

Ecology in Action:



*Biodiversity
Field Studies*

The Paul F-Brandwein
Summer Leadership Institute

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The Paul F-Brandwein
Summer Leadership Institute

July 28 - August 6, 2000



Kathleen A. Rapp

The Paul F-Brandwein Institute
Unionville, New York

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Designed by Thomas Thornton

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A Paul F-Brandwein Institute Vision of Effective Professional Development

The Brandwein Institute (BI) supports teachers who use the environment as a context for instruction and learning through exemplary education programs at the Brandwein Summer Leadership Institutes (BSLI). BI is building a presence for environmental science education by increasing knowledge and stewardship of cultural and natural resources in national parks, conservancies, and land held in trust. Since the teacher is the key to student success, enhancing teachers' knowledge of the environment is an important way to help improve student performance. Paul F-Brandwein, a founder of the Pocono Environmental Education Center (PEEC), noted that teachers, like students, best learn science by doing science, by investigating for themselves and building on their own understanding. This philosophy was the keystone for the first Toyota USA Foundation-sponsored Brandwein Summer Leadership Institute that was convened at PEEC in July 2000 for 20 outstanding science teachers.

Attributes of effective methods to engage students in environmental science are authentic science learning, cooperative learning, hands-on learning and inquiry-based learning. Authentic science learning involves students by engaging them in actual, ongoing science research currently being conducted. Cooperative learning involves students in group projects and learning activities, whereby they develop the skills necessary to improve the learning of one another. Hands-on learning engages students in learning through direct involvement and interaction with materials, rather than by rote memorization of facts. Students engaged in environmental science experience the process skills of observing, measuring, recording, classifying, interpreting data, inferring, predicting, investigating, and making models.

What is unique to the Brandwein Summer Leadership Institute experience is that the teacher-participants, in addition to experiencing the above process skills, discover the joy of analyzing what they are investigating. BI's inquiry-based approach to environmental learning engages teachers in the full processes of science. Teachers choose and conduct environmental research projects guided by a mentor and their own inquiry. This concept is reminiscent of a Phi Delta Kappan cartoon caption in which a student asks his teacher, "How can I

learn anything when you are the one who is asking all the questions?" At the Brandwein Summer Leadership Institute, teachers initiate research questions, collect data, interpret data, and present the results. The facilitators, through their instructional strategies, reflect science as it is practiced, a legacy of Dr. Paul F-Brandwein.

BI core beliefs regarding professional development embody the following concepts: the primary purpose of teaching is to facilitate learning; teachers possess specialized knowledge; and the practice of teaching is complex. Hence Brandwein workshops are structured so that inquiry-based learning lies at the heart of what teachers are provided.

Teachers possess a body of knowledge of content, the students they teach, the forms of instruction and assessment strategies used, and the global context in which they teach. Teachers attending summer leadership institutes expect to continue learning throughout their careers and improve their practice by choosing and attending appropriate professional development learning opportunities. Teaching is a complex practice that requires planning, acting, observing, assessing, and reflecting. It requires constant and consistent decision making. Teachers build on their own experience and expertise, and through the BSLI, have the opportunity to learn in part from the collective wisdom and experience of colleagues and others. BI affords teachers the opportunities for collegial reflection.

Beliefs about professional development have changed over the years. Today's approach embraces not only the teacher, but also the school and community to which the teacher belongs. Effective professional development efforts value teachers learning and sharing together. However, it takes commitment and involvement of school systems to promote continuous learning by providing teachers the time for in-depth field science investigations, collaborative work, and reflection. In short, the Brandwein Summer Leadership Institute enables teachers to use the environment to advance inquiry-based learning, conduct field investigations and problem solving activities, and apply new knowledge—an approach that fosters in-depth understanding.

Never doubt that a small group of thoughtful citizens can change the world. Indeed, it's the only thing that ever has.

– Margaret Mead

by John (Jack) Padalino

Mission Statement

Reflecting the wisdom of Paul F-Brandwein—author, teacher, scientist, publisher, conservationist, and humanitarian—the Paul F-Brandwein Institute educates people to recognize their responsibility for sustaining a

healthy and healing environment. BI programs help all learners develop an understanding of the symbiotic relationship between humans and the environment.

About the Paul F-Brandwein Institute

Established in 1996 as a collaboration between the Brandwein-Morholt Trust and the Pocono Environmental Education Center (PEEC), the Paul F-Brandwein Institute (BI) perpetuates the legacy of Paul F-Brandwein through environmental education. BI programs nurture the gifts and talents of all learners at all levels and foster skills, concepts, and values basic to environmental decision making within a global context. By bringing together students, educators, and scientists, education at the BI encourages an

“ecology of achievement,” allowing ideas to form and be tested through meaningful research and fieldwork. BI educational programs integrate the natural wealth of biodiversity at the Rutgers Creek Wildlife Conservancy (Greenville, New York) with scientific investigation, creative analysis, and state-of-the-art technological research tools. In this way, education and conservation of the environment become intertwined.



Paul F-Brandwein (1912-1994)

Scientist

Born in 1912, Paul F-Brandwein immigrated to the United States from Austria prior to WWII. Paul's interest in science began quite early, partially owing to the time he spent in hospitals with childhood arthritis. Though the condition cut short a career in piano, his love for the instrument remained strong throughout his life. PFB became an assistant at the Littnauer Pneumonia Research Laboratory in New York where he worked while completing his bachelor of science from New York University. This early start in original research had a great impact on the direction of his studies and philosophy on education. By 1940, upon completion of his masters and doctorate studies at NYU, PFB was secure in the belief that "the best way to encourage the young in science was to help them early to do original work."



Teacher

Paul's experience as an educator began at George Washington High School. He moved on, through the 1940s and into the mid 50s, to serve as a member and later as chair of the science department at Forest Hills High School. Here he piloted a program encouraging students to do original work in science. It has been suggested that more of Paul's students won the prestigious Westinghouse Science Talent Search than those of any other teacher.

Author

An accomplished author, PFB began publishing science textbooks in 1946,

revolutionizing the way science was taught throughout the country. Disappointed with lecture and textbook-based teaching, Paul developed classroom materials based on investigation, research, and analysis. His widely used grade-specific series, *Concepts in Science*,

pioneered the style of hands-on, investigative, science education that generations of students have come to experience as the norm. Even so, Paul remained aware of the limitations inherent in any textbook. To forward innovative education methods, he joined with scientists and educators on the Sputnik science project. Additionally he served on the Steering Committee of the Biological Sciences

Curriculum Study, as chair of its Gifted Student Committee, and as consultant to the Physical Science Study Committee. Through these committees, PFB strengthened the presence of programs designed to interest high school students in science through "originative" inquiry.

Humanitarian

Always concerned with and committed to a vision of equity in education, PFB strived to improve education for the students he believed to be most neglected: the disadvantaged and the gifted. He once said, "We do pretty well for the 80 percent of the students in the middle. But the 10 percent at the top and the bottom: we grind them under our feet!" Based in his belief of equal access to opportunity, he promoted self-selection by interested students—rather than assignment based on testing.

Philosopher

Lifelong research and experience with education led Paul to develop the concept of an “ecology of achievement” whereby “the school-community ecosystem acts in mutualism with cultural and university ecosystems.” With this analogy to the relationship of students, educators, scientists, and the community at large, PFB expressed the necessity for integrating education with life and community. Drawing a distinction between “schooling” and “education,” PFB emphasized the impact of the community on the school rather than vice versa. Refusing to allow schools to shoulder the blame for society’s ills, he saw the quality of schools as symptomatic of the state of the community. “Specific communities get the kind of schools their economic and social conditions permit; it is simplism itself to blame schools for the plight of the community or of society.”

Conservationist

In addition to his involvement with primary and secondary education in the United States, PFB participated in many roles with graduate

Evelyn Morholt (1914-1995)

Evelyn Morholt was a long-time friend of Paul and Mary Brandwein, and a former science teacher with PFB at Forest Hills High School. Over the course of her long career, Evelyn served as editor of The Teaching Scientist (Federation of Science Teachers, New York City), chair of a New York City high school science department, and acting examiner for the New York Board of Education. She wrote nine books, and the most recent (in 1986, with PFB), A Sourcebook for the Biological Sciences (3rd ed.), is still an important resource for science education.

Evelyn Morholt bequeathed her home to the Brandweins in 1994. Her house, which is close by the Brandwein residence, currently contains the BI offices and herbarium.

Pennsylvania. This position combined his interests in education and conservation. The Rutgers Creek Wildlife Conservancy, established by Paul and his wife Mary, has been administered by the Brandwein-Morholt Trust since Paul’s death in 1994. In affiliation with the Pocono Environmental Education Center, the conservancy serves as a site for educational programs and research. The Paul F-Brandwein Institute advances Paul’s intention for the land as a place of learning and discovery for students, teachers, scientists, and those interested in natural systems and the environment.

We cannot solve the problems that we have created with the same thinking that created them.

– Albert Einstein

The Brandwein Summer Leadership Institute Sites

The Rutgers Creek Wildlife Conservancy

Greenville, New York

The Paul F-Brandwein Institute is located on the 77-acre Rutgers Creek Wildlife Conservancy preserve, with its offices in the former residence of Evelyn Morholt. The Conservancy land was farmed until the 1960s, and is now wooded and houses diverse wildlife habitats. The land is traversed by stone walls marking the former fields, and is situated along Rutgers Creek. Active dairy farm residential development which is located in the near Greenville, New York and Pennsylvania used by students, teachers, scientists, and other life learners for environmental studies. Two houses sit on the property: the former residence of Evelyn Morholt and the Brandwein home, a farmhouse dating from the mid-1850s. In addition to the BI offices and herbarium, the Morholt residence will eventually house laboratory, exhibit, and classroom facilities.

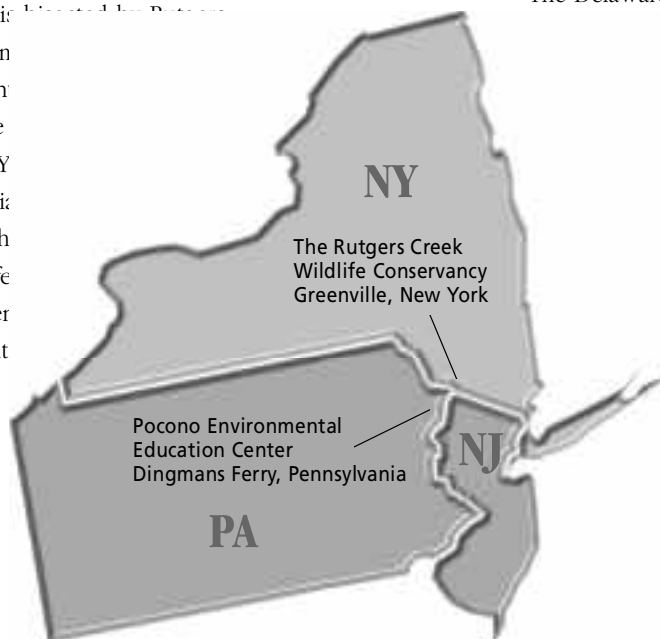
Pocono Environmental Education Center

Dingmans Ferry, Pennsylvania

The Pocono Environmental Education Center (PEEC) is the Western Hemisphere's largest residential environmental education center. PEEC annually serves more than 22,000 students, including children, families, teachers, scientists, and other lifelong learners. More than half a

million people have visited PEEC since it was established in 1972.

Its 38-acre campus sits on the escarpment of the Pocono plateau and within the 67,000-acre Delaware Water Gap National Recreation Area (a National Park). Surrounding parklands and Nature Conservancy lands offer visitors over a quarter million acres for study. PEEC, a nonprofit organization, works in partnership with the U.S. Park Service.



The Delaware Water Gap National Recreation Area is a rich source of natural, recreational, and educational opportunities for public enjoyment in a scenic region. Rich in resources, wildlife, and diverse forests, the area suggests a bright future for the region.

Approximately 40 miles of the exceptionally unpolluted Delaware River lie within the Park's boundaries. The area's geologic and natural features form scenic landscapes and typify landforms and biotic areas of the Appalachian Mountains. The park encompasses elevations from 500 to 1,500 feet, which contain diverse habitats for plants, invertebrates, amphibians, reptiles, birds, mammals, and fish. The park's mission is to provide outdoor recreation opportunities while conserving its natural, cultural and scenic resources by working cooperatively with surrounding communities and the public.

Summer Leadership Institute Overview

The Toyota USA Foundation, with the Paul F-Brandwein Institute, supports the Brandwein Summer Leadership Institute (BSLI) program, offering environmental fieldwork and workshop experiences to K-12 teachers nationwide. The goal of the BSLI is to develop a cadre of teacher/scientist mentors who, as lifelong learners, will share their expertise with teachers and students nationwide.

Each year, 20 teachers are selected from a pool of recognized outstanding science teachers.

A committee composed of

master teachers, field scientists, and members of the BI advisory board select the institute participants from the applications received. Various criteria are considered, including their experience implementing student fieldwork, their interest in environmental education and inquiry-based teaching, and their desire to share their knowledge and expertise with other teachers.

The 9-day BSLI concentrates training in four areas:

- Implementing long-term ecological research by students
- Using the latest technology and integrating it with field-based inquiry
- Exploring assessment strategies to measure field-based learning
- Learning to pursue further funding to sustain student research

The BSLI focuses on activities that provide teachers with science content knowledge and help them develop strategies for facilitating student/scientist interactions. A variety of

scientists, educators, and resource specialists participate in the BSLI. These individuals present sessions, facilitate ecological fieldwork and technology training, and serve as mentors to BSLI teachers in the field and after the summer institute. Teachers are afforded opportunities for informal sharing and collegial reflection during the BSLI. In addition, there is time to explore the

cultural and natural features of the area, including a day in New York City.

At the close of each summer's BSLI, participants are inducted as

Brandwein Fellows, a select group of scientists and educators recognized by the Paul F-Brandwein Institute. As Brandwein Fellows, they take on the task of sharing PFB's philosophy to educate and mentor others to recognize their responsibility for sustaining a healthy and healing environment.

To help them do this, BSLI participants each receive \$1,200 and are expected to provide at least three workshops to share what they learned at the BSLI. Additional funding is available over the next two years to continue and expand their outreach.

Brandwein fellows remain in contact throughout the year via an e-mail list service where they share resources, experiences, and ongoing projects. In the spring, the Brandwein Fellows convene at the NSTA National Convention to share their outreach experience and community-based projects. This luncheon meeting is held following the Brandwein Lecture, a featured event at the National Convention.



Brandwein Summer Leadership Institute 2000 Teacher Participants

The BSLI Focus

At the first Brandwein Symposium in 1997, a forum of scientists and master teachers discussed and determined priority needs for improved field-based science education. This symposium included several Toyota TAPESTRY awardees, and was the first meeting of Brandwein Fellows. The BSLI is designed to address needs identified by the Brandwein Fellows.

Implementing long-term ecological research

At the Rutgers Creek Wildlife Conservancy, BSLI teachers learn to conduct long-term ecological research techniques for use with students. The first BSLI (BSLI-2000) focused on terrestrial biodiversity studies using the Smithsonian Institution's Monitoring and Assessment of Biodiversity (SI/MAB) protocol for establishing and monitoring biodiversity plots. The SI/MAB protocol has been implemented by scientists and educators at 62 sites around the world.

In addition to terrestrial studies, BSLI teachers conduct aquatic studies in Rutgers Creek. Both low tech and high tech approaches to water quality data collection are used.

Integrating field-based inquiry with the latest technology

Teachers need access to and training in the latest technology used by scientists in order to share with students authentic science experiences. With this in mind, the BSLI is designed to provide ample opportunities for teachers to use technology and explore ways of integrating it successfully into student field studies. At the BSLI, teachers work with the latest software for analysis, mapping, displaying and communicating results.

Prior to the BSLI-2000, a web-based e-mail

list service for BSLI participants and resource people was set up. This forum enables teachers to share resources, files, and discussions. After the summer institute, teachers continue posting to the forum, sharing resources and developing new collaborative projects for sharing student-collected data over the Internet. This online list service is an easily-accessible means of continuing the collegial relationships formed among participants and resource people during the BSLI.

While in the field, BSLI teachers use hand-held Global Positioning System (GPS) units within their study quadrats, and transfer these data into a Global Information System (GIS) mapping program. In computer labs, teachers learn to merge field data with databases containing geological, soil, topographical, and other data to create rich "overlays" of their study sites.

Representatives from companies such as PASCO, Inc., demonstrate high tech water quality testing devices. Teachers use the equipment themselves, and then learn to graph and analyze the data.

Exploring alternative assessment strategies

Increased student test scores is only one measure of a program's success. It is more likely that quality environmental science education programs will be assessed, in part, by measuring increased understanding of environmental principles by the public. BSLI participants discuss and devise methods to measure the success of problem-based, environmental science field study. They create

The job of the citizen is to keep his mouth open.

– Gunther Gra



instruments to measure field-based learning and evaluate alternative assessments and performance-based examinations. Participants find ways to measure not only what students have learned, but also whether their learning has had an impact on them, on their society, and/or on the environment. Teachers and scientist review different models and metrics to enable them to demonstrate effectively the success of the inquiry approach to field investigations.

Exploring funding resources

Sustainability is a key point for teachers attempting to implement long-term ecological field studies. Many teachers do not know where to begin when it comes to locating funding sources and writing grant proposals. The BSLI includes sessions to help teachers in this area. The sessions provide grant-writing tips and resources, and advice and perspectives from successful grant writers and grant readers. BSLI participants test their own grant-writing skills by preparing a proposal for use of their \$1,200 Brandwein outreach grant.

The BSLI Impact

There is a reluctance to teach environmental education in a great many school districts today. The leading reason for this resistance is the lack of teachers prepared to teach scientific principles in the context of the environment.¹ The BSLI addresses this need by building a cadre of science teacher leaders who are trained in environmental field techniques and who then mentor numerous teachers and students throughout the country. This group will grow to include 60 BSLI-trained teachers during the three-year period of Toyota funding.

Paul F-Brandwein said that mentoring was a key ingredient in successful science education. Scientists, educators, and resource specialists participate in the BSLI, presenting sessions,

facilitating ecological fieldwork and technology training, and serving as mentors to BSLI teachers in the field and after the summer institute.

Teachers take their BSLI training back to their schools, where they mentor students and other teachers in ecological field studies. In addition, teachers are encouraged to contact resources in their community, and bring in scientists and others who can mentor students.

To maximize the BSLI's impact, participants are selected from a pool of recognized outstanding science teachers including Presidential Awardees in Science Teaching, GTE GIFT Awardees, and Toyota TAPESTRY awardees. By drawing from this group, the BSLI includes many teachers who have already demonstrated excellence and leadership in their profession. In addition, BSLI participants have done extensive student field studies, have demonstrated an interest in the environment and eagerness to share their knowledge with colleagues.

BSLI participants agree to do a minimum of 3 workshops to share the fieldwork protocols and help other teachers implement similar projects. Each Brandwein fellow is expected to reach a minimum of 90 additional teachers through post-BSLI training sessions in the coming year. Venues for these outreach activities include presentations at national and regional NSTA conventions, state and local teachers meetings, and school and district inservice days.

Over the course of Toyota funding, the BSLI will provide training, resources, and mentoring for environmental fieldwork to an estimated 7,500 teachers nationwide.

¹ *Teaming with Life: Investing in Science to Understand and Use America's Living Capital. President's Committee of Advisers on Science and Technology. OSTP. March 1998.*

The Brandwein Summer Leadership Institute

July 28 - August 6, 2000

The Online Discussion Forum

The inaugural Brandwein Summer Leadership Institute (BSLI) was held July 28 through August 6, 2000. However, the participants, facilitators, and Brandwein Institute (BI) staff began communicating regularly several months prior to the Institute via an e-mail list service.

The forum was set up on eGroups (<http://www.egroups.com>) in late May 2000, and enabled teachers to share information about themselves, their locations, and their interests prior to actually meeting. Said Allen Bone, a BSLI participant, "It is almost like we are going to know everyone before we get together, but maybe that was the original intention!"

BI staff used the e-mail forum for general communications, informing teachers about what to bring to the BSLI, where to meet at the airport, and other logistical details.

In addition, the eGroups list service enabled the BI staff and facilitators to assess teacher needs and experience in areas such as technology use and grant writing. Teachers shared their experience with CBLs, various probeware, and kits for water quality studies, and voiced where they wanted more training. They also discussed their familiarity with grant writing, which helped facilitators tailor the grant-writing sessions to teacher interests.

Via this list service, BSLI fieldwork facilitator Dan Bisaccio introduced himself to the teachers, explained his background in student biodiversity

studies, and briefly described the terrestrial studies that he planned for the teachers at Rutgers Creek.

BI Assistant Director Dan Foord posted links to various readings to spur discussion prior to the BSLI. Teachers discussed changing perspectives on conservation and the environment after reading a 19th century examination of a New York county. Teachers also read and discussed online documents

describing National Park Service and U.S. Geological Survey ecological studies in the Delaware Water Gap National Recreation Area (DWGNRA) in preparation for their visit to the area.



The BSLI-2000

Friday, July 28, 2000

Several BSLI teachers arrived early and spent Friday exploring the grounds around PEEC, hiking a variety of trails, experiencing oak-hickory forests, pine plantations, and

hemlock groves, as well as viewing scenic vistas and tumbling waterfalls.

Some early arrivers were treated to a private tour of Grey Towers, the Pinchot family mansion and National Historic Landmark, located near Milford, Pennsylvania, just up the road from PEEC. Aside from enjoying the beauty of the chateau-like mansion, teachers learned about the work and legacy of the Pinchot family, including James Pinchot, who endowed the Yale School of Forestry, and Gifford Pinchot, an early conservationist, friend of Theodore Roosevelt, and first Chief Forester for the U.S. Forest Service.

BSLI participant arrivals were staggered throughout the day and into the evening on Friday. Teachers welcomed one another as vans arrived from the airport, and helped each other settle into the cabins at PEEC. BSLI participants put names with faces during informal socializing on the cabin porches.

Upon their arrival, teachers received a Brandwein Institute tote bag containing a number of items. Teachers were given a copy of "Into the Field," a book about field journaling, along with a sketch diary for journaling. The reference texts "Terrestrial Ecoregions of North America" and "Aquatic Ecoregions of North America," were provided. In addition, teachers received a LaMotte Low Cost Green water quality monitoring kit, and a PEEC water bottle.

Friday evening, the BSLI group convened at PEEC's main building for a welcoming reception. There, the BSLI teachers mixed with the multigenerational (grandparent/grandchild) Elderhostel group also at PEEC for the week. Both groups were welcomed by Jack Padalino, president of PEEC. Afterward, Pat Lynch from the National Park Service welcomed everyone to the DWGNRA, and spoke about the importance of the park and conservation in the area. Pat quoted a statistic that shocked many of the BSLI teachers: 60 million people currently live within a six-hour drive of the park, and by 2020, that number is expected to double. Preserving park woodlands and recreation areas for this growing population is a priority and continuing challenge for the NPS.

Following the reception, everyone enjoyed the outdoor barbecue catered by the PEEC dining hall. After dinner, a small group of teachers hiked to the ponds on PEEC grounds to

look for bats and listen to frogs on the beautiful late summer evening.

Saturday, July 29, 2000

A group of about 10 BSLI teachers awoke early to join PEEC naturalist Wendy Potter for an early morning bird walk on woodland trails. The group heard and saw ovenbirds, pine warblers, eastern phoebes and blue jays—a treat, especially for the Westerners in the group.



After breakfast, the BSLI program began with an introductory session by Dan Bisaccio. Dan talked about his Toyota TAPESTRY-funded HabitatNet project, designed for students to collect data, conduct research, and have an impact on an important global issue: biological diversity. Dan explained how the TAPESTRY grant led to many opportunities and ultimately changed his teaching. Based on his reputation for student field studies, the Smithsonian Institution contacted him to use their SI/MAB (Smithsonian Institution's Monitoring and Assessment of Biodiversity) protocol for biodiversity field studies. Dan explained that the SI/MAB protocol would be the basis for the terrestrial fieldwork they would do over the next few days at Rutgers Creek.

After Dan's session, each BSLI participant described their personal work with student field studies, often using PowerPoint presentations and slides. A few used posters, which were displayed in the PEEC classroom for viewing by all.

Lunch at the PEEC dining hall provided an opportunity for teachers to digest the information they were learning about each other. Many noted how invigorating it is to hear what other teachers do.

After lunch, teachers viewed a brief video about Paul F-Brandwein and the Brandwein Institute, which provided some background on



BI President, Jack Padalino welcomes BSLI 2000 Participants

In any moment of decision the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing you can do is nothing.

- Theodore Roosevelt

the Rutgers Creek land. The video explained Paul and his wife Mary's vision for the Rutgers Creek Wildlife Conservancy, which was verbalized in a trust and assures that the land be available for the perpetual benefit of the general populace.

Teacher presentations finished up in the early afternoon, and everyone took a brief break before traveling in vans for a field trip to



Teachers sort and classify benthic macroinvertebrates

Raymondskill Falls, reportedly the highest falls in Pennsylvania. After hiking back from Raymondskill Falls, a brief drive brought the group to Silver Thread Falls and the scenic Dingman's Falls. Teachers enjoyed the beauty of the waterfalls, and observed with interest the nearby rocks, lichens, mosses, and flowering plants, including native rhododendron.

Saturday evening, the BSLI group crossed the Delaware River at Dingmans Ferry, and enjoyed a lovely dinner at the Walpack Inn, in Walpack Center, New Jersey. The dining room features a wall-sized picture window with a view of the rolling countryside and a herd of white tail deer that approach within several yards of the restaurant to feed.

Sunday, July 30, 2000

After breakfast, the BSLI reconvened in the PEEC classroom for Marily DeWall's presentation, "Proposal Development and Grants for Teachers." Marily shared her experience writing grants and working with judging panels for the Toyota TAPESTRY program. She provided teachers with practical hints on how to get started, how to develop an idea into a project plan, how to identify potential funders, and to write a formal proposal. Marily suggested that

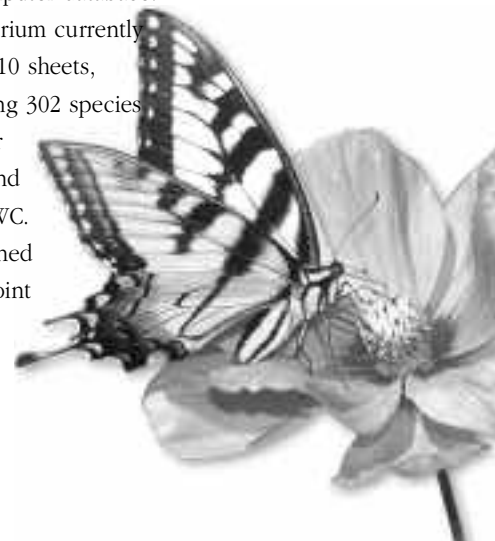
teachers need to market themselves effectively, explaining in detail how they are prepared to complete the proposed project and including relevant press clippings and resumes of project staff and resource people. She advised teachers to follow proposal guidelines explicitly, avoid jargon, highlight the uniqueness and creativity of their ideas, and limit themselves to realistic plans with a concrete end product. In addition, Marily provided handouts and a long list of Internet resources for teacher grants.

Jack Padalino and Steve Case contributed their viewpoints to the grant-writing session. Jack shared his experience as a Toyota TAPESTRY judge for the past 10 years. Steve Case provided insight as a National Science Foundation grant reviewer. He told teachers that he wants to see passion for a program in the grants he reads. He reiterated Marily's advice to avoid jargon, define terms, and he added that for NSF, collaborations and in-kind support are very important, since they are crucial to a project's sustainability.

After the grants session, the BSLI group gathered for a bus ride to the Rutgers Creek Wildlife Conservancy (RCWC) near Greenville, New York.

Once there, botanist Bill Olson explained his work developing the RCWC Herbarium. Bill described collecting and recording the locations of plants, and demonstrated the process for identifying, pressing, and mounting specimens for the Herbarium, and entering data about them into a computer database.

The Herbarium currently contains 810 sheets, representing 302 species of vascular plants found in the RCWC. Bill explained that the point of the Herbarium



collection is to record the plants that are in the RCWC now as a baseline, so that long-term changes can be studied. In the future, it will be possible to examine changes in species occurrence within the Conservancy, and look at how varying ecological conditions affect a species' growth and habit. Bill demonstrated how he uses the U.S. Geological Survey mapping software MapTech to record the location of each plant collected in the RCWC, and the North Carolina Botanical Garden's database of plant names and taxonomies to record the scientific name of each specimen.

The Herbarium session was followed by an outdoor luncheon hosted by Mary Brandwein in her beautiful garden. Mary was a very gracious hostess, welcoming the BSLI participants for a tour of her home and telling stories about many of her interesting collections. Mary provided copies of two books by Paul F-Brandwein, as gifts to the teachers. These were "The Gifted Student as Future Scientist" and "Gifted Young in Science-Potential Through Performance."

After lunch, the teachers received an introduction to journalizing in the field. An example was given of sketching a dragonfly, beginning very rough, and as the observer grows more skilled, progressing in stages to a very detailed drawing. After the introductory exercise, the teachers took their field notebooks and hiked to Rutgers Creek where they spent about an hour thinking about field journalizing and applying what they had read in "Into the Field." They used all their senses to experience their surroundings and recorded these observations in their journal. They were asked to select an organism and examine it in the field, writing in their journals about

what made that organism's habitat unique.

Teachers returned to PEEC for dinner, and then Jan Rethorst from the Pike County Raptor

Center presented an evening session about raptors. She brought several live birds, including various owls and a Bald Eagle, and spoke about bird rehabilitation and conservation issues.



BSLI Chairwoman, Mary Brandwein (left), Teachers debrief after a morning field session (above)



Monday, July 31, 2000

On Monday morning, Dan Bisaccio talked more about his experience with student fieldwork in tropical ecology, their use of the SI/MAB protocol and contribution to the Smithsonian's BioMon database. He explained how the BSLI teachers would use the SI/MAB protocol in the field and described the procedure for tagging and mapping trees within their 20 meter by 20 meter study quadrat. In the field, they would record the location and other information about each tree, and later transfer these data and map them using the Interactive Habitat program developed by Joe Russo. Dan explained that in the Mid-Atlantic region, they would typically find 30-40 trees per quadrat.

The BSLI teachers then bused to RCWC and hiked out to the woods. At the first of four pre-established study quadrats, everyone gathered as Dan helped the first group of teachers begin the process of mapping trees. Then, the teachers divided into groups, and hiked to the other study quadrats to begin recording data. Teachers used portable GPS units to locate trees within the quadrats, densitometers to measure canopy density, and a Wildlife Pro 35mm camera with motion detector to photograph passing wildlife each night (several portraits of white tail deer resulted).

The Terrestrial Studies

HabitatNet: A Global Biodiversity Project
Field Report #1: Rutgers Creek Nature
Conservancy, Greenville, New York USA –
September 2000
Submitted by: Dan Bisaccio, HabitatNet Project
Director

Abstract:

Twenty (20) outstanding educators from across the country were selected to participate in the first Paul F-Brandwein Summer Leadership Institute (BSLI) during late July/early August 2000. As part of the institute, the teachers were trained in the Smithsonian Institution's Monitoring and Assessment of Biodiversity (SI/MAB) protocols while conducting primary biological diversity research at the Rutgers Creek Nature Conservancy.

Four (4) SI/MAB quadrats were surveyed. Two quadrats were upland mixed deciduous forest habitats, while the other two were riparian habitats. An upland and riparian quadrat from each side of Rutgers Creek was surveyed. The intent was to establish a SI/MAB Biodiversity Plot, known as RC00 (Rutgers Creek, year 2000), as well as gain some insight about the plant communities found within the conservancy. Additionally, several target questions for further research were articulated. Those questions concern:

- a. biodiversity with regard to encroaching urban sprawl,
- b. biodiversity with regard to the introduction of exotic species,
- c. biodiversity with regard to natural disturbance, and
- d. biodiversity with regard to global climate change.

Discussion:

The focus of the biodiversity assessment for this first Brandwein Summer Leadership Institute (BSLI) was to begin a systematic analysis of the plant communities found within the Rutgers Creek

Conservancy while offering selected teachers the opportunity to learn established field research protocols. Several research questions were posed that comprised issues related to the integrity of biological diversity found within those plant communities over time. Those questions consisted of viewing long-term biodiversity measurements as they relate to: urbanization, introduction of exotic species, natural vs. anthropogenic disturbance, and global climate change.

Using the Smithsonian Institution's Monitoring and Assessment of Biodiversity (SI/MAB) protocols, four (4) initial quadrats were surveyed during this institute. During the weekend of 15 May 2000, David Foord and myself walked the Rutgers Creek Conservancy property and chose the sites based on differences in plant communities found within the higher terrain and lower riparian communities. A high terrain and riparian site were chosen on each side of Rutgers Creek. Each site,

measuring twenty (20) meters by twenty (20) meters was surveyed and marked. The site was named Rutgers Creek 2000 (RC00) using SI/MAB protocols for naming sites.

Subsequently, Joe Russo (ZedX, Inc.) was developing a web-based analysis program that would enable the teacher/researchers to input their plant community data into a database that would support on-going analysis and hypothesis-testing using an ortho-digital map of the field site.

The teacher/researchers were assigned quadrats and began the SI/MAB research during the week of 31 July–1 August 2000. Quadrat 1 (riparian) and Quadrat 29 (high terrain) are located on the north side of Rutgers Creek, while Quadrat 17 (riparian) and Quadrat 28 are located on the south side of Rutgers Creek. Facilitators and consultants rotated and worked with each quadrat team during the survey period.

Trees measuring a minimum of 10 cm. diameter at breast height (DBH), defined at 1.3 meters above ground, were surveyed. DBH, status,

continues



*BSLI Participant Anne Tweed measures
a tree's diameter*

*Those who
contemplate the
beauty of the earth
find resources of
strength that will
endure as long as
life lasts. There is
symbolic as well as
actual beauty in
the migration of
birds, the ebb and
flow of tides, the
folded bud ready
for spring.*

– Rachel Carson

The Terrestrial Studies (Continued)

and identification of the species were measured by quadrat teams and compiled. Overall DBH averages, tree species density, and tree species frequency were calculated for these four (4) quadrats. Tree acronyms were defined by using SI/MAB definition (the first 3 letters of the Genus followed by the first 3 letters of the species).

Overall, fifteen (15) tree species and a total of seventy-eight (78) individuals were identified in the four (4) quadrats.

Concluding Remarks:

Certainly, this report is just a beginning. Much more fieldwork needs to be done as well as the interpretation of the present and future data. Basic taxonomic work complemented with continuing investigations of species interactions (both short

and long-term) will allow us to more fully understand and appreciate the wisdom of Aldo Leopold in the following notes from A Round River Journal:

“If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of eons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.”

In addition to the basic research and investigations afforded by this project, a primary affective hope is to reacquaint students and teachers with nature so that we may all better understand our fundamental role and responsibility in safeguarding global biodiversity.

Summaries of the four (4) quadrats follow:

Quadrat 1 – Riparian	GPS 41° 20' 37" N, 74° 35' 71" W
Canopy Density: 80%	Ground Cover: 15% detritus, 75% herbaceous, 10% open
Tree Species: 6	Total Individuals: 24
Quadrat 17 – Riparian	GPS 41° 20' 30" N, 74° 35' 81" W
Canopy Density: 75%	Ground Cover: 35% detritus, 40% herbaceous, 25% open
Tree Species: 7	Total Individuals: 15
Quadrat 28 – High Terrain	GPS 41° 20' 28" N, 74° 35' 70" W
Canopy Density: 100%	Ground Cover: 55% detritus, 45% herbaceous, 5% open
Tree Species: 7	Total Individuals: 20
Quadrat 29 – High Terrain	GPS 41° 20' 31" N, 74° 35' 57" W
Canopy Density: 93%	Ground Cover: 35% detritus, 40% herbaceous, 25% open
Tree Species: 9	Total Individuals: 19

A number of experts joined the teachers in the field. Naturalist John Serrao, herpetologist Ed McGowan, mycologist Dorothy Smullen, and Dan Bisaccio consulted with the teachers and helped them identify fungi, amphibians, reptiles, insects, and mammals. Both direct sightings and indirect evidence (such as tracks and scat) were recorded by the BSLI teachers. Said BSLI participant Lura Hegg, “The opportunity to get out in the field with such knowledgeable people

is wonderful.”

Following a picnic lunch at RCWC, half of the teachers returned to the study quadrats, while the others hiked to another location along Rutgers Creek for water quality studies. Representatives from PASCO demonstrated probes and sensors for measuring dissolved oxygen, pH, turbidity, flow, and other water parameters. In addition, Kelly Nolan, from the Hudson Basin River Watch, showed teachers

The Aquatic Studies

The BSLI teachers experienced both high and low-tech approaches to water quality testing at Rutgers Creek. Kelly Nolan, of the Hudson Basin River Watch (HBRW), led teachers in the low-tech version. HBRW is an association of students, teachers, citizen volunteers, environmental organizations, and water resource agencies whose mission is to improve the water quality of the Hudson River and its tributaries through education, community involvement, and

based in schools. Teams are often partnered with local private interests, nonprofit organizations and government agencies.

The HBRW provides recommended protocols for collecting standardized water quality data within a framework of three tiers of environmental monitoring that include introductory investigations, preliminary assessment, and rigorous assessment.

Chemical Data Report Sheet				
School/Group: Brandwein Institute		Stream: Rutgers Creek, Orange County, NY		
Date(s) Sampled: 7/31/00		Site#: 1		
Today's weather conditions: cloudy		Water temp: 19°C		
In the past 24 hours, there was: heavy rain				
Flow (indicate fast reading here and calculated reading below): medium				
	Replicates 1	2	Average	Method Used
Water pH	7.5	7.5	7.5	Pocket pal
Alkalinity (mg/)	60	55	57.5	LaMotte micro-burette
Chloride (mg/l)	—	—	—	
Turbidity	15	15	15 JTU	LaMotte Turbidity Column JTU
Conductivity	228	225	229	meter
Other: _____ Add Units				
Nitrate-Nitrogen as N - OR - Nitrate-Nitrogen as NO ₃ Nitrate-Nitrogen: report as NO ₃ (to convert N to NO ₃ , take the N result and multiply by 3)	0	1	0.5	Cadmium reduction: color comparator other: Standard curve? No
Ortho-Phosphate as PO ₄ -OR-Ortho-Phosphate as P Ortho-Phosphate: report as P (to convert PO ₄ to P, take the PO ₄ result and divide by 3)	0	0	0	Ascorbic Acid Reduction: color comparator Standard Curve? No
Dissolved Oxygen (mg/l) - OR- Dissolved Oxygen (% Saturation)	8.6	8.2	8.4 90% SAT	Winkler with micro-burette

stewardship. The HBRW has developed a comprehensive system for training volunteers, including school children, in how to identify water quality problems; to monitor the physical, biological, and chemical characteristics of waters; and to use the information in river restoration and protection efforts. The HBRW is a coordinated network of autonomous teams, with over 100

Kelly led the BSLI teachers in preliminary assessments at two Rutgers Creek sites. The studies focused on macroinvertebrates and chemical tests. The results of these analyses are available online at:
<http://home.att.net/~volunteerstreammonitoring/>

continues

The Aquatic Studies *(Continued)*

Macroinvertebrates

Using the HBRW protocol, BSLI teachers collected river bottom samples from two fast and two slow areas in a riffle, screened out debris to dislodge the organisms, and then took their time collecting the assortment of critters using forceps, and sorting them in ice cube trays for analysis.



With the help of HBRW sorting sheets, teachers identified the organisms within families, and using HBRW worksheets, the teachers recorded their findings for analysis. HBRW provides metrics for analyzing the macroinvertebrate data. BSLI teachers did three analyses. First they looked at the number of identifiable species of mayfly, stonefly, and caddisfly larvae. Then they arrived at a “biotic value” for each group of organisms, by multiplying the number of individuals (for each of 11 types of organisms found) by an assigned biotic index. Finally, they compared the number of various organisms to a model of expected findings for a pristine stream, and calculated the variation. The macroinvertebrate analyses indicated excellent water quality at one site on Rutgers Creek, and good water quality at a site adjacent to Minisink Highway.

Chemical parameters

Using simple equipment and procedures, the teachers measured water pH, alkalinity, chloride, turbidity, conductivity, nitrate, ortho-phosphate, and dissolved oxygen. The preceding chart summarizes chemical data collected at one Rutgers Creek site.

In addition to the HBRW protocols, BSLI participants were exposed to high tech water quality data collection and analysis tools: PASCO scientific’s ScienceWorkshop 500 Data Acquisition Interface. Using the remote data collection capacity of this interface, the teachers collected environmental data in the field (independent of a computer connection). Data collected included temperature, pH, flow rate, dissolved oxygen, depth vs. temperature profiles, light intensity and barometric pressure. Field-collected data was then returned to the laboratory, downloaded onto a computer and displayed in graphic and tabular form for data analysis.



BSLI teachers collect specimens (top) and perform chemical analysis at Rutgers Creek (left)

how to conduct water quality studies using low tech, inexpensive kits and macroinvertebrate counts.

This group later returned to the Morholt home to download and graph data collected with the PASCO probes. They returned to the quadrat studies, while the second group of teachers went to Rutgers Creek for hydrology studies.

After dinner at PEEC, the first evening presenter was meteorologist Mike Mogil, president of How The Weather Works. Mike shared his fantastic web site (<http://www.weatherworks.com/>), with its many links to meteorological data. He described the

characteristics of various types of clouds, and illustrated his presentation with slides. Mike talked about ground fog, valley fog, stratus, cirrus, and cumulus clouds, and various types of storm clouds.

Later, naturalist John Serrao brought out the herps of the Pocono Plateau. John discussed the habitats and natural history of each species as he walked around the PEEC classroom giving each BSLI teacher an up-close view of the various snakes, frogs, toads, and lizards. He talked about each species in detail, telling of the gray tree frog, which changes color to match tree trunks, the green frog which sounds like banjo strings, and the wood frog, which sounds like quacking

Find your place on the planet, dig in, and take responsibility from there.

- Gary Snyder

ducks. He showed teachers leopard and pickerel frogs, as well as an American toad, and a bullfrog, among many others. Snakes were the hit of the evening, as John displayed everything from a worm snake



(which aptly looks very much like a worm), to a black racer, a milk snake, and a timber rattlesnake, which had molted earlier in the day.

Tuesday, August 1, 2000

After breakfast, the BSLI group again bused to RCWC to complete their mapping of the study quadrats. They were joined by field consultants Steve Case, Tom Formichello, Otto Heck, Ed McGowan, Mike Mogil, Kelly Nolan, John Poliero, and Mike Trimble. While mapping the quadrats, the BSLI teachers also practiced observing, writing, and sketching in their field journals. They observed the forest structure, looking for light gaps, comparing the density of the understory to the canopy, and sketched vertical tree profiles.

After lunch, the teachers went to the National Park Service Peirce House for Tim Smith's session about Geographical Information Systems (GIS) and Global Positioning Systems (GPS). Tim explained the basic fundamentals of GIS and discussed specific types of software available, such as ArcView by ESRI, Inc. He provided teachers with a sense of how they can use the tool of GPS to collect data for input into a GIS. Tim also presented an overview of various GPS receivers that are available, discussing their applications, capabilities and costs. He covered everything from "recreational"-grade GPS equipment that measures within a 5-10 meter range, to the very precise geodetic, survey-grade receivers, which are capable of measuring movement of the earth's crust.

The teachers returned to PEEC for dinner, and the evening program began with Steve Case, who talked about the benefits of learning science while engaged in authentic, meaningful work. Beyond training data collectors, Steve believes that fieldwork holds many possibilities and can help students become analytical thinkers.

He described long-term student ecological research he's been involved in, including student stream monitoring, and a study of tardigrades—tiny organisms that live on moss and lichens, and are an environmental indicator. He pointed out his web site (<http://kancrn.org>) which contains links to various resources for teachers and student research projects.

Steve provided BSLI teachers with additional advice on finding funds for student projects. He encouraged them to be leaders, to publicize the results of their students' research, write articles, do presentations, and generally share their experiences with colleagues in an effort to encourage more teachers to involve students in real science.

After Steve, ecologist Otto Heck shared his passion for owls. He talked about how the changing environment and habitat loss have impacted owl populations and ranges. Otto shared many facts about owls during his slide presentation. For example, most owls are nocturnal and have very keen vision and hearing. Owls can hear a beetle 100 meters away, and a mouse from a ½-mile distance. He described their habits, their prey (rodents and birds), and their diverse habitats. Otto showed slides of various species including burrowing owls in prairies, snowy owls, screech owls, and hawk owls.



Wednesday, August 2, 2000

After breakfast, the BSLI teachers were off to the computer lab for GIS training. Along the way, they stopped for a tour of the Bear Mountain Park Trailside Museums and Wildlife Center near Harriman, New York. The museum has exhibits on native animals, reptiles, geology, nature study, and local history, and the zoo is a refuge for rescued wildlife.

The computer lab, at the Orange County Board of Cooperative Educational Services (BOCES), provided PCs for groups of BSLI teachers to work with the Interactive Habitat software developed by Joe Russo and Mike Anderson. Joe and Mike demonstrated Interactive Habitat and described how it made GIS technology relevant to student fieldwork and the teachers' fieldwork at Rutgers Creek, by incorporating maps from the Orange County Water Authority and aerial photographs of the site.



Teachers separated into the four groups that had done fieldwork in each of the RCWC study quadrats, and gathered at computer terminals to input the data they had collected and explore the possibilities for its analysis using the highly detailed Interactive Habitat software.

Thursday, August 3, 2000

The BSLI group got an early start for New York City and the American Museum of Natural History (AMNH). There, Meg Domroese, Outreach Program Manager for the AMNH Center for Biodiversity and Conservation (CBC) talked to the teachers about the research and education that the center conducts around the world.

Meg explained that the CBC was established in 1993 and is part of the museum's growing effort to increase understanding of biodiversity and promote participation in biodiversity

conservation. Their projects integrate scientific research and training with community outreach. Through exhibitions, symposia, workshops, and publications, they help to inform the public about biodiversity issues.

The Biodiversity Hall is the Museum's "public face" for research and outreach on biodiversity. The exhibition is designed to appeal to a broad audience and is organized around four major questions:

- What is biodiversity?
- Why is it important?
- What are the threats to biodiversity?
- What can we do about biodiversity loss?

Meg showed slides to illustrate these questions and the CBC's work in the field, including examples from around the world. The Center's field projects focus on areas where resources are often lacking. For example, they are working in Vietnam and Bolivia to help governmental and non-governmental organizations apply information about biodiversity to make conservation decisions.

Meg passed out copies of the CBC's consumer guides, and had materials describing various symposia and outreach projects available for the BSLI teachers to browse through.

After Meg, Jay Holmes, from the AMNH Department of Education described the educational programs offered by the museum, which include all age groups from pre-school to adult, and a variety of formats such as lectures, after-school courses, teacher guides and workshops, and science mentorships.

Jay focused on programs he is involved in, including the after-school program, ecology club, and YouthCaN, which culminates in an international environmental conference for youths and presented by youths. Jay also shared a variety of handouts including instructional materials, information on student essay contests, and magazines.

The Interactive Habitat: A Web-Based Program

By: **Joseph M. Russo** and **Aaron Hunt**, ZedX, Inc. and **Michael Anderson**, Spatial Information Technologies, Inc.

ZedX, Inc. and Spatial Information Technologies, Inc. are cooperating in the development of educational tools that take advantage of recent interactive technologies on the Internet. The first development effort is identified as the "Interactive Habitat" program. Interactive Habitat is an Internet-based user interface that allows middle and high school aged students to visually work with environmental data in a Geographic Information Systems (GIS) framework.

Upon entering the program, via the web, students have access to functions that allow them to enter locally-collected data, analyze these data, create reports about these data, and to spatially view the data against photographic images and other surface information as reference.

The actual mechanics for running the "Interactive Habitat" program are similar to any other web-based software. After entering a user name and password on the "welcome" page, a student is presented a screen with two sections. The left-most section is tentatively referred to as the "map" area, while the right-most section is referred to as the "function" area. The centerpiece of the map area is digital imagery, such as an orthophoto distributed by the United States Geological Survey (USGS). A digital orthophoto is a computer-generated image of an aerial photograph. With its 1-meter resolution, a student can easily identify in a photo image the trees, roads, buildings and other familiar surface features that are part of a local ecosystem. Data "overlaid" on an orthophoto helps to orient a student as to the spatial location of particular phenomenon of interest observed in a habitat. Besides data collected by a student, there are many government databases that can be overlaid on an orthophoto or displayed individually. Examples of these databases are roads, streams, political boundaries, and soil types. The application allows the student to zoom in and out, and pan across an orthophoto image. Controls are provided to allow a student to display the

different reference data layers. Clicking on an individual map element with a mouse permits a student to access information about the element.

The "function" area is divided into five "decision" tabs. These tabs are labeled as "Theme, Topics, Info, Analysis, and Products." There are several choices presented as menus under each decision tab. Under the "Theme" tab, a student can choose among different themes that impact an ecosystem, such as "Climate Change, Exotic Species, and Urbanization." The choice of a particular theme sets up the rest of the choices under the remaining tabs. Under the "Topic" tab,

there are various topics for the chosen theme. As an example, if a student chose the theme "Exotic Species," a topic could be "First Detection." The choice of a particular topic affects the later choices under the remaining tabs. Under the "Info" (Information) tab, a student can choose among different data sources. One choice could be an entry form for data collected locally.

Another choice could be previously recorded data or professional citations and papers. Under the "Analysis" tab, student-entered data or data accessed through the program can undergo various methods of analysis. An analysis can be a simple comparison of data sets or a spatial interpolation of a data set. Under the "Products" tab, a student can choose how to display their analyzed data or other selected information sources. Choices could include tables, text, graphs or combinations of figures and text in the form of a report. The various forms of presentation could include an orthophoto image with one or more reference data layers. Under the "Products" section, a student can choose to print a presentation or report.

The "Interactive Habitat" program is only a prototype. The design of its web-based interactive screens will undergo major revision after feedback from teachers and students. It will also be compared to programs that have been successfully used in an educational setting. The choice of professional databases, approaches to analysis, and information sources will be dictated by existing teaching methods, curricula requirements, and other educational standards.



Teachers plot and analyze collected data with Interactive Habitat Software.

*We need the tonic
of wildness, to
wade sometime in
marshes where the
bittern and the
meadow hen came,
and hear the
booming of the
snipe. We can
never have enough
of nature.*

- Thoreau

The educational outreach of the AMNH is extensive, and exposure to these offerings may give BSLI teachers ideas on how they can work with local resources such as museums and nature centers.

Afterward, the teachers toured the museum, and following an introduction to the Biodiversity Hall, the group was free to explore on their own. The highly engaging exhibits of the Biodiversity Hall illustrate the divisions of the animal kingdom and issues that affect biodiversity. Computer resources enable visitors to satisfy their curiosity on a variety of topics. In other areas of the AMNH, teachers enjoyed a new, high-tech, animated exhibit of “fighting dinosaurs” based on fossil footprints. They saw an exhibit where children can pretend to be paleontologists, sweeping sand away to uncover bones. Evolution exhibits and the new Rose Planetarium were other highlights of the museum tour.

Later, the teachers were on their own to explore Manhattan, with groups going in various directions. Some went to the Metropolitan Museum of Art, and others on a walking tour through Little Italy, Chinatown, and South Street Seaport, where they had a good view of the Brooklyn Bridge. One group enjoyed a late night van tour of Manhattan before returning to PEEC, driving past such landmarks as the Plaza Hotel, the Met Life building, home to nesting peregrine falcons, and Grand Central Station.

Friday, August 4, 2000

Friday morning was unscheduled time for the teachers. Some took advantage of the free time to work on proposals for using their Brandwein grant. Others took a fossil-hunting excursion to a local quarry.



BSLI Teachers tour the Sterling Mining Museum

After lunch at PEEC, the BSLI teachers broke into two groups. Some went canoeing on the Delaware River, while another group visited the Sterling Hill Mining Museum in Ogdensburg, New Jersey.

High water from recent rains made the canoe trip exciting and ensured everyone got a little wet on this sunny, warm afternoon. Canoeists saw various interesting natural and historical features along the river, such as an active beaver house, eel traps, and the remains of the Delaware and Hudson canal.

The Sterling Mine, a zinc mine that operated until 1986, is now a museum. BSLI teachers toured the underground mine, learning about the more than 340 minerals found in the area, including at least 80 that fluoresce. After the tour, teachers received curricular materials and free samples of fluorescent minerals.

Friday evening, the BSLI teachers gathered for their last dinner at the PEEC dining hall. Throughout the week, meals at PEEC provided an opportunity for informal sharing, networking, and discussing plans for applying what they learned back at school.

In the evening, teachers were presented with thermohygrometers, for recording temperature and humidity in the field over a 24-hour period. In addition, Brandwein Institute polo shirts were provided to each teacher. Dan Bisaccio then gave a slide presentation on bats. Dan told the teachers a

number of general facts about bats. For example, all bats are nocturnal, and certain species hibernate, migrate, and mate for life. Bat species are more numerous than any other group of mammals except rodents, and some are insect eaters, while others are fruit eaters, fish eaters, or bloodsuckers.

Dan and his students are involved in a number of bat studies, such as monitoring heart rates and metabolism. They glue light sticks on the bats' backs, and track them with an Anabat Echolocation Bat Detector. In the tropics, where there are many species of bats, Dan can identify various species based on the sounds he picks up with the echolocation device. He explained that fieldwork helps students understand how bats function in an ecosystem, and their contribution to pollination and seed dispersal.

Saturday, August 5, 2000

After breakfast, Terry Ippolito, Environmental Education Coordinator for U.S. EPA's office in New York City, provided a session focused on tips and techniques for preparing competitive grant proposals. Terry advised teachers to define measurable results for their projects, and to describe in their proposal how their project achieves the goals of the grant program. Among other advice, Terry recommended partnering with local organizations, parks, and nature centers, and seeking in-kind contributions and matching funds. According to Terry, teachers should also look locally for grant sources, and contact area supermarkets, banks, and businesses such as Home Depot and Wal-Mart, who often have budgets for educational grants.

After Terry, Mike Trimble, a teacher from Arizona, presented a lively session about bears. Mike provided general

information about bears. For example, bears are not social, and do not want to see other bears. During hibernation, which is triggered by photoperiod, bears continue to burn 4,000-5,000 calories per day. Bears are opportunistic omnivores, and while black bear females average 150 pounds, salmon-fed Alaska brown bears can tip the scales at 1,500 pounds!

Working with professionals, Mike's students have caught and sedated bears, measured and weighed them, examined their teeth, and placed radio collars on them. Mike discussed the issues of managing bear populations in increasingly populated areas. Bears that find dumpsters and other human food sources become a nuisance and are often eventually put down. Mike's session generated a good deal of interest among BSLI teachers who were curious about involving their own students in bear studies.

After lunch, Dan Bisaccio led a discussion about alternative assessment techniques that can help gauge student understanding of fieldwork. His focus was poster assessment, which he has used with students. Dan also invited the BSLI teachers to collect student data and submit it to the Smithsonian Institution's BioMon database.

In the evening, the BSLI teachers gathered at the restaurant, Le Gorille in Shohola, Pennsylvania, for dinner. Following a lovely dinner, Brandwein fellowship was conferred on the teachers, and they received framed certificates and specially-designed Tiffany etched crystal paperweights to commemorate the occasion.

After the BSLI-2000

Teachers returned home on Sunday, August 6, 2000, but that did not mark the end of the BSLI, because teachers continued communicating via the eGroups list



Program Evaluation

In their field study groups, teachers were given an opportunity to discuss and evaluate the BSLI. Responses were very positive, with three of the four groups rating the Institute a 4 on a scale where 4 represented “Great!” One group rated the BSLI a 3.5 – somewhere between good and great.

Teachers gave a variety of answers to the question “What did you like best about the program?” Responses included:

- Meeting and networking with a diverse group of peers from around the country
- Doing active fieldwork
- Receiving information on grant resources
- Interspersing fun activities with work, which enables participants to develop relationships more fully
- The New York City trip, including the visit to the American Museum of Natural History
- The wide variety of activities and experts available

The BSLI teachers also appreciated the flexibility and supportiveness of the BI staff, the abundance of materials provided, and the extended length of the BSLI. Teachers were

grateful for being treated as professionals, and for the continued interaction and support available through the eGroups list service.

Teachers were asked to list the most important things they learned from the BSLI. Among other responses, teachers were pleased to learn about the variety of environmental data collection techniques and research methods available, and they were very interested to hear about student fieldwork efforts around the country. A number of teachers felt enlightened about identifying and tapping into local resources. One group of teachers noted that they were returning to their classrooms with a new sense of confidence.

The groups generated good and useful feedback for improving the BSLI in future years. For example, the teachers identified a need for more reflection time – for teachers to talk with one another about implementing field-based programs at their schools. The teachers also said they needed additional training in data analysis and statistics, helping them formulate hypotheses and develop the next phase of study.

service. Several of the BSLI resource people posted to the list, providing additional resources and projects for teachers. Kelly Nolan shared a number of websites on topics such as water quality studies and macroinvertebrates.

Steve Case communicated regularly with the BSLI teachers. He invited everyone to join with their students in Monarch butterfly studies through his KanCRN website. He also shared information about ozone monitoring, and student studies of ozone damage to milkweed plants, and asked teachers to involve students in this project, as well. Steve informed the BSLI teachers about a proposed GIS-based project, and invited the teachers to share in it, if it receives funding.

To help everyone keep in touch and continue sharing, Dan Bisaccio developed a project for

the students of BSLI teachers to exchange data about their local habitats on the autumnal equinox. On a date within a week or so of the equinox, participants collected data at their site, including temperature, humidity, and total daylight, and described the dominant ecosystem and typical flora and fauna. In addition, students answered a number of questions about seasonal change, such as the biotic and abiotic changes that mark the shift from summer to fall in their area, and how local plants and animals react to this seasonal change. Classes from around the country shared their data on the Brandwein eGroups list service. The list service is available indefinitely for future project sharing, discussions, and student data sharing between the Brandwein fellows, staff, and resource people.

*In the end we will
conserve only what
we love. We will
love only what we
understand. We
will understand
only what we are
taught.*

– Baba Doum

BSLI-2000 Teacher-Participants

Vernon R. Beeson

Science Teacher, Grades 9-12

Banks, Oregon

Vern Beeson uses inquiry to introduce course topics and to spark student interest by encouraging them to develop more questions than can possibly be answered in class. He believes it is especially essential to begin student fieldwork with pressure-free time to look around and observe the environment and form questions. He also provides students with the time and resources to reach some conclusions – however tentative – about their field experience, and to connect their research to the real world.

Since 1979, Vern has annually taken has Advanced Biology students on a 5-day field studies trip to the Malheur National Wildlife Refuge, 250 miles away in eastern Oregon. Since their hometown features the wetter environment of the western side of the Cascade Range, his students are often awestruck by the high desert they find at Malheur. At Malheur, they use the PEERS protocol developed by Eastern Oregon University, work in teams, and with the help of professionals from the Fish and Wildlife Service they study the Great Basin biome.

Closer to home, and adjacent to the school, is the one-acre Whispering Waters Wetland, which Vern's students explore on a regular basis. The current hot topic is "how do you protect a wetland?" as a large housing development has risen next to the site. Vern's students also participate each fall in the Oregon Graduate Institute of Science and Technology's Student Watershed Research Project, which involves students from 20 Portland area schools in aquatic studies at two creek sites.

Sharing Expertise:

To share his Brandwein SLI experience, Vern will lead a field-based workshop for local elementary school teachers, training them in outdoor-based watershed education. The workshop will begin with a tour of the Whispering Waters school wetland and catch basin and culminate in a canoe trip on the Tualatin River. Local experts, including the Tualatin Riverkeepers and wetland ecologists from the Unified Sewage Agency will

share their expertise with the teachers. The workshop will include training in nature journaling and suggestions for watershed activities. Vern will also participate in a "share the wealth" session the NSTA Regional Convention in Boise.

Vita

Vern holds B.S. and M.S. degrees in General Science from Oregon State University. For over 25 years, he has taught science at Banks High School, a small school in rural western Oregon. He

currently teaches Integrated Science and Advanced Biology courses. Vern has presented sessions on student field studies and software integration at state teachers conferences, and worked within his district at training teachers in the Oregon Science Benchmarks. He has received several grants, including a National Wildlife Federation grant for developing a schoolyard habitat and funding from the Woodrow Wilson National Fellowship Foundation to

establish a consortium of biology teachers from small schools.

Useful Websites:

www.ogi.edu/satacad/swrp Oregon Graduate Institute of Science and Technology's Student Watershed Research Project

<http://redtail.eou.edu> Eastern Oregon University PEERS (People Exploring Ecosystem Resources as Stewards)

<http://www.r1.fws.gov/malheur/> Malheur National Wildlife Refuge, Oregon

<http://www.teleport.com/~triverk/> Tualatin Riverkeepers

<http://www.nwf.org/nwf/education/> National Wildlife Federation Environmental Education

<http://www.woodrow.org/> Woodrow Wilson National Fellowship Foundation

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"It is becoming more and more apparent to me that the particular curriculum path we follow is not as important as trying to get students to satisfy their curiosity."

- Vern Beeson

Allen R. Bone

*Life Science Teacher, Grade 7
Butte, Montana*

Butte, Montana is a mining town, and the location of the largest Superfund site in the country. Allen Bone's students have monitored a creek that was contaminated with heavy metals and is part of the Superfund site. Talk about involving students in solving real world problems! Said Allen, "The excitement and fun of teaching science and doing extended water activities... is now consuming most of my time."

Over the past 10 years, Allen has trained teachers and students in aquatic monitoring techniques for a variety of projects including several sites along Blacktail Creek for Project WET Montana. His students conduct most of the S.O.S. (Save Our Streams) tests including pH, dissolved oxygen, nitrogen, temperature, and stream makeup. These data are shared with other schools in various watersheds around the state. Along Big Hole River, they call what they do "water education" rather than "water monitoring" to appease local ranchers, but they still do many of the same tests.

Allen tries to develop his students' inquiry thinking and to integrate other subjects into his life science teaching. For example, in addition to water monitoring, students might get a history lesson about Lewis & Clark, who passed nearby.

His middle school students mentor elementary school students from nearby schools. They hold an annual Water Education Day where his students teach younger children to conduct water monitoring tests. Water Education Day also brings specialists to the school, including people from the Fish, Wildlife and Parks department, the Audubon Society, the Forest Service, hydrologists, and fly fisherman.

Always looking to improve and expand his program, Allen finds technology useful in aiding student understanding of water quality. He currently uses CBLs, and plans to further develop his aquatic program with more data collection and analysis and to expand it to include the riparian zone.

Sharing Expertise:

Allen has been providing inservice training to his peers for many years. He plans to share his Brandwein SLI experience with two groups of teachers he is presently working with. The SITES (Science Improvement Through Environmental Studies) group includes elementary and high school teachers in his district. The Big Hole River Education Group is high school teachers from the district, as well as elementary teachers from five schools along the Big Hole River. He will also do an inservice

session for teachers at his own school.

In addition, he plans to share information from the Brandwein SLI with various statewide groups he's active with including the Montana Environmental Education Association, Clarks Fork River, and the STEP Project (Systemic Teacher Excellence Preparation).

Vita

Allen has a B.S. in Physical Education and Elementary Education and a M.Ed. in Elementary School Administration from Montana State University. An educator for over 25 years, he has been teaching middle level life science for nearly a decade. He's also an instructor at the University of Montana's Birch Creek Nature Center, where he helps write and pilot environmental curricula. Allen has presented a variety of professional development sessions over the years, including training teachers to do environmental water monitoring with their classes and earthquake curricula training for FEMA. He is a "Key Leader" for NSTA's Building a Presence for Science, and is helping establish a network to disseminate

science education materials to schools throughout Montana. He is a mentor in the Montana STEP Project (Systemic Teacher Excellence Preparation), which matches early career teachers with veteran educators. Said Allen, "Together we both win. Teaching stays exciting for the experienced teacher and the new teachers stay in education rather than dropping out from frustration."

Useful Websites:

<http://www.montana.edu/wwwwet/> Project WET (Water Education for Teachers)

<http://www.saveourstreams.org/> Save Our Streams (SOS)

<http://www.col-ed.org/pro/sites.html> Science Improvement Through Environmental Studies

<http://www.wmc.edu/acad/outreach/bcrcenter.html> Birch Creek Nature Center

<http://www.montana.edu/~wwwse/> Montana STEP Project (Systemic Teacher Excellence Preparation)

<http://www.nsta.org/bap/> NSTA's Building a Presence for Science

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"During my lab time, I guide my students to develop investigative processes and allow them in the wrap-up to pursue their thoughts."

- Allen Bone

David L. Brock

*Biology Teacher, Grades 9-12
Baltimore, Maryland*

"My emphasis in the classroom is on engaged, investigative lab work and analysis, rather than traditional lecture," explained David Brock. His biology students spend the last six weeks of school engaged in primary research, studying soil microbes as part of the NSF-funded Baltimore Long Term Ecological Research Study (BES). Students examine the role that microbes play in the larger soil ecosystem and determine the value of microbes as indicators for human impact on the soil. David's 9th-graders develop and implement their own experimental protocols (based on standard microbe research techniques), and analyze and evaluate their results, submitting them to peer review.

Soil testing is the heart of the program. Students determine the nutrient value in soil, examine microorganism population and biodiversity, conduct serial dilution, protozoa extraction and identification, and bacteria identification. His students are essentially developing their own dichotomous key, because few of the soil microorganisms have yet been identified.

David has been involved in other major field studies, as well. With a National Institutes of Health Science Education Partnership Award (SEPA), he helped design, implement and evaluate the effectiveness of a genetics curriculum at an inner city high school.

Last summer, he participated in the University of Florida's Teacher Research Update Experience (TRUE), where he used conservation genetics to determine the viability of *Briareum asbestinum* as a potential "seed" organism for coral reef repair.

Field study is the direction he wants to go with his teaching. Although he uses inquiry heavily in the classroom, he hopes to improve his own training so that he can bring more rigor and quantification to student work. Said David, "I believe that only if we model these larger 'habits of mind' for our students can we draw out the reflective, creative individuals in each of us who have the power and wisdom to build fulfilling and meaningful lives for ourselves and our community."

Sharing Expertise:

David has been providing training sessions for other teachers for years, presenting on a wide range of topics. He plans to present fellow teachers with several professional development opportunities as a result of his Brandwein experience. At the upcoming

Maryland Association of Biology Teachers conference, he will give a workshop on his soil microbiology unit, training teachers to use the techniques his students currently use. He will present a session on the uses of field studies in the biology classroom at the NSTA Regional Convention in Baltimore, where he will also participate in the Brandwein Institute and "share the wealth" sessions. He will repeat these presentations at the NSTA National Convention in St. Louis.

Vita

David did undergraduate work in the humanities and biology, and graduate work in the philosophy of science at Washington University. He also has a M.Ed. in secondary education from Vanderbilt. He has taught science for over a decade, and currently teaches high school biology at an all-girls K-12 school in Baltimore, where he serves as science department chair. David is active professionally. He has published 12 articles and has served on a number of boards and committees, including NSTA's Science Teaching Materials Review Panel and as a media reviewer for AAAS's Science Books & Films. He has received several grants and awards, and was honored with Disney's American Teacher Award for Science in 1998.

"[Inquiry teaching] demands an openness to allow students to own the responsibility for their own education. But the rewards of it have been immense: students who really think-critically, creatively, and consciously."

- David Brock

Useful Websites:

<http://baltimore.umbc.edu/lter/> Baltimore Ecosystem Study
<http://www.lternet.edu/> U.S. Long Term Ecological Research Network
<http://www.pbs.org/sixbillion/> Six Billion and Beyond: Population in the New Millennium
<http://www.mp2-pwrc.usgs.gov/frogwatch/> Frogwatch USA, US Geological Survey Toad Monitoring Program
<http://www.anserc.org/> Academy of Natural Sciences' Estuarine Research Center
<http://www.dnr.state.md.us/bay/index.html> Chesapeake Bay
<http://www.umsi.edu/~microbes/> Science in the Real World: Microbes in Action

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Nature is what drives our world; those who ride it willingly might yet catch a glimpse of a dazzling, even a spiritual restfulness. While those who insist... that the world must be piloted by man for his own benefit will be gathering dust but no joy.

- Mary Oliver

David E. Brown

Teacher, Grade 6
Quincy, Illinois

"Cute sells!" David Brown found that some good press highlighting his first-graders' environmental projects garnered attention and ultimately resulted in funding for more and bigger student projects. In the last ten years, he has written 47 successful environmental education grants, ranging from \$100 to \$95,000.

When he began teaching elementary school in Florida, his urban students were literally afraid of anything that moved outside. By working slowly and making environmental education as non-threatening as possible, he earned their trust and their interest. He soon initiated a multitude of environmental field studies involving students from kindergarten through grade 5.

David's students built and ran a 25,000-tree nursery that provided trees for the Atlanta Olympics. They ran a native plant farm and greenhouse, supplying seeds to other schools for habitat restoration projects. David's students enhanced their community by creating a petting zoo, a nature center, butterfly gardens and restoring a 10-acre wetland. His students tracked manatees in the wild for the Department of Wildlife, and assisted in controlled burns after attending "fire college." David's student projects have been recognized with numerous awards, and received local and national media attention, including an appearance on the Today Show.

To help his students learn fieldwork techniques, he enlisted the participation of experts from groups such as the Lowry Park Zoo, the Florida Game and Freshwater Fish Commission, the Division of Forestry, and the Southwest Florida Water Management District.

David recently moved back to his hometown in Illinois, where he is teaching 6th grade. He plans to recreate at his new school the successes he had in Florida. This year, his class studied a severely damaged creek system in hopes to eventually create a city greenway system. They are monitoring six area lakes and providing data to the Department of Natural Resources.

Said David, "By providing them with various hands-on projects and real life field studies, my students have become more motivated, more involved and engrossed in the scientific methods and procedures."

"Over the years, I have found that networking with peers and experts in various fields to be extremely rewarding and beneficial."

- David Brown

Sharing Expertise:

David will promote scientific inquiry and project-based field studies while sharing the Brandwein philosophy at a one-day session for 20 local teachers in grades 3-8. Participants will set up quadrats and learn field techniques for data collection and environmental monitoring in their choice of forest, prairie, or stream ecosystem. Area experts will be available in the field to assist throughout the session. David will conduct a follow-up session with teachers to help them brainstorm their own projects and identify potential funding sources and local resources. In addition, David will incorporate information about the Brandwein philosophy and opportunities at sessions he is presenting at the NSTA Conventions in Milwaukee, Phoenix, and St Louis. He also plans to participate in the Brandwein sessions at NSTA conventions.

Vita

David has Bachelor's degrees in Elementary Education and Special Education/Learning Disabilities from Quincy College. He taught elementary school in Florida for 10 years, and is now teaching 6th grade reading, English, science, and social studies in Quincy, Illinois. While in Florida, David was a state environmental education teacher training facilitator and teacher education coordinator for the Florida Division of Forestry summer program at Withlacoochee Environmental Center. In addition, he was a part-time zookeeper assistant at the Lowry Park Zoo in Tampa. David has presented sessions, often with his students, for teachers, parents, and community groups such as garden clubs and the Audubon Society. He has received numerous awards and grants and was named Florida Conservation Education Teacher of the Year and Environmental Teacher of the Year.

Useful Websites:

<http://www.lowryparkzoo.com/home.shtml>

Lowry Park Zoo, Tampa

<http://www.nationaltreetrust.org> National Tree Trust

<http://www.for-wild.org> Wild Ones – Natural Landscapers

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Gary L. Endsley

*Regional Science Specialist, Grades K-12
Jefferson, Texas*

"As a child growing up in the woods of East Texas, I took advantage of the opportunity to investigate nature as much as possible." His interests took him on a diverse career path, including stints doing environmental work in industry and in private business, before leading back to education. Said Gary, "This mix of experience has produced a connection with reality which translates into meaningful lessons."

He considers himself an ecology teacher, a naturalist, a reform advocate, and an informal science bridge. And for the past year, he has been a Regional Science Specialist for the Texas Rural Systemic Initiative (TRSI). The goals of the TRSI are the successful implementation of Texas Essential Knowledge and Skills (TEKS), alignment of district policies and resources with reform, developing collaborations that benefit education, and reaching all students in Texas with real, standards-based science.

Part of his job is helping teachers identify resources and activities that meet their needs. He aids teachers in making connections and applying for grants with organizations like Texas Parks & Wildlife and the Texas Alliance. His summers are spent locating and developing prototype activities to use with teachers and students. Said Gary, "Working in rural districts as a secondary science instructor forces one to explore 'out of the box' resource and funding avenues to meet national and state standards. I have found learner-centered field studies affordable and practical."

Because it's both cost-effective and beneficial to students, he conducts about half of his classes in the field. Gary and his students (school children and teachers) have done extensive work surveying the cultural and environmental resources at Wright Patman Lake and Lake O' the Pines, and studying Caddo Lake, a wetland of international importance. Over the years, he has come to a better understanding of the true nature of inquiry, and strives to help teachers use it with their students. Explained Gary, "In inquiry, the teacher and students become colleagues in a quest to find truth and understanding."

Sharing Expertise:

"Because the TEKS (Texas Essential Knowledge and Skills) mandates laboratory/field research, K-12, the Brandwein Summer Leadership Institute supplies a model that engages a statewide cadre of teachers with a needed research protocol to initiate

"I find that every community possesses hidden assets on the landscape which can provide the context and community connection to advance systemic reform and bring high quality experiences to all students."

- Gary Endsley

high quality field investigations." In his position as Regional Science Specialist for the TRSI, Gary plans to introduce the Brandwein fieldwork protocol to both teachers and other Science Specialists. He calls his outreach the Texas-Brandwein Ecological Assessment Model (T-BEAM), which he will promote at a TRSI Teacher Partner Academy and a Virtual Field Trip Network Symposium. The T-BEAM workshop and follow-up session will be held at Cypress Valley Education Center. In addition, he will share the Brandwein philosophy and field studies protocol with other TRSI Science and Mathematics Specialists at upcoming meetings, and encourage their use of the protocol with teachers throughout Texas.

Vita

Gary has a B.S.Ed. in Biology, Chemistry, and Physics from the University of Texas Austin. He spent much of his early career doing environmental work in industry and in private business. He was a high school science instructor for ten years before taking his current position, Regional Science Specialist for the

Texas Rural Systemic Initiative. His responsibilities include providing reform-based science teacher training in sixteen counties in East Texas. Through these teachers, his work can ultimately benefit 50,000 children. He is active with state and regional teacher partner academies, presenting at area workshops, and acts as a resource support person for teachers. Gary serves on the state/regional advisory council for NSTA's Building a Presence for Science.

Useful Websites:

<http://www.texasrsi.org/main.htm> Texas Rural Systemic Initiative

<http://www.caddolake.com/> Caddo Lake

<http://www.texasoutside.com/northtexas/lkwrightpatman.htm> Wright Patman Lake

http://www.cypressvalleyalliance.org/ed_center/ Cypress Valley Education Center

<http://www.nsta.org/bap/> NSTA's Building a Presence for Science

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Miguel A. Germain

*Science Teacher, Grades 9-12
Miami, Florida*

After working as a microbiologist, Miguel Germain followed his calling to teach, working first at a community college. There he taught graduates of the public schools, and became frustrated by the lack of basic skills they brought to his classroom. "If these students lacked the basics, this also meant they did not understand the effect we have on our environment." Miguel wanted to help students understand the world around them.

He went to work in the public school system, and eventually taught at a school for students with truancy problems. Knowing that truancy was the result, not the cause, of the students' problems, Miguel sought new ways to get their attention. Field studies and inquiry teaching seemed to fit the bill for these students.

Every year, the entire school (113 students) participated in a multidisciplinary event centered on a 55-acre intercoastal area owned by the city of Miami. Although prime real estate for development, the old "black beach" is now used by students for environmental monitoring, as well as botanical and wildlife studies. In addition to environmental studies, other teachers integrate the black beach experience into their curriculum. In English class, students write poems about the environment; in art class, they sketch birds that they observed at the site; and in social studies, they learn about the Seminole Indians that once lived in the area.

Miguel also involved his students in environmental monitoring using the GLOBE curriculum. His students studied the Miami River, which is contaminated with heavy metals. They did a variety of tests including pH, salinity, nitrate, and phosphate and they shared the data with people around the world through the GLOBE program network.

Learning new techniques excites his students and analysis of the data spurs great discussions. Because his students gain so much from the experience, Miguel hopes to integrate new technologies, such as digital mapping, and new environmental monitoring techniques into the field studies.

Sharing Expertise:

Miguel plans to train other teachers and students in the Miami-Dade County Schools in environmental monitoring techniques. He has developed a hands-on program to introduce students to the protocols for analyzing local plant life and microscopic invertebrates in local rivers and streams and in the Everglades. The program,

called Spectrum Analysis of Local Flora, Fauna, Invertebrates and Water Quality, will focus on helping students become more environmentally aware and concerned about the endangered ecosystems. Students will perform detailed investigations on topics never studied in detail before, such as the effects of seasonal fluctuations in water levels in local canals, lakes, and rivers.

Vita

A native of Cuba, Miguel arrived in the U.S. in 1965. After graduating from Florida International University, he worked in the private sector as a microbiologist in the quality assurance field. He later taught at Miami Dade Community College, before entering the public schools. He teaches high school biology, chemistry, environmental science, and anatomy and physiology. Miguel is very active with the GLOBE project, and recently traveled to Peru to train new teachers in the GLOBE protocols. The River Project is also a big part of Miguel's environmental curriculum. He has given a number of presentations at local and state teachers meetings, on topics including

his students' Miami River water analyses, the Everglades, and multicultural applications in science education. He has received several grants and awards including a Woodrow Wilson fellowship to Princeton in 1997.

Useful Websites:

<http://globe.fsl.noaa.gov/> The GLOBE Project: Global Learning and Observations to Benefit the Environment

<http://www.woodrow.org/> Woodrow Wilson National Fellowship

<http://www.siu.edu/OSME/river/> University of Southern Illinois Rivers Project

<http://www.envirolink.org/> EnviroLink Network: The Online Environmental Community

<http://info.er.usgs.gov/network/science/earth/index.html> USGS Earth and Environmental Science Resources

<http://terraserver.microsoft.com/default.asp> Terraserver Aerial Photos

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"It is our responsibility to prepare the society of the future, as best we can, to take on our jobs as teachers, leaders, laborers and parents. Their future is our future."

- Miguel Germain

A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community; it is wrong when it tends otherwise.

- Aldo Leopold

Lura Hegg

*Teacher, Grade 8
Palmer, Alaska*

"I began taking students into the field when I first began teaching," explained Lura Hegg. She took her English class out to an ancient native village site, and while there, her students discovered an abandoned automobile in a creek leading into a salmon stream. "The kids were amazed that the effects of the rust and chemicals were visible all of the way to the larger stream. This experience led to the development of our 'Pollution Busters' project." The students removed the automobile and cleaned up the creek.

Lura seeks grants each year to enable her students to do the projects that interest them. With a Toyota TAPESTRY grant, her students became "Runoff Rangers" and tackled the problem of lawn chemicals and parking lot runoff that funneled directly into nearby Wasilla Lake. The issue stimulated many questions from students, such as "How do we know that it is a problem?" and "What will slow the runoff the most?" Lura invited community members to provide students with more information. Her students then surveyed and designed a riparian zone to reduce the runoff reaching the lake. They terraced the area, designed field stone retaining walls and replanted with native plants.

Lura has involved students in many other field experiences. They have conducted soil tests and contributed to a student-generated soil survey of Alaska. In cooperation with the Department of Natural Resources, they studied and restored native vegetation to an abandoned coal mine. They have studied salmon habitat.

Her students are active in the community, speaking to adult groups like the chamber of commerce and the planning commission about environmental issues such as runoff. Lura's 8th graders have adopted elementary students and teach the little kids about the environment. Said Lura, "These experiences have convinced me that environmental science field experience is a vital way to bring general science to my students."

Sharing Expertise:

Lura has a non-teaching assignment for fall semester so that she can train other teachers to do field-based science. Explained Lura, "I am seeing many good people trying to teach science within the walls of their classrooms, who would love to step out to the real thing if they only knew how." Her goal is to help other teachers in her district provide students with meaningful and productive field experiences, linking science and community service. Teachers will receive inservice training in inquiry techniques for science and math, and will plan a

"I enjoy watching the youngsters develop increased confidence that comes with performing 'real' science with authentic equipment."

- Lura Hegg

field study unit designed around a community issue or need. Lura will help arrange mutually beneficial linkages between teachers and community organizations, such as the Alaska Department of Fish and Game, the Department of Natural Resources, and the City of Wasilla. Said Lura, "Students will have enhanced prospects for learning in environments that have the high expectations of the working world." This project is a pilot for a proposed program to reach teachers statewide.

Vita

Lura has a B.S. in Psychology from the University of Alaska, and a M.A.Ed. from Alaska Pacific University. She began teaching in 1990, after a career in counseling. She teaches science, math, English, and history. Lura and her teaching partner teach on a two-year loop (7-8th grades), providing time to develop long-term projects. Lura is active with the Science Olympiad, which is extremely popular at her school. She studied geology at the Hawaiian Volcano Observatory and oceanography through the University of Washington Sea Grant program. Lura has been recognized with a number of grants and awards. She has received several

Alaska Science and Technology Foundation Awards for student projects, she is a Toyota TAPESTRY Awardee, and she received the 1999 Presidential Award for Excellence in Teaching for Secondary Science. She has presented at a number of local and national teacher conferences, and her plans for the future include a focus on mentoring new teachers entering the district.

Useful Websites:

<http://hvo.wr.usgs.gov/> Hawaiian Volcano Observatory

<http://www.wsg.washington.edu/> University of Washington Sea Grant

<http://www.ehr.nsf.gov/EHR/ESIE/awards/default.htm> Presidential Awards for Excellence in Mathematics and Science Teaching

<http://www.geocities.com/CapeCanaveral/Lab/9699/> Science Olympiad

<http://www.nsta.org/programs/tapestry/> Toyota TAPESTRY Grants for Teachers

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Thomas D. Hennigan

*Science Teacher, Grades 7-8
DeRuyter, New York*

Living in the woods near Georgetown, New York, Tom Hennigan has developed a keen interest in the natural world and a desire to share that interest with students. Because woods and streams are literally right outside the school door, they have many opportunities to study and observe their environment. Tom's classes are small, less than 20 students, enabling him to do field studies with ease. His interest is integrating environmental studies with other subjects and helping students see connections.

Tom teaches science to his students in both 7th and 8th grades. In 7th grade they get training and set the stage, so in 8th grade they hit the road running with fieldwork. In one unit, students investigate the health of the local Tioughnioga River. They measure and analyze various parameters and draw conclusions about the river's health. Their work has been recognized by the EPA. The highlight of Tom's oceanography unit is a field trip to Massachusetts at the end of the year for whale watching and marine biology studies.

Tom's students participate in Classroom FeederWatch, a project where students across the country identify and count birds they observe, and share their data via the Internet with scientists at Cornell University. In addition to ongoing observations, students identify research questions to investigate, such as "Does the color of the feeder affect the number and kinds of species coming to feed?" and "Does the sound of the barred owl affect bird feeding behavior?" After coming up with a research question, Tom's students devise a method of answering it. Research from one of Tom's students was recently published in Cornell's BirdScope, which generated great enthusiasm. Said Tom, "To see the excitement in her eyes and the motivation gained by her investigation made the whole process more than worthwhile!"

Sharing Expertise:

New York State has very specific standards for grade 5-12 science. Tom finds incorporating environmental inquiry into the standards easy, and he plans to help other area teachers do the same. He hopes providing connections to the standards will help teachers feel comfortable doing student field studies. Tom will present a 1/2-day workshop

on biodiversity for teachers in surrounding school districts. Students will be assistant instructors, as teachers are taught field techniques and collect data in quadrats using the Smithsonian BioMon protocol. Tom will demonstrate high tech equipment, data analysis, and computer modeling, but he will also provide low-cost alternatives to expensive equipment. Workshop participants will be encouraged to keep in touch and support each other via an e-mail network.

Vita

Tom has a B.S. in Natural Resources Management from the University of Alaska, and a M.S.Ed. from Syracuse University. He teaches 7th and 8th grade science in rural upstate New York. As an adjunct instructor at the State University of New York College of Environmental Science and Forestry, he teaches a college credit course called "Global Environment" to high school seniors. During summers, Tom has been a camp naturalist, and has taught wilderness survival skills to teenagers. He has contributed

research for the New York State Amphibian and Reptile Atlas Project. He has published articles on various wildlife topics, and was recently honored with the Outstanding Science Teacher Award by the Technology Club of Syracuse.

Useful Websites:

<http://birdsource.cornell.edu/cfw/> Cornell Laboratory of Ornithology Classroom FeederWatch

<http://www.dec.state.ny.us/> New York State Department of Environmental Conservation

<http://www.dec.state.ny.us/website/dfwmr/wildlife/herp/index.html> New York State Amphibian and Reptile Atlas Project

<http://www.infomall.org/techclub/> Technology Club of Syracuse

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"I love to teach about the importance of habitat, the amazing adaptations found in organisms, and how these organisms interact with each other."

- Tom Hennigan

Larry M. Hodgson

Teacher, Grades 3-4
Laramie, Wyoming

Little kids lobbying the state legislature? Larry Hodgson's elementary school students decided they wanted the Eastern Short Horned Lizard adopted as the Wyoming state reptile, so they drew up a bill, rallied elementary students statewide, delivered petitions with 7,000 signatures, and lobbied the legislature with their cause. They succeeded because they cared about these little herps, and made a good, informed case to the politicians.

Larry loves inspiring in children a love for the critters that share their environment. He created a "Nature Nook" in his classroom, where students observed and cared for various animals, and developed empathy for these living beings. For several years, Larry's students bred African Clawed Frogs. Another classroom project involved caring for and breeding Australian Bearded Dragons, Yemen Chameleons, and Leopard Geckos. His students obtained a permit to relocate Eastern Short Horned Lizards for the Thunder Basin Coal Mine Reclamation. This involved students capturing the lizards near school, weighing and recording their sex, and relocating them to the reclamation area.

Other student projects include field trips to the Cheyenne River dinosaur beds and tracks. Larry's students built a nature walk at school. Recently, his students worked in conjunction with the Wyoming Game and Fish Department and raised brown trout in the classroom and in an in-stream hatching box. They compared development stages and overall health between the two hatching sites.

Larry's current classroom project is a Toyota TAPESTRY-funded effort to study and help save the endangered Wyoming Toad, which is only native to nearby Lake Mortenson. For the project, his students will join forces with local scientific authorities from the Wyoming Game and Fish Department and the Wyoming Children's Museum and Nature Center. In addition, professors from the University of Wyoming, who love the rare opportunity to teach young children, will participate. Said Larry, "When working with a real life problem, students naturally ask questions, dig for answers, and discover wonders that I as a teacher may not even be able to predict."

Sharing Expertise:

While other fields become more specialized, elementary teachers must still be generalists, and sometimes feel like "jacks of all trades and masters of none." Explained Larry, "Presently, as technology in science advances, elementary teachers are more than ever intimidated, resulting in less active science within or outside the classroom." Larry believes the mistake is feeling that they must

master every topic and technology. Instead, he taps the community for the necessary expertise. Larry wants to spread this philosophy to other elementary teachers, and help them make community connections. He will do several inservice sessions for teachers in his district and in southern Wyoming. He and Brandwein fellow Tim Maze will present a session about the Brandwein SLI at the upcoming Wyoming Interdisciplinary Conference. Finally, he will participate in Brandwein sessions at a NSTA Regional Convention, and possibly the NSTA National Convention in St. Louis.

"Whatever the field study may be, I believe it is important for students to align their projects to real life scientific processes and problems. In choosing such projects, local scientific authorities play a vital role in demonstrating proper techniques and protocol."

- Larry Hodgson

Vita

Larry received his B.A. in Elementary Education with a concentration in Science from the University of Wyoming, and is currently enrolled in the Master's of Natural Science program there. He has taught elementary school for 13 years, first in Colorado, and currently in Wyoming. Said Larry, "This recent move [to Laramie] has allowed me to continue my education in the field of Natural Science while doing what I love, teaching the youth of my home state."

Useful Websites:

<http://gf.state.wy.us/> Wyoming Game and Fish Department

For more information:

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But indeed, it is not so much for its beauty— that the forest makes a claim on men's hearts as for that subtle something, that quality of the air, that emanates from the old trees, that so wonderfully changes and renews a weary spirit.

- Robert Lewis Stevenson

Jenelle D. Hopkins

*Science Teacher, Grades 10-11
Las Vegas, Nevada*

The Las Vegas area is booming, so while Centennial High School is currently surrounded by desert, an interstate highway is planned adjacent to campus, and urban development will encroach within a couple years. Jenelle Hopkins is taking this opportunity for students to study and monitor the changing ecosystem around them.

In Clark County, the environmental science course is considered a lower level science course for non-college bound and at-risk students. This group arrives with very weak science backgrounds. Said Jenelle, "As I lead them through a series of investigations, I am hoping to teach them the basic science concepts as well as the source and possible solutions to the environmental concerns that will impact their life in Las Vegas."

Key environmental concerns for the Las Vegas valley are her focus. Issues include water conservation and supply in the desert, and growth-related concerns such as pollution, land use, and biodiversity. Nuclear issues are also at the forefront, as the U.S. Department of Energy studies storage of radioactive waste at Yucca Mountain, only 100 miles north of Las Vegas.

Jenelle recently received an Edwin F. Weigand Fund grant for students to conduct field studies in the desert around the school. A weather station downloads daily weather data into a computer database. Jenelle's students will monitor conditions to see if microclimate change occurs as the desert becomes homes, office buildings, roads, and parking lots. In addition, Jenelle's high school students mentor younger students from feeder schools, teaching them about desert ecology through hands-on activities.

With a physics teacher at her school, Jenelle is developing a GIS "cube" of the students' study area. Said Jenelle, "We will have layers of geology, hydrology, soil, plants, air quality, and anything else we can think of. We are going to be comparing/contrasting our "cube" with one being developed on the other side of town. That high school will be studying a wetlands area adjacent to Lake Mead. Should prove as an interesting contrast with my desert."

Sharing Expertise:

As president of the Southern Nevada Science Teachers Association and an active member of district committees, Jenelle will have the opportunity

to share the Brandwein SLI message with many teachers. Initially, she plans a presentation about the Brandwein experience at state and regional science teacher conventions. She will also present a session focusing on active student engagement for new teachers in the Clark County Schools. Finally, she will give a one-day workshop, possibly offering professional development credit. This workshop will offer training in water quality testing, quadrat mapping, GIS, web-based research projects,

journaling, and alternative assessment techniques. In all cases, she will share her own experiences with student biomonitoring projects and offer to mentor and support the teachers as they start their own programs.

Vita

Jenelle earned a B.S. in geology from the University of Nevada, Reno, and worked as a geologist in the mining industry for several years. Jenelle has been teaching for 7 years, and currently teaches 10-11th grade chemistry and environmental science.

She provides teacher training and presentations and serves on district committees. Jenelle is the current president of the Southern Nevada Science Teachers Association. She is active in course development for the school district, and has written test questions for the new state science proficiency exam. Sponsored by the Nevada Science Project, she spent two weeks touring the Southwest to study sustainability in desert communities along the Colorado River. In addition, she was part of a team of students and teachers participating in a Desert Research Institute program in the Ruby Mountains, where they conducted sampling and DNA analysis of daphnia populations in high alpine lakes.

Useful Websites:

<http://desertusa.com/> Basic information about deserts

<http://www.epa.gov/radiation/yucca/> EPA Yucca Mountain Information

<http://www.dri.edu/> Desert Research Institute

<http://www.snwa.com/> Southern Nevada Water Authority

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"I feel that students need to be able to examine an environmental issue from many angles. This can include political and economic assessment as well as examining different types of scientific research."

- Jenelle Hopkins

D.J. Huddleston

*Life Science Teacher, Grade 7
Page, Arizona*

"There are no natural lakes in Arizona," said D.J. Huddleston. In such a dry environment, water is a precious resource, and D.J. helps students understand this by studying nearby Lake Powell, a large man-made lake on the Arizona/Utah border. With a Toyota TAPESTRY grant, D.J. and his students are working with the National Park Service (NPS) to establish baseline data on the lake level transition zone along Lake Powell's southern shore. The students have established study quadrats on land and in water (which they will study from boats) and are using NPS protocols to collect baseline data on plants and animals. Using standard survey techniques, they monitor the long and short-term effects of weather, seasonal water level fluctuations, and human activity.

Because a majority of D.J.'s students are Native American, and English as a Second Language (ESL), he is especially interested in alternative assessment techniques, and frequently uses portfolios to gauge students understanding. He finds a multidisciplinary approach benefits these students, and often integrates with English and mathematics teachers. D.J.'s ESL students are creating a graphical key to the flora and fauna of Lake Powell, that they will use for their quadrat studies and that the NPS expects foreign tourists will eventually use at Lake Powell.

Since students traveling from reservations up to 50 miles away cannot stay for after-school activities, D.J. developed the "Research Immersion Science Program," or RISP, which offers relevant, hands-on, multidisciplinary science club investigations during study hall periods within the regular school day. RISP activities have ranged from hot-air balloon studies to investigating the effects of acid rain on corn germination.

Prior to moving to Arizona, D.J. taught in Hawaii where he received a grant for students to establish baseline data on ancient Hawaiian fish ponds in various degrees of eutrophication. Students worked with local elders and landowners, using low-impact techniques to restore these aquatic treasures.

Sharing Expertise:

D.J. expects to promote Paul F-Brandwein's philosophy of "science education through hands-on

real science practices" on the local, regional, and national levels. Locally, he will present a workshop for 10 of his peers. The workshop will emphasize field science study techniques, and a hand-held GPS unit will be purchased for each participating school. At upcoming Regional and National NSTA Conventions, D.J. will participate in the "share the wealth" and Brandwein Institute sessions.

Vita

D.J. graduated from Northwestern Oklahoma State University with a B.S. in Zoology and Botany. After graduation, he worked in the biomedical industry and published several biomedical research articles. He has taught science for 17 years, and currently teaches 7th grade general life science in rural Arizona. His students include a high population of Native Americans, many of whom are ESL. D.J. has received a number of grants, including several Effective Schools Project Mini-Grants for student environmental studies in Hawaii. He recently won a Toyota TAPESTRY grant for baseline aquatic studies at Lake Powell, and he was runner-up for an INTEL Innovations in Teaching Award for his criteria-based Research Immersion Science Program (RISP). D.J. recently earned his National Board for Professional Teachers Certification in Early Adolescent Science.

Useful Websites:

http://www.pageud.k12.az.us/MS_Science_Web/Tapestry/about.htm Lake Level Transition Zone Study – funded by Toyota TAPESTRY

<http://www.nsta.org/programs/tapestry/> Toyota TAPESTRY Grants for Teachers

<http://lake.powell.national-parks.org/> Lake Powell National Park

<http://www.intel.com/education/k12/innovations/> INTEL Innovations in Teaching Program

<http://www.nbpts.org/nbpts/> National Board for Professional Teaching Standards

For more information:

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"Inquiry is the ability to question and the motivation to seek out answers to those questions. Inquiry is the basis of true science."

- D.J. Huddleston

Susan Jeffries

Teacher, Grade 5
Bryant, Arkansas

Susan Jeffries loves to teach science! She enjoys involving her elementary school students in various science investigations, and is especially enthusiastic about getting her young students working together with high school students. Her classes join with high school seniors for day-long field studies that include tagging trees and locating fossils. "Through this mentoring," said Susan, "my students were able to gain extensive knowledge."

Susan will use much of her Brandwein grant to support additional student field studies. Her students will study the plants of central Arkansas in collaboration with experts from the Arkansas Forestry Department and the University of Arkansas at Little Rock. Susan's students will create individual field study guides, assist in tree tagging, and mentor other students in various biodiversity activities. Susan expects these activities will increase her students' awareness and knowledge of local organisms and help them understand the importance of respecting and preserving the environment.

Susan frequently does shorter field study activities with her classes and her after-school science clubs. Students keep science logs to record their data, and they often work in cooperative groups, which Susan says help them find confidence in themselves as scientists. They discuss, argue, and refine their ideas while in small groups. Said Susan, "By being involved in more than the science textbook, I can bring more inquiry-based learning to the students I teach. I can bring the National Standards to life instead of having them die on a shelf in my room."

In class, Susan and her students do a variety of long-term projects and investigations. The students maintain a worm bin in the classroom where they recycle newspaper and organic material. Recent long-term student studies include exploring the rate at which buds open on various plants, and studying how surface area affects water evaporation rates. "We may not study as many topics as most classrooms, but we certainly study a few fundamental concepts to a great depth," said Susan.

"I truly believe that the one thing that affects the learning of the students the most is the 'learning' of the teacher. If a teacher is isolated, how can she share the world with her students?"

- Susan Jeffries

Sharing Expertise:

As the science facilitator for one of the largest districts in Arkansas, Susan can influence a great number of both elementary and secondary teachers. She will invite teachers from the regional cooperative of schools to participate in a hands-on workshop on student field studies. At the workshop, Susan will train her peers in techniques for doing fieldwork with upper level elementary students. In addition, Susan will participate in the Brandwein sharing session at the Regional NSTA Convention in Baltimore and will present about the Brandwein experience at the National NSTA Convention in St. Louis.

Vita

Susan has a B.S. in Education from the University of Arkansas and an M.S.Ed. from Henderson State University. A teacher for 13 years, Susan currently teaches 5th grade science. In addition, she teaches language arts to her homeroom. "I am constantly looking for ways to increase my professional knowledge and to grow as an educator," said Susan. Last year, she did a two-week field study in Yellowstone National

Park. Recently, as a Fulbright Memorial Fund Scholar, she spent three weeks in Japan, studying Japanese culture. Susan was a coordinator for the Space Science Student Involvement Program (now NASA Student Involvement Program). She is the science facilitator for her district, and is in the process of getting her National Board Certification as a Middle Childhood Generalist. Susan received the Presidential Award for Elementary Science Education in 1999.

Useful Websites:

<http://www.nsip.net/> NASA Student Involvement Program (formerly SSIP)

<http://www.ehr.nsf.gov/EHR/ESIE/awards/default.htm> Presidential Awards for Excellence in Mathematics and Science Teaching

<http://www.iie.org/pgms/fmf/> Fulbright Memorial Fund Teacher Program

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The last word in ignorance is the man who says of an animal or plant, "What good is it?" ... if the biota, in the course of aeons, has built something that we like but do not understand, then who but a fool would discard seemingly useless parts. To keep every cog and wheel is the first precaution of intelligent tinkering."

- Aldo Leopold

Lori L. Kindsvatter

*Science Teacher, Grades 10-12
Pewamo, Michigan*

Lori Kindsvatter's high school students know all about her affinity for snakes – she has even been known to model her "living jewelry": allowing a snake to encircle her waist and arms. She frequently brings her field experience studying snakes into her classroom teaching, and her enthusiasm for herps is contagious.

She takes her tenth-grade students for four-day field trips to Beaver Island, where she also conducts her own research on the Eastern Milk Snake. After students get an island tour and instruction in using various equipment including anemometers and thermohygrometers, they study five different ecosystems on the island. Students collect data from soil samples, and record and analyze light intensity, cloud cover, canopy, and vegetation. On another field trip to the island, students conduct surveys of dune and bog succession sites. They note vegetation type and diversity from the water's edge to woodland and graph this succession data.

Of course, given her area of expertise, Lori also involves students in snake ecology studies. Snakes are numerous on Beaver Island, and students can easily collect 500 garter snakes of several species in a matter of hours. She shows students how to collect and crunch their data to do snake size and age comparisons, and relate these data to environmental and soil analyses.

Aside from studies on Beaver Island, Lori involves students in various other fieldwork. She takes general biology students into the woods to learn about trees. Each student creates a leaf book that includes characteristics of the collected leaves and information about the trees they come from. She aims for the students in this agricultural community to understand the ecological significance of trees and respect the importance of woodland habitats.

Sharing Expertise:

Said Lori, "I often hear teachers express their frustration about implementing hands-on laboratories into their curriculum since many feel inadequately prepared to do so." To help district teachers implement student field studies, Lori will offer K-12 teachers a workshop summarizing the techniques learned at the Brandwein SLI, helping teachers define inquiry and to see how it can be used for student field research. Lori will provide teachers with "Into the Field" and discuss the art of field observation and journal writing. In addition, she will provide workshop participants with LaMotte Low Cost Water Quality Kits so that

teachers can begin student water studies. She will later offer a similar experience to teachers throughout central Michigan at a second workshop at the Capital Area Science and Math Center. In addition to workshops, Lori will present a session at the Michigan Science Teachers Association meeting, and will participate in the "share the wealth" sessions at regional and national NSTA conventions. Next summer, Lori plans to provide area high school teachers with a weeklong workshop at Beaver Island, learning to use GPS and GIS and to efficiently analyze field data in a geographical system.

"I particularly enjoy the challenge of converting agriculturally-based students into ecologically-minded individuals with a love and respect for nature."

- Lori Kindsvatter

Vita

After graduating from Michigan State University with a B.S. in Medical Technology, Lori worked in a hospital hematology lab. She later earned a B.S. in Science Education at Ferris State University. She has been teaching high school science in an agricultural community in central Michigan for the past nine years. She currently teaches general biology,

chemistry, physics, and anatomy and physiology. Lori is working on her masters thesis "Habitat Selection in the Eastern Milk Snake, *Lampropeltis triangulum triangulum*." For the past three summers she has done field work on Beaver Island, surgically implanting radiotransmitters in the snakes, tracking them using GPS, and using radiotelemetry to collect data about their habitat. Lori has presented inservice sessions for her colleagues and recently co-presented a workshop on evolution for the Michigan Scientific Evolution Education Initiative. She serves as science chair at her school, and coaches Science Olympiad and Quiz Bowl teams. She received the Tandy Technology Scholars Outstanding Teacher Award.

Useful Websites:

<http://www.beaverisland.net/> Beaver Island, Michigan

<http://www.cst.cmich.edu/centers/cmubs/> Central Michigan University Biological Station on Beaver Island

http://jajhs.kana.k12.wv.us/vwv/animal/rep_amph/emilksnake.htm Info on the Eastern Milk Snake

<http://isd.ingham.k12.mi.us/~casm/> Capital Area Science and Math Center

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Ruth Krumhansl

*Science Teacher, Grade 9
Amherst, New Hampshire*

During her career in environmental consulting, Ruth Krumhansl dealt daily with both scientists and non-scientists. She oversaw field studies and clean-ups at Superfund sites around the country, and she felt everyone involved, from lawyers to landowners, would have benefited from clearly understanding the scientific realities of the situations at hand. Ruth became heavily involved in her own children's schools, organizing various science workshops and summer camps. She got together with other scientist-parents and gave workshops to provide kids a glimpse of science in the real world, and created a school "Discovery Room" where parents taught hands-on workshops related to their scientific careers.

Ultimately, Ruth decided to pursue teaching as a career, and she endeavors to bring her experience as a scientist into her classroom teaching. Her 9th graders design field investigations for a real hazardous waste site. Students work as hydrogeologists, soil scientists, hydrologists, and geophysicists to select sampling methods, locations, and analyze the data collected onsite. Ruth's students also have ecological study plots near the school and practice taking field notes at the nearby Souhegan River. Said Ruth, "I find that I can most effectively teach when I engage the students in doing scientific work themselves."

Ruth developed a field study unit called "Reading the Rocks: A Journey into New Hampshire's Past" where students observe the area around their homes, looking for evidence of past mountain-building events, glaciers, and the influence of rivers on the rocks and landscape. She wants them to see rocks as clues to the area's geologic history. Students spend over a month studying their map area and taking field notes. In class, they combine their notes with data from topographic, surficial, and bedrock geology maps to recreate the geologic history of their backyard and interpret what the past environment was like. Students pull together their understanding by writing a scientific paper describing their field studies and including maps and figures that demonstrate their findings.

Sharing Expertise:

Because she's fairly new to teaching, Ruth wants first and foremost to improve her own practice and develop additional field-based activities for her students. She intends to use her Brandwein funds to develop an ecology unit involving student data collection in a forest ecosystem adjacent to school. Students will use the Smithsonian protocol for terrestrial data collection in quadrats identified in the forest. In addition, Ruth plans to communicate to other

teachers the importance of engaging students as scientists and provide practical ideas for how to do this. She will present a workshop to discuss these ideas and provide information about the Brandwein SLI to other science teachers at her school. In addition, she will participate in the "share the wealth" session at the NSTA Regional Convention in Baltimore, and at the NSTA National Convention in St. Louis.

"While in environmental consulting, I worked with not only other scientists and engineers, but also lawyers, government officials, and members of communities affected by environmental pollution. I developed a conviction that scientific literacy is important for all people, whether or not they plan to become scientists."

- Ruth Krumhansl

Vita

With a B.A. in Geology from Bucknell University, Ruth worked for 20 years as a petroleum geologist and environmental consultant. "I managed large field studies assessing the extent of soil, groundwater and surface water contamination," explained Ruth. Later, she received an M.S. in Environmental Studies from Antioch University and decided to pursue a teaching career. Ruth has taught for two years and currently teaches 9th grade integrated science focusing on the physical world. Prior to teaching, Ruth was active in education and especially in encouraging middle school girls in science through Women in Science and Engineering (WISE) career days sponsored by the

Collaborative Project for Math and Science Education at Salem State College. During an internship at the Education Development Center's Center for Science Education, Ruth learned about education reform efforts and contributed to an Implementation Guide for the inquiry-based curriculum Insights in Biology. Ruth particularly enjoys curriculum development. Said Ruth, "I spent several years in graduate school focusing on how to effectively teach science and developing ways in which I could bring my experience into the classroom."

Useful Websites:

<http://www.edc.org/CSE/> Center for Science Education, Education Development Center

<http://www.salem.mass.edu/soas/cpmsie/>

Collaborative Project for Math, Science and Interdisciplinary Education, Salem State College

<http://www.epa.gov/superfund/> EPA Superfund Program

<http://www.epa.gov/ged/wise/wise.htm> Women in Science and Engineering (WISE)

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Timothy Maze

*Teacher, Grade 8
Ranchester, Wyoming*

Tim Maze is fortunate to live and teach in a beautiful rural area at the base of the Big Horn Mountains. However, this agricultural community, like many others, has to deal with environmental issues related to land use. Tim's students are participating in a Coordinated Resource Management (CRM) program that links willing ranchers with school classes and appropriate agencies such as the Soil Conservation Service to make decisions for wise land use. Through CRM, students help landowners find solutions to environmental problems. For example, Tim's students are developing a plan to improve stream bank stabilization on one area ranch. Tim expects that the CRM program will raise issues that lead to science fair projects. Eventually, he plans to expand the CRM program and implement student biodiversity studies on ranchland study plots.

In addition to fieldwork on local ranches, Tim's students have developed a natural area close to school that is used as an outdoor classroom. They do periodic monitoring, an annual survey and condition analysis. With support from the National Forest Service and Sheridan County Extension Service, students planted 400 native trees and shrubs, and monitor their growth and survival rate. The area is now used to teach biodiversity, soil science, succession, survey and management techniques and other topics. Students monitor water quality at the nearby Tongue River and share their data with the Wyoming Department of Environmental Quality.

Each year, Tim takes his 8th graders to the Teton Science School in Kelly, Wyoming for a week-long winter field ecology experience. Leading up to the field trip, students cover a 14-week preparatory curriculum. At Teton Science School, they cross country ski out to study sites where they learn about plant and animal adaptations to winter, weather, snow science, and various field naturalist skills.

Sharing Expertise:

Tim would like to help develop a greater conservation ethic among Wyoming science teachers, and improve their use of field studies. To fill this need, he plans to conduct sessions for teachers at his school and throughout the state. He will invite all K-12 teachers at Tongue River

Middle School to an inservice session where he demonstrates data collection techniques and takes teachers for a tour of the school's outdoor classroom. He will also discuss field teaching ideas and share student projects. With Brandwein fellow and colleague Larry Hodgson, Tim will present a similar session for teachers at the Wyoming Interdisciplinary Conference in Casper, Wyoming. Tim also plans to participate in the Brandwein panel session at the NSTA Regional Convention in Phoenix.

"Students that investigate and find the truths about nature themselves will develop a much fuller understanding of scientific concepts and processes. They also have a lot more fun!"

- Tim Maze

Vita

Tim completed his B.S. in Elementary Education at Montana State University and M.S. in Natural Sciences at the University of Wyoming. For 14 years, he has taught at Tongue River Middle School, a small school in rural Wyoming. He currently teaches grade 8 general science and language arts.

Tim has served on his district's science curriculum committee for a decade, and he is a district science fair coordinator. He also serves on the board of the Wyoming Association for Environmental Education. Tim has presented inservice sessions on topics including astronomy and integrating technology in the classroom. He helped in writing, training, and implementing a district conservation curriculum. Tim was nominated for the Presidential Award for Excellence in Science Teaching and he recently received the Stokes, Love, Leopold Award for Excellence in Environmental Education from the Teton Science School.

Useful Websites:

<http://www.tetonscience.org/normal-index.html>
Teton Science School

<http://www.state.wy.us/governor/openspace/openspaces.htm#31a>
Coordinated Resource Management

<http://www.fs.fed.us/> USDA Forest Service

<http://deq.state.wy.us/> Wyoming Department of Environmental Quality

<http://wind.cc.whecn.edu/~wace/> Wyoming Association for Environmental Education

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*Wilderness can be
a means of
reassuring
ourselves of our
sanity as creatures,
a part of the
geography of hope.*

- Wallace Stegner

Marilyn K. McComber

*Science Teacher, Grades 9-12
Emporia, Kansas*

Several years ago, Marilyn McComber received a GTE GIFT grant and used it to work in the field with scientists on the Kemp's Ridley Sea Turtle project between the U.S. and Mexico. She worked with wildlife experts and researchers from Texas A&M University as they struggled together to establish a nesting ground along the Texas coastline for this endangered turtle. The experience changed her outlook on science teaching. Said Marilyn, "I didn't know how scientists really worked until then."

Since then, Marilyn has relocated back to her home state of Kansas, where she is involving students in environmental studies. They participate in the Kansas Acid Rain Monitoring Project organized by Emporia State University. Her students presented their findings to the Kansas Junior Academy of Science. They have used the Oklahoma Mesonet, a multipurpose network that measures various environmental conditions for use by scientific researchers, educators, and public policy decision makers.

Marilyn's applied biology and chemistry students monitor water quality at a pond on the school campus and at two nearby rivers. The pond is surrounded by development, including an apartment complex and WalMart that drain directly into it. Students take samples at the pond as well as at the Neosho and Cottonwood Rivers. Community residents sometimes have questions and request the students come out to test the local waters. Because waste from the city and a large beef packing facility drain into the Cottonwood River, the students have to face political pressures in their water monitoring.

Since the applied biology and chemistry course is for non-college bound 11-12th graders, Marilyn has a fairly large degree of freedom in her curriculum and involves students in various field projects. She plans to expand their fieldwork to include HabitatNet-style study sites, quadrat mapping using GIS technology, and sharing data electronically with other study sites.

Sharing Expertise:

Marilyn plans to promote the Brandwein spirit of environmental education with other teachers at the local, state, and national levels. She will give a presentation for colleagues at Emporia High School,

and she will share with teachers statewide by giving a session at the Kansas science teachers meeting in the spring. In addition, Marilyn will participate in the Brandwein session at the NSTA National Convention in St. Louis.

Vita

Marilyn has a Bachelor's Degree in Science Education from Kansas State Teacher's College, and a Master's Degree in Science Education from the University of Houston. She has 27 years of teaching experience in grades 6 through college, including a Peace Corps assignment in Belize. Marilyn currently teaches 9th grade earth science and Applied Biology and Chemistry for 11-12th grades. About 30% of her students are English as a Second Language (ESL), many from Hispanic and Asian families attracted to job opportunities at a nearby meat packing facility. Marilyn has recently completed her ESL certification to further assist the diverse student population. Marilyn has presented a number of sessions over the years at state and national science teacher

meetings and recently facilitated a Woodrow Wilson Environmental Workshop on global climate change. She co-chairs the science committee for the school's Quality Performance Accreditation and is involved in mentoring new teachers. Marilyn is a GTE GIFT award recipient, and has sponsored two national winners in student science competitions.

Useful Websites:

<http://www.utexas.edu/depts/grg/ustudent/gcraft/fall96/scroggs/projects/projects.html>

Kemp's Ridley Sea Turtles

<http://okmesonet.ocs.ou.edu/> Oklahoma Mesonet

<http://www.woodrow.org/> Woodrow Wilson National Fellowship

<http://www.ksbe.state.ks.us/outcomes/qpa.html>
Quality Performance Accreditation

http://foundation.verizon.com/04010_a.html
Verizon GIFT Program (formerly GTE GIFT)

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"The exposure to conducting HabitatNet quadrats, water analysis and assessment, GIS experience and an introduction to the KanCRN website has given me the tools needed to further inquiry for myself and to share it with others."

- Marilyn McComber

Connie B. Petruskevich

*Science Teacher, Grades 9-12
Somerset, Texas*

The more the merrier! That's Connie Petruskevich's philosophy about student field study programs. Her students have been involved in GLOBE, Project WET, Project Wild, Project Learning Tree, Adopt A Wetland, Classroom Feederwatch, and more.

Connie's students are monitoring Leon Creek in San Antonio. Prior to attempting fieldwork, her after school science club did a lot of preparatory work so that once outside they knew what they were doing, stayed on task, and stayed safe. Preparatory activities were fun and focused, including games like "critter bingo" to learn macroinvertebrate identification. In the field, students used part of the GLOBE curriculum, and conducted turbidity, dissolved oxygen and pH tests. They placed streambed samples in ice cube trays and took them back to school to view under microscopes. Students wrote up their findings in a formal research report and reported their data at a meeting of the water commission. One student told Connie she liked doing the fieldwork because it made her feel like a scientist. Connie hopes to generate such enthusiasm in even more students next year by expanding the water quality studies to students in her aquatic studies course.

Connie received a grant from the San Antonio Water System for developing a xeriscape area on campus. Her biology students researched and built the garden and students continue to maintain the site. Her classes now use it for observing birds and butterflies.

Even simple things like bird and butterfly watching get her students very excited, so Connie is always searching for new things to do in the field. Working through Our Lady of the Lake University, Connie is in the process of obtaining permission for student biodiversity studies at one of the San Antonio Missions. She continues to pursue additional training herself so she can teach her students new data collection techniques, applications of technology in the field, and reporting and analysis methods.

Sharing Expertise:

"The first goal of this project," said Connie, "is to train, encourage and challenge teachers in my district and the South Texas Rural Regional Collaborative for Excellence in Science Teaching, to

enable their students to do scientific research using approved field techniques." To meet this goal, Connie plans to do a series of presentations based on her Brandwein experience. She will conduct inservice sessions for middle and high school students in her district. Connie also plans to give Brandwein presentations at the South Texas Rural Collaborative meeting and the Science Teachers Association of Texas meeting. In addition, she will participate in the Brandwein sessions at the NSTA National Convention in St. Louis.

Vita

Connie served in the U.S. Army as a clinical lab technician before pursuing a B.A. from William Paterson College of New Jersey. She also earned an M.A. at the University of Texas San Antonio, and is currently working on a Master's in Integrated Science Curriculum. Connie has been teaching for 24 years, and currently works in a small, rural school. She

teaches grade 9-12 biology and aquatic science. Connie has presented at state and local teachers meetings. She recently facilitated a day-long program of Project WET activities, correlating the activities to the state science standards. She and a colleague developed a digital field guide to native plants, and demonstrated it at a Conference for the Advancement of Science Teaching. Connie wrote a curriculum about Riparian Zones for the National Park Service San Antonio Missions. She has received grants for student projects, including one from the San Antonio Water System.

Useful Websites:

<http://www.saws.org/> San Antonio Water System

<http://www.montana.edu/wwwwet/> Project WET (Water Education for Teachers)

<http://www.projectwild.org/main.html> Project Wild

<http://www.nps.gov/saan/> National Park Service San Antonio Missions National Historic Park

<http://www.statweb.org/CAST/> Conference for the Advancement of Science Teaching

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Paul M. Schlotman

*Science Teacher, Grades 11-12
Amherst, New Hampshire*

When Paul Schlotman began teaching at Sauhegan High School, it was newly built, and the campus bore the scars of construction – all the trees were cut down and much of the topsoil scraped away. In this situation, Paul saw opportunity. He set up study quadrats for his students and they began a reforestation project. Eight years later, their efforts are still focused on bringing back this land and creating a natural, productive, sustainable forest area on campus.

In the study quadrats, Paul's students conduct long-term field studies including measuring topsoil, counting plants and animals and monitoring progress over time. Paul's students compare their findings to established white pine forests, and they study successional models in other areas of New England.

To speed the reforestation process, Paul's students research native plants and decide which plants will be appropriate and improve the soil fastest. They rescue native plants from areas under power lines, and they transplant them to the reforestation area with help from master gardeners.

The restoration process includes learning the land-use history of the area, mapping, soil analyses, plant and animal surveys, monitoring growth of woody plants, and evaluating the survival rate of transplants. Students who work on a section as freshmen note changes to their plots as they progress through high school.

Paul teaches an integrated science course for upperclassman that focuses on project-based work. Students in this course do a lot of field studies. Explained Paul, "In my teaching, I have my students walk through the wooded area around the school and just come up with questions. I then have them answer the questions." For example, students wanted to know how far birds come below the forest canopy. To answer this question, they hung birdfeeders every few meters in the forest and measured seed loss. Other questions students have examined include determining the size of the local deer population, evaluating the solar radiation difference between field and woods, and considering questions about bird migration. These student studies lead to very interesting results and even more questions that fuel additional fieldwork.

Sharing Expertise:

Paul wants his students to gauge the effects of global warming in southern New Hampshire by

studying the impact of decreased snowfall on various organisms in the area. Many organisms depend on the insulating value of snow for winter survival, and the effects of delayed and decreased snowfall are unknown. Students will identify local organisms that depend on snow cover, and with help from experts, they will study the impact of warmer winters. Paul will use Brandwein funds to enable his students to share their research and protocols with other high schools in the area and at local and national science teacher conventions including the New Hampshire Science Teachers Association and NSTA. Said Paul, "Data will be shared with government agencies to add data and possibly help develop policies to stop global warming."

Vita

Before entering the teaching profession, Paul was a chemical engineer and worked on EPA contracts. He has been teaching for 20 years, and has been at award-winning Souhegan High School since it was established 8 years ago. Paul currently teaches an integrated science course for 11-12th graders that focuses on nature and the environment. Over the years, he has taught various other science and mathematics courses, as well as Native American Studies. Paul helped establish a Community Council at the school, a democratic forum

where students, faculty, community and school board members discuss and resolve issues that concern school life. He has done a variety of presentations, including an annual workshop for preservice teachers at Hampshire College, focused on inquiry and integrated approaches to science teaching. He facilitated an Annenberg Summer Institute on inquiry teaching at Brown University. In 1998, Paul participated in the National Humanities Center's institute, "Nature Transformed: Imagination and the North American Landscape." He was a Math/Science fellow at the Coalition of Essential Schools.

Useful Websites:

<http://www.nhc.rtp.nc.us:8080/> National Humanities Center

<http://www.essentialschools.org/> Coalition of Essential Schools

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"Inquiry is a human instinct. I have a two-year-old son, and watching him find out about the world through his various exploration and discovery methods reminds me that this is something human beings do naturally."

- Paul Schlotman

The last pleasures of contact with the natural world are not reserved for scientists but are available to anyone who will place himself under the influence of earth, sea and sky, and their amazing life.

- Rachel Carson

Blake Sills

*Science Teacher, Grades 11-12
Ft. Worth, Texas*

How does environmental education affect students? That was the question Blake Sills decided to address in his Master's degree thesis. He developed his thesis to measure a person's environmental ethic, and gauge how he was impacting the middle school children he involved in extracurricular environmental studies.

An urban setting and traditional science curriculum somewhat limited the amount of fieldwork and inquiry-based teaching Blake could do with his classes. "I am always striving to create/find/borrow/steal activities that engage my students into inquiry-based learning. It is this type of engaging learning that kids respond to and benefit from most," said Blake. So he established an afterschool club called "The Environmentals" who met twice weekly, adopted a stream, monitored it, assessed its water quality and reported their results. Their effort was part of the Texas Watch project, a statewide grassroots environmental program. This experience helped the kids develop an appreciation for the stream, trees, and small natural areas in the city.

Blake now teaches in a large, urban high school where virtually no student fieldwork takes place. The fact that most of the other teachers are untrained in field techniques, as well as its urban setting, contributes to this lack. Blake will teach environmental science this year, and although challenged by the logistics of moving students to off-campus sites, he plans on getting them outdoors to study the environment as much as possible.

Sharing Expertise:

With Brandwein funds, Blake is developing a biomonitoring program at a local off-campus natural area that will allow his high school students to use scientifically rigorous data collection and analysis techniques. He will invite fellow biology teachers who are unfamiliar with environmental fieldwork and provide training in field techniques and technologies. Brainstorming and discussion will follow the teacher training, so that teachers have

concrete ideas for use with their classes. Brandwein funds, together with matching district funds, will enable participating teachers to take students to field study locations multiple times during the school year. In addition to teachers at his own school, Blake will share the Brandwein experience with teachers at the NSTA Regional Convention in Phoenix.

Vita

Blake has a B.S. in Wildlife Biology from Stephen F. Austin State University, and recently finished his Master's in Environmental Science from the University of North Texas. His thesis was "Assessing effects of an environmental education field science program fostering responsibility at an urban middle school." Before teaching, Blake was a zookeeper in the bird department of the Ft. Worth Zoo, where he successfully bred endangered species. He taught middle school science for 13 years, and high school science for three. This year, he will teach AP biology and AP environmental science. He recently held a summer environmental science internship that involved wetlands delineation and permitting, site inspections, and GPS and GIS fieldwork. Blake presented a session at the Texas State Science Teachers Convention on using technology in the science classroom. He was selected by the Ft. Worth Clean City Committee as Environmental Teacher of the Year. Blake recently received a grant that will enable him to bring technology, such as CBL labs and probeware, into his students' environmental science field studies.

Useful Websites:

<http://www.texaswatch.geo.swt.edu/> Texas Watch

<http://www.ccities.doc.gov/> Clean Cities

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"The inquiry method of teaching allows students to practice science in its true form, making observations of phenomena that lead to more questions and greater understanding. Students are challenged to think critically on a high level and use creative problem solving techniques in seeking answers."

- Blake Sills

Anne L. Tweed

*Science Teacher, Grades 9-12
Aurora, Colorado*

We all learn best by doing. That's why experiential learning and inquiry are the guiding principles for Anne Tweed. Anne's environmental science students conduct field research of their own design at the Plains Conservation Center. Prior to working in the field, they complete preparatory work, such as learning sampling techniques and how to record field data. Students have concentrated on vegetation studies using quadrat sampling and transect lines. They also do biodiversity studies at various sites. These studies include calculating diversity indices and comparing habitat diversity to averaged data.

In addition to local fieldwork, Anne has traveled with students, studying marine science in California, Hawaii, and Mexico. For 12 years, she taught a Marine Mammals and Island Ecology course, taking her land-locked Coloradoan students to San Diego for extended studies. One year, Anne and her students participated in Bob Ballard's Jason Project off the coast of Baja, Mexico. There they studied gray whales, and students worked on research projects alongside scientists – a truly memorable experience.

Ten years ago, when Anne began teaching at Eaglecrest High School, there were pronghorns, porcupines, and rattlesnakes within view of school, so it was easy to engage students in nature. Since then, suburbia has encroached, an interstate highway was built adjacent to the school, and nature suddenly seemed far away. Students developed a natural area on campus, consisting of native prairie grasses. Now this area is where students learn to read the signs of nature and ask inquiry questions.

Anne recently received a Toyota TAPESTRY grant that will enable her students to collect and analyze data from a variety of habitats in the Chatfield Basin Drainage Area. Students will do water quality studies, riparian sampling, collect data in a scrub oak habitat, and map a prairie dog town. Said Anne, "I like teaching all aspects of fieldwork from designing studies to gathering data and interpreting and redesigning inquiries."

Sharing Expertise:

Anne plans to share her Brandwein experience far and wide. She will train other teachers about biodiversity studies and student investigations at both the state teachers convention and all of the NSTA conventions in the coming year. In addition to convention sessions, Anne will offer teachers a two-day hands-on workshop through the Colorado School of Mines. Teachers will learn sampling techniques and protocols and practice using the

tools to gather, analyze, and present biodiversity data. The teachers will take away with them the resources they need to implement fieldwork with their own students, and will have opportunities to network with other teachers in the state who are conducting biodiversity studies.

Vita

Anne earned a B.A. in biology from Colorado College and an M.S. in botany from the University of Minnesota. She has taught for 25 years in suburban Denver. She currently teaches biology, AP environmental science, and marine science. Anne is very active professionally at the local, state, and national levels. She has given workshops on various topics including performance assessment, student portfolios, and inquiry. She is a member of the Colorado Science Education Leadership Cadre, and worked on an Inquiry Toolkit that is

used at staff development presentations throughout the state. She is co-author of an environmental science textbook published by Scott-Foresman-Addison Wesley, and she has contributed to other textbook and curriculum projects. She is an active member of NSTA, serving on various committees and on the board of directors. Anne is on the national judging committee for the Toshiba NSTA ExploraVision Awards program. She herself has won many awards and grants over the years, including the NSTA Distinguished High School Teacher Award, GTE GIFT, and Toyota TAPESTRY.

Useful Websites:

<http://www.ci.aurora.co.us/parks/PLAINSCENTER.htm>

Plains Conservation Center

<http://www.douglas.co.us/DC/Manager/chatfield.htm>

Chatfield Basin Conservation Network

<http://www.jasonproject.org/> Jason Project

<http://www.nsta.org/programs/tapestry/> Toyota TAPESTRY Grants for Teachers

<http://www.mines.edu/> Colorado School of Mines

<http://www.toshiba.com/tai/exploravision/> Toshiba NSTA ExploraVision Awards

<http://www.nsta.org/programs/> NSTA Awards Programs

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"I am an advocate of Rodger Bybee's (Executive Director, BSCS) five E's for student learning: engage, explore, explain, elaborate, and evaluate."

- Anne Tweed

Brandwein Summer Leadership Institute Resource People

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Dan Bisaccio

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Dan has been developing and implementing a districtwide program to meet the needs of students for the 21st century. Souhegan High School, now in its seventh year, has received a number of state and national awards for offering public school students authentic research and interdisciplinary opportunities in academic areas. During this time, Dan has won several national awards for teaching. His work is cited in George Wood's *Schools That Work* (1993) and Robert Fried's *The Passionate Teacher* (1995). In addition, he received a Toyota TAPESTRY Grant for his project HabitatNet: A Global Biodiversity Monitoring Project.

Steve Case

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Steve Case has experience with grant reviewing and writing. He served on review panel for NSF, and has also reviewed grants for the U.S. Department of Education. He has written many grant proposals, that have ranged from small in-school district minigrants to his current project, a \$4.5 million Technology Innovation Challenge Grant through the U.S. Department of Education. He is currently at the University of Kansas, although he was a classroom teacher for twenty years. He taught a field class called Student Naturalist in which they did lots of field research. He also lived on and managed a 300-acre tallgrass prairie nature center for 12 years.

Marilyn DeWall

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Meg Domroese

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Meg Domroese is Outreach Program Manager for the American Museum of Natural History's Center for Biodiversity and Conservation. In association with the Center's international field projects, she develops training materials and workshops on biodiversity education and interpretation for education specialists. She coordinates the Center's participation with other Museum departments to develop public programs and publications to raise awareness of biodiversity conservation. Meg has a M.S. from Michigan State University with a concentration in international development and conservation.

Otto Heck

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Jay Holmes

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Jay started working at the Museum in 1992 as a lecturer for the special exhibit *Global Warming: Understanding the Forecast*. In 1993, he became the Coordinator of the Museum's After School Program for high school students. This program is a series of five session courses in the natural sciences and anthropology. Participating students work with museum educators and scientists from institutions around New York in hands-on laboratory classes. This

Take heed to the world of our grandfathers who instruct us to "take care how you place you moccasins on the earth ... for the faces of the future generations are looking up from the earth, waiting their turn for life."

- Oren Lyons

spring, Jay transferred to a new project, the Discovery Room, a Hands-on learning area in the Museum scheduled to open in April 2001. Over the past 8 years, Jay has also been the advisor for the Museum's Ecology Club for teens and YouthCaN, a collaborative project between New York University, the International Education and Resource Network and several schools. YouthCaN culminates in an international environmental conference for youth by youth. Jay also conducts teacher workshops and writes curricula in a variety of geology and environmental science subjects. Prior to working at the Museum he was a laboratory manager for an environmental consulting firm in New York and a junior high school science teacher. He has a Bachelor of Science from Rensselaer Polytechnic Institute in Geology and attended graduate school in geophysics at the Pennsylvania State University.

Teresa Ippolito

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Terry is the Environmental Education Coordinator for U.S. EPA's office in New York City serving New Jersey, New York, Puerto Rico and the U.S. Virgin Islands. She came to EPA in 1988 and in 1990 transferred to the Community Relations Branch. While coordinating Region Two's environmental education program, Terry is also the region's program coordinator for the grants program authorized under section six of the 1990 National Environmental Education Act. Terry came to EPA after sixteen years in education as a science teacher and school administrator. Her years in education were preceded by two years as a medical research technician. Her current position at EPA combines her educational expertise with a long standing interest in the environment. She holds a bachelor's degree in biology from Marymount College. She did graduate work at New York University and received a master's in environmental health science from Hunter College, City University of New York.

Pat Lynch

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Ed McGowan

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A native of western New York, Ed developed his interest in natural history during childhood summers spent on his grandparent's farm (much like the Brandwein Farm at Rutgers Creek). After receiving a B.A. in Biology and Environmental Studies from Bowdoin College in 1988, he worked for the U.S. Fish and Wildlife Service in Alaska on a wide range of wildlife studies. He returned to New York in 1990 to join the Department of Environmental Conservation (DEC) Endangered Species Unit, where he spent six years researching New York's rare and endangered fauna. In 1996, he left the DEC to pursue a Ph.D. in biology at the State University of New York at Binghamton. Currently in his final season of field research near his home in the Hudson Valley, Ed is investigating the mating behavior and reproductive ecology of the timber rattlesnake, a state threatened species and one of just three venomous snake species native to New York. He has also worked as a contract zoologist with the New York Natural Heritage Program during the past two years on surveys of New York's rarest reptiles.

Ed has recently begun to inventory the reptiles, amphibians, mammals, and fishes of the Rutgers Creek Conservancy using a variety of live-traps and search techniques. The inventory will provide baseline data on the diversity and distribution of these vertebrate groups for use by future researchers young and old. Ed and his wife Panni live in Fort Montgomery near the Hudson River where they share their property with 8 species of frogs, 4 species of salamanders, 5 species of snakes, and 3 species of turtles (and counting).

Mike Mogil

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H. Michael Mogil is a certified consulting meteorologist with B.S. and M.S. degrees in meteorology from Florida State University. He has

earned the American Meteorological Society's Television Seal of Approval and is also a Certified Consulting Meteorologist. He has practiced meteorology for over 30 years, working closely with educators across the country since 1979. He has also taught fifth grade math and science. Mike has co-authored several books about weather experiments and a comprehensive teacher's guide for using the newspaper to study weather in the classroom. He has also developed several weather posters and cloud charts. He has written scores of articles for National Science Teachers Association and American Geologic Institute journals, and numerous other magazines and newspapers. During 1999 he served as a consultant to the Discovery Channel's new WEATHER Field Guide. Mike has also co-authored six articles in the "Geography and Weather" series in Science and Children Magazine. He recently began serving as the weather consultant to Grolier's New Book of Knowledge Encyclopedias and Mississippi State University's "Teachers In Geosciences" Education Program.

Mike has also conducted dozens of in-service teacher training workshops and graduate courses in meteorology and many workshops for young people nationwide. He is an avid photographer and videographer with published weather photographs in numerous weather text and trade books, educational journals, various magazines, and the Washington Post. Mike was recognized by the National Weather Association in 1988 for his outstanding efforts in weather education.

Kelly Nolan

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Kelly Nolan is the Mohawk River regional coordinator for Hudson Basin River Watch. He is active in training volunteers, teachers, and area students in stream monitoring, and has recently completed a stream study on the Indian Kill in Glenville, New York. He previously worked as the assistant director for the Environmental Clearinghouse of Schenectady where he established both an environmental summer day camp for middle school students and an environmental study team for local high school students. The study team, which he continues to advise, works with numerous environmental agencies on outdoor and conservation projects. Kelly has also served as

educator and advisor for Schenectady County students participating in the Envirothon. He is a research associate for Bat Conservation International, and has supervised students in making and installing bat houses for the NYS DEC Stoneykill Environmental Education Center. A native of Glens Falls, New York, Kelly has also lived in Mississippi where he worked as a forest technician and earned a degree from Mississippi College. He lives in Niskayuna, New York, with his wife and two children.

Bill Olson

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Bill Olson, who has completed course work towards a master's degree in biology with an emphasis on plant ecology, currently works with Maser Consulting, an environmental consultant firm in New Jersey. He has experience with Wetland delineation, natural resource evaluations, environmental impact analysis, and many other aspects of ecology. With his extensive botanical knowledge, he has conducted numerous field investigations to determine the presence or absence of rare and endangered species. Olson's expertise is not limited to plants, as he has identified rare and endangered reptile, amphibian, and bird species as well. Well accomplished in his field, Olson is a member of numerous regional professional societies including the Philadelphia Botanical Club, the New Jersey Native Plant Society, and the New England Botanical Club. National Societies with which he is associated include the National Audubon Society and the Nature Conservancy. His dedication to ecology and science is complemented by his commitment to science education, having been involved in seminars, workshops, and presentations to share his experience and knowledge with others.

John Poliero

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Joseph M. Russo, Ph.D. in agricultural meteorology, is cofounder and president of ZedX, Inc., a 10-year-old information technology company that specializes in custom weather databases and decision support algorithms for the agricultural and environmental industries. He has created databases and algorithms compatible with geographic information systems and other data management programs. Russo's research duties call for participation in the design phases of university, government, and private projects that require information from meteorological and other environmental data sets. From 1981 to 1988, Russo was an assistant professor of agricultural climatology at the Pennsylvania State University. His research efforts were in theoretical aspects, experimental designs, and database needs of agricultural production systems. Since 1993, Russo has been active in the International Geosphere-Biosphere Programme, which conducts research worldwide on how climate change will impact global biogeochemical cycles and life support processes. He also participates in the Biospheric Aspects of the Hydrological Cycle program and the Data and Information System committee. As part of the former program, Russo is cooperating with an international team of scientists evaluating numerous collected and generated climatological and environmental data sets for incorporation into ecological and hydrological models. These evaluations are being published.

John Serrao

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Dorothy Smullen

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Dorothy Smullen has an M.A. in biology from Brooklyn College, and received an NSF fellowship for a six-week study of tropical botany in 1968. She served as director of the Reeves-Reed Arboretum in Summit, New Jersey for five years. Dorothy has taught middle and high school science for 15 years, currently at North Plainfield High School. For ten years, she's been teaching environmental science and biology. She has been a member of the New Jersey Mycological Association for 25 years, and has served as the group's president. She received the Eximia Award from the Northeast Mycological Foray in 1987 for her contribution to amateur mycology. Dorothy has lived in Millington, New Jersey for 31 years with her husband and two children.

Mike Trimble

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John Michael Trimble, M.S. in education, has taught biology at Corona del Sol High School for 20 years. He also teaches classes for dual high school and college credit in biology and environmental science and courses in human ecology at local colleges. Mike, a native Arizonan who grew up close to desert and farmlands, brings his outdoor experience-camping, hunting, horse packing, scuba diving, canoeing-both into his classrooms and into fieldwork. He has developed several courses that include substantial outdoor experiences. These include a biology program that trains students in wilderness survival, independent field research, oceanography, and diving, as well as applied anatomy and physiology and a summer field program emphasizing partnerships with working scientists in wildlife management, riparian ecology, and so forth. He has received numerous grants to develop and implement these and other programs and won various awards for his work.

*Treat the earth
well. It was not
given to you by
your parents, it
was loaned to you
by you children.*

- Kenyan Proverb

The Paul F-Brandwein Institute Board of Directors

William D. Bavoso

Bavoso & Plotsky

Port Jervis, New York

William Bavoso, JD, is admitted to practice law in New York, Florida, Pennsylvania, and the U.S. Supreme Court. He is a fellow and director of the New York Bar Foundation and member of the Ninth Judicial District Grievance Committee, overseeing ethical conduct of attorneys in five counties. He has served as President and Director of the Orange County, New York Bar Association and as the Orange County Delegate to the New York State Bar Association House of Delegates. William is the attorney for several town in New York, and his column "It's the Law" appears monthly in the Tri-States Gazette.

Henry Burger

Hoffberg, Oberfest, Burger, Berger

New York, New York

Marilyn DeWall

Executive Director, Jason Academy

Jason Foundation for Education

Lorton, Virginia

Marilyn DeWall is Director of the Jason Academy for Science Teaching and Learning, a new initiative of the Jason Foundation for Education. The Jason Academy will provide online science content courses for middle level teachers beginning in Fall 2001. Marilyn previously spent many years with the National Science Teachers Association, most recently as Associate Executive Director of Corporate, Legislative and Public Affairs. She also served as director of the Building a Presence for Science Program and oversaw many industry-sponsored programs, such as those affiliated with Duracell, Shell, Sears, Toshiba, and Toyota. In addition, she was editor of various NSTA journals and publications including Science Scope (for middle and junior high school science teachers), which she launched in 1978 and edited for nine years. She has been principal investigator for several National Science Foundation-supported programs, award programs, and student science competitions. Marilyn planned and coordinated two international NSTA conferences, was instrumental in the formation of the Academy of Mexican Science Teachers, and serves on numerous advisory boards.

Dr. William F. Hammond

President, Natural Context

and Associate Professor of Interdisciplinary Studies

Florida Gulf Coast University

Fort Myers, Florida

For over three decades, William F. Hammond, Ed.D. and Ph.D. in curriculum theory and

environmental education, was the director of curriculum development services and environmental education for the Lee County School District in Fort Myers, Florida. His career began with a decade of junior and senior high school science teaching. In the late 1960's, Bill became the Lee County science supervisor and coordinator of environmental education, positions he held until 1983. At that point, he became the district's director of the Department of Curriculum Services, retiring in 1993. From 1978 to the present, he has been consulting in corporate training for several Fortune 100 companies through his firm Natural Context. In 1997, Bill joined the faculty of Florida Gulf Coast University. During the course of his school, university, and consulting career, he has lectured, made presentations, and led workshops on curriculum and program development. He has presented in all 50 states, Canada, England, the former Soviet Union, and 19 Caribbean nations. He advises a wide range of private and public organizations, as well as over 250 nonprofit organizations.

John "Jack" Padalino

President

Paul F-Brandwein Institute, Inc.

Pocono Environmental Education Center

Dingmans Ferry, Pennsylvania

John Padalino, M.S. in field natural history, M.S. in conservation education, and Ph.D. candidate in science education, has been working at the Pocono Environmental Education Center (PEEC) since 1972, assuming his current post in 1986. PEEC, which cooperates with the National Park Service, is the largest residential center for the study of the environment in the Western Hemisphere. Before coming to PEEC, he taught precollege science and social science and directed Head Start programs. Since 1992, with support from the Rockefeller Foundation, Jack has been providing technical assistance to education specialists from nature preserves in the former Soviet Union. Jack wears a number of other hats as well. In the late 1960's and early 1970's, he was a Trainer of Teacher Trainers at New York University. In the early 1980's, he was principal investigator on two National Science Foundation-sponsored initiatives in field science, science leadership, and science for persons with disabilities. Late in the decade, he led a Wheels of the Mind project sponsored by the Apple Corporation. He is president of the John Burroughs Association and past president of three national science and education organizations. He is also an active member of the National Science Teachers

Association and a fellow of the American Association for the Advancement of Science. Jack has received numerous awards, most recently the Thomas P. Shelburne Environmental Leadership Award from the Pennsylvania Environmental Council (1997).

Alan R. Sandler

Executive Director

*Architectural Foundation Of San Francisco
San Francisco, California*

Alan R. Sandler is the Executive Director of the Architectural Foundation of San Francisco (AFSF). Alan joined AFSF in the summer of 1999 to develop, implement and administer AFSF programs. Prior to directing AFSF, Alan was director of operations and education programs for The American Architectural Foundation and The American Institute of Architects from 1979 to 1999. At the AAF and the AIA, Alan was responsible for the development of Learning by Design, the AAF's elementary and secondary education program, which involved development and dissemination of information resources, teacher training, and instructional materials to the education and architectural communities. He also established a national technical assistance network. Alan served as an advisor for technology and instructional television programs, and served as the executive producer of The White House Is Our House: A CD-ROM Visit. Alan coordinated the management of Building Connections: Enriching Learning Through the Power of Architecture and Design, a concept paper released in 1999 by the Carnegie Foundation for the Advancement of Teaching and the AAF. This report explored the possibility that the design process used by architects to create buildings might also serve as a general model for teaching and learning, and it discussed the ability of architecture itself to be used as a tool for enriching curricula in a variety of subject areas. Alan has authored publications and articles on education and also has

served as contributing editor to several education journals and magazines. Alan also has served as an education administrator in several school districts in Florida. He has also worked for the U.S. Forest Service and the Florida Governor's Office, as well as serving as a consultant to school systems throughout the nation.

Keith A. Wheeler

Director

*The Center for a Sustainable Future
Shelburne, Vermont*

Since 1997, Keith Wheeler, M.S. in soil science, has directed the Center for a Sustainable Future, an international nongovernmental organization whose mission is to educate learners of all ages to act sustainably on personal, family, community, and global scales. He was the first executive director of the 136-nation Global Rivers Environmental Education Network, an organization aiming to create formal and informal educational programs and networks that focus on watershed sustainability and stewardship. As the assistant director for the Adirondack Park Agency (New York, 1987-1993), he worked for sustainable development and sensible land use of the state's natural resources, both public and private. He has also worked in research, policy, and management capacities for the U.S. Department of Agriculture and as a research soil scientist for Cornell University (New York). Keith has also served as member and leader of many international, federal, national, and local organizations working for education for sustainability and the environment, for conservation, for science education, and for watershed protection. In addition, he consults in national and international policy settings to encourage creation of sustainable programs in developing areas. He contributes publications and makes presentations dealing with resource issues, education, and sustainability and is currently at work on a book tentatively titled Education for Sustainability: A Paradigm for the 21st Century.

The Paul F-Brandwein Institute Staff

David M. Foord

Assistant Director

Greenville, New York

David M. Foord, M.S. in environmental studies, joined the Brandwein Institute as assistant director in 1997. Before coming to the Institute, he studied and worked in advertising in Philadelphia and New York. In 1988, he left the ad industry to pursue his interest in film, beginning in freelance film production and working as a production assistant and lighting technician on the sets of commercials,

features, and video projects.

During his New York film career, Foord's continuing commitment to conservation led him to maintain a small orchard in nearby Burlington County, New Jersey. Eventually, he also left the film business for a career in environmental education, first working as an intern at the New Jersey School of Conservation and then entering graduate school. He spent four summers as assistant director of a wilderness camp in Maine.

The Paul F-Brandwein Institute Fellows

Richard W. (Dick) Arnold

Special Assistant to the
Chief for Soil Science
Natural Resources
Conservation Service
U.S. Department of Agriculture
Washington, D.C.

Vernon R. Beeson

Science Teacher
Banks High School
Banks, Oregon

Daniel Bisaccio

Science Teacher
Souhegan High School
Amherst, New Hampshire

Allen R. Bone

Life Science Teacher
East Middle School
Butte, Montana

David L. Brock

Biology Teacher
Roland Park Country School
Baltimore, Maryland

David E. Brown

Teacher
St. Peter School
Quincy, Illinois

Robert Williams Brown

Science Teacher
The Wheeler School
Providence, Rhode Island

John M. (Jack) Byrne

Project Director
The Center for a Sustainable Future
Shelburne, Vermont

Gary L. Endsley

Regional Science Specialist
Texas Rural Systemic Initiative
Jefferson, Texas

Edwin (Win) M. Everham, III

Assistant Professor
Program Director of
Environmental Studies
Florida Gulf Coast University
Fort Myers, Florida

Deborah C. Fort

Freelance Writer and Editor
Washington, D.C.

Miguel A. Germain

Science Teacher
Miami Sunset Senior High School
Miami, Florida

Lura Hegg

Teacher
Colony Middle School
Palmer, Alaska

Thomas D. Hennigan

Science Teacher
DeRuyter Central School
DeRuyter, New York

Larry M. Hodgson

Teacher
Linford Elementary School
Laramie, Wyoming

Jenelle D. Hopkins

Science Teacher
Centennial High School
Las Vegas, Nevada

D.J. Huddleston

Life Science Teacher
Page Middle School
Page, Arizona

Susan Jeffries

Teacher
Springhill School
Bryant, Arkansas

Elizabeth (Beth) Johnson

Division Chief for Research and
Resource Planning
National Park Service
Delaware Water Gap National
Recreation Area
Bushkill, Pennsylvania

Lori L. Kindsvatter

Science Teacher
Pewamo-Westphalia High School
Pewamo, Michigan

Ruth Krumhansl

Science Teacher
Souhegan High School
Amherst, New Hampshire

Elissa R. Levine

Soil Scientist
Biospheric Sciences Branch
Goddard Space Flight Center
National Aeronautics and Space
Administration
Greenbelt, Maryland

Timothy Maze

Teacher
Tongue River Middle School
Ranchester, Wyoming

Marilyn K. McComber

Science Teacher
Emporia High School
Emporia, Kansas

Bill Olson

Field Botanist
Maser Consulting
New Jersey

Larry Peterson

Director
Florida Design Initiative
School of Architecture
Florida A & M University
Tallahassee, Florida

Connie B. Petruskevich

Science Teacher
Somerset High School
Somerset, Texas

Joseph M. Russo

President
ZedX, Inc.
Bellefonte, Pennsylvania

Paul M. Schlotman

Science Teacher
Souhegan High School
Amherst, New Hampshire

Blake Sills

Science Teacher
R.L. Paschal High School
Ft. Worth, Texas

John A. Smallwood

Assistant Professor of Vertebrate
Ecology
Department of Biology
Montclair State University
Upper Montclair, New Jersey

Cynthia Hart Stevens

Teacher
W. C. Mallett School
Farmington, Maine

Calvin Whitney Stillman

Professor Emeritus
Rutgers University [New Jersey]
St. Petersburg, Florida

Frank William Taylor

Science Teacher
Radford High School
Radford, Virginia

John Michael Trimble

Science Teacher
Corona Del Sol High School
Tempe, Arizona

Randolph Richard Tully, Jr.

Resource Teacher
Lee County School District
Fort Myers, Florida

Anne L. Tweed

Science Teacher, Grades 9-12
Eaglecrest High School
Aurora, Colorado

Brad Williamson

Biology Teacher
Olathe East High School
Olathe, Kansas

Internet Resources

Please note: these websites are available as direct links on the Paul F-Brandwein web site: <http://www.brandwein.org>

Organizations and Schools

<http://ael.er.usgs.gov/groups/gis/hemlock/dewa.html>
USGS ecological research at Delaware Water Gap NRA
<http://pw.k12.mi.us/hs/hs.htm> Pewamo-Westphalia High School, Michigan

<http://sunsethigh.dade.k12.fl.us/> Miami Sunset Senior High School

<http://sustainable.state.fl.us/> Florida Design Initiative

<http://trms.sheridank12.net/> Tongue River Middle School, Wyoming

<http://www.aafpages.org/> American Architectural Foundation

<http://www.butte.k12.mt.us/schools/ems.html> East Middle School, Montana

http://www.cpn.org/sections/affiliates/center_study_community.html Center for the Study of Community and the Sol y Sombra Foundation

<http://www.deruyter.k12.ny.us/> DeRuyter Central School, New York

<http://www.ehs.ccsd.k12.co.us/> Eaglecrest High School, Colorado

<http://www.jasonproject.org/> Jason Project

<http://www.mat-su.k12.ak.us/schdist/> Colony Middle School, Alaska

<http://www.nature.nps.gov/sfancy/> NPS Monitoring Natural Resources in our National Parks

http://www.pageud.k12.az.us/MS_Home/Default.htm Page Middle School, Arizona

<http://www.paschalhs.org/> R.L. Paschal High School, Fort Worth

<http://www.rpcs.org/> Roland Park Country School, Baltimore

<http://www.somerset.k12.tx.us/hs.htm> Somerset High School, San Antonio

<http://www.sprise.com> Souhegan High School, New Hampshire

<http://www.texasrsi.org/main.htm> Texas Rural Systemic Initiative

<http://www.umf.maine.edu/> The University of Maine at Farmington

<http://www.usd253.kansas.net/~ehs/> Emporia High School, Kansas

<http://www1.nature.nps.gov/im/index.html> NPS Inventory & Monitoring

Science and Math Education Resources

Botany

<http://www.bbg.org/> Brooklyn Botanic Garden

<http://www.botany.hawaii.edu/faculty/carr/fp/families.htm>
Images and Descriptions of Flowering Plant Families

<http://www.botany.org/> Botanical Society of America

<http://www.bonap.org/> Biota of North America Program (BONAP) of the North Carolina Botanical Garden

<http://www.cnps.org/> California Native Plant Society

<http://www.for-wild.org> Wild Ones - Natural Landscapers

<http://www.gardenweb.com/> Garden Web

<http://www.helsinki.fi/kmus/botvasc.html> Internet Directory to Vascular Plants

<http://www.nationaltreetrust.org> National Tree Trust

Education Organizations

<http://www.aaas.org> American Association for the Advancement of Sciences

<http://www.nsta.org> National Science Teachers Association

<http://www.concord.org/> The Concord Consortium

<http://www.edc.org/CSE/> Center for Science Education, Education Development Center

<http://www.efgedu.org> EFG Global Partners

<http://www.enc.org> Eisenhower National Clearinghouse

<http://www.epa.gov/ged/wise/wise.htm> Women in Science and Engineering (WISE)

<http://www.essentialschools.org/> Coalition of Essential Schools

<http://www.nbpts.org/nbpts/> National Board for Professional Teaching Standards

<http://www.salem.mass.edu/soas/cpmsie/>
Collaborative Project for Math, Science and Interdisciplinary Education, Salem State College

<http://www.statweb.org/CAST/> Conference for the Advancement of Science Teaching

Environmental Education

<http://adopt-a-watershed.org/> Adopt-A-Watershed

<http://atm.geo.nsf.gov/devo/extras/dsinfo.html> The DataStreme Project:

<http://baltimore.umbc.edu/lter/> Baltimore Ecosystem Study

<http://birds.cornell.edu> Project Feeder Watch

<http://csf.concord.org/> The Center for a Sustainable Future

<http://desertusa.com/> Desert USA: Basic information about deserts

<http://eelink.net/> Environmental Education on the Internet

<http://globallab.terc.edu/> Global Lab Curriculum, TERC

<http://home.att.net/~volunteerstreammonitoring/> BSLI Stream monitoring data

<http://indiankill.home.att.net/> Indian Kill Study

<http://okmesonet.ocs.ou.edu/> Oklahoma Mesonet
<http://osf1.gmu.edu/~avia/page1.htm> An Introduction to benthic macroinvertebrates
<http://redtail.eou.edu> Eastern Oregon University PEERS (People Exploring Ecosystem Resources as Stewards)
<http://www.anserc.org/> Academy of Natural Sciences' Estuarine Research Center
<http://www.ccities.doe.gov/> Clean Cities
<http://www.chebucto.ns.ca/Science/SWCS/benthos.htm> I Freshwater Benthic Ecology and Aquatic Entomology Homepage
<http://www.natureserve.org/> An online encyclopedia of life
<http://www.seanet.com/~leska/Online/Guide.html> Field Guide to Freshwater Invertebrates
<http://fluid.state.ky.us/ww/bugs/orderkey.htm> Key to the Orders of Benthic Insects
<http://www.cnies.org/> National Council for Science and the Environment resources
<http://www.col-ed.org/pro/sites.html> Science Improvement Through Environmental Studies
<http://www.dnr.state.md.us/bay/index.html> Chesapeake Bay
<http://www.dri.edu/> Desert Research Institute
<http://www.earthforce.org/green/> Global Rivers Environment Education Network (GREEN)
<http://www.egroups.com/files/brandweinsummer/bmii.nf%2Edoc> Benthic Macroinvertebrate Sheets
<http://www.epa.gov/airnow/ozone.html> Air Now, animated maps of ground level ozone
<http://www.epa.gov/ceisweb1/ceishome/atlas/bioindicators/benthosclean.html> Benthic Macroinvertebrates in Clean Waters
<http://www.epa.gov/radiation/yucca/> EPA Yucca Mountain Information
http://www.epa.gov/students/surf_your_watershed.htm EPA Surf Your Watershed
<http://www.epa.gov/superfund/> EPA Superfund Program
<http://www.fs.fed.us/> USDA Forest Service
<http://www.globe.gov/> GLOBE, Global Learning and Observations to Benefit the Environment
<http://www.hudsonbasin.org/> Hudson Basin River Watch
<http://www.kancrn.org/ozone/cproto1.cfm> Protocols for measuring ground level ozone
<http://www.montana.edu/wwwwet/> Project WET (Water Education for Teachers)
http://www.ncnerr.org/main_page.htm North Carolina National Estuarine Research Reserve
<http://www.nwf.org/nwf/education/> National Wildlife Federation Environmental Education
<http://www.pbs.org/sixbillion/> Six Billion and Beyond: Population in the New Millennium
<http://www.people.virginia.edu/~sos-iwla/Stream-Study/Key/MacroKeyIntro.HTML> Aquatic macroinvertebrate Identification Key with color photos
<http://www.projectwild.org/main.html> Project Wild
<http://www.saveourstreams.org/> Save Our Streams (SOS)

<http://www.siu.edu/OSME/river/> University of Southern Illinois Rivers Project
<http://www.utexas.edu/depts/grg/ustudent/gcraft/fall96/scroggs/projects/projects.html> Kemp's Ridley Sea Turtles

Scientific and Environmental Monitoring Equipment

<http://www.vernier.com> Vernier Software and Technology-monitoring equipment
<http://www.dataharvest.co.uk> Data Harvest-data loggers and monitoring equipment
<http://www.pasco.com> Pasco Scientific-monitoring equipment
<http://www.teamlabs.com> Team Labs-monitoring equipment
<http://www.lamotte.com/> LaMotte-chemical test kits and monitoring equipment
<http://www.hach.com/> Hach-chemical test kits and monitoring equipment
<http://www.ti.com> Texas Instruments-manufacturers of Calculator Based Laboratory (CBL) equipment
<http://www.forestry-suppliers.com> Forestry Suppliers-scientific equipment and supplies
<http://www.benmeadows.com> Ben Meadows-scientific Equipment and supplies

Math

<http://forum.swarthmore.edu/mathmagic> Math Magic
<http://ipt.lpl.arizona.edu> Image Processing for Teaching Project
<http://www.edc.org/CCT/mlf/MLF.html> Math Learning Forums
<http://www.geom.umn.edu/apps/gallery.html> Gallery of Interactive Geometry

Network Science Programs

<http://birds.cornell.edu/cfw/> Classroom Feederwatch
<http://cleo.terc.edu/cleo/cleo-home.cfm> Collaborative Learning Environments Online
<http://kancrn.org> Kansas Collaborative Research Network
<http://kancrn.org/monarch> Digital Monarch Watch
<http://quest.arc.nasa.gov/> NASA's Quest Initiative
<http://quest.arc.nasa.gov/interactive/index.html> Online Interactive Projects
<http://whale.wheelock.edu/> WhaleNet, Upper elementary through secondary
<http://www.egroups.com/files/brandweinsummer/BSLIAU%7E1%2EDOC> BSLI Autumnal Equinox Activity
<http://www.energynet.net/> EnergyNet, Grades 6-12
<http://www.envirolink.org/> EnviroLink Network: The Online Environmental Community
<http://www.gsu.edu/~wwwgtp/altgtp.htm> The Global Thinking Project, Grades 5-12

<http://www.igc.org/iearn/> I*EARN
<http://www.kidsnet.org/> Kidsnet
<http://www.learner.org/jnorth/> Journey North
<http://www.lternet.edu/> U.S. Long Term Ecological Research Network
<http://www.mp2-pwrc.usgs.gov/frogwatch/> Frogwatch USA, US Geological Survey Toad Monitoring Program
<http://www.nyu.edu/projects/youthcan/> YouthCaN (Youth Communicating and Networking) Summit
<http://www.sciencenetlinks.com/index.html> Sciencenet
<http://www.si.edu/simab/biomon.htm> Smithsonian Institution BioMon - the Biodiversity Monitoring Database
<http://www.si.edu/simab/simabmain.htm> Smithsonian Institution's Monitoring and Assessment of Biodiversity (SI/MAB) Program

Programs for Teachers

<http://hvo.wr.usgs.gov/> Hawaiian Volcano Observatory
<http://www.cpet.ufl.edu/true/index.htm> Teacher Research Update Experience (TRUE) at the University of Florida, Gainesville
<http://www.nhc.rtp.nc.us:8080/> National Humanities Center
<http://www.woodrow.org/> Woodrow Wilson National Fellowship Foundation
<http://www.wsg.washington.edu/> University of Washington Sea Grant

Satellite Data

<http://landsat7.usgs.gov/> LANDSAT 7 Satellite
<http://liftoff.msfc.nasa.gov/realtime/jtrack/3d/JTrack3D.html> NASA J-Track 3-D
<http://www.bom.gov.au/weather/national/satellite/> Current Australian Region Satellite Images
<http://www.globeexplore.com/> GlobeXplorer Satellite Tracking

Geographic Information Systems (GIS) and Global Positioning Systems (GPS)

<http://kangis.org> Kansas Collaborative Research Network- GIS projects and information
<http://www.howstuffworks.com/gps.htm> Diagrams of how GPS systems work
<http://www.giscafe.com-updates> on GIS technology
<http://www.trimble.com> Trimble-manufacturers of GPS equipment
<http://www.garmin.com> Garmin-manufacturers of GPS equipment
<http://www.magellangps.com> Magellan-manufacturers of GPS equipment
<http://www.esri.com> ESRI-publishers of GIS software, ArcView

Science

<http://info.er.usgs.gov/network/science/earth/index.html> USGS Earth and Environmental Science Resources
http://jajhs.kana.k12.wv.us/vwv/animal/rep_amph/emilksnake.htm Info on the Eastern Milk Snake
<http://mapping.usgs.gov/www/gnis/gnisform.html> USGS National Mapping Information
<http://members.tripod.com/~hurstrh/start.htm> Starting a Quiz Bowl Team
<http://ngdc.ncaa.gov> National Geophysical Data Center
<http://spaceflight.nasa.gov/realdata/nasatv/index.html> NASA TV Real-Time Data
<http://terraserter.microsoft.com/default.asp> Terraserver Aerial Photos
<http://volcano.und.nodak.edu/> Volcano World
<http://www.covis.nwu.edu> CoVis - Collaborative Visualization
<http://www.deepspace.ucsb.edu/rot.htm> Remote Access Astronomy Program
<http://www.earth.nasa.gov/education/index.html> NASA Teaching Earth Science
<http://www.geocities.com/CapeCanaveral/Lab/9699/> Science Olympiad
<http://www.jasonproject.org/> Jason Project
<http://www.nsip.net/> NASA Student Involvement Program (formerly SSIP)
<http://www.rsmas.miami.edu/> University of Miami Rosenstiel School of Marine and Atmospheric Science
<http://www.toshiba.com/tai/exploravision/> Toshiba NSTA ExploraVision Awards
<http://www.unsl.edu/~microbes/> Science in the Real World: Microbes in Action
<http://www.usgs.gov> US Geological Survey
<http://www.noaa.gov> National Oceanic Atmospheric Administration (NOAA)

Weather

<http://goeshp.wwb.noaa.gov/> Geostationary Satellite Server
<http://grads.iges.org> Institute of Global Environment and Society
<http://groundhog.sprl.umich.edu> One Sky, Many Voices
<http://www.weatherworks.com/> How the Weather Works
<http://www.intellicast.com> Weather forecasts

Grant and Award Resources

<http://199.95.142.7/grants/> Dana.org Grants
<http://disney.go.com/disneylearning/ata/index.html> Disney's American Teacher Awards
http://foundation.verizon.com/04010_a.html Verizon GIFT Program (formerly GTE GIFT)
<http://grants.nih.gov/grants/guide/pa-files/PAR-96-052.html> National Institutes of Health Science Education Partnership Award (SEPA)

<http://grants.snonet.org> SnoNet Sources of Grant Funding
<http://infoserv.rtonet.psu.edu/osp.htm> Penn State Office of Sponsored Programs
<http://ocfo.ed.gov/> Department of Education Grants and Contracts Information
<http://rsi.cee.org/> Center for Excellence in Education
http://www.access.gpo.gov/su_docs/ Official Federal Government information at your fingertips
<http://www.anovember.com/grants.html> Writing Winning Grants
<http://www.aolfoundation.org/> AOL Foundation
<http://www.aspenpub.com/> Aspen Publishing (search on Education Grants)
<http://www.att.com/foundation/> AT&T Foundation
<http://www.carnegie.org/> Carnegie Corporation of New York
<http://www.cos.com> Community of Science
<http://www.cs.virginia.edu/research/sponsors.html> University of Virginia listing of funding agencies
<http://www.ed.gov/funding.html> Department of Education Funding Opportunities
http://www.ed.gov/prog_info/SFA/StudentGuide/ Department of Education Student Guide
<http://www.ed.gov/Technology/chalgrnt.html> Department of Education Technology Innovation Challenge Grants
<http://www.ed.gov/Technology/techno.html> Department of Education Office of Educational Technology
<http://www.ehr.nsf.gov/EHR/ESIE/awards/default.htm> Presidential Awards for Excellence in Mathematics and Science Teaching
<http://www.epa.gov/fedrgstr/EPAFR-CONTENTS/2000/August/Day-31/contents.htm> Solicitation Notice for EPA's 2001 Environmental Education grants
<http://www.epa.gov/region2/community> EPA Community Resources
<http://www.epa.gov/seahome/grants/src/grant.htm> EPA Grant Writing Tutorial
<http://www.fdncenter.org/> The Foundation Center: Your Gateway to Philanthropy on the Worldwide Web
<http://www.gf.org> John Simon Guggenheim Memorial Foundation
<http://www.iie.org/cies/> Council for the International Exchange of Scholars
<http://www.iie.org/pgms/fmf/> Fulbright Memorial Fund Teacher Program
<http://www.intel.com/education/k12/innovations/> INTEL Innovations in Teaching Program
<http://www.irex.org/> International Research and Exchanges Board
<http://www.iteawww.org/TAA/TAA.html> International Technology Education Association

<http://www.learner.org/sami/> Science and Math Initiatives
<http://www.ncss.org/home.html> National Council for Social Studies
<http://www.ncura.edu/> National Council of University Research Administrators
<http://www.nsf.gov/home/grants.hrm> NSF Overview of Grants and Awards
<http://www.nsta.org/programs/> NSTA Awards and Competitions
<http://www.nsta.org/programs/tapestry/> Toyota TAPESTRY Grants for Teachers
<http://www.os.dhhs.gov/> Department of Health and Human Services
<http://www.schoolgrants.org> School Grants: One stop site for K-12 grant opportunities
<http://www.sloan.org> Alfred P. Sloan Foundation
<http://www.tandy.com/scholars/> RadioShack National Teacher Awards (formerly Tandy Technology Scholars)
<http://www.techlearning.com/grants.html> Tech Learning Grants and Contests
<http://www.tgci.com> The Grantsmanship Center
<http://www.toshiba.com/tai/exploravision/> Toshiba NSTA ExploraVision Awards
<http://www.triangle-coalition.org/grantguide.htm> Triangle Coalition Guide To Winning Grants For Mathematics And Science Education: Where To Look And How To Win
<http://www.yam.regulus.com> Young Author's Magazine

Miscellaneous

<http://www.egroups.com/> eGroups List Service
<http://www.horizon-research.com/publications/stock.pdf> Horizon Research, Inc.: Taking Stock, A Guide To Evaluating Your Own Programs
<http://www.nsta.org/bap/> NSTA's Building a Presence for Science

Museums

<http://research.amnh.org/biodiversity/> American Museum of Natural History Center for Biodiversity and Conservation
<http://sln.fi.edu> Franklin Institute (Philadelphia)
<http://www.exploratorium.edu> Exploratorium (San Francisco)
<http://www.mos.org> Museum of Science in Boston

Publications

<http://ehrweb.aaas.org/~sbf/> AAAS Science Books & Films
<http://www.cpet.ufl.edu/true/true99/brock/brock.htm> "Life Among the Corals: Exploring Conservation Genetics with *Briareum asbestinum*," by D. Brock

<http://www.islandpress.org/> Island Press: The Environmental Publisher
<http://www.musemag.com/cgi-bin/cricket.cgi?tpl=mc/index> Muse Magazine (from the publishers of Cricket & Smithsonian)
<http://www.nature.com/nature/> Nature: The International Weekly Journal of Science
<http://www.orionsociety.org/> Orion Society
<http://www.russianconservation.org/> Russian Conservation News
<http://www.wested.org/tales/> Tales from the Electronic Frontier: Using the Internet in K-12 science and mathematics
<http://www.hudsonbasin.org/dataexchange.html> Hudson Basin River Watch Guidance Document

Regional Resources

Government Agencies

<http://deq.state.wy.us/> Wyoming Department of Environmental Quality
<http://gf.state.wy.us/> Wyoming Game and Fish Department
<http://www.dcnr.state.pa.us/> Pennsylvania Department of Conservation and Natural Resources
<http://www.dec.state.ny.us/> New York State Department of Environmental Conservation
<http://www.dec.state.ny.us/index.html> New York State Department of Environmental Conservation
<http://www.dec.state.ny.us/website/dfwmr/wildlife/herp/index.html> New York State Amphibian and Reptile Atlas Project
<http://www.dep.state.pa.us/> Pennsylvania State Department of Environmental Protection
<http://www.dep.state.pa.us/dep/counties/Pike/Pike.htm> Pennsylvania Department of Environmental Protection for Pike County:
<http://www.nps.gov/> The National Park Service
<http://www.nps.gov/dewa/index.htm>,
http://www.parec.com/natnl_parks/delanapk.htm National Park Service, Delaware Water Gap National Recreation Area
<http://www.parec.com/pennsyl.cgi> Pennsylvania Outdoor Recreation and Information Guide
<http://www.pasda.psu.edu/flash.shtml> Pennsylvania Spatial Data Access
<http://www.saws.org/> San Antonio Water System
<http://www.snwa.com/> Southern Nevada Water Authority
<http://www.state.wy.us/governor/openspace/openspaces.htm#31a> Coordinated Resource Management

Local Organizations and Initiatives

<http://web.grcc.cc.mi.us/mseei/> Michigan Scientific Evolution Education Initiative

<http://wind.cc.whecn.edu/~wae/> Wyoming Association for Environmental Education
<http://www.infomall.org/techclub/> Technology Club of Syracuse
<http://www.ksbe.state.ks.us/outcomes/qpa.html> Quality Performance Accreditation, Kansas
<http://www.montana.edu/~wwwse/> Montana STEP Project (Systemic Teacher Excellence Preparation)
<http://www.nj.com/audubon/enviored/anjee.html> The Alliance for New Jersey Environmental Education
http://www.pageud.k12.az.us/MS_Science_Web/Tapestry/about.htm Lake Level Transition Zone Study - funded by Toyota TAPESTRY
<http://www.teleport.com/~trivark/> Tualatin Riverkeepers
<http://www.texaswatch.geo.swt.edu/> Texas Watch
<http://www.hudsonbasin.org/> Hudson Basin River Watch

Points of Interest

<http://isd.ingham.k12.mi.us/~casm/> Capital Area Science and Math Center, Michigan
<http://lake.powell.national-parks.org/> Lake Powell National Park, Arizona and Utah
<http://pinchot.org/gt/gt.html> Grey Towers, the Pinchot Mansion, Pennsylvania
<http://www.beaverisland.net/> Beaver Island, Michigan
<http://www.caddolake.com/> Caddo Lake, Texas
<http://www.ci.aurora.co.us/parks/PLAINSCENTER.htm> Plains Conservation Center, Colorado
<http://www.cst.cmich.edu/centers/cmubs/> Central Michigan University Biological Station on Beaver Island
http://www.cypressvalleyalliance.org/ed_center/ Cypress Valley Education Center, Texas
<http://www.douglas.co.us/DC/Manager/chatfield.htm> Chatfield Basin Conservation Network, Colorado
<http://www.lowryparkzoo.com/home.shtml> Lowry Park Zoo, Tampa
<http://www.mines.edu/> Colorado School of Mines
<http://www.nps.gov/saan/> National Park Service San Antonio Missions National Historic Park
<http://www.r1.fws.gov/malheur/> Malheur National Wildlife Refuge, Oregon
<http://www.state.nj.us/drbc/drbc.htm> The Delaware River Basin Commission
<http://www.sterlinghill.org/> Sterling Hill Mine and Museum, Pennsylvania
<http://www.tetonscience.org/normal-index.html> Teton Science School
<http://www.texasoutside.com/northtexas/lkwrightpatman.htm> Wright Patman Lake, Texas
<http://www.walpackinn.com/> Walpack Inn, New Jersey
<http://www.wmc.edu/acad/outreach/bcrcenter.html> Birch Creek Nature Center, Montana



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