

LTER Education Committee Final Report 1/99

LTER Workshop on Education
October 22-25, 1998
Biosphere 2 Center, Oracle AZ

Submitted by Diane Ebert-May, Chair, on behalf of the members of the Education Committee

Executive Summary

The national need for long-term initiatives in science education reform, kindergarten through post-graduate education, parallels the need for long-term research initiatives -- both take time. A unique feature of the Long-term Ecological Research sites (LTER) is their long-term nature. In education, many programs are funded for the short-term (one to three years), during which substantive results and impacts are difficult to gather. Therefore, the persistent character of LTER sites provides us opportunities to establish science education programs over the long-term. Importantly, the sites also are ideal environments to promote effective learning of science through active engagement and inquiry by all students. At LTER sites, post-secondary and K-12 faculty can engage in professional development about teaching and learning. Ideally, within the LTER structure, they would and learn to apply those active learning strategies to their schoolyards and classrooms.²⁰

In 1998, the LTER Network invited a group of individuals to serve on the LTER Education Committee and to write a supplemental proposal to plan a national workshop. The Committee designed the workshop to provide teams composed of scientists, science educators and teachers associated with LTER sites an opportunity to gather together and share ideas, strategies, and plans for further developing educational programs at their sites. This was a unique opportunity to build what we hope will be long-term education partnerships among scientists, teachers, students, community members. These partnerships would promote science learning that

- 1) contributes towards development of the next generation of potential LTER scientists;
- 2) provides opportunities for increased scientific literacy of citizens who ultimately support the LTER research initiatives;
- 3) develops a framework for inter-site communication and outreach activities; and
- 4) establishes new career opportunities for scientists in education.²⁰

Two divisions of the National Science Foundation, Environmental Biology (DEB) and Education and Human Resources (EHR) funded the supplemental proposal through the Principle Investigator, Diane Ebert-May, from Michigan State University.

Outcomes from the workshop include the following recommendations for education programs at LTER sites, Education Committee structure, funding required to sustain educational initiatives, and recommendations from the Education Committee.

Education Programs

The initial response regarding an organized educational effort within the LTER was overwhelmingly positive.

*20 of 21 LTER sites responded to the NSF request for supplemental grants to establish "Schoolyard LTER Projects."

*18 of 21 LTER sites responded to invitations to participate in this first educational workshop and 12 were selected (participation was limited due to space the meeting site and amount of funding in the supplemental budget).

Prior to the workshop, LTER sites prepared informal reports and posters describing their current education efforts. These reports, along with the action plans prepared during the workshop, indicate that several individuals at LTER sites are sincerely committed to educational programs at their sites and are extremely interested in advancing those efforts. However, since education activities are not the primary focus of the majority of LTER grants, educational activities are often ad hoc. In addition, the majority of university faculty working on LTER projects have committed their time primarily to research. Resources and time limit the potential for educational programs at the LTER sites, except in the case of the Central Arizona Project and Baltimore Project, which have permanent supplemental funding built into the grants. With the LTER's visibility, infrastructure, accessibility, and relationships to other institutions and research programs, LTER has the potential to facilitate change in attitudes toward science in education and in science education if additional funding becomes available.

Structure and Function of the Education Committee

We envision an Education Committee of the LTER Network composed of at least one representative from each LTER site, plus a person from the Network Office. The Committee would meet once per year to plan activities and form policy. Smaller task groups would serve as liaisons to various LTER sites depending on the educational support requested by the sites. For example, one task group of the Committee would develop protocols and methods of assessment for LTER educational programs. The following tasks would be delegated to other task groups:

Identify options for funding educational programs and projects and inform all sites of the possibilities.

- *Serve as centralized information point for education programs at all the LTER sites.
- *Advocate role of education in LTER to LTER.
- *Advocate role of education in LTER to NSF.
- *Serve as an advisory body to NSF for developing RFPs about science education.
- *Establish partnerships between scientists, educators, data managers, and teachers who are represented on the Education Committee.
- *Plan and implement future education workshops.
- *Mentor proposal-writing activities - either network-wide, by site or by region.
- *Prepare a white paper to advocate collaboration between the NSF Divisions of HER and DEB that would influence guidelines and funding for a new educational competition for biological field stations. This white paper would include the rationale why LTER should be involved in education, demonstrate how sites function as individual sites and suggest what they could do at the Network level. Together with the Organization of Biological Field Stations (OBFS), these field stations and programs would become a systemic initiative for education reform focused on field-based natural science.²⁰
- *Provide opportunities for post-doctoral students to learn and implement the role of science educators at LTER sites (such as a biology Ph.D. who wished to pursue career pathways in teaching)

Funds to Sustain LTER Educational Efforts

We recommend the development of an RFP from the NSF that would encourage LTER sites as well as other field stations associated with, for example, the Organization of Biological Field Stations (OBFS), to develop proposals for educational programs at their sites. The RFP would promote quality, competitive proposals and the Education Committee would

assist sites in proposal development through the Network Office. Ideally, both the Divisions of Environmental Biology and Education and Human Resources at the NSF would collaborate to secure resources to fund this systemic educational effort. Ideally, the details of this report provide direction and ideas for the goals of the RFP.

Recommendations from the LTER Education Committee

Proposal Development:

We have resources remaining to conduct a workshop to write proposals both for the site-level(s), cross-site level and network-level concurrently. Potential models for Education/LTER programs include:

- *Informal teacher professional development
- *Individual teacher and student involvement
- *Informal affiliations such as contact with environmental groups (See Jornada example)
- *Undergraduate participation in research (REU)
- *Formal K-12 teacher and undergraduate faculty professional development

Representation on the Education Committee should include at least one person from each LTER site and a representative from the Network Office.

3. Collaboration should continue with program officers at the NSF, Divisions of Environmental Biology and Education and Human Resources, to develop future requests for proposals.

Summary of the Workshop

Teams composed of one scientist, one science educator, and one K-12 teacher from the following 13 LTER sites plus the Network Office participated in the workshop:

H.J. Andrews
 Hubbard Brook
 North Temperate Lakes
 Coweeta
 Shortgrass Steppe
 Jornada Basin
 Palmer Station
 Plum Island Ecosystem
 Baltimore Ecosystem Study
 Kellogg Biological Station
 Mcmurdo
 Konza Prairie
 Central Arizona

Four national leaders in undergraduate and K-12 science education worked with the Ebert-May to facilitate the workshop: Bill Carlson (Cornell University), Marianne Krasney (Cornell University), Jim Gallagher (Michigan State University), Julie Luft (University of Arizona). A total of 44 individuals participated in the workshop. The committee members actively involved in the workshop include Karen Baker, Palmer Station, Brenda Shears from Central Arizona Project, Marianne Krasney from Cornell University, Laura Huenneke from Jornada, John Moore from Shortgrass Steppe, Alan Berkowitz from Baltimore Ecosystem Study, and Patty Sprott from the LTER Network Office.²⁰

The design and implementation of the workshop modeled the type of active and inquiry-based learning we advocate for the LTER education programs. On day 1 we examined the national standards that are guiding science

education reform and framed an inquiry-based field activity around two questions: 1) What is inquiry? and 2) How do the National Science Education Standards and AAAS Benchmarks guide science education reform? The teams went out into the desert and began to explore ways of framing educational activities in natural systems that would help accomplish the goals of national standards.

Throughout the workshop, we explored models for teacher/scientist/student partnerships and the components of effective science education programs. Teams brought posters that described the educational activities currently in place at their site and shared these with other teams throughout the workshop. By the end of day one, we identified common themes for education programs across the LTER sites. Then each team developed individual site plans based on their current educational supplement and ideas from the workshop. Each team's action plans are posted on the LTER Web page linked to the proposals for the Schoolyard Ecology supplement.

Finally, the participants worked in groups to summarize ideas and make recommendations to the LTER Network and the National Science Foundation for consideration in forthcoming requests for proposals. First, we developed a statement of vision for the Education Committee in an effort to build consensus about our charge in the LTER Network. Recommendations for educational efforts were grouped into four categories: cross-site collaborations; role of the Network Office; assessment, evaluation and dissemination; and roles of teachers in LTER teams. Each of these recommendations is summarized below.

Working Vision of the Education Committee

In general, the Education Committee sees the educational programs of the LTER sites as opportunities to frame, assess, and promote learning programs by students and the general public about long-term ecological processes and research approaches. General questions driving these programs include:

Framework: What are the key ecological concepts, processes and phenomena that people should learn about through long-term studies?

Assessment: What evidence do we accept that students are learning important links among scientific concepts through their long-term ecological studies?

Promotion: How can long-term ecological study be infused into formal kindergarten through graduate education, as well as informal education programs?

After the participants as a whole discussed this working vision, we turned to specific recommendations for educational efforts at LTER sites.

Recommendations for Development of LTER Educational Programs

I Cross-site Collaborations

Funding for future education activities at LTER sites should focus on inquiry-based experiences for students (K-undergraduate), faculty (K-undergraduate). These activities easily fit into current site research activities. These site-research activities are largely standardized and implemented between several sites, facilitating cross-site research. Education programs can parallel these cross-site collaborations.20

II Potential Projects:

*Site-related research projects, in which the subject matter coincides with the LTER "five core areas of research" (pattern and

control of primary production; spatial and temporal distribution of populations; pattern and control of organic matter accumulation; patterns and movements of inorganic inputs; and patterns and frequency of disturbances); and

*Projects for which the content emphasis differs from the above, and also may coincide with other LTER research, such as biodiversity studies and climate studies.

Within this framework, these research themes parallel the National Standards for Science Education. It is this parallel that represents the unique position of LTER to facilitate systemic change in science education.

Projects may involve single LTER sites or multiple LTER sites. Long-term ecological research projects, and the data sets they produce, offer unique opportunities for teachers and students to understand the nature of ecosystems and the nature of science. Funding priority would go to projects that clearly describe how LTER resources will be used to teach concepts and ideas, such as long-term population changes, spatial variation and dynamics of resources, and the evolution of scientific theories—that are best understood through long-term study (process of how research is done, scientific procedures).

Role of Education Specialists and Teachers (K-12) at LTER Sites

The teachers in the workshop focused their recommendations on the role of LTER programs in K-12 education and teaching, and conversely, the role of K-12 teachers in LTERs.

A consensus formed that LTER sites should have an educational specialist who would:

- *Serve as outreach coordinator and contact person to lead the development and writing of educational proposals, and to implement education programs at the site.
- *Identify accessible data from different ecosystems for teachers and students and work with Information Managers to make it useable for school-based scientific investigations.
- *Serve as a resource to help students and teachers pursue questions that could be investigated at the LTER site and/or the schoolyard site.
- *Collaborate with teachers as partners to develop guidelines from programs for setting up parallel schoolyard research projects.
- *Provide public forums in school communities to discuss current topics in ecological research.
- *Provide experiences for teachers as research collaborators to learn basic research methods, nature of science inquiry, statistics/data analysis.
- *Offer grant writing workshops for teachers.
- *Organize a resource repository for science education materials.

In addition, teachers can provide input to the LTER educational projects by

- *Collaborating with scientists to develop and disseminate resources/curriculum.
- *Serving as mentors and resource people for other teachers.
- *Collaborating with scientists and science educators to develop grants.
- *Serving as liaisons to community (education and general public).
- *Working with school groups to facilitate teacher professional development, and communicate to the public the role and mission of LTER sites.
- *Communicating to researchers that some students and teachers are capable of sophisticated work.
- *Updating researchers about what happens in schools and what today's students are like.
- *Cultivating and nurturing their own network of support and resources.
- *Reaching out for resources to build their own program (writing grants, developing scientific knowledge and skills, and finding resource

people).

IV. Role of Assessment, Evaluation, and Dissemination of LTER Education Programs and Activities

These recommendations are based on what we know about the requirements of various federal agencies that fund science education projects, in particular, the National Science Foundation.

Assumptions:

- *Assessment will be based on the stated objectives of programs and activities.
- *Assessment will be at the LTER Program level, but individual programs should collaborate on development of plans, instruments, and procedures to avoid duplication of efforts.
- *Instruments and procedures should be assembled from existing sources where possible to avoid the extensive costs of development and validation.
- *It is highly probable that NSF will require an external project evaluator as part of the project consultant staff.

Assessment will focus on:

- *Programs and activities including opportunities to learn science for teachers, students, practitioners, community members
- *Four groups:
 - Students from K - 16
 - Teachers from K - 16
 - Adult community members
 - Practitioners: foresters, ext. service, managers, city managers, etc.
- *Collaborative work among scientists, education specialists, informal education specialists, and classroom teachers

Program evaluations for each of the four target groups:

- *Does the program have an inquiry component?
- *Do opportunities to learn match program goals (for the 4 target groups)
- *Is the program age appropriate?
- *Is the content accurate and valid?
- *Is the vision appropriate and does the presentation convincingly support scientific viewpoints.

In general terms, what kind of evidence will we gather for students, teachers, adult community members and practitioners?

- *Number of participants
- *Changes in content understanding
- *Changes in inquiry skills
- *Changes in vision of environmental issues

More specifically what data will we seek for students?

- *Development of skills and techniques for inquiry
- *Development of understanding of inquiry as a process for formulating knowledge
- *Development of understanding of relevant concepts

Are students able to develop relevant concepts as a consequence of inquiry?

Do students revise ideas based on inquiry?

- *Development of students' capability to transfer and apply knowledge.
- *Assess students' confidence in and attitudes about ecology

What data will we seek for teachers?

- *Development of skills and techniques for inquiry.
- *Development of understanding of inquiry as a process for formulating knowledge.
- *Development of understanding of relevant concepts.

Are teachers able to develop relevant concepts as a consequence of inquiry?

Do teachers revise ideas based on inquiry?

Development of teachers' capability to transfer and apply knowledge.

- *Assess teachers' enthusiasm and interest in ecology.

- *Skill and techniques for teaching inquiry based ecological science.
- *Skill and techniques for assessing students' inquiry in based ecological science.

What data will we seek for adult community members and practitioners?

- *Capability to revise understandings based on evidence.
- *Improved understanding of the nature and practice of ecological science.
- *Improved application of information to new and existing environmental issues in the workplace or in the community.
- *Dissemination of Educational Program

Source: LTER site, cooperating university, and partners

Audience: Teachers, students, adult community members, and practitioners

Other LTER sites

Outcomes:

- *Education program
- *Process of program development
- *Data from LTER sites/research programs
- *Data from Assessment of LTER educational programs
- *Educational materials
- *Student demonstration of learning

Mode of transfer:

- *Electronic media
- *Web-sites
- *Video presentations
- *Printed materials
- *Workshops and conferences

The first activity of the Education Committee was enthusiastically supported by many teams from the LTER sites. In order to sustain the efforts by the Committee, more active representation and participation from the sites needs to occur. Support of the Education Committee from the LTER Network office could be achieved by hiring a staff person to interface with the committee. For this workshop, Patty Spratt served that invaluable role. The Chair of the Committee and other representatives from LTER Network should meet with program officers at the NSF to discuss future funding initiatives.
January, 1999