What would people know, be like, and be able to do if they were educated for a sustainable future?*

* NAAEE (North American Association for Environmental Education)
Major Achievements from 2003-2006

1. Thirty-one new or revised courses were offered over six semesters (48 sections total).
2. More than 30 faculty members participated in ongoing assessment exercises and discussion groups. These faculty members continue to teach environmental topics and participate in other campus environmental activities.
3. Approximately 300 students participated in these courses each semester.
4. The environmental theme is now embedded permanently in several sections of the required writing course, architecture and art studios, and design history course, as well as various electives in history, materials science, music, and anthropology.
5. We have an engaged group of faculty who continue to include environmental topics in their courses.
6. Department heads are now committed to support the introduction and perpetuation of environmental coursework.
7. We developed a comprehensive website for environmental education at Carnegie Mellon as a complete information source for students and advisors.

Goal 1 of proposal: Develop and disseminate curricula and teaching resources for educators at Carnegie Mellon and beyond

Outcome: A Learning Community

- Each semester we hosted a variety of meetings for faculty to share challenges they face in teaching for the environment.
- Each semester, faculty who were actively teaching environmental courses and those who were not teaching that particular semester attended meetings to share ideas. We also invited key students to the discussion groups.
- Over the three years, the faculty developed relationships with one another and now know many more members of the Carnegie Mellon environmental community.
- Our website represents the first attempt on campus to spotlight all educators with environmental interests.
- We now have a community of about 30 very engaged faculty across campus who are planning, working together, and continuing to teach courses with environmental content.
- Assessment workshops held the first two years and brainstorming sessions strengthened the faculty’s understanding of the challenges of teaching for environmental literacy.

Outcome: A Learning Experience for Faculty—Improved pedagogy through a sharing of ideas and methods

The personal statements from faculty included in Attachment 1 demonstrate that as environmental educators, we significantly strengthened our skills in:

- defining, teaching for, and assessing student gains in environmental literacy
- measuring the impact of specific courses on students’ environmental literacy
- re-evaluating and improving our own understanding of how to convey knowledge to students
- improving and critiquing our own teaching methods and effectiveness in helping students learn
- developing standard practices and easily adaptable curricular and pedagogical frameworks
- creating a rubric and a set of standard, yet flexible, questions to gauge environmental literacy
To show other teachers how the environment covers such a diverse spectrum of disciplines and to provide ideas for teachers looking to add environmental content to their own courses, we “captured” six of our courses: “Interpretation and Argument”, “African History”, “EcoArt”, “Design and Social Change”, “Exploring Connections”, and “Technology and the Environment”. We used the information collected from professors to make an interactive section for teachers on our website. The section provides examples of how our professors address certain environmental topics, difficult questions they have encountered, and challenges faced and successes realized in the classroom.

The following comment from an instructor conveys the consistency across disciplines of our approach to environmental literacy: “I have a deaf interpreter for one of my students this semester. She made the interesting remark to me that since she interprets for several different classes, she is quite struck by the consistency of the environmental messages each instructor is transmitting, despite the broad range of subjects. I was delighted to hear this; teaching in a single department I have no way of knowing this. But she is in the unique position to actually see whether we are teaching green across the curricula!”

Outcome: Systematic Assessment of Learning Objectives

One of the challenges in teaching for environmental literacy is the difficulty in assessing whether students have attained a general level of “literacy”. This project gave us the unique opportunity to experiment with four distinct rounds of assessment tests over the past three years, with guidance from an assessment expert of the Eberly Center for Teaching Excellence at Carnegie Mellon. We found that a common testing method for the diverse courses was useful for evaluating what students know and how they engage with and think about the environment, but realized that the question-answer assessment did not capture the thought process students use to come to an answer. Indeed, environmental literacy is a way of thinking as much as it is knowledge of facts and methods. Seeking to capture how students think about and understand environmental issues, we tried an interview protocol, in which students verbally discussed an environmental case study with a moderator. From these interviews we devised an essay question based on a case study to illuminate additional students’ thought processes. This version was tested in Fall 2006 and we plan to continue refining this promising open-ended method of assessment.

Outcome: Scholarship of Teaching and Pedagogy: Teaching for Environmental Literacy

Several advantages resulted from this project being at a research-intensive university. Among these are the faculty members’ exploratory approach and the integration of research and education, as exemplified by the inclusion of breaking research results, such as those from the university’s Green Design Initiative, into courses.

- A set of interesting observations contributing to teaching environmental literacy came from the analysis of our assessment results. We made observations about the ways students interpret familiar and unfamiliar environmental concepts and the ways students display bias in their responses.
- We identified many of the challenges that instructors face regardless of the disciplines they represent.
- A jointly authored paper on teaching for environmental literacy is in progress.
- We presented our findings at the American Society for Engineering Education (ASEE) International Colloquium in Rio de Janeiro, in a poster titled “Systems Thinking for Engineers: A Requisite for Global Thinking.”
- We also presented at the 2006 American Association for Sustainability in Higher Education (AASHE) conference in Phoenix on the “Role of Higher Education in Creating a Sustainable World,” as a part of a panel discussion about environmental sustainability across Carnegie Mellon’s campus.

<http://www.design.cmu.edu/show_news.php?id=86>
One of the faculty members presented her Luce course as a model of teaching for technological and environmental literacy at the annual meeting of the ASEE.

**Outcome: Definition of Environmental Literacy**

We documented our process of defining, teaching, evaluating performance, and assessing the learning of environmental literacy and how to measure the impact of a specific course. Documentation will be compiled on our website and publications in a form suitable for dissemination.

**Outcome: Website for the Luce Courses and Environmental Education at Carnegie Mellon**

The website that was partially supported by this grant is nearing completion. We have attempted to capture all the facets of environmental education at Carnegie Mellon, with highlights about the “Greening” project. It reflects the diverse ways in which our faculty members approach teaching about the environment. We have reached out to about fifty faculty and staff with environmental interests throughout campus and asked them to write about environmental education. The responses we have received are inspiring and provide helpful information for potential students and/or collaborators. The site also lists all environmental courses, environmental majors and minors, graduate research, example assignments, student work, book/web/field trip resources, and information on Carnegie Mellon's own environmental history. The site will expand over time as environmental education evolves at the university. The website, still under development, may be viewed at <www.education.andrew.cmu.edu>. Attachment 2 is a print of the first two pages highlighting the Greening project on this website.

**Goal 2 of proposal: Meet the demand among undergraduates for accessible opportunities in environmental education and awaken the interest and attention of students who aren’t yet educated about the environment**

The Luce Foundation’s support has facilitated teaching an average of eight courses each semester, covering a wide range of subjects and reaching students from every college. Attachment 3 contains the complete listing of courses and departments.

As previously reported, our Fall 2005 survey indicated that almost 50% of the students had never taken an environmental course in either high school or college. In Fall 2005, 61% of participating students were taking a “greening” course because it was required or fulfilled a requirement. With first and second year students not having the freedom to choose electives, this showed that our strategy of “greening” (embedding the environmental material in courses such as required writing and studio art courses was effective in reaching students who may not be exposed to environmental content otherwise. Students from every college participated in this set of courses, which covered a wide range of subjects.

- We implemented the first environment-themed “Interpretation and Argument” course, which is a university writing requirement for first-year students. At least two sections of this course were taught every semester and four different variations on the environmental focus were offered. This practice is expected to continue.
- “Design and Social Change” evolved from a core curriculum sophomore design course formerly called “Design History II.” The professor completely changed the face of this course to encompass more environmental thinking. This course is taught every other semester.
- An art professor created an “EcoArt” studio for freshman and sophomores. This course is now taught every semester.
- In the program’s final semester, we introduced three new electives: “Materials, Energy and Environment”; “From Soil to Oil: Energy, Ecology, and Globalization”; and “Environmental Sounds”
(the first Luce grant-supported course in the School of Music). The professors teaching these courses are permanent and we expect that these courses will continue to be offered.

- The project encompassed multiple non-permanent offerings of courses unique to Carnegie Mellon. These include “Environmental Geology”, “An Introduction to Global Agriculture”, “The Legacy of Rachel Carson”, “Collective Ecologies <-> Future Emergence”, and “Rivers as Environmental Gateways to American History”.

**Continuation of the Luce Project Goals:**

The gains made during the grant period will persist well into the future because of the way that the program has woven environmental themes and perspectives into so many permanent, regular, required and recurring courses. Ongoing sections of “Interpretation and Argument” will retain an environmental focus, as will “Design and Social Change”, two sections of “African History”, “Exploring Connections”, “History of Sustainable Architecture”, “The Role of Environment in the Collapse of Ancient Societies”, and “Real Estate Design and Development”.

To continue the work started in the Greening Project, the Steinbrenner Institute for Environmental Education and Research (SEER) has committed funds for the continuation of up to three courses per year. SEER will cover preparation or salary support for these courses.

**Conclusion**

Our project goal was to expose students, early in their undergraduate education, to environmental thinking. While we can confidently report we achieved this goal, this project also provided critical centralized support for and made a permanent impact on environmental education at Carnegie Mellon. This sends the message to the campus community that the university is dedicated to making environmental awareness a prominent focus across all disciplines. Our group of faculty consisted of innovative thinkers who are making active efforts to continue teaching for the environment in a variety of course subjects. We also learned of the many challenges educators face when teaching environmental issues, especially to freshman and sophomores across a range of disciplines. This has been an immense learning experience for students, faculty, and the university at large, strengthening the ways in which we will continue disseminating environmental thinking across the campus. We can truly say that this significant enhancement of our education would not have been possible without the Luce Foundation’s support.
Course: INTRODUCTION TO ENVIRONMENTAL SOUNDS  
Instructor: Franco Sciannameo  
Department: Music

Sounds and noises surround every facet of our real and surreal lives. We navigate through them as though they were thick clouds of smoke often without understanding the encoded meanings they portend unless averting immediate danger. The Luce Foundation has allowed Carnegie Mellon University to institute an experimental course entitled “Introduction to Environmental Sounds.” The course is dedicated to foster awareness of the wealth of infinitesimal nuances which sound waves continuously broadcast for humanity to absorb. At the end of the course, participants have discovered the keys to listen to the world and to use sound as a measurement to assess, nurture, and answer global needs.

Course: MAPPING THE TERRAIN  
Instructor: Maureen Dawley  
Department: Art

The Luce project has been one of the most significant experiences of my years here at Carnegie Mellon. Everything was there: support, deep discussion, and collegiality—an excellent model of how to approach taking care of “our house”. The generosity of sharing that took place during the project has been and continues to inspire me in both my personal and professional life, practically and spiritually. In discussions with former students, I’m sure that some of this eco-wisdom was absorbed in each of their lives. I could not have taught the course without all of you.

Course: STUDIO ART: ECOART  
Instructor: Robert Bingham  
Department: Art

Since the mission of my art and teaching practice is to change the way people view and treat ecological systems, I feel extremely fortunate to have been involved teaching environmental literacy to freshman and sophomores through my Ecoart course. It was an extremely satisfying and rewarding experience that will continue on as a regular part of the School of Art curriculum. I could create a long list of benefits derived from the course, however I will relay one of the stories that I most often communicate when people ask about the course.
The facts are that it is a collaborative process on many levels; the students work together with each other and the Pittsburgh Parks Conservancy learning how to be eco-stewards in Schenley Park to address issues of invasive plants and soil stabilization strategies. This process leads to the proposal and implementation of ecoart projects within a given area of the park, Phipps Run. The second year a pair of students had a strong desire to designate where Phipps Run Stream used to run before being diverted into an underground culvert, infrastructure of the original park construction. Their project involved planting hundreds of crocus bulbs in a curvilinear configuration across a one acre lawn, this sprouted in the spring thus designating the former path of the stream in a poetic manner. This gesture led the conservancy staff to acquire permission from Pittsburgh City Parks to enable a group of students the following year to plan and create a raingarden meadow in the same site. A priceless series of events to revert a common lawn back to a naturalistic landscape all catalyzed by young students!

Courses: DESIGN HISTORY II (2004); SOCIAL ISSUES IN DESIGN (2005 AND 2006)
Instructor: Melissa Cicozi
Department: Design

When I first became a member of the Luce faculty group, I was teaching a design course that was mildly related to environmental literacy. My goal was to introduce the students to some important literature on sustainable design, giving them the opportunity to discuss it a bit in class. Hopefully I could expose them to enough information to allow them to feel comfortable entering into an impromptu environmental debate with friends, and some day at work.

In a short time, I realized that environmental literacy requires system thinking. System thinking requires visual tools. Sustainable design is simply good design - design solutions that consider the impact on people, the environment, and the economy. Our faculty group also discussed developing clear learning goals, along with a plan to achieve those goals.

Every lesson plan, project or assigned reading has a purpose. This might sound obvious, but it has made a huge difference in my course planning, and in the way I present information. Now I look at environmental literacy as a fundamental concept in the system of higher education.
Course: EXPLORING CONNECTIONS: MIND, COMMUNITY AND ENVIRONMENT  
Instructor: Patricia Carpenter  
Department: Interdisciplinary Seminar

The relation of living organisms to their environments is a theme found in many disciplines including ecology, cultural geography and psychology. Three faculty from these different fields (I. Nair, L. Patrick, P. Carpenter) created this seminar to explore with students ideas about this relation. For example, neurobiologists, H. Maturana and F. Varela, argue that an organism’s experience arises from this relation. One specific hypothesis, by C. Davia, is that living systems catalyze their environments, and that such catalytic processes occur at all levels, including that of the organism. [Catalysis is the ability of a molecule to speed up a chemical reaction; here the term is generalized to levels beyond the molecular.] Students with interests in music and ecology often catch on quickly to the idea that there is a ‘resonance’ between life and its environment; music itself arises from the interaction of the listener and the notes. Exploring such a hypothesis leads us naturally to reinterpret many phenomena in psychology, biology and ecology. Rather than being a process in the environment, life is a process of the environment. Exploring how such ideas connect to the students’ experiences has been an exciting part of this seminar.

Course: THE ROLE OF THE ENVIRONMENT IN THE COLLAPSE OF ANCIENT SOCIETIES  
Instructor: Ruth Fauman-Fichman  
Department: Anthropology

Some thoughts on teaching an environment course through the Luce Foundation grant.

In teaching a course that is as multidisciplinary as mine (The Role of the Environment in the Collapse of Ancient Societies), I spent a large amount of time in the beginning presenting a basic framework and vocabulary. I wanted to get across to students that we function in our environment as unconsciously as peoples of the past, and alter it just as dramatically as they did. I wanted students to understand the earth system that surrounds them and the ways in which humans regulate social society. We discussed the basics of earth systems – the atmosphere, hydrosphere and solid earth. We spoke about the anthropological basics of human societies – subsistence systems and social systems, the origins of agriculture and animal husbandry and the dramatic, yet recent change to complex societies only in the last 5,000 years. Is human impact on the environment a new thing, just from the advent of the Industrial Revolution? How can you tell if society is collapsing? Is there a particular moment in time when you know? What would you look at to be able to tell? What are the different parts you need to look at? How do you match up material evidence and behavior? I was sure the students were totally bored. How could I make them see this all mattered?
I decided we needed to look at the world around us before we ventured into the past. Before looking at three societies in the past (the Indus of South Asia, the Maya of Mesoamerica and the Moche of ancient Peru), we looked at Pittsburgh. What is the “natural” environment? (Are you sure?) Have Pittsburgh and CMU always looked this way? Has the water always just come out of the tap? Where does it come from? How do you know it’s clean? How does it get there and who is responsible for bringing it to you? Has it always been that way? We looked at the local newspapers. Should people move back to New Orleans after Hurricane Katrina? Whose decision is it? Why did the hillside collapse in Killbuck Township this fall? Why should you care? We heard about the evolution of water systems in Pittsburgh over the last 100 years from Professor Joel Tarr and took a field trip to Nine Mile Run to see how and why a watershed has changed significantly. Suddenly, the students started waking up….

It has been wonderful to see students begin to grapple with the realities. Did the custom of covering Maya temples in lime plaster contribute to deforestation? Did the Maya practice water rituals for religious purposes, societal control or some of both? Did elites direct agricultural intensification or did common folk organize irrigation schemes and gardening plots? Did drought affect the elite the same as the small householder? Was the Maya collapse the same for all regions?

My students are learning to ask questions about environmental effects in ways that consider nested systems, scale and human behavior. They are learning to look more carefully at different levels and points of view and critically evaluate the information they uncover. Students tell me that they had no idea that the problems we encounter in today’s world are not new, just on a global scale with (sometimes) different technology. I have encouraged them to write papers using their major area of interest. I hope it has given them an informed interest in the world around them and some tools to thoughtfully consider how we live in our world today.

Course: INTRODUCTION TO AFRICAN HISTORY
Instructor: Edda L. Fields-Black
Department: History

My two-semester “Introduction to African History” is designed to introduce students to major historical themes, concepts, and chronological shifts in African history. It begins with the earliest periods of hunter-gatherer societies and ends with the fall of apartheid and the election of Nelson Mandela. In between, it examines a diversity of modules. The first semester examines political centralization in ancient Nile Valley (Egypt and Sudan) civilizations, Islamic conversion and trans-Saharan trade in Mali and on the Swahili coast, political centralization in the kingdom of Mali, Catholic conversion and the trans-Atlantic slave trade in the kingdom of Kongo. The second semester tackles the following additional modules, the illegal trade in slaves in Ghana, colonial exploitation in the Belgian Congo, and the rise and fall of apartheid in South Africa.
Thanks to funding from the Luce Foundation, I have been able to foreground two central themes, broadly speaking, the environment, the continent’s resources, and its inhabitants’ contentious and ever changing relationship with both, and to organize the modules around them. For example, the course materials show that favorable environmental conditions and production of surplus resources were central factors in the location and timing of the development of Nile Valley civilizations, interregional trade networks, and centralized states in West Africa’s savannah region. The introduction of capitalism brought fundamental changes to the ways that some West African societies valued labor, traditionally the most valuable resource, contributing to the rise of the trans-Atlantic slave trade. And finally, the exploitation of Africa’s natural resources, both raw materials and again labor, were also the life-blood of colonial administrations in both the Belgian Congo and South Africa.

In Fall of 2005 when I first taught the revised version of the pre-colonial African history course, I attempted to highlight the course themes using a textbook, The Civilizations of Africa by Christopher Ehret. The textbook was incomprehensible to my students, the overwhelming majority of whom lacked a background in placenames, speech communities, and ethnic/cultural groups, which themselves have changed over time and changed throughout the narrative. The students were so confused that I discontinued its use halfway through the semester!

Instead, last spring semester (2006) and this past semester (Fall 2006), I emphasized the themes in lecture and discussion and illustrated them with documentary films. The films also enabled me to supplement the case studies in the modules, therefore broadening and deepening the students’ understanding of Africa’s regional and historical diversity. For example, I contrasted readings and lectures about ancient Nile Valley civilizations, where agricultural surplus led to the highest forms of political centralization, with a PBS documentary about hunter-gatherer societies in the rain forests of present-day Democratic Republic of the Kongo which never developed permanent centralized authority. And, I supplemented readings and lectures about the extreme exploitation of raw materials and labor by king Leopold of Belgium with a documentary on the English colonial government and white settlers’ alienation of the most fertile farm lands in colonial Zimbabwe. The result was a well-rounded course that educated students about environmental literacy and about key historical developments in Africa.

The assessment was difficult to relate to my courses, because it covered contemporary topics lacking in historical depth (and the first half of my course deals with very deep historical depth!). For the final assessment, I opened up the assessment question and asked my students to reflect on how their knowledge of resources had changed as a result of the course. Their responses addressed indigenous social institutions, labor, and the environment and their transformations over time, showing that the students had achieved a pretty sophisticated level of both environmental and African cultural literacy.
I was invited to participate in the Luce Project partly because my course was already “green” but also because there was a need to expand the course offering to students in the early stages of their academics. My course, Technology and the Environment, is a technical elective for undergraduates who are not engineering majors. The idea of the course grew out of research completed by myself and my colleagues in the Green Design Institute, a research center at the university. The content of the course links modern technology with associated major environmental issues and concerns. For example, one segment of the course examines the development and use of chlorofluorocarbons and the depletion of stratospheric ozone, then proceeds to consider the development and use of nanotechnology applications as potentially similar. The purpose of the class is to help students recognize how human activities related to science and technology have changed the world we live in as a starting point for making future decisions to minimize future problems. While environmental problems are often scientific in nature, it is essential that students consider the issues accessible to their general comprehension. This allows us to analyze issues and think critically about these complex problems. Despite what knowledge is gained in the class, students should realize that decision making is difficult and often doesn’t have one right answer – especially in the area of environment due to the uncertainty of future outcomes. A main goal of this course is to instill self-confidence in the areas of technology and environment that you use when approaching these issues and decisions in the future.

The three objectives of the Luce project (systems thinking, life cycles, and self-as-agent) were a core part of the course from the outset. A main topic of our research is life cycle assessment – examining a product from its origins as raw materials through manufacturing materials, parts, and the product itself, to using the product and disposing of it. The concept is applied to various technologies and at each life cycle stage the environmental impacts are considered. Despite this original “greenness” of the course entering the Luce Project, I benefited from the interactions with Luce faculty and hearing about their courses, content, and application of the Luce objectives. It is amazing to think that the courses, with such a wide variety of content, could find common ground in the Luce objectives. The Luce meetings provided an opportunity to share and acquire resources, to gather ideas for activities, to educate (and be educated) about how environmental issues accompany all areas.

Perhaps the most beneficial part of my participation was learning how to reflect on my teaching in conjunction with the course content. As an instructor, I receive feedback from students a few weeks into the semester, and at the end of the course, but the questions and feedback center on teaching aspects – presentation skills, level of material, amount of work, etc. Through the Luce program, I had the opportunity to work with (I forget her name!!) to truly reflect on my course and how well the students were learning what it is I wanted them to learn. This reflection involved examining my objectives, relating them to the content and materials and activities for the students,
then being observed and surveying the students. The feedback from this process identified areas where the environmental impacts and their importance needed to be emphasized more, where certain activities needed to be changed, and where my biases and beliefs needed to be removed from the classroom discussion. I learned how to incorporate this reflective process in my day-to-day teaching activities, recognizing how important it is to take the time when the course is fresh in your mind, to make notes about how well things work (or didn’t work), to document student comments and questions, and to leave a record both for developing the course further and for developing my abilities to facilitate student learning (rather than improving “my” teaching).