

2005 Education Supplement Request for NSF Grant # DEB-0423704: Central Arizona-Phoenix LTER- Phase 2

Summary of Proposed Work

CAP LTER requests supplemental funds for education-related activities that will interface strongly with CAP2 research activities:

- I. **Support for Ongoing Central Arizona–Phoenix SLTER Program** - to support the CAP SLTER program through summer teacher workshops, research experiences, and evaluation activities, as part of the Ecology Explorers (EE) K-12 educational outreach program.
- II. **Expanding the Central Arizona–Phoenix SLTER Program Access and Analysis** - to expand the educational mission of CAP LTER at the K-12 level.
- III. **Proposal for EdEn Co-Funding for the Central Arizona–Phoenix SLTER: Phoenix Flyways Project** - to integrate Ecology Explorers protocols and lessons into a related program.

Activity I. CAP2 will continue its successful Ecology Explorers summer workshops. This school year, we plan to expand our in-district teacher training workshops to include ASU’s Alpha Partnership school districts. Students in these districts are from low-income, high minority areas. Additionally, we have developed assessment tools that we will use with teachers participating in this summer’s internships. In particular, we are interested to see how well we can integrate the Ecology Explorers program into the newly articulated Arizona State Science Standards (\$15,000).

Activity II. To train teachers in ecological methods, the Ecology Explorers program makes extensive use of online data resources, created by Ecology Explorers staff, the IIS Informatics lab, and CAP LTER scientists. An evaluation of the Ecology Explorers program indicated that teachers and students could benefit from increased use of technology for data analysis. This activity will expand the online resources of the Data Center beyond the current Ecology Explorers participants by providing access via the Ecology Explorers interface to more CAP monitoring datasets; and enhancing the analysis tools with technical features used in our SEINet tool such as online maps (\$26,987).

Activity III. An important component to expanding Ecology Explorers is to work with other projects and organizations to integrate Ecology Explorers protocols and lessons into their activities. One such program is the *Phoenix Flyways* project currently being developed at Arizona State University (ASU) through the University College’s Academic Community Engagement Services. Through this project, ASU undergraduate students will explore patterns of bird diversity, migration, and conservation with students at an underserved, inner-city school in metropolitan Phoenix. *Phoenix Flyways* will engage students in authentic ecological research conducted by CAP LTER scientists and employ technology as a tool for communication, data collection, analysis, and critical thinking. In addition, students will have the opportunity to connect with researchers and students in Ecuador and Belize. This formal learning experience will increase understanding of science and math as well as the ability to use technology (\$26,953).

Activity I: Support for Central Arizona–Phoenix Ongoing SLTER Program
Investigators: Elser, Saltz

Update on Previous Support

Environmental education and outreach activities are woven throughout CAP LTER. We reach out to the K-12 community in a program called Ecology Explorers (EE), which aims to:

- implement a schoolyard-ecology program where students collect data similar to CAP LTER data, enter results into our database, share data with other schools, and develop hypotheses and experiments to explain their findings;
- improve science literacy by exposing students and teachers to real-world research;
- enhance teachers’ capabilities to design lessons and activities that use scientific inquiry and encourage interest in science;
- provide access to and promote the use of CAP LTER-generated materials and information;
- and encourage collaboration between CAP LTER researchers and the K-12 community.

Previous external evaluation of our program indicated that summer teacher internships, school-year workshops, and continuing support from the CAP LTER education team (Monica Elser and Charlene Saltz) are essential to meeting these goals. Seven previous SLTER Supplements have supported summer internships, academic-year workshops, and classroom supplies that have engaged many teachers in our schoolyard sampling protocols (<http://caplter.asu.edu/explorers>). Our internships are in great demand—in 2004, over 50 teachers applied for 16 internships. We recruit teachers from across metropolitan Phoenix and particularly encourage the participation of those in underserved populations. Schools with participating teachers have an average 43.5% of their students in free/reduced lunch program and 40% from underrepresented minority groups (African-American, Native American, Hispanic). Teachers from over 20 different school districts, as well as some charter and private schools, have interned with Ecology Explorers.

Goal

This school year, we plan to expand our teacher training workshops to include ASU’s Alpha Partnership school districts. Students in these districts are from low-income, high minority areas. We have developed assessment tools for this summer’s internships. In particular, we are interested to see how well Ecology Explorers can be integrated into the newly articulated Arizona State Science Standards.

Budget and Justification

We request support, including participant support in the form of stipends for teacher research interns and technical workshop participants (\$8,000), travel to professional meeting to present internship research (\$1,500), lunches and refreshments for workshops (ASU and non-ASU personnel), internship-sharing gatherings (\$500), technical workshops (\$500), evaluation activities (\$500), and materials and supplies such as plant presses, books, and binoculars (\$2,000). These materials and supplies are for workshop participants and for returning teachers active in Ecology Explorers programs. Facility and administration costs (\$2000) are limited to 25% of stipends.

SUPPORT FOR ONGOING SLTER SUMMARY BUDGET	
Participant Costs	
Stipends	8,000
Travel	1,500
Subsistence	1,000
Other	2,500
Total Direct Costs	13,000
F & A (25% stipends)	2,000
TOTAL	15,000

**Activity II. Expanding the Central Arizona–Phoenix SLTER Program:
Data Access and Analysis
Investigators: Elser, Saltz, McCartney, Gries**

To train teachers in ecological methods, the Ecology Explorers program makes extensive use of online data resources created by Ecology Explorers staff, IIS Informatics lab, and CAP LTER scientists. With funding from CAP1 and supplemental grants from BDI, this collaboration constructed a set of tools (<http://caplter.asu.edu/eedata/index.jsp>) that allow participants to enter field observations into a shared database, download data based on simple filtering queries, and follow guided tutorials that introduce tools of inquiry and hypothesis testing. We have integrated these tools into teacher-outreach activities in two ways: 1) teachers evaluate application prototypes and 2) through summer internships and school visits, we train and support teachers in the use of the final project.

Goals

An evaluation of Ecology Explorers suggested that teachers and students could benefit from more training and opportunities for teachers to use the Ecology Explorers database. Presently, our online resources only offer access to data collected by Ecology Explorers participants. The underlying data-access technology used in this application is shared by the Southwest Environmental Information Network (SEINet), the main distribution platform for CAP LTER research. The goal for this expansion project will be to exploit that common structure to: 1) provide access via the Ecology Explorers interface to more CAP monitoring datasets; and 2) enhance the data-analysis tools with technical features used in SEINet such as online maps.

Project Implementation

- We will extend the content of the existing Ecology Explorers Data Downloads and Analysis Wizard sections by defining configurations for core LTER research-monitoring data. These will include datasets from biodiversity protocols that parallel protocols used by our teachers, enabling them to pose questions derived from their own experience to similar data collected over a broader range of space and time.
- We will expand existing applications with a map-viewer application that can be linked to the analysis. Initially, this map viewer will display locations of the data being analyzed along with other spatial data layers and imagery, giving the user better spatial contexts. We will render symbols dynamically to show the data patterns on the map. The map viewer will help users select sample locations for analysis during the process of forming hypotheses.
- Once the map viewer has been created, we will expand the lesson scope of the analysis wizard by adding spatial analytic capabilities to the formation of hypotheses. This will allow users to specify gradient or proximity-based questions in their analysis or to group data according to spatially defined features such as land use.
- We will hold workshops where teachers can evaluate the interface and the lesson content. This approach, used in creating the existing analysis wizard, follows a structured sequence in which conceptual designs are presented in PowerPoint format, mocked up for evaluation in interactive html, and then coded and tested. Teachers participate in the evaluation process at every step.
- Incorporate the new features into our summer-internship program, an essential component for effectively linking our online resources with the overall Ecology Explorers program.

Because the process is tightly coupled with the teacher activities, we will develop new content and application features around the timetable for the base-supplement request and for the EdEn match, should that be awarded. We will develop new lessons for the existing wizard tools and conceptual designs for the mapping enhancements in early Summer 2005, with presentations and feedback given

during the summer internships. Interactive prototypes and final coding will begin in Fall 2005, again with regular feedback from the user community. We expect to release the finished product by Spring 2006 in time for the 2006 summer internships. PIs Elser and McCartney, Education Coordinator Saltz, and Data Manager/Scientist Gries will contribute time toward the design and content of the added features. We will hire a graduate student to prepare the actual data and code the application enhancements.

Budget and Justification

Support of \$16,500 is requested for a graduate research assistant developer to create the configuration files to the added datasets, produce the application mockups, and code the final product. To cover fringe benefits @ 36%, we request \$5,940. A total of \$4,547 is requested for ASU facilities and administrative costs @ 26%.

EXPANDING THE SLTER SUMMARY BUDGET	
GRA Developer	16,500
Fringe Benefits @ 36%,	5,940
Total Direct Costs	22,440
F & A (@26%)	4,547
TOTAL	26,987

**Activity III. Proposal for EdEn Co-Funding for the Central Arizona–Phoenix SLTER:
The Phoenix Flyways Project
Investigators: Crocker, Elser, Pearson**

To heighten the impact of the Ecology Explorer’s program, CAP LTER’s K-12 educational outreach program, we must collaborate with other projects and organizations. *Phoenix Flyways* is a pilot program being developed by Arizona State University’s (ASU) Academic Community Engagement Services (ACES), housed in University College. Through this project, ASU undergraduates will work with schoolchildren at an underserved, inner-city school in Phoenix to explore local bird diversity and migration patterns. The bird studies will serve both as surrogates for a broad appreciation of plants and animals as well as specific models for developing and practicing science, math, critical thinking, communication, and technology skills.

We are requesting funds from the EdEn Venture Fund to pilot this project in one inner-city school for the 2005-2006 academic year.

Background

Ecology Explorers employs scientific inquiry and data-collection protocols to train teachers in ecological principles and processes. Although this model has engaged teachers and students from across metropolitan Phoenix in urban ecological research (Banks, Elser, and Saltz, in press), the Ecology Explorers education team has been pursuing an opportunity to work directly with inner-city schoolchildren. This service-learning opportunity, called *Phoenix Flyways*, provides a formal learning experience that increases understanding of science and math and the ability to use technology. Individuals are engaged in authentic research and use technology as a tool for communication, data collection, analysis, and critical thinking. The central focus is on issues related to bird migration, bird conservation, and urban ecology.

Partnerships

Phoenix Flyways personnel have extensive experience in developing and evaluating environmental education and service-learning programs for pre-collegiate students in formal and informal educational settings. Nancy Crocker, Associate Director of ACES, has developed and implemented innovative science and math service-learning internships and afterschool science and gardening clubs, and assisted with other science and math outreach activities. ACES administers ASU’s Service-Learning Program, America Reads, America Counts, and AmeriCorps VISTA. Through these programs, ASU students enhance their academic skills through community engagement while increasing the chances of success for at-risk children. Each year, ACES places 300 to 359 undergraduates in community settings. Through the Service-Learning Program, ASU undergraduates enroll in three-credit service-learning internships, in which they tutor children after school or guide them in hands-on science and math activities during the school day. The ASU students also offer educational services for the parents such as English-language tutoring and GED test preparation. The *International Institute for Sustainability* (IIS), which houses and administers CAP LTER and the Ecology Explorers program, weaves education and outreach initiatives throughout its urban-focused research and training programs. Since 1998, *Ecology Explorers* has worked with local schools to bring real-world science to the classroom; CAP LTER scientists and science educators have developed protocols to provide science research experiences for K-12 students that contribute to the long-term ecological monitoring activities.

Particular to the *Phoenix Flyways* focus on birds, David Pearson (School of Life Sciences) will provide expertise on bird ecology and migration, as well as connections with bird ecologists in Ecuador. Another international point of contact will be provided in Belize, where ASU will offer a Study Abroad Program in Spring 2006. The program will focus on Belize as a case study in

sustainable-development issues and each of the 24 undergraduate students will take part in a semester-long internship. Some of these students will intern at Blue Hole National Park in Belize, with partial funding by the Belize Audubon Society. These interns will communicate with the schoolchildren about the progress of birds that migrate from the Phoenix area through Belize. The interns can also report to the children on the differences between the habitats of these respective regions. In addition to the above partnerships, we will collaborate with Arizona Game and Fish Department and Arizona Audubon Society.

Participating School

ACES' current partnership with Valley View Elementary School in the Roosevelt School District will provide the physical setting, teachers, and students (Grades 7-8) for this project. We will conduct *Phoenix Flyways* during the school day and pattern it after similar in-school service-learning programs. The active learning strategies implemented in *Phoenix Flyways* will follow the Arizona Department of Education Academic Standards in Science, Math, Language Arts, and Social Studies. The ASU Service-Learning facilitator, under the direction of the Ecology Explorers team and Pearson, will mentor the undergraduate students, who will be recruited through their academic advisors, e-mails to students in relevant majors, and posted flyers. A multitiered structure will ensure that all project participants benefit from their involvement.

Valley View School is a K-8 school serving more than 700 students in South Phoenix. The school enrollment is 92% Hispanic, followed by Anglo, Native American, African American, and Asian students. Over 70% of the students come from a home where the first language spoken is other than English, over half are English-language learners, and 75% participate in the free or reduced-price lunch program. Many residents of this neighborhood are from low-income and underserved populations. Frequently, low-income, minority populations' connection to their local environment revolves around the environmental and social problems in their vicinity: abandoned lots, industrial pollution, graffiti, and gangs. *Phoenix Flyways* will connect students and their families to the environment by familiarizing them with their local ecosystem and bird populations. Additionally, many Hispanic middle-school students in Phoenix maintain a cultural identity that involves Mexico, Central, and South America. Following migration routes of birds throughout these countries, reinforces personal pride and engages students who may be initially lukewarm about the relevance of science to their lives.

Implementing *Phoenix Flyways*

Phoenix Flyways connects ASU students, K-12 teachers, and schoolchildren to their local environment and to the larger, global environment. Our guiding principle is that children gain a deeper understanding of science by engaging in scientific inquiry prompted by their own concrete experiences, stimulated through communication, and enabled by technology. Children will learn about the birds that migrate through their communities and develop research projects based on their observations and communications. The curriculum will include the Ecology Explorers protocols for bird observation, background information in ecology and bird migration, techniques for assisting children in critical thinking, and technology use. The children will enter data they collect into the Ecology Explorers database and use the data-analysis tool for simple statistical analysis. We will use a newly developed map viewer to display the locations of data being analyzed along with other spatial data layers and imagery, giving the schoolchildren a spatial context for the data. Children will develop predictions on spatial and temporal patterns of bird migration through Phoenix based on their new knowledge of avian ecology. A simple predictive model linking CAP LTER's bird monitoring, land-use, vegetation, and climate data will be developed online for student use. They will communicate their observations and research with other children via the Kid's Newsletter on the website and present the results of their research to members of the local Audubon Society or Arizona

Game and Fish Department. Children will connect with researchers in Ecuador and service-learning interns in Belize to learn about other parts of the world through which our local birds migrate. Through direct involvement in the research, schoolchildren will learn the importance of careful observation, consistent use of research techniques, and quantitative methods. Through natural curiosity and their new knowledge and skills, they will gain a deeper understanding of science as a process of inquiry.

We will monitor and evaluate the project's effectiveness so that successes can be maximized and shortcomings remedied in a timely fashion. To maximize knowledge gain, credibility, and utility, the evaluation design will incorporate multiple and mixed measures as well as direct and indirect data collection methods. To evaluate project impact, a variety of methods, procedures, and tools will be developed and implemented, including surveys, interviews, and/or focus groups with project staff and participants and structured observation and analysis of curricular materials, student products, and content analysis of project online and print materials. Data sources will include project staff, schoolchildren, curricular materials, student products, project databases, and web-based activities.

Broader Impacts

This pilot project will serve as a model for increasing the participation of other service-learning programs. ACES would like to expand *Phoenix Flyways* from one school to many afterschool clubs in South Phoenix, thereby maximizing the impact of its curriculum and web-based activities. Additionally, teachers from Valley View and other schools will be recruited to attend the summer teacher internships offered by the Ecology Explorers program. In addition, Ecology Explorers will offer teacher workshops on the new data-analysis and predictive-modeling tools developed from *Phoenix Flyways*.

Previous experience has demonstrated that middle-school students enjoy interacting with ASU students, and undergraduates invariably report that they learn more from the children than vice versa. Specifically, schoolchildren will better understand natural history in the urban setting of Phoenix as well as rural sites through studies of birds and their migratory movements among environments. Students will learn to:

- Identify bird species by visual and auditory clues;
- Apply the scientific method by linking with a CAP LTER;
- Hone critical thinking skills; and
- Use computer software, basic statistical inference, predictive modeling.

ASU students will benefit in many ways. They will improve their mastery of science and math, develop leadership skills, explore career options, and acquire a commitment to community service and a greater understanding of social justice issues. ASU students will be involved for a full 15-week semester, resulting in 13 weeks of twice-weekly contact between ASU and younger students. Such sustained contact may spark interest in science and increased aspiration to complete high school and attend college or university.

Budget and Justification

We request a total of \$26,953; most funds will go directly to coordinating the service-learning program at Valley View Elementary School for two semesters. Expenses include salary for a service-learning facilitator who will function as the internship supervisor (\$8,640), classrooms supplies and a final celebration event (\$1750). Support for curriculum development and implementation will be provided to David Pearson (\$888) and Ecology Explorers (\$1,000), with assistance from an undergraduate student (\$800), while ACES will receive funding to support the project's evaluation (\$2,700). We also request funds for transportation for birding field trips (\$1,060) and travel to conferences to present results (\$3,000); one participant will be a teacher from the school. Additional support for summer teacher internships, teacher workshops, and developing new data-analysis tools are included in the SLTER and SLTER expansion supplement funding requests.

EDEN CO-FUNDING FOR SLTER: PHOENIX FLYWAYS SUMMARY BUDGET	
Personnel	
Curriculum Development	1,888
Evaluation	2,700
Undergraduate	800
Undergraduate Facilitator	8640
Fringe Benefits	1,554
Travel	4,060
Materials and Supplies	1,750
Total Direct Costs	21,392
F & A (@26%)	5,561
TOTAL	26,953

References

Bank, D., M. Elser and C. Saltz. Analysis of the K-12 Component of the Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) Project, 1998 to 2002. *Environmental Education Research*. In press.