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**Palmer Long-Term Ecological Research Education Outreach Forum**

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PALMER



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Palmer Long-Term Ecological Research  
Education Outreach Forum**

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## FOREWORD

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.

In 1998, the LTER Education Committee accrued funding from the NSF and implemented a national 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, and 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.

Outcomes from the workshop include initiation and implementation of various kinds of educational programs by LTER sites. The Palmer LTER represents an example of how small supplemental funds to an LTER site are being used to create a long-term perspective in classroom science. I applaud this collaborative group of scientists and educators for bridging the distance to the Antarctic with a creative plan to engage students and teachers in their own classrooms.

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July 25-28, 1999

Held at the

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735 State St, Santa Barbara, CA

## **Introduction and Executive Summary**

The Palmer Long-Term Ecological Research (LTER) is supported by the NSF Office of Polar Programs as part of the NSF LTER Program. The Palmer LTER is constrained by the logistics required for Antarctic field work and national policies governing research associated with an internationally governed continent. Education efforts by Palmer LTER initially took the form of investigators giving individual classroom and meeting presentations. This outreach has grown as investigators respond to requests for interviews by the press or NSF sponsored media, for video taping by broadcasting and multimedia companies, for information by educational groups generating activities, curricula and an online internet presence, and for coordination with programs to put students and/or teachers in the field. A brief history of Palmer LTER education outreach is summarized as the timeline found in the Lists and Figures section of this report.

The LTER Network has focused attention on LTER Education Outreach efforts through supplemental education grants and a workshop held at the Biosphere in October of 1998 (see Appendices for workshop final report and contacts). The workshop was successful in bringing together LTER site teams of teachers, informal educators and scientists in order to discuss science education outreach, national standards, inquiry-based science, and assessment. Although differing individual site dynamics creates a diversity of outreach approaches, such a forum provides an opportunity to coordinate on larger education issues. Seed funding in the form of two LTER Schoolyard Supplements (1998-1999 and 1999-2000) has provided the resources for each site to consider a site-initiated education outreach plan and to expand upon existing efforts.

The LTER Schoolyard Supplemental funds have been used by the Palmer LTER to re-establish ties with a past 'Teacher Experiencing Antarctica' (TEA) participant (Besse Dawson) and to establish ties with a new TEA participant (Mimi Wallace). NOTE: the procedure linking TEA teachers with researchers does not address researchers requesting specific teacher assignments early in the process. Following contact with the TEA program office, we were assured that if teachers currently affiliated with Palmer LTER successfully apply for the TEA program, they will be matched with Palmer LTER researchers.

Supplemental funds also supported a working group held in San Diego in March 1999 to set the stage for a larger Palmer LTER Education Forum held in Santa Barbara in collaboration with the National Center for Ecological Analysis and Synthesis (NCEAS) in July 1999. The appendices include the forum announcement, agenda and participant list along with a participant survey handed out in order to determine relevant participant technology including computer and weather equipment. Responses revealed a broad range of equipment, underscoring the need to avoid assumptions regarding computing and

communication equipment accessible to partners. Lists containing vocabulary, URL summaries, weather collection options and potential products are incomplete but included as a starting point for further discussions.

The main body of these proceedings comprises the sections on Forum goals, discussion topics and two prototypes. The exchange of information and insights during discussions stimulated the development of two prototypes identified as important for future outreach efforts. Although the group was focused specifically on polar research, the prototypes as written are independent of ecosystem type in order to be relevant for the broader LTER community. These two prototypes are:

### **LTER Education Outreach Goals**

As the phrase "Long-Term Ecological Research" becomes more commonly used, it is important to recall that the easily said "LTER" actually encompasses three broad concepts. The outreach goals specifically address these three topics: long-term research (LT), ecology (E), and research (R).

### **Guidelines on Creating a Long-Term Perspective in Classroom Science**

The concept of long-term research is not self-evident and thus requires time and experience to establish an appreciation for and understanding of long-term ecological views. The approach for developing an understanding of this type of research is to immerse students in the actual experience of long-term research including collection activities, instrument calibrations, record keeping, data archiving, sampling design, and consideration of variable relationships.

Speakers at the forum frequently alluded to the complexity of relationships involved in determining optimum outreach strategies. Discussion of the conceptual diagram of the Palmer LTER food web suggested the value of constructing a conceptual diagram for learning environments in order to portray visually the interrelatedness underlying effective teaching and educational research.

The description of how the four goals for the Palmer LTER Education Forum have been met is summarized by the content of this proceedings. The forum was instrumental in identifying some existing education programs and partnerships that could serve as instructive models. The workshop generated some suggestions for future Palmer LTER educational outreach directions of interest. In the near term, Will Winn, as Goleta Valley Junior High representative in the Science Partnership for School Innovation (SPSI), plans to share the "long-term" concept with the existing SPSI network of teachers in Goleta/Santa Barbara (CA); Besse Dawson will be exploring the installation and use of the Davis weather station purchased by the Palmer LTER for Pearland High School in Pearland (TX); and Mimi Wallace will be considering how to apply long-term

concepts to a recirculating stream currently set up in her classroom, in addition to developing new activities that will bring her upcoming Antarctic field experience in January 2000 directly into the Montwood High School classrooms in El Paso (TX). A return visit to UCSD/SIO this fall has been proposed for Mimi Wallace and the Montwood Synergy Team technology representative to explore technology issues salient for interfacing the Palmer LTER project and the school classroom.

An important milestone is the establishment of the Palmer LTER Education Associates Group. The initial members, Besse Dawson, Mimi Wallace and Will Winn, helped create this report and will continue to help define the Associates concept. Note that joint development of an "ice chest" as an Palmer LTER kit of materials and artifacts to be exchanged among teachers was discussed as a potential next project. A web site for the Associates could serve as an effective communication platform.

As in the original LTER Education Workshop, the Forum participants identified the paramount importance of the dialogue among teachers, education researchers and scientists. To facilitate this dialogue and eventually to implement outreach programs, a liaison position, such as outreach coordinator, seems essential. For this forum Karen Baker and Dawn Rawls fulfilled the coordination function in addition to their functions as LTER information manager (Baker) and informal science educator (Rawls).

The active participation of high school and middle school teachers was the keystone upon which the forum depended. The forum benefited greatly from collaboration with National Center for Ecosystem Analysis and Synthesis and their outreach coordinator Scott Bell, overview talks provided by the Palmer LTER scientists Robin Ross and Sharon Stammerjohn, and the summary presentations made by UCSB Education Department participants Gregory Kelly and Candice Brown. Thanks are also given for the cross-program explorations made possible by discussions, tours and demos by Eric Solomon, Shiela Cushman, Fiona Goodchild, and Bruce Caron.

Karen Baker and Dawn Rawls  
Palmer LTER Education Outreach

## Palmer LTER Education Forum Goals and Discussion Topics

### **GOALS for the Palmer LTER Education Outreach Forum were to:**

1. discuss educational outreach alternatives,
2. consider elements of successful outreach,
3. formulate steps toward joint programs, and
4. develop guidelines for Palmer LTER Schoolyard efforts.

Discussion topics explored during the Forum addressed these goals.

**TOPIC 1:** What is the currently used terminology that describes personnel who will contribute to the Palmer LTER Schoolyard programs?

**Formal Educator** - the classroom teacher.

**Informal Educator** - representative of an outreach program provided by:  
institutions such as museums and science centers (docents, instructors);  
recreational facilities such as national/state parks (ranger) or for-profit parks;  
environmental groups such as Sierra Club, World Wildlife Federation.

**Nonformal Educator** - informational sources in a child's daily environs, such as parents, other relatives, and friends.

**Science-Education Researcher** - researcher investigating effectiveness of curriculum content and presentation, teaching techniques and modes of learning.

**Science Researcher** - for the discussion here: scientists within the LTER network.

**Information Manager/Technologist** - for the discussion here: LTER data managers and computer consultants working with formal educators.

**Outreach Education Coordinator/Liaison** - a person with background in several of the above disciplines who functions as a coordinator to facilitate dialogue among these specialists and to implement outreach programs.

Each of these specialties was represented at both the LTER Biosphere Workshop and the Palmer LTER Education Outreach Forum. Partition among these education specialties is given in the Participant Science-Education Specialties in the Appendices.

**TOPIC 2:** Which organizations, institutions and programs might participate directly or indirectly in Palmer LTER schoolyard programs?

**Palmer Long-Term Ecological Research Program (PAL LTER)** will provide the scientific expertise, data and researchers to ensure accuracy in content for all



education materials and training for formal educators and/or liaisons with informal educators that might be undertaken through Palmer LTER Schoolyard programs. When practical, interactions with teachers, students, informal educators and science-education researchers will be encouraged. Karen Baker is the Palmer LTER Information Manager; Dawn Rawls works with the Palmer LTER as an informal educator and science writer/editor. [[www.icess.ucsb.edu/lter](http://www.icess.ucsb.edu/lter)]

**Long-Term Ecological Research Program (LTER)** will, as sites develop education outreach programs, provide opportunities for cross-site outreach activities, such as cross-site data bases that are easily accessible by and useful for middle and high school students. Diana Ebert-May is the chair of the standing Committee on Education of the LTER Network. [<http://www.lternet.edu/>]

**National Center for Ecological Analysis and Synthesis (NCEAS)** provided the conference site for this Forum as well as the valuable experience and assistance of their outreach education coordinator, Scott Bell. As an NSF Center for Excellence, NCEAS facilitates collaborative research on major fundamental and applied problems in ecology, and maintains ties with researchers at UCSB and with the LTER Network. NCEAS maintains the Kids do Ecology program. Kids do Ecology consists of NCEAS' scientists adopting local 5th grade classes and, together with the students, exploring specific ecology problems (questions and hypotheses) through the collection, analysis and interpretation of empirical data. [[www.nceas.ucsb.edu](http://www.nceas.ucsb.edu); <http://www.nceas.ucsb.edu/nceas-web/kids>]

**Teachers Experiencing Antarctica (TEA)** is a program sponsored by the NSF in which teachers are selected to travel to the Antarctic and the Arctic for a field season to participate in ongoing research. TEA is a partnership among teachers, researchers, students, the school district, and the community. Two Teachers Experiencing Antarctica, Besse Dawson and Mimi Wallace, are currently working with the Palmer LTER outreach program. [<http://tea.rice.edu>]

**Department of Education, U C Santa Barbara** is a community of students, faculty and staff committed to reshaping schooling from kindergarten to twelfth grade for the benefit of children within our diverse society. Department researchers Gregory Kelly and Julie Bianchini have a particular interest in science education. Presentations by Gregory Kelly and graduate student Candice Brown provided an overview of science education research and of an SPSI supported classroom assessment project. [<http://education.ucsb.edu>]

**Santa Barbara Museum of Natural History (SBMNH)** in addition to being a center for exhibits and research on California natural history and California Native American culture, offers extensive on-site and outreach education opportunities. Shiela Cushman is the Director of Education at SBMNH. [[www.sbnature.org](http://www.sbnature.org)]

**Santa Barbara Sea Center**, found on the Santa Barbara pier, is the marine-science branch of the Santa Barbara Museum of Natural History. The Sea Center displays live-animal and static exhibits about the Santa Barbara Channel ecosystem and

offers school group tours that include oceanographic sampling from the pier. Eric Solomon is the manager of the Sea Center. [<http://seacenter.coastline.com>]

**The Marine Educators Regional Alliance (MERA)** is coordinated by the Channel Islands National Marine Sanctuary (CINMS) focusing on the California coastal and marine ecosystem. [<http://www.rain.org/~mera/>]

**Science Partnership for School Innovation (SPSI)** is a collaborative program among two NSF research centers at U C Santa Barbara, the Center for Quantized Electronic Structures (QUEST) and the Materials Research Laboratory (MRL), and the Santa Barbara County Education Office. SPSI forms teams of middle, junior and high school teachers, together with a regional administrator and a project coordinator to support development of curricula and assessments. SPSI also gives these teams access to new technologies and university scientist partners. Fiona Goodchild is a U C Santa Barbara researcher working with SPSI; Will Winn, Santa Barbara area Middle School Teacher, is an active member of SPSI.

**Planet Earth Science** is an educational software development company located in Santa Barbara and working with U C Santa Barbara scientists. Bruce Caron presented demonstrations of the El Nino cd-rom and discussions of the Antarctic ozone hole cd-rom. [[www.planearthsci.com](http://www.planearthsci.com)]

**TOPIC 3:** Which currently available curricula and/or activities feature Antarctic, ecology or weather/temperature content?

**Skymath** This curriculum is designed for 7th and 8th grade mathematics, but has several inquiry-based activities treating thermometry history, calibration and design of experiments to measure air temperature. [[www.edc.org/LTT/SKYMATH](http://www.edc.org/LTT/SKYMATH)]

**Global Learning and Observations to Benefit the Environment (GLOBE)** is a hands-on international environmental science and education program linking students, teachers, and the scientific research community through student data collection and observation. Students transmit their data to a central data processing facility via the Internet, and receive vivid images composed of their data and data from other GLOBE schools around the world. Any student may download data. Uploading requires previous workshop training in data-collection protocols. [[www.globe.gov](http://www.globe.gov)]

**Glacier** is funded by the Directorate for Education and Human Resources (EHR) and the Office of Polar Programs of NSF and involves polar researchers, education specialists, formal educators from several states and TEA participants. The website offers background information and links to current polar research. A curriculum is being tested in a pilot program. [[www.glacier.rice.edu](http://www.glacier.rice.edu)]

**Forecasting the Future** is an NSF-funded curriculum based on global climate

change research done at Scripps Institution of Oceanography of U C San Diego. Birch Aquarium at Scripps conducted teacher training and supplied inquiry-based-science activity kits.

**Live From Antarctica** (LFA) is a series multi-media presentations sponsored by NSF, Office of Polar Programs and NASA. Live video broadcasts from Palmer Station and television coverage on PBS were supplemented with online curriculum materials. [<http://quest.arc.nasa.gov/antarctica2>]

**Los Marineros** (SBNHM) is a curriculum program now adopted for all 5th graders in Santa Barbara. SBMNH provides the program which includes teacher training and regular support meetings, five field trips for students, pre- and post- field-trip lesson materials and evaluation forms. [<http://www.rain.org/~losmar/mariner.htm>]

**Regional Alliance for Information Networking** (RAIN) is a non-profit educational program of Visible Light, an educational corporation in Santa Barbara, California. It serves as a model of Public Internet Broadcasting 'Technology that Works for People'. [[www.rain.org](http://www.rain.org)]

**TERC** is a nonprofit organization established in 1965 to improve math and science learning and teaching through creation of innovative curricula and facilitation of teacher development. [<http://www.terc.edu>]

#### **TOPIC 4: What is Inquiry-Based Science Education?**

To address this topic we formed working groups, each of which comprised a formal educator, informal educator, and a science-education researcher. The groups' reports reflected a general consensus, expressed in a variety of vocabulary.

**Working Group 1:** Inquiry-based science education centers upon  
open-ended question(s),  
information gathering,  
emphasis on processes of critical thinking, and  
some form of deliberation, sharing of ideas, and of moving toward consensus.

**Working Group 2:** Inquiry-based science education centers upon anything involved in answering a question, which could be:  
'cookbook' types of labs,  
a problem posed with no specific directions, and  
open ended questions on a topic.

**Working Group 3:** Inquiry-based science education centers upon:  
giving students opportunities to explore posing a question and  
investigating answers;  
structuring an open-ended experience without a preconceived right answer;  
providing time, activities, and discussions to help students explore

misconceptions; and  
involving community based, non-school time experiences.

**TOPIC 5:** What successful paradigms exist for teacher-student-researcher interactions? These interactions usually rely upon an interpretive or instructional interface such as:

**1. Formal Educator (classroom teacher) serves as interface in these models:**

**Teachers Experiencing Antarctica/Arctic:** teacher interns with polar researcher and later works in Antarctica/Arctic; teacher then reports on experience and brings new activities to the public online, to his/her students and to other teachers through workshops.

**TERC:** teacher interns with ecologist and brings new insight and activities to the students.

**Mentoring :** teachers share their classroom techniques and activities with other teachers and classrooms.

**Science Partnership for School Innovation:** teacher team produces new approaches, curriculum, assessment tools. Members of this team lead workshops for other teacher/administrator teams.

**2. A liaison or coordinator provides the interface in these models:**

**National Center for Ecological Analysis and Synthesis (NCEAS):** outreach coordinator recruits scientists and classroom teachers/students to participate in Kids do Ecology program. Scientist makes five classroom visits progressing through an introduction of scientists' work, assisting class in designing an experiment, setting data protocols and implementing the experiment, helping with data analysis and guiding documentation of the experiment. [<http://www.nceas.ucsb.edu/nceas-web/kids/>]

**Santa Barbara Museum of Natural History:** through the Los Marineros program museum liaison personnel conduct field trips for teacher's classroom of students. [<http://www.rain.org/~losmar/mariner.htm>]

**NSF funded liaison positions:** REU (Research Experience for Undergraduates) fellows have served as conduits for current research to enter classroom curriculum. At some LTER sites an education coordinator is funded through outreach supplements.

**3. A field trip serves as an interface opportunity in these models:**

**Santa Barbara Sea Center and Santa Barbara Museum of Natural History:** teachers bring classes to see exhibits and have hands-on experiences.

**Santa Barbara Museum of Natural History:** teachers bring classes to visit curatorial scientists in their labs at the museum.

**4. Communication media and forums can also serve as an interface:**

**Live from Antarctica:** the press, writers and artists visit the researcher in the field and report to the classroom and public via live broadcasts and printed material.

**Curriculum development:** many institutions dealing in either formal or informal education write classroom curricula in collaboration with scientists.

**Activity kits/ hands-on materials/videos/cd-rom development:** these interface media are now supplementing or even replacing the fully developed curricula. The worldwide web is now a publication site for activities and entire curriculum packages.

**Workshop format:** participants can vary, but, as in the case for LTER, NCEAS and SPSI, often include: teachers, science-education researchers and scientists.

Teachers presenting at workshops sponsored by state and national teachers' associations often mentor other teachers by providing examples and demonstrations of new activities and materials for science classrooms.

**Email contact:** Ask-A-Scientist programs exist at many informal science institutions and as a component of many research institutions' outreach programs. This link between teachers and researchers can exist at several levels from personal correspondence to aiding students with forming questions for ask-a-scientist programs.

# **Prototypes**

Prototype for LTER Education Outreach Goals  
Prototype for Guidelines on Creating a Long-Term Perspective  
in Classroom Science

## **Prototype for LTER Education Outreach Goals**

### **OVERALL GOAL:**

To partner with K - 12 science teachers to incorporate activities and programs that encourage students to initiate and complete investigations using scientific methods, exploring research processes and collecting long-term data as well as with LTER associates to enhance LTER outreach and inreach materials.

### **L-T-E-RESEARCH GOAL:**

Through inquiry-based science activities and programs, to provide opportunities for students to participate in the scientific process.

**Objective A:** to provide expertise and experiences for teachers and students that mentor development of viable questions and hypotheses, collection and analysis of data, drawing conclusions, presentation of each investigatory phase and constructive peer review.

**Objective B:** to base teacher/student/researcher mentoring on activities that integrate time-scale into student investigations.

**Objective C:** to help teachers take science activities out of the "artificial" classroom setting into "natural" setting of the schoolyard or nearby locales.

**Palmer Objective A:** to integrate outreach efforts with national, state and local standards for inquiry-based science.

**Palmer Objective B:** to partner with existing, effective national/local programs and teachers.

### **L-T-ECOLOGICAL-R GOAL:**

Through inquiry-based science activities and programs, to highlight ecology as a critical component in understanding the interrelationships of earthwide systems.

**Objective A:** to provide scientific content through activities that broaden students' view of science both temporally and spatially.

**Objective B:** to provide scientific content through activities that center upon ecological systems or large-scale, periodic phenomena.

**Palmer Objective A:** to provide scientific content on data pertinent to, or issues addressed by, polar research.

### **LONG-TERM-E-R GOAL:**

Through inquiry-based science activities and programs, to let teachers and students conceptualize the nature and value of long-term scientific research.

**Objective A:** to provide expertise and experiences for teachers and students that explicate, by personalizing and localizing, the concepts of the "invisible present" and

the "invisible place."

**Objective B:** to provide expertise and experiences for teachers and students that illustrate the importance of long-term research and data collection as pertinent to their daily lives or local community.

**Objective C:** to base teacher/student/researcher mentoring on activities that emphasize students' long-term collection of data.

**Objective D:** to introduce teachers and students to readily available, easily usable pre-existing data that is salient for their own investigations.

**Palmer Objective A:** to develop filters and visualizations that would facilitate teacher/student use of existing Palmer data.

### **LTER NETWORKING GOAL:**

To develop, within-site (inreach) as well as cross-site and outside-site (outreach), integrated outreach materials and information management techniques.

**Objective A:** to develop data collection and information management systems that facilitate cross-site as well as teacher/student access.

**Objective B:** to consider and develop outreach prototypes for representing and analyzing information.

**Objective C:** to consider and develop prototypes for outreach activities designed for chosen grade levels: kindergarten-third grade; fourth grade through middle school; high school.

**Objective D:** to review, evaluate and adopt (where appropriate to each site) prototype activities developed by various LTER sites.

**Palmer Objective A:** to develop prototype outreach materials and activities (not elaborate curricula) based on cross-site weather data.



# **Prototype for Guidelines on Creating a Long-Term Perspective in Classroom Science**

## **1. What are long-term research and long-term data?**

Long-term research investigates a specific site (spatial area) by observing or measuring a specific set of characteristics (parameters). Investigators take samples at set intervals and locations within the site throughout an extended period of time. The area and parameters, as well as the sampling intervals and locations, are chosen based upon the nature of the questions or phenomena being studied. These studies can investigate, spatially, over a few square meters or many square kilometers and, temporarily, over a few decades or many centuries. Data on phenomena that occurred many centuries ago can be gleaned from "time capsule" records such as sediment or ice cores. Scientists often make observations themselves using various instruments, but data can also be taken by instruments left in the field or carried on satellites.

Data is annotated to record the measured value, and the time when and location where the measurement was made. Information about the data is called metadata. Details about instruments, procedures and other important interpretive background information are included as metadata. Long-term data sets are stored and enlarged after each interval of sampling.

Storing these data sets lets scientists use them to answer, at a later date, new questions that might arise. Long-term data sets are necessary for asking questions about earth's climate, ecology, weather, geology and biology - earth systems that change slowly over long extents of time.

## **2. Why should long-term science be incorporated in science education?**

Scientific research carried out over many years gives us the basis to answer many pressing questions our society faces: Is our climate warming? If so, how will the warmer temperatures of the atmosphere and ocean change weather patterns, high water levels along coasts, crop production, water supplies and spread of tropical diseases? What are the effects of endangered species dying out? Do small changes to food webs have far-reaching effects? Are mountains, rivers, lakes and ice caps changing? What drives earthquakes and volcanoes? If the dinosaurs became extinct, could humans?

These questions interest students and their parents. Students, teachers and parents hear about these topics from newspapers, radio and television. To weigh the trustworthiness of these sources, students need experience conducting long-term studies of their own. Doing long-term studies in class allows students to gain

ownership of the data they collect, the analysis they perform and the conclusions they reach in consultation with their classmates. Because the studies are continued over a longer span than one or two lab periods, the students can devote a lot of on-going thought to the processes and content matter of the research they have chosen. This contemplative approach models how research scientists review and reshape experiments, and look at their data from many different viewpoints. Long-term studies are an ideal format for inquiry-based science and for collaborative learning.

### **3. How can we model long-term research and long-term data sets in the classroom?**

To establish a long-term research project for the classroom, choose

- 1.) a research question,
- 2.) a location inside or outside the classroom to model or study,
- 3.) characteristics(variables) to measure
- 4.) intervals for these measurements and
- 5.) procedures and methods.

Repeat the measurements at these intervals all during the school year and from one school year to the next. From the start, information about the experiment and experimental procedures should be recorded as part of the metadata. Keep all data and metadata files for later reference. For example, if students take the outside air temperature each day at 9am at a specific location, they can track seasonal changes throughout the year. Make sure the students realize they are contributing to a study that will continue after they move to another class. After several years of data are collected, students can note changes from year to year such as El Nino warming trends.

### **4. What characteristics (variables, parameters) could provide long-term data?**

Sampling can be carried out both inside and outside the classroom using a variety of sampling strategies (single point, plot, transect, cross point, cross plot), intervals (hourly, daily, weekly, monthly, annually) and themes:

weather - temperature, cloud cover, humidity, barometric pressure, precipitation, dew point

water sampling - pH, nitrates, salinity, hardness, dissolved oxygen, turbidity

plankton hauls - abundance, diversity, biomass

birds - abundance, diversity, nesting

plants - abundance, diversity, height

beach transect - profile, diversity of life, debris by incidence

classroom stream or pond - temperature, biomass

Data comparisons and sampling strategies could include:

sampling during a full school year (annual variability)

comparing data taken in different years (interannual variability)  
comparing data taken at different seasons (seasonal variability)  
comparing data taken at different times during the same day (diurnal variability)  
comparing data taken at one point to data taken at several (spatial distribution)  
relating several different variables, e.g., weather and animal abundances

## **5. What other components of classroom long-term research can model the scientific process?**

**Formulating a research question or project.** Students should be allowed to form research teams and formulate their own long-term research project. A useful model for helping students formulate research questions is the "21 Question" technique developed at the Institute for Teacher Development through Ecology (ITDE)(<http://www.terc.edu>) (ITDE manual) Failure to successfully develop a viable question will result in student frustration and mediocre research results.

**Research and the real world.** It seems highly beneficial for students to realize the connection between scientific research and the world around them. Therefore, if the research can be integrated with English, math, history, and technology, a richer student product may be produced.

**Documenting the research process.** Another important component is for students to journal the data collection and research experience. Reflection of this sort will show the students what they initially know, what it is they want to know, and what it is that they learned. It will reveal subtleties that may otherwise be missed.

**Dissemination of results.** A type of intellectual celebration should occur at the conclusion of the project. This will share the learning experience with a wide audience and again bring value and importance to student learning. Also, this models what scientists do with their findings. Presentations and scientific meetings are held to share information and stimulate further research. Possible forums include a poster session with scientists, school communities, and parents attending. Or perhaps a student can take their presentation to other classrooms at other schools. Whatever the chosen medium, students must be allowed to celebrate and share their experience.

## **6. How could LTER research and scientists contribute?**

Initially, it is important to allow students to share their own ideas about long-term research. They might be expected to research one of the LTER sites and report their findings to the class. This allows for opportunities to compare the different LTERs and identify the common ecological research threads that exist. This levels the playing field for the class while giving them insight about the learning experience.

An ecologist that advises and mentors the student team is desirable. The Kids Do Ecology (KDE) program [<http://www.nceas.ucsb.edu/nceas-web/kids/>] which enlists scientists to work with fifth grade students as mentors and science advisors, provides an excellent example of a possible format to be used for the student/scientist alliance. This partnership can solidify the experience and validate learning for the student. The collaboration between scientists and student is equally beneficial for the scientists. It affords scientists an opportunity to engage student interest in their own work as well as offering them a platform to share their excitement about science in general. In addition, the students' interest in the scientists' work is infectious and reveals whether the explanations given are generally clear.

It may prove helpful if the scientist presented his or her original proposal to the class in order to model the expected or appropriate outcome. Students will appreciate the undertaking and will likewise strive towards personal excellence.

Being able to communicate effectively about an often times complicated scientific topic can be a challenge for scientists. Classroom teachers serve as an interface to help the scientists tell their story most effectively. A scientist's research experience must be communicated at many levels: with other scientists, non-discipline adults, members of the media and also with students. In the classroom arena, students are eager to hear their individual story. Effectively communicating the essence of scientific research with students by creating simulations, demonstrations, and analogies will serve the scientist well when faced with a colleague from another discipline, a government official or a journalist.

## **Lists and Figures**

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Palmer LTER Education Outreach Forum Potential Products

## LTER Education Outreach Timeline (Palmer Focus)

1898	US	School identified as dullifying
1950	US	NSF established
1986	US	Education Project 2061
1991	PAL	First LTER REU students in Antarctic
1992	PAL	Newton's Apple Public Broadcast Educational Video
1992	TEA	TEA program begins
1993	US	Benchmarks for Science Literacy (Project 2061)
1993	US	TERC Training Academy w/21 Questions
1993	PAL	Antarctic Video Disk with UCSB Video Department
1994	TX	Inquiry-Based Learning Workshop (Brazoria County, Texas)
1994	US	Science Education Standards (National Research Council)
1994	PHS	Dawson becomes science department chair
1994	MHS	First integrated curriculum at sophomore level: science, math, English, and social studies
1994	PHS	Annual Science Fair begun
1995	MHS	Synergy Department established
1995	NCEAS	National Center for Ecosystem Analysis and Synthesis established
1995	MHS	Building wired for internet
1995	PHS	Single phone line/modem installed
1996	PAL	Blue Ice Collaboration with Palmer LTER PI Fraser
1996	US	Education Reform
1996	PAL	Live from Antarctica2: NASA Passport to Adventure
1997	NCEAS	Kids Do Ecology begins
1997	TX	Texas State Standards established
1997	CA	California State Standards established?
1997	TEA	Dawson/PHS Internship with Palmer LTER PI Karl/Hawaii
1998	PHS	Marine Science changed to Aquatic Science
Jan98	TEA	Dawson Palmer LTER cruise Field Experience
1998	MHS	Synergy Department expands to four grade levels
Oct98	LTER	Network multi-site Biosphere Workshop
1999	TEA	TEA transition to TEPR
Feb99	PHS	Internet cable connection installed
Mar99	PAL	Palmer TEA Workshop (K.Baker/UCSD-SIO)
Jun99	PAL	Online Teacher Journal from LTER Ice Cruise
Jul99	TEA	Wallace/MHS Internship with Palmer LTER PI Baker/UCSD-SIO
Jul99	PAL	Palmer/TEA/NCEAS Education Outreach Forum
Sep99	TEPR	TEPR Advisory Board Meeting

US=National

PHS=Pearland High School, Houston, Texas

MHS=Montwood High School, El Paso, Texas

PAL=Palmer Long-Term Ecological Research Site

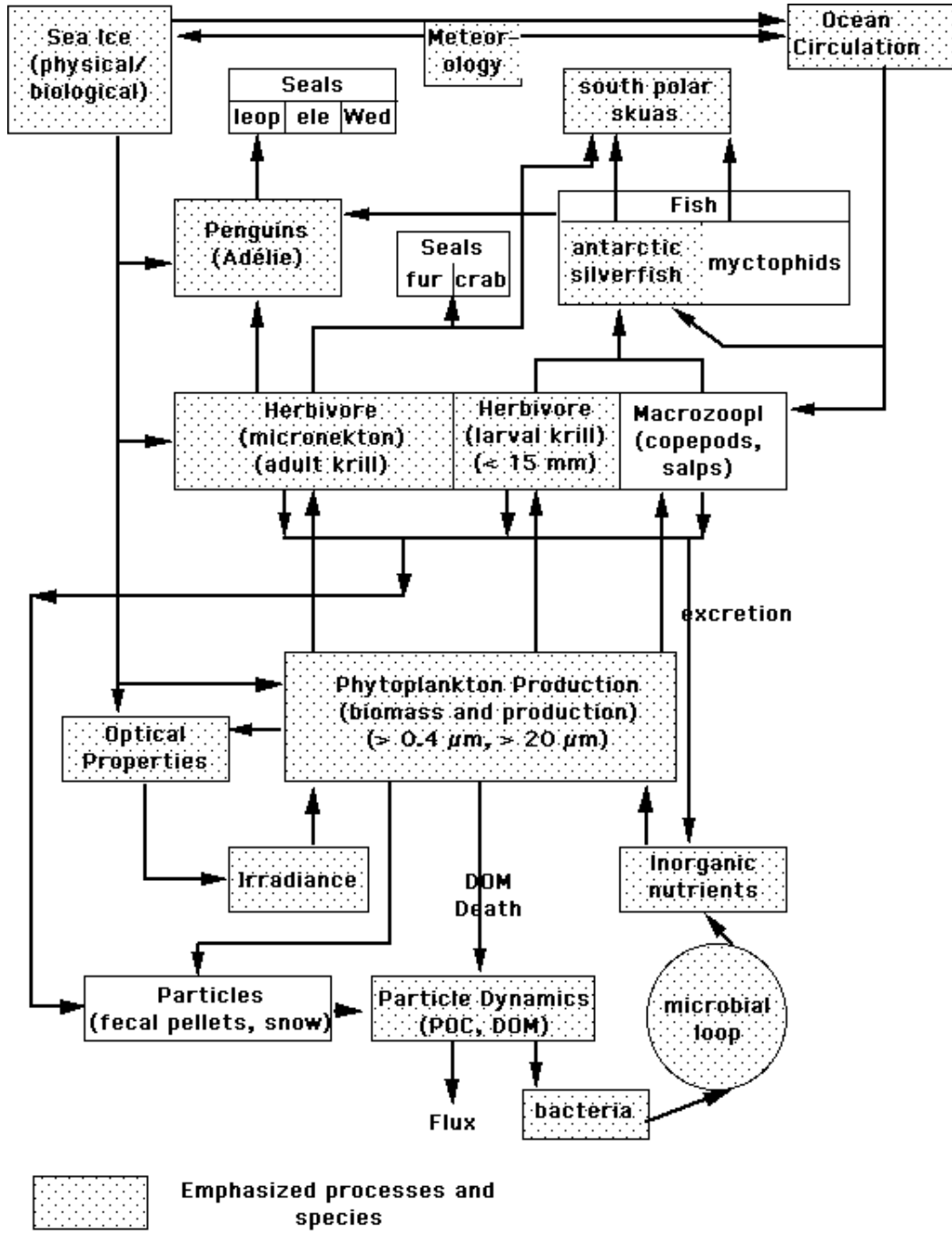
NCEAS=National Center for Ecosystem Analysis and Synthesis

NSF=National Science Foundation

TEA=Teachers Experiencing the Antarctic/Arctic

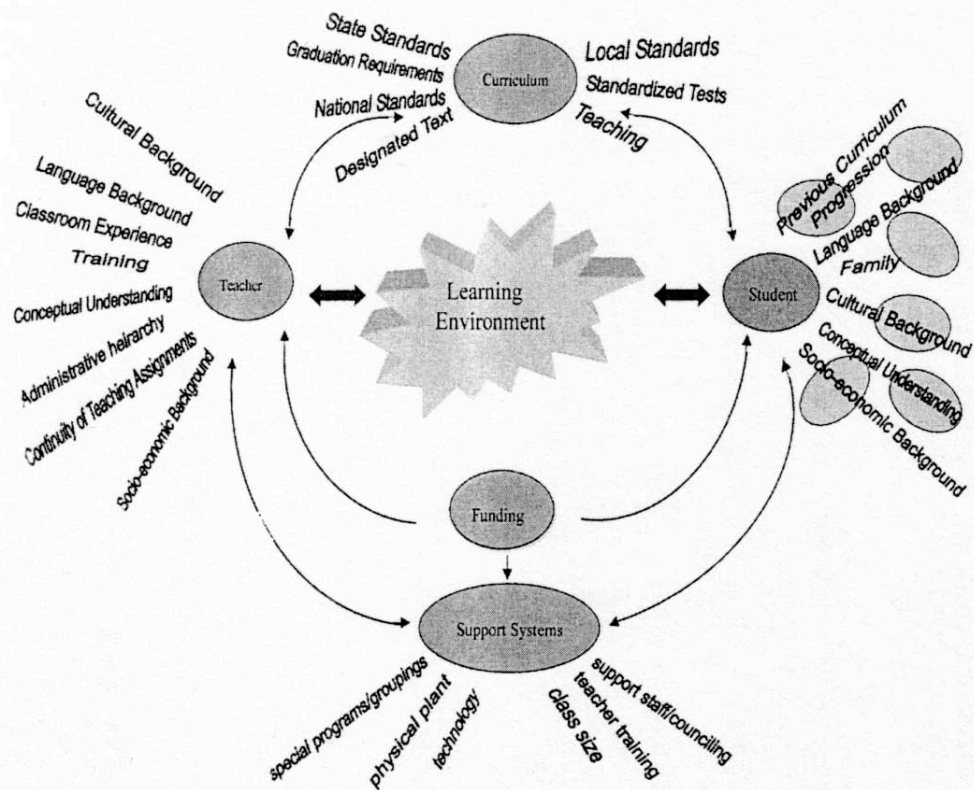
TEPR=Teachers Experiencing Polar Regions

# Conceptual Diagram of the Antarctic Food Web and Environmental Factors Investigated by the Palmer LTER



Smith et al., 1995.

# Conceptual Diagram of the Education Web and Environmental Factors Producing a Learning Environment



Teaching is an incredibly complex web  
of social and intellectual phenomena...G.Kelly



# Palmer LTER Education Outreach Vocabulary

## 1. Education Vocabulary

**assessment**- the process of monitoring both student learning and also the effectiveness of the learning environment (ie authentic assessment is often associated with diagnostic, nonjudgmental, suggestive, and goal-related techniques).

**cooperatively based learning** - learning undertaken in collaborative student groups or teams.

**engaged students** - those students challenged on multiple levels where academic learning is connected to the social and economic world of the student using the four C's: cooperation, collaboration, coordination, and communication.

**formative** - an act of development, of giving form or shape to something or of developing; (ie assessment is formative in contrast to grades which are summative).

**incidental learning** - a teaching method whereby the specific lesson being taught is not selected by the teacher, only the path to the learning is teacher directed. What is learned is driven more by the student's interest than by the teacher's guidance. Examples include a CD simulating a drive across the country making choices based on geography, or shop class where students design a project which entails use of their math and geometry concepts.

**inquiry-based learning** - see Topic 4 in "Forum Goals and Discussion Topics."

**integrated curriculum** - a synergistic approach to curriculum development in which the core subjects, in conjunction with technology, are taught together so that students are exposed to the enriching connections existing among disciplines.

**pedagogy** - theory of teaching.

**VHS** - Virtual High School

<http://vhs.concord.org/Pages/Campus+Life+Newspaper> which started as a project of the Hudson Public Schools and the Concord consortium. In exchange for contributing a small amount of teaching time, a school in the collaborative can offer its students NetCourses ranging from advanced academic courses to technical and speciality courses. Each school provides a VHS site coordinator responsible for project management and support of teachers and students at their local school. Each school can enroll up to 20 students for each course a teacher contributes.

## 2. Technology and Scientific Research Vocabulary

**csv** - comma separated variable electronic computer file (ie x, y, z) format enabling file exchange between software packages, ie an excel file is usually stored in the excel format but can be 'save as' a csv file and then able to be imported into any text editor.

**data set** - a grouping (set) of data. Data can be grouped by different principles; for example, by variable(characteristic measured), sampling location, duration of studies or by a combination of such factors. Data from several sets can be drawn together to make up a new data set.

**ftp** - file transfer protocol is a software technique (now a ftp software package using the ftp protocol) for transferring files from one platform to another (ie from one pc to another pc, or from one pc to a mac, or from one pc to a unix location). Computer servers are often configured to have available an anonymous ftp area permitting transfer to and from the computer even without a user account name and password.

**long-term research** - see discussion in "Creating a Long-Term Perspective in Classroom Science."

**metadata** - documentation information about a data set, instrumentation, sampling design and protocols.

## Palmer LTER Education URL Summary

### Participants

<http://www.lternet.edu/> (LTER)  
<http://www.icesb.ucsb.edu/lter> (Palmer LTER)  
<http://www.icesb.ucsb.edu/lter/projects/education> (Palmer LTER)  
<http://www.lternet.edu/oppts/education/links.html> (LTER)  
<http://www.nceas.ucsb.edu/> (NCEAS)  
<http://tea.rice.edu> (NSF/TEA)  
<http://www.glacier.rice.edu/> (aa/glacier)  
<http://www.terc.edu> (TERC)  
<http://www.sbnature.org> (SB Museum of Natural History)  
<http://www.sbnature.org/seacentr.htm> (SB SeaCenter)  
<http://seacenter.coastline.com> (SB SeaCenter)  
<http://gvjh.sbceo.k12.ca.us/gv/teachers/winn/index.html> (Will Winn)  
<http://education.ucsb.edu/people/faculty/kelly.html> (Greg Kelly)  
<http://gvjh.sbceo.k12.ca.us/gv> (Goleta Junior High)  
<http://aqua.ucsd.edu/> (SD Stephen Birch Aquarium)  
<http://www.coolearth.org/backcountry> (SB Rain Community Network)  
<http://www.sb-outdoors.com> (Santa Barbara-OutDoors)

### Antarctic

<http://antarctica.computerworld.com/> (aa/computer)  
<http://www.onlineclass.com/BI/blueice.html> (aa/blueice)  
<http://www.onlineclass.com/BI/links.html> (aa/blueice links)  
[http://www.nerc-bas.ac.uk/public/mlsd/Reference\\_List.html](http://www.nerc-bas.ac.uk/public/mlsd/Reference_List.html) (aa/basrefs)  
[http://www.lmcp.jussieu.fr/icsu/Report96/AR\\_IIBodies/scar.html](http://www.lmcp.jussieu.fr/icsu/Report96/AR_IIBodies/scar.html) (aa/scar)  
<http://www.pbs.org/wgbh/nova/warnings> (aa/nova)  
<http://www.bajasalt.com/BIO/bio.html> (whale; kids section)  
<http://www-nsidc.colorado.edu/NSIDC/EDUCATION/> (aa; nsidc)  
<http://www-nsidc.colorado.edu/NSF/NADCC/servers.html> (aa/nsidc)  
<http://www.ti.com/calc/docs/mathlife.htm> (math: PBS video)  
<http://www.mathlife.com/standard/index.html> (math/from ss)  
<http://pumas.jpl.nasa.gov> (on-line journal of math & science examples)  
<http://www.antarcticconnection.com> (on-line store)  
<http://www.terraquest.com/antarctica> (virtual travel)

### Weather

<http://www.globe.gov> (GLOBE)  
<http://globe.gsfc.nasa.gov/> (GLOBE)  
<http://www.unidata.ucar.edu/staff/blynds/homepage.html> (skymath)  
<http://www.unidata.ucar.edu/staff/blynds/Skymath.html> (skymath)  
<http://www.unidata.ucar.edu/staff/blynds/tmp.html> (skymath)  
<http://www.edc.org/LTT/SKYMATH/> (skymath)  
<http://www.howstuffworks.com/therm.htm> (how works)  
<http://onesky.engin.umich.edu/> (weather)

## **Weather Equipment**

<http://www.davisnet.com> (Davis weather system)  
<http://www.rainwise.com> (Rainwise weather system)  
<http://www.aws.com> (AWS weathernet)  
<http://www.aws.com/globalwx.html> (AWS weathernet)  
<http://www.campbellsci.com> (Campbell equipment)

## **Long-Term Sites**

<http://statweb.org/monarch.html> (monarch butterfly)  
<http://www.mgfx.com/butterfly> (butterfly plus links)  
<http://www.africam.com> (africa)  
[http://www.turner.com/cpf/mission\\_statement.html](http://www.turner.com/cpf/mission_statement.html) (captain planet)  
<http://dnr.state.il.us/nredu/classrm/grants.htm> (IL dept resources)  
<http://www.ianr.unl.edu/nsa/neb/neb.htm> (NEB School Nature SNAP)  
<http://caplter.asu.edu/po12> (birds arizona LTER CAP)  
<http://caplter.asu.edu/explorers> Other (arthropods and vegetation)  
<http://lter.kbs.msu.edu/Biodiversity/Insects/HPARN.html> (ladybugs)  
<http://www.cevl.msu.edu> (plants)  
<http://www.usra.edu/esse> (ESSE-NASA earth system science edu)  
<http://www.usra.edu/esse/essonline/>

## **Education**

<http://www.cambriansystems.com> (GETIT; earth science; cambrian systems)  
<http://agcwww.bio.ns.ca> (EARTH NET: geologic; geological society of canada)  
<http://www.agiweb.org/earthcomm/about.htm> EARTHCOMM;HS curriculum; Am GeolInstit)  
<http://www.agiweb.org/earthcomm/about.htm> (Earth Sc; Dynamic Envir & Ecosystems)  
<http://www.nr.state.ut.us/tputah/firs5.htm> (Utah Snowmeasurements)  
<http://www.nr.state.ut.us/tputah/seco6.htm> (Utah Rocks)  
<http://www.nr.state.ut.us/tputah/fift5.htm> (Utah Birds)  
[http://selsvr.stx.com/edu-outreach/solar\\_system/school\\_ss.html](http://selsvr.stx.com/edu-outreach/solar_system/school_ss.html) (solar system)  
<http://www.nwf.org/nwf/habitats/schoolyard/activities/index.html> (habitats)  
<http://www.nwf.org/nwf/habitats/resources/links.html> (naturalist projects)  
<http://www.planearthsci.com> (earth sci edu)  
<http://www.teachtsp.com> (earth sci edu)  
<http://www.dir.ucar.edu/iss/learn>  
<http://www.siu.edu/~deder/assess/index.html> (assessment)  
<http://vhs.concord.org/Pages/Campus+Life+Newspaper> (virtual high school)

## **Other**

<http://www.cinms.nos.noaa.gov> (NOAA Marine sanctuaries)  
<http://www.galv.bay.org> (Galvestan Bay Foundation )  
<http://www.amnh.org> (expeditions; Am Museum of Natural History)  
<http://core.cast.msstate.edu> (oceanography)

<http://www.drifters.doe.gov> (NOPP/YOTO drifters)  
<http://www.marine-ed.org> (bridge to marine resources)  
<http://rst.gsfc.nasa.gov/Start.html> (remote sensing CD)  
<http://btc.montana.edu/ceres> (CERES-NASA Universe Plus (Montana State Univ)  
<http://btc.montana.edu/nten> (NTEN-geoscience/Nat.Teachers Enhancement Network)  
<http://www.amesoc.org/amsedu/maury> (MAURY; American Meteorological Society)  
<http://www.amesoc.org/amsedu/maury> (DATASTREME: weather forecasting;AMS)  
<http://www.geosociety.org/educate/teach.htm> (ESSTEP/Earth&Space Sci Tech EduProject; Geo Soc of America)-geoscience/GIS/GPS

**Weather Data Collection Options**  
 and Prototype Template for Technology Metadata  
 Keep first form blank to copy for successive use as html file.

item	<b>SAVE THIS FORM AS TEMPLATE; COPY AS NEEDED</b>
item category	
<b>URL</b>	
date	
primary contact	
other contacts	
primary contact site	
archive	
use	
use for <b>LTER</b>	
description	
cost	

item	<b>Weather Equipment for Schoolyard LTER</b>
item category	(controlled): automated, nonautomated, input(web), visualize, curriculum, training, archive retrieve
<b>URL</b>	
date	30 March 1999
primary contact	Karen Baker
other contacts	
primary contact site	<b>PAL</b>
archive	
use	
use for <b>LTER</b>	
description	
cost	

item	<b>GLOBE</b>
item category	nonautomated
<b>URL</b>	<a href="http://www.globe.gov">http://www.globe.gov</a>
date	
primary contact	
other contacts	
primary contact site	
archive	
use	Texas - Pearland Middle School; SD-Natural History Museum; SD County Office of Education; Lewis MS; Bay Park Elem.; Waggenheim Middle; WI-Appleton;
use for <b>LTER</b>	
description	standard kit includes equipment; training required to upload data and (?) receive kit
cost	

item	<b>Davis</b>
item category	automated
<b>URL</b>	<a href="http://www.davisnet.com">http://www.davisnet.com</a>
date	
primary contact	
other contacts	
primary contact site	
archive	pc or mac, Weatherlink Software Suite - downloads from datalogger on remote command; archives data by time (intervals: 1 min, 5min, 3min) to flat file that can export all variables by day/month/year
use	200 schools; can post online, national and internet, Jim Richmand/NEAES Besse Dawson, Pearland High School, Houston, TX
use for <b>LTER</b>	NTL
description	small online center, Internet Solution Guide Software (\$250 -> \$500), best known or most population of three is weatherview by Palap
cost	\$400-\$500

item	<b>Rainwise</b>
item category	automated
<b>URL</b>	<a href="http://www.rainwise.com">http://www.rainwise.com</a>
date	
primary contact	Bar Harbor, Maine; 800-762-5723 or 207-288-5169
other contacts	
primary contact site	
archive	
use	
use for <b>LTER</b>	Texas: (Dawson/PAL) Pearland Middle Schools
description	minor curriculum materials
cost	

item	<b>AWS Weathernet</b>
item category	automated
<b>URL</b>	<a href="http://www.aws.com">http://www.aws.com</a>
date	
primary contact	Gaithersburg, MD 800-544-4429 x107
other contacts	
primary contact site	
archive	
use	300 schools in US and Canada; Pal/Aquarium (SD TV Channel 39; Bob Wiley at Aquarium 534-5751; Chn39 approached SIO; display at membership desk and machine in Wiley office); macmet application 1-800-544-4429; software \$200 for retrieve local site or other online sites over web historical data; not know re calibration; archives locally and presented on web; SB (Hollister Elementary School); SD(Silver Gate Elme; Chula Vista HS; Univ of Wisc at Whitewater; WISC WSAWTV) see <a href="http://aws.com/globalwx.html">http://aws.com/globalwx.html</a>
use for <b>LTER</b>	
description	for profit company develops links to local meteorologist and tv broadcast; software, equipment, webpage to post weather, access others
cost	\$4000-\$5000



item	<b>Campbell</b>
item category	automated
<b>URL</b>	<a href="http://www.campbellsci.com">http://www.campbellsci.com</a>
date	
primary contact	Logan, Utah 84321-1784; phone 435-753-2342
other contacts	
primary contact site	
archive	
use	
use for <b>LTER</b>	LTER sites; CWT schoolyard
description	weather equipment used on majority of LTER sites; no educational online materials
cost	

item	<b>NOAA weather kiosk</b>
item category	synthesis provider
<b>URL</b>	<a href="http://www.cinms.nos.noaa.gov">www.cinms.nos.noaa.gov</a>
date	
primary contact	Shanna Bingham - Channel Island Nat. Marine Sanctuary 805-966-7107
other contacts	computer: Kathryn Hintergardt 805-966-7107 x377
primary contact site	
archive	none
use	Channel Island Nat. Marine Sanctuary (NOAA) via SB Museum of Natural History
use for <b>LTER</b>	
description	web-based site at fuel dock in Santa Barbara harbor and Navy pier
cost	not for sale

## **Palmer LTER Education Forum Potential Products**

### **Potential Products of this Forum**

- \* Proceedings
- \* Establish Palmer LTER Education Associates
- \* Establish Palmer LTER Education Associates web page
- \* Overview Resource List
- \* Activities-weather
- \* Palmer LTER introduction
- \* Kits
- \* Ask an 'LTER' er/ Los LTER/Los ecologisto
- \* Publication in Journals: ie Science Teacher HS; AM Biology Teacher (HS+college), Science Scope (Jr High), Journal for Society of Conservation Biology, California Science Teachers Assoc (CSTA)

### **TEA Potential Products**

- \* Choose Los Marineros activity/handout to take to Antarctica (ie transect or secchi)
- \* Read/view materials and describe (few sentences) each item on URL and reference lists
- \* Palmer LTER Introductory Kit for TEAs
- \* Design TEA activity for weather
- \* Publish TEA weather activity in PUMAS
- \* Design web page for Palmer LTER education associates portal reference
- \* Collaborate on Palmer LTER introduction (see Products above)
- \* Implement Antarctic Artifact Archive-Ice Chest-Treasure Trunk Program (name?)-curator, prototype, collection catalog->TEA (themes: Palmer LTER TEA, Antarctic/TEA, Arctic/TEA, LTER sites)

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# Appendices

Forum Announcement

Agenda

Palmer LTER Education Outreach Forum Participants

Science-Education Specialties of Workshop Participants

Participant/Electronic Survey

Final Report: Biosphere LTER Workshop on Education

Primary Education Contacts for LTER Sites



# Palmer LTER Education Forum, 25-28 July 99

## NCEAS, Santa Barbara, California



The Palmer LTER Education Forum is being held 25-28 July 1999 at NCEAS in order to bring together teachers, educators and Palmer LTER researchers as part of the Palmer LTER Schoolyard program outreach. Topics of overlapping interest will be identified for a cross-section of programs and institutions including NCEAS (Kids Do Ecology!), SB Natural History Museum, the SB Sea Center, the SD Stephen Birch Aquarium, the NSF/OPP Teachers Experiencing Antarctica Program, UCSB Graduate School of Education with specific curriculum focus from selected junior and senior high schools. Opportunities for education outreach will be considered in general and weather station installations, programs and potential curriculum elements in particular.

### Meeting Contacts:

- Organization: Karen Baker (LTER PI; Data Manager)  
kbaker@ucsd.edu; 619-534-2350 ([Palmer LTER](#))
- Logistics: Scott Bell (NCEAS; Education Outreach)  
bell@nceas.ucsb.edu; 805-892-2533 ([NCEAS](#))

### Goals

- Review experiences, programs and opportunities
- Discuss successful curriculum elements
- Define boundary conditions for curriculum development  
-including timeframe, structure, format, uses
- Formulate a pilot curriculum
- Codify "visions for" and "uses of" such a pilot
- Consider evaluation techniques
- Discuss future directions

[Draft Agenda](#)  
[Participants](#)

**Agenda**  
**Palmer LTER Education Forum (JULY 25-28, 1999)**  
at the National Center for Ecosystem Analysis and Synthesis (NCEAS)  
735 State St, Santa Barbara, CA

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SUNDAY July 25th

9:00

Overview/Welcome - Karen Baker

What is LTER - Robin Ross

What is the LTER Schoolyard program - Karen Baker

Review of logistics/schedule for Forum - Karen Baker

10:30 - 11:00 Break

Introductions of participants

Overview of NCEAS /Kids Do Ecology outreach - Scott Bell

Overview of Sea Center/ SB Natural History Museum/ Los Marineros - Eric Solomon

Workshop goals - Karen Baker

12:15 - 1:15 Lunch in Santa Barbara

Education research/evaluation and assessment - Greg Kelly

UC Santa Barbara weather projects with local schools - Candyce Brown

Palmer LTER weather/ice research programs - Sharon Stammerjohn

4:00 Visit to Santa Barbara pier and Sea Center

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MONDAY July 26th

9:00

Reprise of yesterday's events

Teachers Experiencing Antarctica program - Besse Dawson and Mimi Wallace

Working groups breakout session

Topic: Paradigms for teacher-researcher interactions

10:30 - 10:45 Break

Reports form working groups

Curriculum activities based on weather and temperature

12:00 Lunch at NCEAS

1:00 Mini conference at Santa Barbara Natural History Museum - Shiela Cushman

Topics: Outreach programs, elements of curriculum and assessment

3:00 Visit museum

4:00 Potential return to NCEAS

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TUESDAY July 27th

9:00

Reprise of Forum

Discussion of data collection - Karen Baker

Data collection activities in groups - Besse Dawson, Mimi Wallace, Dawn Rawls

11:00 - 11:15 Break

11:30

Discussion of weather/temperature instrumentation - Karen Baker

12:15 - 1:15 Lunch in Santa Barbara

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AFTERNOON SESSION AT ICESS, UC Santa Barbara, 6th floor Ellison Hall

2:00

Overview of ICESS - Karen Baker

LTERR krill research/ education outreach - Robin Ross

Educational products from Planet Earth Science - Bruce Caron

3:15 - 3:30 Break

3:30

Science-education research dialogue - Greg Kelly

Educational collaborations with UC Santa Barbara - Fiona Goodchild

5:00 End of session

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WEDNESDAY July 28th

9:00

Reprise of Forum

Discussion of assessment

Review program alternatives

10:30 - 11:00 Break

Discuss future directions for Palmer LTER Schoolyard program

Discuss communication tools Forum participants can use to keep in touch

12:00 Close of Forum

## **Palmer LTER Education Forum Participants**

### **Kyle Abello**

UCSD, SD  
805-968-2541 x291

### **Neal Abello**

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### **Karen Baker**

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### **Scott Bell**

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### **Julie Bianchini**

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### **Candice Brown**

UCSB Graduate Student  
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### **\*Walt Bunning (CBrown)**

Regetti High School, SB

### **Bruce Caron/Catherine Gautier**

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### **Sheila Cushman (Monday at museum)**

SB Natural History Museum Director of Education  
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**Besse Dawson**

Pearland High School, Houston, TX; TEA 1998  
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281-412-1314

\***Jeff Foote** (CBrown)

Kermit McKenzie Junior High, SB

**Ray Ford** (not attending; WW)

Goleta Valley Middle School, SB; Technology Consultant  
riveray@rain.org  
805-683-4917

**Fiona Goodchild** (Tuesday at ICES)

UCSB Education Outreach Co-ordinator  
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**Kelli Hagen**

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**Gregory Kelly**

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**Andrea Moe** (Monday at museum)

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**Langdon Quetin**

Palmer LTER investigator/krill  
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**Dawn Rawls**

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**Robin Ross**

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**Erik Silberman** (applied biology/chemistry)  
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**Raymond Smith** (not attending)  
Palmer LTER lead investigator/bio-optics  
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**Eric Solomon**  
SB SeaCenter Manager  
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**Sharon Stammerjohn**  
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**Ken Uchio**  
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805-967-4581

**Mimi Wallace**  
Montwood High School, El Paso, TX; TEA 1999  
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915-599-1546

**Will Winn**  
Goleta Valley Middle School, SB  
wwinn@gvjh.sbceo.k12.ca.us  
805-682-42721

Others invited:

Dennis Savage (biology, applied biology/chemistry, marine biology)  
Richard Watkins (physics and applied biology/ chemistry)

## Science Education Specialties

As Represented Among Participants at LTER and Palmer Education Workshops

<u>Specialty</u>	<u>LTER98</u>	<u>PAL 99</u>
<b>Formal Science Educator</b>	<b>15 (26%)</b>	<b>07 (33%)</b>
A. Classroom Teacher	09	06
B. Instructional Support/District Resource Teacher	06	01
<b>Science-Education Educator</b>	<b>12 (21%)</b>	<b>04(19%)</b>
A. Academic Science-Education Researcher (scientists trained in education "about learning")	06	03
B. Academic Science Educator (scientists in education "to do learning")	06	01
<b>Informal Educator</b>	<b>10 (10%)</b>	<b>05 (24%)</b>
A. Education Liaison/Coordinator	06	01
B. National Center	00	01
C. Museum	01	02
D. Foundation	02	00
E. Environmental Group	01	00
F. Educational Company	00	01
<b>Science Researcher</b>	<b>14 (25%)</b>	<b>03 (14%)</b>
A. Scientist	11	03
B. Technician	03	00
<b>Computer Liaison</b>	<b>02 (04%)</b>	<b>01 (05%)</b>
A. Information Manager	02	01
B. Computer Technologist	00	00
<b>Administrator Liaison</b>	<b>04 (07%)</b>	<b>01 (05%)</b>
A. LTER Network	02	00
B. NSF	01	00
C. Site	01	01
<b>TOTAL</b>	<b>57</b>	<b>21</b>

## Palmer LTER Education Forum Participant/Electronic Survey

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### Participant Information:

name:  
email address:  
phone work:  
phone home:  
fax:  
work place:  
work address:  
position:  
grade level(s):

teaching subjects:

special aspects to science approach:

affiliations:

outreach projects:

Days attending LTER Palmer Education outreach (circle/modify)  
25jul/9 to 5; 26jul/9 to 3; 27jul/9 to 5; 28jul/9 to noon

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### Electronic Information

What type of email access do you have (ie modem, cable)?

At home?  
At school?

How often do you check email (ie daily, regularly weekly, irregularly monthly)

At home?  
At school?

What web browser do you use?

At home?  
At school?

What computer and operating system do you use (ie pc-nt, pc-windows, mac)?

At home?  
At school?



What type and how much computer access is available for students?

At home?

At school?

Type of school technology support (ie technician, consultant, teacher 2 pds)?

What internet access speed do you have?

At home?

At school?

What type of external storage devices can your computer read?

(ie floppy disk, zip drive, tape, CD, etc)?

At home?

At school?

What type of external storage devices can your computer write?

(ie floppy disk, zip drive, tape, CD, etc)?

At home?

At school?

How would you prefer to view ppt modules?

(ie online, CD, zip, etc?)

What wordprocessor software do you use?

What spreadsheet software do you use?

Have you worked with csv files in excel?

Do you have available Microsoft PowerPoint Software?

What software do you use routinely?

What hardware do you use routinely (ie digital camera, scanner)

Are you able to download files? How (ie browser, ftp)? Formats that be handled after download (ascii, jpeg, csv, word, rtf)?

How would you prefer to receive a dataset file  
(ie paper list, web posting, floppy disk, etc)?

# **LTET Education Committee Final Report 1/99**

## **LTET 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 (LTET) 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 LTET 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 LTET sites, post-secondary and K-12 faculty can engage in professional development about teaching and learning. Ideally, within the LTET structure, they would and learn to apply those active learning strategies to their schoolyards and classrooms.

In 1998, the LTET Network invited a group of individuals to serve on the LTET 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 LTET 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 LTET scientists;
- 2) provides opportunities for increased scientific literacy of citizens who ultimately support the LTET research initiatives;
- 3) develops a framework for inter-site communication and outreach activities; and
- 4) establishes new career opportunities for scientists in education.

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 LTET 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 LTET was overwhelmingly positive.

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

\*18 of 21 LTET 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.
- \*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**

#### **1. 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

2. 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.

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.

#### **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).

#### **III. 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 Sprott 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

## **Primary Education Contacts for LTER Sites**

Chair: Diane Ebert-May (Michigan State University)  
from the Spring 1999 Education Committee Report

LTER recognizes the value of sustained interactions between students, teachers, and scientists, and has launched an effort to integrate LTER science with K-12 education. Most LTER Sites conduct individual programs at the local level, and the Network supports centralized approaches to educational initiatives.

These are contacts at LTER sites who serve as the first point of contact for education issues and have an overview of the education programs for their site:

Andrews Experimental Forest (Oregon) **Art McKee**  
Baltimore Ecosystem Study (Maryland) **Alan Berkowitz, Vicki Fabiyi**  
Bonanza Creek (Alaska) **Glenn Juday, John G. Irons III**  
Cedar Creek Natural Area (Minnesota) **Peter B. Reich**  
Central Arizona (Phoenix-Arizona) **Brenda Shears**  
Coweeta Hydrologic Lab (Georgia/North Carolina) **Robert McCollum, Brian Kloeppel**  
Harvard Forest (Massachusetts) **John O'Keefe, David Foster**  
Hubbard Brook (New Hampshire) **Kathy Fallon Lambert, Maryanne Krasny**  
Jornada Experimental Range (New Mexico) **Kris Havstadt**  
Kellogg Biological Station (Michigan) **Mike Klug**  
Konza Prairie Research Natural Area (Kansas) **Valerie Wright**  
Luquillo Experimental Forest (Puerto Rico) **TBD**  
McMurdo Dry Valleys (Antartica) **Berry Lyons**  
Niwot Ridge (Colorado) **Diane McKnight**  
North Temperate Lakes (Wisconsin) **Ann Mclain, Tim Kratz**  
Palmer Station (Antarctica) **Karen Baker**  
Plum Island Sound (Massachusetts) **Hap Garritt**  
Sevilleta National Wildlife Refuge (New Mexico) **Bob Parmenter**  
Shortgrass Steppe (Colorado) **John Moore, James Detling**  
Virginia Coast Reserve (Virginia) **Dave Smith, Randy Carlson**