her. Visitors mill about, excited by the newly arrived Charles W. Morgan, which floats behind the USS Constitution. This is a unique opportunity to view the Morgan, the oldest commercial sailing ship in the United States, docked beside the Constitution, the oldest commissioned warship in the world. With the sound of sea chanteys in the background and the sight of several small whaleboats in the water, Molly finds herself in a living time capsule. She pulls out her yellow notebook, records the date, time and GPS location of the ship, and then she prepares to drop a rubber bucket over the side of the pier into Boston Harbor. A visitor with children stops by to observe. “What are you doing?” he asks. Accustomed to such questions, Molly responds with one enthusiastic word: “Science!”

Gathering a small crowd, she continues collecting data next to the Morgan, explaining each step aloud. Taking out a handheld YSI meter and leaning out over the side of the pier, she measures temperature and salinity from the surface down to six meters. She then records light attenuation with a small white Secchi disk. From a bucket of harbor water she gathers a sample to record chlorophyll-A with a fluorometer. Finally, visitors watch as she drops and raises a cylindrical fine-mesh net into the water ten times, filtering the harbor’s plankton into a cod-end jar. Setting the net on the pier, she unscrews the jar, caps it, and places it aside to take back to the lab. Beside her findings in the notebook she records observations of cloud cover, air temperature, and wind direction.

Next, Molly gathers her gear into a duffel bag and walks up the gangway and on to the Morgan. Onboard, the ship’s deck is crowded. Parents lift up small children to peek into a large wooden barrel that used to hold whale oil. Others glance skyward, admiring the rigging and inhaling the smell of wood and rope. Molly greets crew members as she navigates through the crowd to the center of the ship. She places the bag and notebook in the chicken coop beneath the carpenter’s bench, beside the tryworks, one of many indicators that the Morgan was not exactly designed for modern-day science. However, lack of a sterile lab environment is a small price to pay for the opportunity to do research on a piece of living history.

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Alongside a small whaleboat in Boston Harbor, Molly Weiner writes her observations in her yellow field notebook.
Photo Credit: Alexandra McInturf
A Historic Vessel in the Modern Age

The last of the American whaling fleet that dominated New England waters in the 19th century, the Charles W. Morgan was built and launched in 1841. It sailed on 37 voyages until 1921. After an 80-year career, the ship was preserved and exhibited at Colonel Edward H.R. Green's estate in South Dartmouth, Massachusetts. After Green's death, the ship came to Mystic Seaport in Connecticut, where it has remained docked since 1941 as a National Historic Landmark.

In 2008 the Seaport began a six-year restoration of the ship, using historically appropriate materials and techniques.

This past summer, the restored Morgan made its way down the river for the first time in 73 years, outbound to sea for the “38th Voyage.” Between May and August 2014, the ship visited several New England ports.

Data Collection and Research

For Molly, data collection of the waters at the Charles W. Morgan’s ports of call became routine, but for those who surrounded her beside Boston Harbor and elsewhere - in anticipation of viewing a museum piece -- scientific sampling beside a historic vessel appeared a novel concept. Lisa Gilbert, professor of oceanography at the Williams College-Mystic Seaport Maritime Studies Program and a specialist in marine geology and geophysics, created the summer’s science plan. Many basic scientific processes, from observation to navigation, were useful to the 19th-century voyager in the era of Melville’s Moby-Dick, and so for Gilbert, science was a clear way to both revive an important aspect of maritime history and stimulate interest and discussion about larger global ocean issues.

“Nineteenth-century whalers made careful observations of where and when they sighted whales, and of the ocean conditions,” Gilbert said. “On the 38th Voyage we made some traditional observations, with traditional tools alongside modern scientific equipment. It is interesting to compare what we can still learn from basic methods and what new technology helps us see what the early American whalers could not.”

The scientific process of collecting data on the voyage was only one part of defining the Morgan as a vessel of education and an inspiration for current generations. Part of the greater education of the 38th Voyage was the sheer experience of being at sea. With Molly, Gilbert’s research assistant, in charge of data collection at several of the ports, Mystic Seaport invited visiting scientists, painters, historians, and scholars to conduct individual research projects during separate legs of the voyage. A diverse interdisciplinary range of 80 “38th Voyagers” and distinguished guests sailed, including Sylvia Earle, artist Evan Turk, and three Williams-Mystic alums who are now, respectively, a science writer, a graduate student in fisheries policy, and a digital librarian in maritime history. When the Morgan visited Stellwagen Bank
National Marine Sanctuary, Gilbert relied on the voyagers and museum staff onboard over the entire summer to gather hourly samples when the ship was underway, similar to the data that Molly was collecting in port.

Meanwhile the 38th Voyagers conducted a variety of science projects on their own. Anne DiMonti of Rhode Island Audubon, for example, sought to “go back to the roots” of marine science by observing natural whale behavior, while testing temperature, salinity, water clarity, and plankton composition to determine the habitat of the whales on Stellwagen Bank. Brian Corbett, an engineer at Tetra Tech, Inc., created a GIS map of the voyage and digitized nineteenth-century nautical charts to compare with modern-day geography. Dave Grant from the American Littoral Society collected plankton samples to identify copepods that serve as food for humpback whales.

University of Connecticut-Avery Point professor Michael Whitney released student-designed surface ocean drifters to track the currents connecting Stellwagen Bank to other areas of the North Atlantic in order to compare the data to historic observations and climate models.

Gilbert and Molly were joined at the beginning and end of the voyage by Jim Carlton, a familiar face onshore. Carlton, director and professor of marine sciences at Williams-Mystic, is widely recognized for his expertise in global marine bioinvasions. He saw the Morgan as “a novel platform to replicate what may have been a very common thing in the nineteenth century.” Carlton placed 12 fouling panels on the stern of the ship before the hull went into the water in 2013. His goal, he explained, was to determine what sorts of organisms move around New England and came back with the Morgan on the voyage. After the ship moved from Mystic to New London, Williams-Mystic and University of Connecticut divers removed six of the 12 already-fouled panels to determine what the Morgan would be carrying with her on the voyage. Six blank panels were also added to document what the vessel would pick up en route. These were retrieved at the end of the 54-day voyage.

“On a first pass inspection,” Carlton said, “the ship picked up an impressive fouling fauna, including the prominent invasive Japanese seasquirt *Didemnum vexillum*, which was in the process of smothering native barnacles on the panels.”

**Inspiration for Future Generations**

Molly spent her final summer days in Gilbert’s lab. She worked back through the data from each port, reliving the 38th Voyage with each page of her yellow notebook. As she reflected, she found that its influence was surprisingly complex. “There was a small-scale impact in terms of the community of the 38th Voyagers and the crew on the ship,” she said. “There were a lot of people who weren’t science-based, and it was really awesome having artists, for example, doing our sampling.” Through many different vectors, the 38th Voyage taught connections between maritime history and marine science.

“Observational science is still a relevant field,” Molly said. “I think a lot of kids in our generation forget that there are still things to learn using basic tools. We are adding a lot of cultural information behind the science to show future generations that science has meaning in any context.”

With nitrate samples to defrost and analyze and plankton sample identifications to triple check, Molly is counting on future Williams-Mystic students to continue the analysis of the voyage.

Looking back, Gilbert emphasized the importance of viewing this voyage from both a cultural and scientific perspective. “The Charles W. Morgan’s 38th Voyage is a humbling reminder of why so much of the ocean is still unknown,” she said. “Among all of the other messages of this voyage, the ship made history this summer as a platform for both traditional and modern oceanography, contributing to knowledge about our changing oceans in 2014.”
NOAA B-WET Projects Help Teachers Make Nature the Classroom

by Peg Van Patten

NOAA B-WET is an environmental education program that promotes locally relevant, hands-on learning about local watershed environments. Students and teachers (K-12) experience real life challenges using science, math and other skills to study watersheds.

One very popular B-WET project in Connecticut in the past several years was Project Periphyton, which began in 2010, and continues this year by Education Connection and seven high schools. Participating high schools have included Crosby, Danbury, Newtown, Terryville, The Sound School (New Haven), and Wamago. Periphyton, tiny diatoms that are part of watershed phytoplankton, were one vehicle used to study the environment. The diversity of the diatoms can be used as indicators of water quality and watershed health.

“Project Periphyton gave students an opportunity to study real science using nature as the classroom,” Abby Peklo said. Peklo coordinated the program for Education Connection, the regional educational service center (RESC) of Northwestern Connecticut. Teachers and about 300 students each year study Connecticut’s Housatonic and Pomperaug watershed and their relationship to western Long Island Sound. Expansion of the original 2010 B-WET program for 2013 targeted additional underserved populations from heavily urbanized school districts. Through their investigations of periphyton populations, water quality, fish aging, stomach contents, sediment changes, environmental conditions, and climate change indicators, students discovered the connection between their local watershed (rivers in the Housatonic watershed) and Long Island Sound.

Teacher Sue Clarkin from Wamogo, a regional school located in Litchfield, participated in past years and was delighted to introduce a new crop of students each year to Long Island Sound and then to the Shepaug and Pomperaug Rivers again this year. Earlier, in 2010, SoundWaters also received a B-WET Project Periphyton grant to help students in Stamford study water quality in the Mianus River, so this program has had a broad reach in our state.

The students also found opportunities to present their scientific findings to peers at UConn, to community leaders and environmental groups and to parents at school. In their summaries, students said that they felt empowered to have a positive impact in their own watershed environments. For great examples, see Newtown’s web page at https://class8projectperiphyton.wikispaces.com and Wamago’s video at https://www.youtube.com/watch?v=zLoC5ucmU-E.
Mentoring Workshops Help Teachers Explore the Sound with their Students
by Nancy Balcom and Diana Payne, Connecticut Sea Grant

“I am 100% confident I can bring students here.” “You have helped me inspire, inform and manage my students.” “This workshop was absolutely fantastic...a wonderful day of learning and exploration! I will be getting my students into the field next month.”

These quotes are from educators who participated in a Long Island Sound (LIS) mentor teacher workshop offered by the dynamic team of Donna Rand and Donna DuBaldo. Donna and Donna, as we refer to them, are teachers of science and physical education, respectively at the Capitol Region Education Council’s Glastonbury-East Hartford Elementary Magnet School. More importantly to us, they are long-standing mentor teachers in a professional development program initiated by Connecticut Sea Grant and supported by the EPA Long Island Sound Study (LISS). Since 2002 the Long Island Sound Mentor Teacher (LISMT) Program has recruited teams of top notch, highly respected educators to create and hold one-day workshops for their peers, to assist them in bringing Long Island Sound content into their curricula. All workshop activities tie into state and national science standards, so they are not an added program to fit into an already busy schedule but an enhancement of what is already being taught. In 2010, New York Sea Grant and EPA brought the LISMT Program into New York.

“The goal of our workshop is to help teachers feel comfortable with the logistics of bringing their own students to the Long Island Sound coast and providing an authentic learning experience for them,” says Rand. The teachers have brought their own students to Hammonassett Beach State Park in Madison for many years; for some students, it is the first time in their lives they are exposed to a saltwater environment. “We want our students to work as scientists, ask questions about the ocean environment, and find out what lives there. By encouraging other teachers to take their students to the shore twice a year, they too may be able to find evidence of changes over seasons and years,” she continues. DuBaldo adds, “When the teachers then go back and involve their own students in a study of the Sound that is not just hands-on but activates the whole body and mind, they gain an appreciation for Long Island Sound and a sense of environmental stewardship that can stay with them their whole lives.”

In Connecticut and New York, mentor teachers have teamed up to offer 37 LISMT workshops for 501 formal and informal K-12 educators; the workshop participants in turn teach more than 26,050 students annually in 74 Connecticut and 69 New York cities, towns, and regional school districts. With oversight by Connecticut Sea Grant Education Coordinator Diana Payne, teams of mentor teachers develop a workshop highlighting a theme of their choice, identify appropriate resources and equipment to share with workshop participants, and conduct the workshop at the location(s) of their...
choice. The workshops emphasize “learn by doing” participation so teachers can experience all of the activities firsthand. EPA financial support covers the cost of the workshop resources and “start up” field equipment given to the participants and provides modest stipends for the mentors.

Targeting formal and informal educators of grades 4–12, Rand and DuBaldo run them through a series of field activities that address different science disciplines. They focus on how to find out what’s there, and how to collect meaningful data and even evidence that things are or are not changing over time. When the teachers return with their own students to the field site and then follow up with additional classroom activities, they are helping students forge a personal connection to the ocean environment. To help make this happen long after the workshop participation “happy glow” fades, Rand and DuBaldo summarized what they have learned about running a successful field experience in “Science Lessons at a LIS Field Site,” a section of Sea Grant’s Long Island Sound Curricular Resource Guide.

Developed for educators interested in teaching about the Sound, the guide is a composite of activities and lesson plans, background information and resources contributed by mentor teachers and Sea Grant staff. Also available in Spanish, “Science Lessons” breaks down tried and true logistical stations in a way that enables parents and teachers with limited science / ocean backgrounds to work with a standardized protocol to lead a group of students and focus their attention on, for example, the exploration of a rocky beach. “We encourage teachers of art, music, technology and other disciplines to take the workshop so they can guide the students doing the work at each station, and at the same time share their own unique spin,” says Rand.

She adds, “If students look at field guides, they might expect to find all sorts of marine life on the rocky coast, but in reality now they will likely only find the invasive Asian shore crab. This leads to discussions of how we determine if a species is considered invasive, and how do scientists collect that information.”

Preparing and giving a mentor teacher workshop is a lot of extra work, so what brings back mentor teachers like Rand and DuBaldo, and Ken Fusco and Leanne Nolan of Plainville High School back year after year? “For me,” says Rand, “the reward is seeing teachers who have taken the workshop at the beach with their own students. It’s rare not to see one of our workshop “graduates” with students at Hammonassett on the same day that we’re holding the mentor teacher workshop. One science coordinator took the workshop, and then returned the following year with several science teachers who participated. In the third year, those same teachers brought their own students to Hammonassett while their student teachers took the workshop the same day.” DuBaldo adds, “It’s great to see the results, the effectiveness of what we are doing.”

Rand and DuBaldo also note that all learning is two-way in the workshops; they learn from their peers as all share expertise and perspective, and exchange ideas.

“The Sea Grant / LISS workshop gives teachers the tools to get started,” says Rand. “We provide each teacher with a seine, minnow trap, field guides and other resources. We get them in the water using waders and the equipment, so teachers feel comfortable leading the field experience themselves, reducing costs and perhaps enabling them to take their students more often.”

“From our own student trips, we have learned how to rotate the time spent on the rocky beach and sandy beach,” says Rand. “We might be measuring the particle size of tiny sand crystals but we also include time to look up and around at the overall environment. We try to make sure there is something for everyone while keeping it geared to our goal of addressing what we want students to learn from the curricula and standards. We immerse them in the environment in a substantive way, capturing squirming life in a seine net, looking at them under a microscope and then putting them back.”
The LISMT Program and the myriad of resources developed through Connecticut and New York Sea Grant’s extensive and productive relationship with the EPA LISS will continue to ensure that the relevant science is properly translated and utilized by citizens of all ages in the Long Island Sound watershed. With the finalization of the Next Generation Science Standards, the successful LISMT Program is even more critical and relevant. Unlike current state and previous national science standards which are nearly devoid of marine and aquatic science content, educators will now incorporate Earth systems science (which includes ocean, coastal and climate change topics) into K-12 curricula. The LISMT Program will help ensure that current science-based content is utilized by mentor teachers and participants during the transition to new standards and frameworks.

“Students can learn about the ocean in a lab setting or even virtually, but you can’t really duplicate the experience of being in the field looking through hand lenses, peering under rocks, smelling the salty air, and checking weather conditions,” says DuBaldo. “After completing a station where lots of Asian shore crabs were collected from under the rocks, measured and gender determined, one student commented ‘If this was a sport – I’d like it better than football!’ How can you beat that?” She adds, “The success of these workshops began with Diana Payne’s vision for how they should be structured around peer-to-peer teaching. Participants in our latest workshop had the added benefit of meeting Sea Grant Communications Director Peg Van Patten, author of *The Seaweeds of Long Island Sound*, one of the resources we handed out. Peg added a layer of expertise as an author and scientist to the workshop, talking about seaweed as food source and a new commercial sea vegetable industry. It’s really a privilege to do this workshop year after year and work with teachers willing to step out a bit and guide their students. Thanks for keeping us on board.”
Helping Students Become “Sea Stars” by Dianne Selditch

Marine education in Long Island Sound continues to innovate as educators adapt to meet the specific needs of local students. In the first wave of teaching in the Sound, the focus was on creating stewards who would learn about, care about and then protect the environment. The emphasis was discovery: school groups took field trips to the shore, combing the beach and turning over rocks looking for crabs or holding sea stars caught in a trawl net. In the second wave, educators layered this concept with rigorous, in-depth science. Students learned, for example, how to measure temperature and salinity, hypothesize about how changes in water quality affect the ecosystems of the marine environment. Now, innovators are taking nature-based education on Long Island Sound to a third phase.

In this third wave, selected educators are creating programs designed especially for students from families with limited resources. They draw upon the marine environment as a tool for transforming students’ lives. While many organizations in the Long Island Sound region open their programs to all children, this is a story of three organizations that created programs to target specific academic issues that strengthen students’ fundamental science, math and literacy skills; train them for new careers and success in higher education; and challenge them toward personal growth.

SoundWaters (Stamford) partnered with the public schools to identify underperforming students whose lack of access to real experiences in the natural world translated to a loss of academic gain, requiring intensive reinforcement of basic skills in reading, counting and measuring. The Bridgeport Regional Aquaculture and Science Technology Education Center (Bridgeport) draws upon aquaculture career opportunities to enhance science and math readiness for those who need it. Rocking the Boat (Bronx) entices students who build boats, sail their boats, and participate in hands-on river restoration, while learning marketable skills, confronting social issues, and strengthening academics.

SoundWaters is a recognized innovator of marine education: its advanced and rigorous marine science and STEM curriculum are integrated into over 175 schools throughout the Long Island Sound region. This past summer SoundWaters piloted a unique, place-based program for underperforming students. The goal was to combat the “summer slide,” the well-documented dynamic where, during the summer months, children without learning opportunities fall behind on measures of academic achievement. Studies have shown that, by the end of 5th grade, low-income children have lost two months in reading achievement, while their student peers from wealthier backgrounds actually make improvements and can be as much as three grade levels ahead by middle school.1

“SoundWaters is an organization that understands the need to engage students in hands-on, interactive, fun, summer programs with the goal of keeping them engaged and excited about school and future career opportunities,” said Leigh Shemitz, President of SoundWaters. “We know summer is the perfect time to create positive memories and help students retain academic knowledge. Before SoundWaters, this population study reinforced lessons in arithmetic, measurement, patterns and comparison. With each lesson, the tangible, accessible Long Island Sound environment elicited opportunities for students to reinforce new skills, and to delight in the joy of connecting with their environment.

The SoundWaters Summer STEM Academy, a month-long program conducted in partnership with the Stamford Public Schools, attracted 30 rising 5th graders. Teachers selected the students, who were significantly behind their peers in all key academic areas.

The Academy combined intensive, core study of math and reading with outdoor experiences that offered practice and mastery. For example, collecting and identifying marine species for a population study reinforced lessons in arithmetic, measurement, patterns and comparison. With each lesson, the tangible, accessible Long Island Sound environment elicited opportunities for students to reinforce new skills, and to delight in the joy of connecting with their environment.

The success of this program depended in part on a small educator-student ratio, a rigorous curriculum during the four-week, full-day schedule, and equally important, the partnership with parents, many of whom did not speak English, but who recognized that their children’s future achievement depended upon their success in school.

“At SoundWaters, we know about teaching science through the study of the Sound. Our challenge with the Summer STEM Academy was to use the natural world as a true springboard for success in reading, writing and math,” said Leigh Shemitz, President of SoundWaters. “Traditional summer school is a sad and tired concept, but summer learning is more vital than ever. Our goal was to stop the slide in performance and propel these students ahead.” Shemitz adds.

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“The program served as an important part of stopping summer slide and accelerated students on a positive trajectory,” said Cheryl Poltrack, Director for Grants and Funded Programs for the Stamford Public Schools. “I had the opportunity to personally see the rigorous program and intensity of the students as they experienced, experimented and enjoyed learning at an absolutely pivotal point in their academic journey.”

SoundWaters students sample a shallow area and learn the connection of species and habitats to the Sound.
A similar philosophy of learning in the natural world informs the Bridgeport Regional Aquaculture and Science Technology Education Center, where self-selected high school students spend part of their school day enrolled in applying science and technology in a real-world way, said Director Lea Catherman, a former biology teacher. “We use the same curriculum as the city schools, but they get to use it in application to the marine environment. That’s the hook that gets them in, and out doing stuff. They’re not just listening to a lecture but applying what they know on a regular basis.”

The vision at the Aquaculture Center is that all students have access to unique opportunities and are put in a position to succeed. Two crucial factors contribute to its success: All the programs consciously enroll students from both city and neighboring suburban school districts, and all the classes are project-based. Working side-by-side with peers from different communities, students learn from each other as they solve problems together, create exhibitions, or study aboard research vessels.

“We choose students based on interest, with a short essay from students describing why they want to come here,” Catherman said. The school offers two pathways for all students: one is exploratory for careers in aquaculture, seafood and restaurant work with coursework that meets state standards. The other focuses on higher education and careers in science and technology in the marine environment with access to college-level courses in oceanology, national science competitions, and sophisticated equipment not available in traditional high schools. Students with a range of abilities apply and are accepted, and for those students insecure in math and science, the school offers courses for students to give them “a leg up when they are ready to do chemistry,” she said.

The dramatic change from their first day to senior year is evident both academically and socially. This transformation reveals itself each morning as students arrive to class. Where they once walked in with eyes cast downward and headphones in their ears, they now smile, make eye contact and engage with teachers and peers.

Some students require greater intervention. Rocking the Boat, a highly structured youth-development program in the South Bronx, N.Y., fulfills that need with a specialized marine education program infused with comprehensive social-emotional support from social workers who strategize with students on how to deal with social-emotional issues, family issues, and getting through high school and into college. Students are drawn from the South Bronx neighborhood, primarily the Hunts Point Section, representing Latino, African-American, Caucasian, West Indian, Indian, Asian, South American, and African cultures.

The Sound and its watershed can offer significant, life-altering experiences for students.
By building boats, learning to row and sail their boats, and restoring the Bronx River and bringing it back to life, students develop valuable skills and experiences during their tenure at Rocking the Boat. But that’s not the whole story. “As magical as our activities are, it’s not enough to make the impact and change. It’s the excuse, the medium,” said Executive Director Adam Green. “These are crucial, but these are just tools to do the real work, which is to build kids. In order to do that we need social workers to help put all that our students learn at Rocking the Boat into practice in their lives off the River and outside the shop.”

Similar to Bridgeport, Rocking the Boat students participate through a self-selection process. The organization puts the word out to schools and neighborhoods but students decide on their own to commit to participating in both after-school and summer programs for multiple semesters. The goal is for students to stay involved for a minimum of two years. Students begin in grades 9 and 10, working one-on-one with social workers on life skills and youth development as they learn to build boats, row, sail, and do environmental science. They move into more challenging technical projects in boatbuilding and environmental science in grades 11 and 12, while focusing on graduating high school and getting into college or trade school; and maintain involvement after high school graduation as paid Program Assistants or as part of the broader alumni body, still receiving services from Rocking the Boat’s social work staff.

That long-term engagement strategy is the main reason why Rocking the Boat can have such an impact, Green said. This strategy is critical for kids whose neighborhoods are located in the poorest congressional district in the nation. At the same time, Rocking the Boat is not just a social service agency designed to help kids feel good about themselves, he said. The social-emotional support Rocking the Boat provides is the foundation for its students to achieve both academic success and technical competency in wooden boatbuilding, sailing, and environmental science.

Long Island Sound is rightly celebrated throughout the region as a rich natural resource for students of all ages to discover and learn about its varied marine life. But the Sound and its watershed can also offer significant, life-altering experiences for many students in the region who lack key academic skills. Real experiences in the natural world, which are often presumed as part of growing up, do not happen for many children from low-income families. “There is not one approach or a single action that transforms students’ lives,” notes Shemitz. “It is many pivotal elements: from family to school to community. What we have seen with the SoundWaters STEM Academy is that marine education, learning in the natural world, is a crucial element of academic success.”

Environmental education here in Long Island Sound is not only about creating future stewards. It is not only about teaching rigorous science. It is also about creating authentic learning experiences for underperforming students. Long Island Sound offers an ideal environment for learning and success.

Dianne Selditch is director of special projects at SoundWaters in Stamford, Connecticut.

SoundWaters is a nonprofit organization dedicated to protecting Long Island Sound through education.
were introduced to possible job environments when they eventually explore post secondary education. The students worked hard to comprehend the level of information presented, but the ability to produce a usable piece of equipment aided their determination and persistence. They left the experience with a positive perception of themselves and good self-esteem.

The teachers at ASD benefited from reaffirming science they already knew, applying it, and gaining more knowledge in areas unfamiliar to them. Although the three teachers were from various backgrounds, none of them had very much experience in electronics. This experience provided a challenge and a different teacher/student interaction for the teachers. Students saw teachers as learners. Working together with both teachers and students on a level playing field opened eyes for both constituents. The teachers were enthusiastic working with the technicians and having a hand in developing new lessons that they will share with other schools for the deaf.

Ivar Babb is director of the Northeast Underwater Research Technology and Education Center (NURTEC) at UConn.

Mary LaPorta is a teacher at ASD.

UConn's Northeast Underwater Research, Technology and Education Center (NURTEC) has collaborated with the American School for the Deaf (ASD) in West Hartford since 1998, using advanced technologies to bring ocean science and engineering to deaf students. The most recent example of this partnership has been supported by the Center for Ocean Sciences Education Excellence – Technology and Engineering for Knowledge (COSEE-TEK). In 2013 three teachers at ASD received training in ocean acoustics, including building their own hydrophones and learning to use acoustic software to visualize sounds as both waveforms and sonograms. COSEE-TEK staff then provided students from ASD the opportunity to build a new version of a hydrophone adapted from a simpler piezo-electric sensor. The students also learned to use the software to visualize sounds in a test tank set up in a classroom at ASD.

The culmination of their experience for the students was to go behind the scenes at the Mystic Aquarium to test their hydrophones' ability to record the sounds of the beluga whales in the Arctic Exhibit. The students were very excited to see the sounds of the whales displayed on the computers used to receive the sounds from their hydrophones. Students were able to view and evaluate the recordings made of the beluga vocalizations and discuss the results with Peter Scheifele, an acoustician at the University of Cincinnati. With the opportunity to practice using the hydrophones they built to capture sounds at Mystic Aquarium, an otherwise auditory experience became visual for them circumventing their own varying degrees of hearing loss and/or deafness.

The students benefited from higher-level science instruction, interaction with university professors and technicians, and connecting school with a scientific research environment. Through their conversations with the technicians students were introduced to possible job environments when they eventually explore post secondary education. The students worked hard to comprehend the level of information presented, but the ability to produce a usable piece of equipment aided their determination and persistence. They left the experience with a positive perception of themselves and good self-esteem.

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Students from American School for the Deaf test their hydrophones with Kevin Joy of NURTEC.

Students test their hydrophones with beluga whale sounds at Mystic Aquarium.

Ivar Babb is director of the Northeast Underwater Research Technology and Education Center (NURTEC) at UConn.

Mary LaPorta is a teacher at ASD.
The COSEE-TEK and LSAMP Partnership – Providing Ocean Science and Technology Opportunities for Underrepresented Students

by Ivar G. Babb and Diana Payne

OSTI’s goals were to provide students an orientation to ocean science and technology, expose them to ocean science and technology careers.

UConn Marine Sciences research specialist John Hamilton works with UConn students learning to strip and splice electrical wires. Photo credit: Ivar Babb

continued on next page
For the past three years the Center for Ocean Sciences Education Excellence – Technology and Engineering for Knowledge (COSEE-TEK) has collaborated with the Louis Stokes Alliance for Minority Participation (LSAMP) to provide innovative ocean science and technology experiences for underrepresented minority students, to help them succeed in Science, Technology, Engineering, and Mathematics (STEM) fields. (http://www.lsamp.uconn.edu/about.html). Based on assessment and feedback from participants, the collaboration has evolved over the three years,

In year one (2012) 11 undergraduate and two graduate students spent two days immersed in ocean science and technology at UConn’s Avery Point campus and Project Oceanology participating in the Ocean Science and Technology Institute (OSTI).

“OSTI’s goals were to provide students an orientation to ocean science and technology, expose them to ocean science and technology careers,” said Joy Erickson, UConn’s LSAMP Coordinator. “We also provided the opportunity to work as a team to build a hydrophone and conduct hands-on oceanographic sampling on board the Project Oceanology’s EnviroLab2 vessel.”

In the second year, a more facilitated inquiry approach was adopted and the program was renamed the Ocean Science and Technology Challenge (OSTC). OSTC began with a kickoff in January 2013 at the Northeast LSAMP Alliance Winter symposium on the UConn main campus in Storrs, Connecticut. Nine students from UConn and UMass-Amherst participated in a two-day field experience last April at the UConn Avery Point campus in Groton, Connecticut. In addition to exposing students to ocean science and technology careers, an added dimension of the OSTC was a focus on 21st century skills.

For the next four months the student teams from each school met periodically with their Tech Mentors either in person or via a virtual Webex teleconference system. Students were assigned team roles such as leader, budget, or reporter. They identified an autonomous sampler idea and the design process begun. Teams were given a $300 budget to work within for their sampler. The OSTC culminated with the two-day hands-on building and testing of their designs at UConn- Avery Point that included final design/building of the teams’ technologies, in-tank testing, orientation to ocean technologies including a remotely operated vehicle challenge. Finally, teams deployed their technologies for an overnight test of their devices to sample the ocean simultaneously.

The National Research Council (NRC) examined the nature of deeper learning to define the range of attributes comprising 21st century skills, describe how they relate to each other, summarize research demonstrating the importance of these skills to academic and workforce success and identify what works to build these skills (NRC, 2012). The report describes three “domains of competence” and identifies clusters of closely related competencies within each: 1) the cognitive domain (critical thinking, problem-solving, decision making, creativity), 2) intrapersonal domain (flexibility, initiative, self-direction, perseverance) and interpersonal domain (teamwork, communication, cooperation, leadership).

In the third year, the team realized the goal of having all five university partners in the LSAMP Northeast Alliance (Northeastern University, UConn, UMass, University of Rhode Island, and Worcester Polytechnic Institution) participate in the OSTC. The 2014 OSTC program improvements included an earlier start in the fall. The program included an overview and orientation to the OSTC concept and a presentation of the theme for 2014, “Autonomous Samplers.”

The LSAMP OSTC actively involved students from all five of the academic institutions comprising the LSAMP Northeast Alliance, making this one of the first times that all members of the Alliance collaborated on a joint project. The OSTC involved 25 undergraduate students from the five universities participating in the project. The open-ended nature of a guided technology challenge provided an effective venue for undergraduate students to work in teams to develop 21st Skills. The five participating schools each came up with a technology they wanted to develop and worked closely with a COSEE-TEK technical advisor to take their idea from concept to reality. The students learned simple hands on tasks such as splicing wires as well as broader skills such as how to communicate and work effectively in a team setting.

As a national network the LSAMP provides a ready-made network to engage underrepresented undergraduate students in ocean science and technology and the COSEE-TEK team looks forward to continuing the OSTC in the coming year.
What are “Underrepresented Students” in the sciences?

This is a broad term referring to groups historically less engaged in science, technology, engineering and math. It can include racial and ethnic minorities, females, and/or those with disabilities.

Resources for further reading:
COSEE-TEK: http://www.cosee.net/
Louis Stokes Alliance for Minority Participation (LSAMP): http://lsamp.uconn.edu/

A trio of students from UMass Dartmouth work together on a computer coding project. Photo credit: Ivar Babb

Ivar Babb is director of the Northeast Underwater Research and Technology Education Center at UConn. Diana Payne is the education coordinator for Connecticut Sea Grant.
Coach Lorrie Martin looked on as her team celebrated their first Quahog Bowl championship. A bit surprised and somewhat in awe of the accomplishment, she sat with the team mascots (a collection of stuffed animals representing the nickname Cephalopods) as other coaches offered heartfelt congratulations. Coach Martin and the Cephalopods from Regional District #13 serving rural, inland Durham and Middlefield Connecticut, were headed to Seattle, Washington and the National Ocean Sciences Bowl finals competition.

The Quahog Bowl is an annual event coordinated by Connecticut Sea Grant and Project Oceanology. It is the Connecticut-Rhode Island regional bowl of the National Ocean Sciences Bowl (NOSB), a nationally recognized and highly acclaimed high school academic competition that provides a forum for talented students to test their knowledge of the marine sciences including biology, chemistry, physics, and geology. The NOSB was created in 1998 in honor of the International Year of the Ocean and since its inception, the competition has grown to include 25 regional competitions with 300 schools and over 2,000 students participating annually. The NOSB mission is to enrich science teaching and learning across the United States through a high-profile national competition that increases high school students’ knowledge of the oceans and enhances public understanding and stewardship of the oceans.

A national competition with a lot of local flair, the Quahog Bowl takes place each February on the UConn-Avery Point campus. A typical competition involves 16 teams from Connecticut and Rhode Island, each with five high school student members and a teacher from the school serving as the coach. Each team competes in a series of round robin matches on the morning of the competition and then goes into an elimination round in the afternoon. Each match requires team members to answer individually and also to work as a team to develop answers to the challenging ocean-based questions. Points accrue throughout the match, ending with a winning team who earns the right to move onto the next match. At the end of the day, one team is declared the winner and spends the next couple of months preparing for the National competition later in the spring.

All of the teams, however, have spent months studying and practicing, sharing in the camaraderie of building a team and absorbing tremendous volumes of information about the world’s oceans. They all come to the competition ready to challenge themselves and other teams. Their coaches are able to motivate and encourage them while providing perspective so that they have a great time, win or lose. The dedication of the coaches to the process of preparing their teams for the event is commendable.

Upon graduation, many team members have gone on to study at local universities, including UConn. Our dedicated volunteers hail from all over southern New England and include graduate students and faculty from local colleges and universities. Many of our volunteers are past participants of the Quahog Bowl (or a bowl from another part of the country) who want to give back by contributing their time.

As regional coordinators, we aim to host an exciting and organized competition while providing a genuine community atmosphere and experience for our teams, coaches, volunteers and family and friends in the audience. The event depends on sponsorship from local and distant venues, including the Consortium for Ocean Leadership (host of NOSB), our host institutions and many others such as Mystic Aquarium, Mystic Seaport, Dominion and Rhode Island Sea Grant.

The Quahog Bowl Competition Day is open to the public, so if you want to see some amazing students take up the challenge of this rigorous competition, come and join in the fun!

Coginchaug students Abby Eilser, Deanna Puchalski, Ryan Gossart and Tyler Bjarnason (left to right) at the Quahog Bowl. Team Member Amelia Bianchi not shown.
Dave Bednarz, 
Ledyard High School 
2012 Quahog Bowl champions

As a coach for a team that has won the Quahog Bowl, I see this competition as an incredible opportunity for students to compete academically at a regional and perhaps national level. The amount of dedication that I see in my students is inspiring.

The Quahog Bowl not only inspires high academic achievement in my Ledyard High School students, but helps them to develop great interpersonal relationship skills as they mesh as an effective team and meet other students with backgrounds that may be very different from theirs.

The camaraderie within and between teams in the Quahog Bowl has made it an environment where Ledyard High School students have learned to be gracious winners and losers. This is an invaluable lesson for real life.

Lorrie Martin, 
Coginchaug Regional High School 
2014 Quahog Bowl champions

I had a young man on my team who in school, operated with special needs for years. He has a love for the ocean, and he somehow gravitated to our Ocean Bowl team. Though not always equipped with the higher level science courses that often accompany NOSB success stories, he was an avid “ocean fact collector” with a mind like “flypaper.” A reader of historic ocean literature with a passion for PBS and NOVA videos, he would just “mop up” the odd ball questions in a way that would leave my jaw dropped….HOW ON EARTH DID YOU KNOW THAT?? Somehow he was a cog in our very special Coginchaug Cephalopod “machine” that just unexpectedly rolled to First Place in the Connecticut/Rhode Island Regional Quahog Bowl and then on to 10th place at the National NOSB Competition in Seattle. To this day, this past NOSB Spring Adventure has not advanced past the DREAM stage in my mind – a euphoric experience that this team just left in the memory of this ole Ocean Bowl Coach of eight years.

But, the most amazing part of the whole tale was the sensitivity, cooperation and “can-do” attitude that every one of the NOSB coordinators, judges, competing teams and coaches displayed. All contributed to the success story throughout this incredible experience.

I would be so remiss not to mention the incredible support and encouragement that our awesome NOSB regional coordinators, Diana Payne and Thaxter Tewksbury, provided to this “surprised” coach and her small town team after our regional win – a positive push that continued right through the three-day National Competition in Seattle. No problems were too insurmountable for Diana Payne equipped with her backpack full of team pins, energy, spirit and enthusiasm for her first-time little team from Connecticut.

Diana Payne is the education coordinator for Connecticut Sea Grant at UConn. Thaxter Tewksbury is director of Project Oceanology.