ITEST Learning Resource Center

NEWSLETTER

ISSUE 3, FALL 2006

This newsletter is accessible online at http://www2.edc.org/itestlrc/newsletter/issue3.htm.

In This Issue

Dear Reader:

ITEST (Information Technology Experiences for Students and Teachers) is providing educators and young people with special opportunities to deepen their understanding, skills, and knowledge related to various aspects of science, technology, engineering, and mathematics (STEM). ITEST experiences call on youth to use technology tools and systems, frequently in collaboration with scientists and engineers, to solve many of today's real-world challenges. This newsletter shares many examples of hands-on activities that promote inquiry and enrich learning, and illustrates strategies that engage learners while they develop STEM knowledge and skills. Our webcast series on information technology (IT)/STEM skills development serves as a foundation for examining the emerging concept of "technological thinking." Please visit our website for archives of these webcasts and a wealth of materials and information about the work of the ITEST projects.

Sincerely,
Joyce Malyn-Smith
Principal Investigator, ITEST LRC at EDC

ITEST LRC ■ 55 Chapel Street, Newton, MA 02458 ■ www.edc.org/itestlrc ■ itestinfo@edc.org

FEATURE STORY: HANDS-ON SCIENCE

Using Hands-on Activities to Spark Inquiry and Investigation: Compelling Examples from the ITEST Program

In a small Boston lab, a group of middle school students are working gingerly to extract essence from an orange, using a "green chemistry" process that employs dry ice rather than harsh chemicals. They work carefully because the test tube can explode from the pressure.

On the other side of the country, out at sea off the California coast, 15 teenagers embark on a bioacoustic recording expedition to capture dolphin sonar. Traveling aboard a 70-foot research vessel, they use digital recording equipment to track the acoustic behavior of a pod of more than 500 dolphins.

These are just two examples of the remarkable work of youth and educators engaged in ITEST summer programs.

Marrying Hands-on Learning and Inquiry to Boost Interest in STEM

ITEST projects are supported by the **National Science Foundation** with the promise that they will offer participating students and teachers hands-on, technology-rich learning experiences—chemistry experiments, archaeological digs, computer modeling, video production, DNA analysis—and that these hands-on activities will be pursued in the context of scientific inquiry and investigation.

Youth study the acoustic behavior of whales and dolphins with the SeaTech project

Learner-driven inquiry, where teachers and students define and explore their own questions, is a hallmark of the ITEST experience, and an essential element in kindling excitement about STEM careers. Technology-rich, hands-on activities that are collaborative in nature underpin robust inquiry-based learning experiences.

A recent *Boston Globe* editorial[1] put it this way:

> "The relentless drumbeat is true: America needs more science, technology, math, and engineering majors who will go on to careers that help keep the country competitive. It's a lesson that's so heavily flogged, one imagines dreary education camps where children memorize the periodic table of elements. A better message: Children should fall in love with microscopes, experiments, and unanswered questions. And while love can't be forced, more sparks might fly if more boys and girls were to meet more science projects."

ITEST projects like **Technology at the Crossroads, Urban Ecology, Robotics** (all Boston, Mass.), and **SeaTech** (Dana Point, Calif.) are the matchmakers in this scenario, introducing young people to science projects and technology tools not through lecture or demonstration, but through hands-on experience. Working directly with the materials and tools of inquiry has been shown to yield better outcomes; students retain far more information about what they've learned as opposed to traditional pedagogical approaches. This summer, ITEST LRC staff had the opportunity to sample these hands-on activities during site visits, both locally (Greater Boston) as well as farther afield.

Indepth Oceanographic Research with SeaTech

Keeping pace with a pod of 500-plus dolphins, the *R/V Sea Explorer* ferries several teens and their oceanographer guides off Southern California's Dana Point. Today they are learning how to effectively use digital recording equipment and special software to study dolphin behavior. "We get to experience it," reflects one of the youth participants on this trip, when asked about the learning program. "We get to do stuff—we don't just listen and talk all the time, like we usually do in regular school." A peer agrees: "They make it exciting for us."

On a day when the sunshine glinted off the sea and the dolphins' backs, ITEST LRC staff had the chance to join young people on this expedition and to document the hands-on learning taking place (see video online at www2.edc.org/itestlrc/newsletter/media/SeaTech4Web.mov). The Ocean Institute, in partnership with Scripps Institution of Oceanography, Capistrano Valley Boys & Girls Clubs, and the Institute of Electrical and Electronics Engineers, created this program, called **SeaTech: Underserved Teens Hooked on Ocean Technology!** This ITEST project provides 120 female and minority middle and high school students with IT-intensive oceanographic research experiences. SeaTech content focuses on understanding the acoustic behaviors of whales and dolphins, specifically, sound production, noise impacts, and the acoustic population census in California, the Bering Sea, and the Southern Ocean.

As with all ITEST projects, a key element is fieldwork—the opportunity to do authentic research with scientists. One summer program participant observed: "I've been through a lot of learning [programs] . . . like science camps. But this is different because this is more hands-on, working with real researchers and scientists, going out there gathering the data, and doing analysis and documentation."

Many of the young people commented on the interactive nature of this program, and how it is powerful to work directly with professionals in the field. One student noted, "I've come to appreciate so much more what these scientists are doing; it links together all the stuff we've been doing with the data research . . . how they collected the data."

> ***"When you're learning in the classroom, you just look at facts and information," one youth participant with the SeaTech project explained. "You don't really fully understand this is actually happening in the real world, and that you can go and experience it for yourself."***

SeaTech partners with staff from the local Boys & Girls Club, who recruit and supervise youth in this fieldwork at sea and at "home base." Their program illustrates the value and complexities of innovative models where youth and adults function as equals and part-

ners, learning and working together. Sharing in real-time research and practicing hands-on science collaboratively with scientists and technology professionals engages young learners in authentic STEM work. Further, these programs help us recognize the potential of today's youth—as tomorrow's scientists—to make significant contributions to the field.

The **project's principal investigator, Harry Helling**, reflected on the challenges faced by programs that seek to engage teens:

> "When you start adding on the connections between informal science centers and their resources and the research institutions who have the frontiers of science in front of them . . . you can begin immersing kids in these frontiers. We happen to do that with whales and dolphins, so, yes, it's very exciting—but we think it would work in any part of the world, in any collaboration, so long as you're bringing kids in an intelligent way to that frontier and involving them in that excitement of science."

Eco-Science in the City with Urban Ecology

Using high-quality microphones and recording equipment, a group of teachers and students record city noise and birds' songs around Boston. Next, they learn to view and analyze the frequency rate, pitch, and individual bird's voiceprint on a spectrogram with the help of sound wave analysis software called Raven LITE, which was donated by the Cornell Lab of Ornithology. At the beginning of the summer workshop, participants were trained on this software—a new tool to be deployed in a broader inquiry and investigation. What they learn from the software analysis compels them to ask research questions about the relationship between the volume of birds' communication calls and city noise decibels, for example:

- At what frequencies do the birds in my study site sing?
- Are the frequencies of the birds high enough to overcome the background noise?
- How does the background urban noise impact bird song?

Because they themselves did the research and analyzed the bird calls, these students and teachers are all the more driven to define and explore the unanswered questions revealed by their fieldwork.

> ***"Our projects engage students in inquiry-based learning through the collection, analysis, and interpretation of data with the goal of social environmental action," explains Dr. Michael Barnett, PI of Urban Ecology. "At the heart of how we interpret inquiry is the asking of questions. The goal is not to ask just any questions, of course, but ones that students honestly care about."***

This intensive experience in hands-on learning was facilitated by the **Boston College Urban Ecology and Information Technology Project**. Through this project, 100 middle and high school teachers and up to 400 students are developing, evaluating, and disseminating IT materials for integration into field-based urban ecology modules.

The participants' work in the summer program culminated with final presentations where they focused on research questions related to urban tree study or urban bird bioacoustics. As student teams presented their research questions, the spirit of scientific inquiry was evident.

Teams discussed their work process, the data they gathered, their findings, and their recommendations. The students demonstrated knowledge of complex software programs that they used to complete analysis on bird calls and tree placement.

They used PowerPoint to present their information, and fielded questions from fellow students, teachers, and project staff. And when they didn't know the answer to a question, they said so—a response that project staff praised.

"It's important for scientists to admit when they don't know the answer," said **Dr. Michael Barnett, the project's principal investigator**, "because when there's something that you don't understand, that is when exciting science can happen."

The teachers asked thoughtful guiding questions about what part of the work each student enjoyed most (i.e., fieldwork, analysis, teamwork, preparing the presentation, presenting, etc.) and reminded them that scientists do all of these things. The youth reflected on their favorite parts of the experience, which ranged from building skills with technology to learning about birds and trees to meeting new people and making new friends. One student remarked, "I had no idea how important trees were until this experience!"

> ***"It's the hands-on portion that has been the most valuable to me, taking on the role of a student being able to touch and feel and play," reflected Diane Johnson, a teacher participating in the Robotics project, based at Northeastern University. "I'm going to be thinking more from an inquiry-based focus than doing the work for the students. For example, in the case of labwork, we give them formatted labs where so much has been set up, pre-diagnosed for the students. Instead, let* them *write the labs; let* them *create the project. 'What do you want to build?' instead of 'We're going to build . . . '"***

This kind of revelation, this affinity and capacity for using technological tools in pursuit of a question, forms the basis of the ITEST model for learning. Using hands-on activities to spark inquiry honors and cultivates young people's natural curiosity, and promotes the STEM fields as a place to find their calling.

ITEST Experiences and New Patterns of Thinking and Learning

One of the model practices that has coalesced through the ITEST Program is connecting and leveraging the promising practices in STEM learning found in both formal and informal learning environments. Marshalling hands-on activities to promote inquiry engages learners and is a fundamental example of how informal learning strategies can enrich and advance classroom teaching. Given the focus on standards that characterizes formal learning environments and the hands-on, inquiry-based activities that are the hallmark of the informal science world, students make the connections as they move from one environment to the other—scaffolding their own learning and developing their own intellectual, life, and career interests.

Both formal and informal ITEST environments provide the context for us to observe students and raise questions about emerging patterns of "technological thinking." As part of its role in serving the ITEST community, the LRC at EDC is working to understand this new concept of "technological thinking" and to map its evolution. In our events and publications, we will pursue this, our own inquiry, into what's at stake when young people in IT and STEM learning programs, rather than being told "We're going to build X," are instead asked, "What do you want to build today?"

[1] Elmo's off-screen world. (August 25, 2006). *The Boston Globe*. Retrieved September 9, 2006, from www.boston.com/news/globe/editorial_opinion/editorials/articles/2006/08/25/elmos_off_screen_world

Project Examples

Additional project examples of hands-on science and scientific inquiry are available on the LRC website, including:

- Environmental Research with Technology at the Crossroads
  www2.edc.org/itestlrc/newsletter/issue3_TechCrossroads.htm
- Building Machines with the Robotics Project
  www2.edc.org/itestlrc/newsletter/issue3_Robotics.htm
- Strategies for Inquiry-based Learning from Urban Ecology
  www2.edc.org/itestlrc/newsletter/issue3_UE.htm

Up Close with Teachers and Students of the DataTools Project

By Siobhan Bredin and Monica Biswas, ITEST LRC

In July 2006, we had the chance, along with other EDC colleagues, to visit the **DataTools (Tools for Data Analysis in the Middle School Classroom)** ITEST project sponsored by TERC in Cambridge, Mass. During the first week of the two-week summer program for this comprehensive project, middle school science, math, and technology teachers learned about Earth Science—resources and strategies for formulating questions, and gathering and analyzing data. Teachers worked in pairs to develop lessons that they "tested out" on the students that attended during the second week of the workshop.

During the school year, teachers will expand upon the work that they started in the summer session to create more in-depth units aligned with state standards in their schools across Massachusetts.

DataTools participants access the Massachusetts GIS website as part of their inquiry project

On the morning we visited, teachers led sessions with two groups of students (one group of 6th/7th graders, and one with 8th graders). The 6th/7th graders were introduced to Geographic Information Systems (GIS) data and the Arc/Voyager software. Their guiding questions, set out by the teachers, were "Where am I?" and "How did I get here?"

Then, using data from the Massachusetts GIS (mass.gov/mgis) website (already downloaded by the teachers onto all the computers), students learned how to read and view data with the software, how to change colors, how to label locations, how to find the towns they passed through to get to Cambridge, and so on. It was interesting to see that the teachers allowed some "play time" with the software before diving into "task-related" activities, letting kids change colors of the state, and the outlines.

The 8th graders used the "Duck Tours"—a land and water tour of Boston on amphibious vehicles, which is popular with locals and tourists—as the central theme of their activities, exploring the functionality of GIS, drawing the path of the duck tour between sites in Boston, producing site images, and measuring the distances, etc.

Tamara Ledley, principal investigator of the DataTools project, commented,

> "The teachers told us that the experience of teaching to students during the training was invaluable as an 'immediate application' of their knowledge and skills. Because they have now led activities with the support of their colleagues, they are more comfortable teaching these skills to their own classes. After this training, teachers will continue their involvement in the program through online discussions, teleconferences, and online workshops, and two one-day call-back meetings to debrief their experiences, and to share other digital library resources and GIS data. Teachers will have the option to choose from a range of follow-up activities, to accommodate those that have greater facility with the technology and to allow others who are having greater difficulty to come to the TERC office for extra guidance."

serc.carleton.edu/eet/msdatatools/index.html

From the CITERA Team~

Comprehensive Information Technology Education in Rural Appalachia (CITERA) emphasizes career and educational pathways to IT professions and provides IT skills and knowledge to North Central West Virginia educators and students in grades 7–9. During a two-week summer workshop, teachers learn about real-world IT projects and meet IT professionals. They also learn 3-D graphics programming and simulation and how to find existing 3-D graphic examples to enhance their curriculum. The teachers then build lessons and modules to pilot in a one-week student workshop. So far in the first two years, the CITERA-trained teachers have created 34 lessons (available through the CITERA website) in 16 mathematics, science, and technology topic areas.

The teacher participants of the CITERA project have played a great role in the dissemination of the project's outcomes. Along with CITERA team members, they have attended and presented their lessons at the West Virginia Council of Mathematics Teachers Conference, the West Virginia Science Teachers Conference, and the West Virginia Statewide Technology Conference. They have been able to show audiences of K–12 teachers, administrators, higher-ed faculty, and industry people how 3-D graphics can be used to excite students about mathematics and science and to interest them in IT careers. This year in the summer program teachers and students were challenged to build 3-D simulations of solar systems. Winners of this challenge will be posted on the CITERA website.

www.citerawv.us

From the Eagle Vision Team~

Employing Geographic Information Technologies in Indian Schools and Communities is a comprehensive project that trains high school math, science, social studies, and technology teachers within the Bureau of Indian Affairs (BIA)-funded school system to integrate Geographic Information Technologies (GIT) into their classrooms. Each summer teachers attend special two-week workshops, where they learn how to utilize GIT, such as global positioning systems and geographic information systems. Eagle Vision is coordinated by the Center for Educational Technology in Indian America, a nonprofit professional development center focused on assisting American Indian schools and educators with integrating technology into curricula. The center is located on the Pueblo of Laguna, New Mexico.

Students and teachers come to the summer program in New Mexico from BIA schools across the United States, so participating is a big commitment. When the summer program ends, teachers and students disperse to their local schools. Through our work on this project, we are realizing that we have an opportunity to study how teachers can implement GIT into education, and what supports are needed for them to succeed. The schools where the program has been most successful have support from the principal to offer dedicated classes. So far, two schools have fully implemented the research projects with students during the school year. We hope to increase that number in the coming school year.

www.ldoe.org/eaglevision

From the SoBRO TEC Team~

SoBRO TEC's focus is to help participants develop technological fluidity, providing them with an IT foundation on which to build their academic and future careers. The goal of the program is to broaden students' entry points into IT-related fields.

SoBRO TEC students work collaboratively on their projects

The program, held at **SoBRO (South Bronx Overall Economic Development Corporation)**, makes use of

the surrounding urban environment to enable participants to understand tech-driven information and communication systems. Mentors from Vision Education & Media teach the classes with the help of interns from Columbia University's Fu School of Engineering.

After completing their first year, SoBRO TEC students spent the next semester designing and modeling solutions to New York City's public transportation system using robotics. One group of students built an accessible door that allows subway riders with disabilities to more easily enter the subway platform. In the second semester, students took pictures of their neighborhoods and built websites inviting people to visit. Over the summer, students had the opportunity to experience the work environment by interning at various multimedia organizations around New York City. Some of the organizations were so impressed that they asked the students to continue to intern.

Students who have taken one or more semesters of this program have an increased awareness of how technology around them is created. They are critically looking at applications around them and breaking down the components to analyze how products are developed.

www.vemny.org/sobrotec

EVENTS & PUBLICATIONS

Welcome, ITEST Cohort 4 projects!

Information on new projects is available at the ITEST LRC website.

Save the date: ITEST 4th Annual Summit, February 6-8, 2007, Arlington, Virginia

Look for more information about the public symposium in the coming months, and see our previous newsletter for a recap of last year's event.
www2.edc.org/itestlrc/Materials/ITESTNewsletterVol2.pdf

Visit the newly designed ITEST LRC website and come back often for updates!

The LRC team is pleased to re-launch our website with new features such as a greatly expanded resource library and enhanced accessibility.
www.edc.org/itestlrc

Recent Events and Publications

Infusing IT/STEM Skill Standards in Informal ITEST Learning [Webcast, October 2006]

Three ITEST projects share model practices for integrating IT/STEM skill standards into dynamic youth programs, and reveal how ITEST experiences support advanced IT skills and knowledge beyond the standards.
www2.edc.org/itestlrc/webcastITskills1_Oct5.htm

Leveraging Informal Learning Strategies to Engage Students in STEM Classes [Webcast, October 2006]

ITEST projects that run teacher training programs share model practices for fostering student engagement in the STEM classroom.
www2.edc.org/itestlrc/webcast/ITskills2_Oct24.asp

Conference Presentation: Board on Science Education—Learning Science in Informal Environments

National Research Council, The National Academies, September 19–20, 2006
"How Can Program Evaluation Contribute to Understanding How Diverse Learners Benefit from Informal Science Learning?"
Presenter: Leslie Goodyear, LRC

For more information about publications and events, visit the ITEST LRC Events & Conferences page.
www2.edc.org/itestlrc/ITEST/events

Webcasts on Key Topics in Informal Science

Two topical webcasts, "Exploring the Impact: Informal Science Experiences for Girls" and "Successful After-School Science Partnerships," are available for viewing at the Academy for Educational Development's Science, Gender, and Afterschool Community of Practice website. The latter event was co-sponsored by the National Girls Collaborative Project and funded by the National Science Foundation. **Karen Peterson, of the Puget Sound Center for Teaching, Learning and Technology** and **PI of a new ITEST project**, presented.
www.afterschool.org/webcasts.cfm

Studying the Impact of Inquiry Science

"What is the impact of inquiry science instruction on student outcomes compared with the impact of other instructional strategies and approaches?" The Center for Science Education (CSE) at Education Development Center, Inc. (EDC), was funded by the National Science Foundation to synthesize the relevant research and address this question. An overview of this study, "Understanding 'Inquiry Science,'" was published in EDC's *Mosaic* this summer.
main.edc.org/Mosaic/Mosaic12/inquiry.asp
Detailed information about the study, including technical reports, is available at the CSE website.
cse.edc.org/products/inquirysynth

Tips on Asking Good Questions and Facilitating Inquiry-based Learning

The YouthLearn Initiative at EDC offers this resource covering the key principles and benefits of inquiry-based learning. Recommended techniques and in-depth information about the art of asking good questions are also featured, along with other materials that support inquiry- and project-based learning.
www.youthlearn.org/learning/approach/inquiry.asp

Children's Literature with a "Science Sensibility"

Fostering a love of science and inquiry starts early, in the best of all possible worlds. In light of this, we offer a booklist assembled by science bloggers. Some of these stories and volumes are for the youngest among your participants, and many are for pre-K, but this list includes a rich variety of works for display on your bookshelf.
www.scienceblogs.com/worldsfair/2006/07/childrens_book_roundup.php

For additional resources on innovative uses of technology for learning, STEM/IT content and standards, sustainability, etc., see the ITEST LRC Resource Library.
itestlrc.edc.org/SPT--Home.php

About ITEST

The Information Technology Experiences for Students and Teachers (ITEST) program was established by the National Science Foundation in direct response to the concern about shortages of information technology workers in the United States. The ITEST program funds projects that provide opportunities for both school-age children and teachers to build the skills and knowledge needed to advance their study and to enable them to function and contribute in a technologically rich society. The ITEST National Learning Resource Center at EDC supports, synthesizes, and disseminates the program's learnings to a wide audience.
www.edc.org/itestlrc

© 2006 ITEST Learning Resource Center at EDC
This newsletter is published by the ITEST Learning Resource Center, a project at Education Development Center, Inc., under contract #0323098 from the National Science Foundation. Opinions expressed herein do not necessarily reflect the position of the National Science Foundation, and no official endorsement should be inferred. Upon request, this publication is available in alternate formats to provide access to people with disabilities; please contact itestinfo@edc.org.