

Technical Assistance to LTER Network Office: *Assessment of Opportunities and Constraints in the Development of LTER Education and Training Activities*

Note: This document contains technical assistance for the project and network level assessment of all education and training activities conducted by LTER projects. Contained is a model (i.e., possible) scope of work for the assessment as well as a list of possible evaluation performers.

Background:

The LTER program has evolved from five sites with an annual budget of \$1.2 million into a network comprising 24 ecologically diverse sites, including two urban sites, a network office, an annual budget of \$17.8 million in FY 2002 across four NSF directorates, and over 1,200 scientists and students who generate over \$50 million in LTER-related research. In addition, 24 other nations now have associated International LTER (ILTER) programs.

In the decade ahead, the LTER enterprise will inhabit a new scientific landscape, according to the report, *Long-Term Ecological Research Program: Twenty-Year Review* (http://intranet.lternet.edu/archives/documents/reports/20_yr_review/), "Technology is revolutionizing how research is done and enlarging the scope, scale and complexity of research that can be done. Policymakers, funding agencies, organizations, and the public increasingly are asking science to provide solutions to environmental issues and to be more accountable for public investments in research."

The 20 Year report makes 27 recommendations about how the LTER program might best enter its third decade. Among the recommendations are that: the LTER program adopt and make systemic what NSF has informally termed "21st century biology," science that is multidisciplinary, multidimensional, scalable, information-driven, predictive and model-based, education-oriented, and increasingly virtual and global; biological diversity be designated a new core area (or function) for the LTER program at all or selected sites; and the LTER program should partner with social scientists to increase understanding of the interrelationships and reciprocal impacts of natural ecosystems and human systems in order to inform environmental policy.

While the LTER sites focus on different long-term ecological issues, they share some common features, including:

- Asking similar scientific questions in a wide variety of landscapes
- Examining similar core research areas
- Sharing data
- Incorporating new technologies in research
- Associating with other ecologists, broadening their exposure to different research approaches and ideas
- Conducting synthesis of ecological concepts across sites and Networks

A map of the LTER sites and links to individual site websites are available at:
<http://www.lternet.edu/sites/>.

In addition to numerous scientific achievements, long-term projects have made contributions through:

- **Scientific discovery.** Significant scientific advances and discoveries have been made by LTER and cross-site studies.
- **Synthesis.** The increased emphasis on synthesis by LTER investigators has led to a variety of new efforts, including the production of new synthesis volumes being published by Oxford University Press and the increased sharing of data throughout the LTER network. In addition, Cross-site grants awarded from special NSF competitions in 1997 and 2000 are fostering research collaboration among LTER and non-LTER sites. The LTER Network Office collaborates as a leader in the development of national ecological metadata standards and other information management and electronic communication technologies.
- **Interdisciplinary investigations.** The LTER sites, which were originally established for the purpose of collecting long-term ecological data, have in many cases expanded their roles to include research and collaborations in non-ecological fields, including sociology and education. This is exemplified by the establishment in 2000 of two urban LTER sites in Phoenix and Baltimore.
- **Sociology and culture of teamwork & networking.** The development of an increasingly integrated culture of teamwork within and among LTER sites has led to new opportunities for cooperation and synthesis within the LTER network.
- **Outreach.** The emphasis, via supplementary funding by NSF, on both K-12 and undergraduate education has resulted in an increasing awareness of the importance of education and outreach to the success of LTER programs.

Education Context:

LTER recognizes the value of sustained interactions between students, teachers, and scientists, and has launched an effort to integrate LTER science with education. Most LTER sites conduct individual programs at the local level, and the Network supports limited centralized approaches to educational initiatives.

The “LTER 2000-2010: A Decade of Synthesis White Paper” lists among its goals “to advance the theory and practice of ecological and environmental education at all levels and in all areas of LTER expertise.” LTER education uses outdoor, inquiry-based teaching and learning to build ecological literacy; it creates effective strategies for interdisciplinary and collaborative learning about ecology; and it teaches about local ecosystems while fostering an understanding of distant ones as well. Objectives for the coming decade (cited in the White Paper) include:

- 1) Develop a broad vision for LTER education and acquire new resources for achieving it.
- 2) Train, mentor and support a next generation of ecologists equipped to conduct long-term, collaborative research to address complex ecological problems.

- 3) Enhance the understanding of long-term ecological study and concepts among students at the undergraduate and graduate levels.
- 4) Integrate core content areas and approaches into education programs at K-12 levels.
- 5) Form partnerships with education institutions, programs, and professionals to infuse long-term ecological study, key concepts and research approaches into education activities and initiatives.
- 6) Develop models and resources for teaching and learning that are well documented and assessed, and then disseminate these broadly.
- 7) Build our knowledge of how people learn about long-term ecological processes and the earth's ecosystems.
- 8) Continue to use the important supplemental SLTER funding to support educational activities that build on the unique educational opportunities of the LTER program.

Education Funding and Opportunities in LTER:

LTER is a broad-scale, long-term effort that combines scientific research and science education. The mission of LTER education is to use the *uniqueness* of the LTER network to promote learning about long-term ecological processes and the earth's ecosystems. LTER sites sponsor activities at K-12, undergraduate, graduate, and adult education levels. The extent of these activities and emphases vary across sites and has grown over time as increased emphasis has been placed throughout NSF on the integration of research and education.

The LTER sites support their education and training activities from a variety of sources. Since 1998 the NSF Division of Environmental Biology has provided a \$15K supplement per site for Schoolyard Projects (<http://schoolyard.lternet.edu/>) primarily focused on involving K-12 teachers and students in discovery based learning. This is the largest K-12 education program supported in the NSF Biological Sciences Directorate (BIO). Currently, all 24 sites receive Schoolyard supplements. In some instances, these supplements have been leveraged into larger programs but most sites find that the money provided although essential, is insufficient for the education activities they would like to pursue. All sites also receive NSF Research Experiences for Undergraduates (REU) supplements or site awards, and several sites receive Research Experiences for Teachers (RET) supplements. Some sites have graduate training support from NSF's Integrative Graduate Education and Research Training (IGERT) program. Other sources of education support include the Graduate Teaching Fellows in K-12 Education (GK-12) program, graduate assistantships supported under the LTER award, Research Experiences for Minority High School Students (RAMHSS), other education grants from NSF (including teacher enhancement and undergraduate course and curriculum development), and funds from other organizations such as Eisenhower Professional Development Grant and GLOBE. Several sites are involved in increasing the number of underrepresented minorities in their programs mainly through the NSF Undergraduate Mentoring in Environmental Biology (UMEB) and GK-12 programs. Numerous non-LTER, non-NSF funds (e.g., DOE, EPA, NASA, USDA) are also used to support graduate students conducting research at LTER sites.

The NSF Directorate of Education And Human Resources (EHR) supports the two urban sites (Central Arizona - Phoenix and Baltimore) as part of the core budget of LTER. EHR currently provides support to LTER by a Program Officer from EHR assigned to the Network Office to coordinate and facilitate education activities at LTER and to help craft a strategic plan for education.

The network office has completed a brief survey of the educational activities at LTER sites. The findings can be viewed at:

http://intranet.lternet.edu/committees/education/01_slter_survey_results.html

One-page descriptions of education programs at each site can be found at:

http://intranet.lternet.edu/committees/education/02slter_activity/

For a list of LTER site education contacts, see:

<http://intranet.lternet.edu/committees/education/members.html>

Assessment Context: Twenty-Year Review

In June 2002, an outside group of experts reported on the results of a 20-year review of the progress of the NSF LTER program. In their report, the committee made several findings and recommendations on the topic of education and training, which are reproduced below. One principal recommendation was to evaluate the LTER Schoolyard activity (which, in this statement of work, has been broadened to focus on all education and training activities of the LTER sites and network). Nonetheless, it was this report (see, in particular, the italicized section below under recommendation 18), which gave impetus to the assessment work described in this statement of work. Additionally, a review of the LTER Network Office in October 2002 raised the question of a central coordination mechanism for LTER education and also recommended that current education efforts be evaluated.

“5.4.1 Undergraduate and Graduate Education

The LTER program has played a primary role in training a generation of ecological scientists by combining undergraduate and graduate education with site-based research. LTER sites continue to provide multi-disciplinary research training opportunities for graduate students and take advantage of regular NSF programs for undergraduate education (REU--Research Experience for Undergraduates; UMEB--Undergraduate Mentorships in Environmental Biology.)

Citing a study by the National Academy of Sciences, a recent article in *Science* concludes that:

More than at any time in the recent past, there is a demand for mechanisms and incentives to foster interdisciplinary research, education and problem solving. ...[T]oday's young scientists will find their advancement restricted unless they are trained from the start to diversify their expertise...[27]

An NSF workshop report [28] echoed this recommendation for the biological sciences in general and for ecology in particular. Building on its educational accomplishments, the LTER network, in partnership with associated universities, is a natural arena for such interdisciplinary, cross-domain education.

Recommendation 17. The LTER program should expand the scope of its undergraduate and graduate education in field-based ecological research by incorporating the cross-disciplinary, collaborative approaches and characteristics of 21st century biology.

The LTER network can be the platform for helping universities educate a new cadre of ecosystem scientists for the 21st century, ones trained across disciplinary domains - ecology, systematics, conservation biology, population genetics, informatics, environmental economics, geospatial sciences and so on. These students will be better equipped to study and decipher

complex ecosystem phenomena, and to work in teams with other biologists, earth systems scientists, engineers, computational scientists and social scientists. One mechanism to achieve this goal is multiple, collaborative NSF IGERT projects involving many of the LTER sites and associated universities. Other mechanisms might involve educational partnerships with natural history museums, field station and marine laboratories, genomics and geospatial facilities, and social and economic research entities that focus on environmental issues.

Broader student education across LTER sites will have collateral impacts. For example, when biodiversity becomes a core area or function of LTER study, students trained in this field will help reverse the loss of taxonomic expertise from the nation's systematics community, especially expertise in poorly known organisms, such as soil biota, that are key to understanding ecosystem processes. Also, LTER-based students who are provided the opportunity to work with policy makers, for example, as AAAS Science and Technology Policy Fellows or as interns with local congressional representatives, will broaden the impact of LTER science and scientists in the policy arena, as recommended earlier in this report.

5.4.2 K-12 and Public Education

The Schoolyard LTER program has become one of the most visible education and outreach activities in the LTER network. Participation in the Schoolyard program is high at many sites, with Web-based documents available to students and teachers worldwide. Yet, this initiative is cited by the LTER Executive Committee as an example of an underfunded mandate—most sites must add funds from other sources to the annual \$15,000 NSF supplements for the Schoolyard activity. NSF and the LTER network need to resolve this issue.

Recommendation 18. The implementation and impact of the Schoolyard LTER should be enhanced in three ways. First, the LTER sites should leverage funds provided for this program to achieve economies of scale and increased outreach; second, NSF should increase its support for LTER K-12 educational programs; and third, *the design and outcomes of LTER K-12 educational programs should have formal evaluation to inform appropriate growth and improvements.*

For example, LTER sites might pool their Schoolyard supplements to develop a cost-effective suite of modular “suitcase” education programs that can be implemented by a group of sites or across the network. Such modular programs might change every two or three years and be tailored to biotas, habitats and public issues specific to single sites, groups of sites or the network. Curricular modules at several educational levels might be developed around the valuation of ecosystem services--the importance to people's lives of healthy ecosystems, the consequences of ecosystem degradation, and other topics that relate to people's economy, health, food and quality of life. Joint Schoolyard and public outreach programs for the next decade might tie these broad educational themes to state environmental objectives, which might prove effective with elected officials in illustrating the importance of a science-based public policy. Finally, with increased funding from NSF, LTER might provide a laboratory for research on K-12 and public informal science education by investigators in schools of education, natural history museums, science museums and other informal science institutions.”

See the full report at: http://intranet.lternet.edu/archives/documents/reports/20_yr_review/

Special Considerations:

This assessment is intended to be primarily formative in its design. To insure the quality and usefulness of information derived from this assessment, the assessor shall consult with

appropriate officials in the LTER Network Office and LTER governance structures (e.g., Education Committee, Executive and Coordinating Committee). The LTER Network Office staff will assist the evaluator in providing additional information as needed.

Assessment Questions:

The assessment shall answer the following questions:

Baseline Descriptive Information:

- What kinds of K-adult education and training (hereafter “education”) activities are the sites engaged in and whom do they serve? What is the nature of faculty/researcher involvement in education activities, what are the total resources allocated, and who is served in what fashion?
- What is the nature of the impact or experience afforded to the education activity participants, be they students, adult learners, or teachers?
- Have evaluations/assessments of education activities been conducted by the sites? If so, what has been learned from them?
- What amount of funds (dollar value) have the sites devoted to education? Have the sites been able to leverage those funds by making “dual use” of funds allocated to other missions or from other sources? To what extent (dollar amount) and from what sources?

Education as a Mission, Integration as an ultimate goal:

- To what extent are research and education missions of the sites integrated? Provide examples. How do the sites capitalize on their research programs to build their education programs and vice versa? Provide examples.
- In relation to research and other missions of the sites, is there evidence that the sites are placing appropriate or well-conceived emphasis on the education mission? How is this level determined (is there an education plan for the sites)?
- Is education an explicit mission of the sites? In what way is it part of the stated mission of the sites? Does it manifest itself this way in practice? Are education activities regularly reported on to NSF?
- To what extent are the sites making use of the unique site characteristics and ecological resources in shaping their education activities?
- Have partnerships been developed among the sites or between the sites and other appropriate third parties for developing and enhancing their education activities? Provide examples.
- Since CAP and BES have an education component from their inception, how do they interact with others sites?
- Are all of the education activities integrated (with each other) within any given site as a “program” of education? How does this program, if it exists, relate to the resources, research work agenda, capabilities of the site, and needs of the local K-adult education communities?
- How well connected are sites’ education programs to the local K-12, undergraduate, and graduate education communities?
- How do sites share their education strategies and success within and outside the network?

- To what extent are network educational programs linked electronically? Can, and do, students at various levels, scientists and teachers communicate electronically and utilize centralized web-based resources?
- What types of international educational experiences have been facilitated by LTER? To what extent are ILTER sites used in this regard? What are the limitations to international educational activities at various levels?

Needs and Capabilities:

- What are the real and perceived needs of the sites in terms of assistance with education activities? How does this vary across sites? What could NSF or other appropriate partners do to better serve these needs?
- What are the capabilities of the sites for providing education activities to local or remote communities? Are the capabilities well exploited? What could the sites be appropriately doing that they are not? Or, perhaps, are doing but shouldn't be? What is the range of capabilities across sites? What are the limitations? Is it appropriate that some sites have greater capabilities than others or should they all offer a minimum set of opportunities?
- Are there clear needs of the sites that are not being addressed or any capabilities that are not being made proper use of? Are there obvious potential benefits for greater centralized coordination of LTER education activities? In what ways would such benefits be best realized?

Possible Models and Recommendations:

- Based on the above questions and findings of this assessment, what recommendations should be made to the projects, the LTER Network Office, and NSF about the education and training activities of the LTER program?
- Based on these results, could a model or logic diagram be created that further articulates the role of LTER sites in terms of the education activities as a whole (and how parts interrelate) and in terms of the education activities compared with other missions of the LTERs, such as research and public policy outreach?
- What are the appropriate roles of the sites versus the LTER Network Office in the shaping and conduct of education activities?
- What role can education and training play in the greater LTER mission of discovery, innovation, and learning? How can education help to advance the vision of knowledge development and scholarship of 21st Century biology as laid out in the 20-year review report?
- What recommendations can be made to the individual projects, the network, the network office, and to NSF about future evaluations/assessments? Are there specific recommendations that can be made for ongoing or periodic indicators data collection and monitoring? What would such a system of data collection look like?
- What specific findings from this assessment can be integrated in the strategic plan for the LTER Network and for the Network Office?

Assessment Subtasks: The Work to be Performed

Task 1. The Contractor shall become familiar with all the funded projects, including any individual project evaluations/assessments that have already been conducted, and perform a

literature review of relevant education and research literature, including any necessary theory that has already been developed.

Task 2. The Contractor, in consultation with the Network Office, shall send at least one representative to attend four meetings of the LTER program: the Executive Committee meeting (February 24-26, 2003 at the NSF in Washington, DC), the Coordinating Committee (May 6-8, 2003 at the Kellogg Biological Field Station, MI), and to the All Scientists Meeting (September 19-21, 2003, Seattle WA). At least one synthetic oral presentation should be made at the ASM summarizing the preliminary findings of the assessment; poster presentations, workshops, and other oral presentations are also encouraged and may be appropriate. A draft final report will then be prepared and circulated for critique and review by LTER affiliated personnel. A final presentation and briefing meeting will be held at NSF in December 2003.

Task 3. The Contractor, in consultation with the LTER Network Office will revise the assessment design as appropriate.

Task 4. The Contractor, in consultation with the LTER Network Office, will develop an instrument or approaches that each site can use in the future to assess their own education programs/projects.

Task 5. The Contractor will prepare a site visit protocol and survey questionnaire instrument.

Task 6. The Contractor will administer the survey to all 24 sites, and will site visit 12 projects and the network office, and perform case studies, interviews, or any other data collection procedures as are necessary and appropriate to complete the assessment.

Task 7. The Contractor will prepare brief (2-4 page) site visit reports, a draft final report, and a final report on the program assessment.

Task 8. The Contractor will prepare information about this assessment and its findings and recommendations for dissemination. In consultation with the Network Office, the Contractor may make use of this information for professional publication and dissemination.

Deliverables:

1. **Revised Assessment Design (if needed):** Due no later than March 2003.
2. **Site Visit Protocols and Instruments:** Due no later than March 2003.
3. **Literature Review:** Due within six months from the start of this project.
4. **Site Visit Reports:** Due thirty (30) days after each visit.
5. **Interim Briefing to Appropriate Officials:** Due by the sixth (6th) month of the contract.
6. **Draft Final Report:** Due 2 weeks before the September 2003 meeting and presentation.
7. **Presentation of Draft Final Report:** September 2003 meeting, Seattle Washington.
8. **Final Report and Briefing:** December 2003, Arlington VA.

Period of Performance and Expected Level of Effort:

It is anticipated that the contract will be for one (1) year requiring one (1) FTE person year, allocated to one but no more than two individuals.

Proposal Instructions:

The proposal in response to this Statement of Work is due at the University of New Mexico no later than 5 p.m. on February 1, 2003. Proposals are limited to 5 pages, not including the Table of Contents, resumes, and budget materials. Proposals should be submitted via email to sortega@lternet.edu or by postal mail to the following address:

Robert Waide, Director
LTER Network Office
Department of Biology
University of New Mexico
Albuquerque, NM 87131-1091

Questions can be directed to sortega@lternet.edu or by telephone at (505) 272-7350.

The proposal shall contain the following sections, matched to the assessment criteria:

I. Conceptual Framework and Work Plan (40 points)

- Cohesive rationale and intellectual plan for the study
- Reasonable work-plan
- Match of rationale, work-plan, and Statement of Work

II. Personnel (40 points)

- Qualified staff
- Project Director has appropriate background and experience
- PD and staff have appropriate time available

III. Management Plan (20 points)

- Timeline is appropriate
- Staffing plan reflects needs and requirements

For More Information: <http://www.lternet.edu>