**Environmental Track Record**

Over the last decade, a significant body of work at Carnegie Mellon has taken as its theme the environment and sustainability.

*Environmental Research*—The University is home to nationally known departments, centers, and investigators working in the areas of air and water quality, green design and architecture, environmental systems modeling, environmental risk analysis and communication, and environmental engineering, science, history, and art.

*Green Practices*—We practice what we preach. In 2001, Carnegie Mellon purchased more wind-generated electricity than any other consumer in the nation. In Southwestern Pennsylvania and beyond, our students, faculty, and president are working to revitalize brownfields, overcome water-pollution problems, and introduce green building to the landscape.

*Environmental Education*—With so many complex systems at play (ecological, political, economic, ethical), environmental literacy is challenging to teach. But Carnegie Mellon, being dedicated to interdisciplinary inquiry, is proving to be an ideal setting. Popular environmental courses run the gamut from Technology and the Environment to Green Chemistry to Environmental Decision Making to International Environmental Law and Policy. Undergraduates can major in Environmental Studies or Environmental Engineering or incorporate environmental topics into any course of study.

Two critical background issues: 1) We believe environmental literacy should be more widespread among our students that it is at present and that starting this early in their curriculum would enable more students to bring environmental considerations into their entire course of study. However, we do not have enough courses that fit the early part of our rather structured curriculum. Environmental courses for first- and second-year students are largely restricted to disciplinary majors. Open courses, geared towards third- and fourth-year students, are regularly oversubscribed. 2) Carnegie Mellon is an entrepreneurial institution. As such, our efforts in environmental research and education have emerged in a bottom-up, grassroots fashion. But with the arrival of an environmentalist as our president five years ago—formerly
Dean of Forestry and Environmental Science at Yale, President Cohon is an expert in water and nuclear waste issues—and with the drafting of the university’s strategic plan in 1998, the goal of expanding our work in environmental science, engineering and policy has taken its place as a central and clearly-articulated goal.

**Goals**

Today we intend to become a rarity among research institutions by marshaling a university-wide effort in environmental education for first-year and second-year undergraduates—a diverse set of small-section courses that enroll 500 students a year and feature interdisciplinary, project-based learning and skill development.

The program’s global objectives are to: 1) seize the opportunity presented by an eager student body; 2) raise the environmental awareness of a majority of our students early in their undergraduate education; 3) awaken the interest and attention of students who aren’t yet educated about the environment; 4) give students experience in working in multi-disciplinary groups to tackle environmental problems; 5) impart to students a sense of agency—the belief that they can make a difference in working towards environmental sustainability in their various roles as professionals, consumers, and citizens.

**Expanding Circle of Impact**

In the short term, the proposed program will result in a sharp increase in the number of undergraduates taking first-year, second-year, and upper division courses on the environment and sustainable development; more students choosing environmental studies as a second major or minor; more students conducting environmental research under the auspice of our Undergraduate Research Program (recognized as a model by the NSF in 1997).

Mid-term outcomes and assessment measures will include a significant number of each semester’s participants bringing an environmental perspective to bear on subsequent classes and activities. After being piloted in new courses, teaching material (much of which will be implemented on the web to facilitate re-use and dissemination) will then be made widely available to educators at this and other
institutions. Advanced graduate students who assume a portion of the program’s teaching load (after being selected on the basis of their desire to make teaching an integral part of their career) will export elements of the program as faculty at institutions across the country. The program also will yield new insight into teaching for environmental literacy and a clearer picture of young peoples’ perceptions of environmental issues, which participating faculty will use as the basis for submissions to educational and environmental research journals. We will make educational research into pedagogy for environmental literacy an integral part of the overall project. Environmental literacy has to do with factual knowledge and skills as well as a sense of time and place. Agency has to do with self-consciousness and articulation of the students’ place with respect to the environment. By asking a sample of students to keep follow-up notes and with periodic interviews, we hope to keep of students’ relevant learning and practices in this area over time.

Over the long term, participating students will be more likely to make environmentally-sound decisions as consumers, at the pools, and as leaders in business, engineering, science, and public policy-making. They will promote environmental consciousness in the myriad institutions (universities, corporations, public agencies) to which their career paths lead.

Curriculum Development and Implementation Plan

The Luce Foundation’s funding will facilitate four years of course development, deployment, and evaluation, as well as dissemination of teaching tools and best practices. We intend to offer ten environmental courses per semester for first-and second year students. Most courses will be entirely new; others will be reformulations of existing courses. Courses will encompass, in varying degrees, background and skill-development components as well as action or project elements. Courses will be interdisciplinary in nature (bringing together students, approaches, and perspectives from all majors), but they will be part of individual department course offerings. This will ensure the program’s long-term sustainability.
To facilitate the introduction of new courses into already heavy course loads, the proposed courses will fit into existing curricular frameworks. That is, they will do double-duty: They will impart an environmental education while satisfying general education requirements, fulfilling major requirements, or counting toward elective credit.

**Timeline**

*Summer 2003*—Establish overarching philosophy for program; begin developing courses.

*Fall 2003 semester*—Develop new courses; publicize existing and in-development opportunities in environmental education; establish on-line portal for distributing teaching materials.

*2004 calendar year*—Offer new courses; publicize new courses and opportunities in environmental education in general; conduct course and program evaluations; disseminate teaching materials; conduct educational research on promoting environmental literacy;

*Spring 2005 semester to Spring 2007 semester*—Offer and publicize courses; conduct evaluation; disseminate teaching resources and findings of educational research.

**Paradigms for New Courses**

The program will be integrated into the individual departments, but the courses will have some common characteristics consistent with the ethos of our education. Project-based learning will combine background teaching with hands-on, interdisciplinary work on solving problems developed in collaboration with the campus Green Practices Committee, and others drawn from the City and the County. While a few courses may be semester-long projects, most projects will be small, yet large enough to give the students a sense of the complex and interdependent nature of environmental sustainability. Courses that are likely to be among those we develop for the program are envisioned to be of several types (entirely new courses are noted with a *) outlined below. The faculty and graduate student teams teaching the courses will evolve the philosophy and the content distribution of the courses in consultation with the Project Team.
Core Area Courses with Environmental Themes:

- “Argument and Interpretation: Environmental Literacy”*—imparting to students the fundamental language skills and knowledge base needed to function as environmentally-informed citizens; encompassing the interpretation of texts, synthesis and evaluation of arguments, and contribution to public discussion and debate.

- “Critical Issues in American Environmental History”—focusing on how ideas about the environment have shifted from the past to the present.

- “Environmental Art”—a concept studio focusing on the environment, open to majors and non-majors; students will draw upon environmental perspectives from diverse disciplines and translate them into individual and collaborative projects in a variety of forms (installations, performances, writings, two- or three-dimensional media, electronic media); projects will be presented in a public space to encourage community dialogue about environmental issues.

- “Environmental Statistics”*—covering the fundamentals of quantitative and causal reasoning through exercises in monitoring pollution, detecting health effects, extrapolating for low doses, testing for differential exposure and enforcement (e.g, environmental justice), and examining historical data for evidence of global phenomena such as warming.

Modules of Existing Environmental Courses that Merit a Full-Semester Curriculum:

- “Pollution and Propaganda”*—a collaboration between English and chemistry examining the use of language to manipulate science and distort the facts of environmental impact.

- “Framing Environmental Problems”*—a statistics-based course covering the tools: risk perception, risk communication, risk ranking, decision analysis, cost-benefit analysis, life-cycle analysis, valuation of health and environmental amenities; students will learn how to structure complex environmental problems, conduct analyses, and make recommendations.
Interdisciplinary Courses/Course Clusters Built Around a Single Theme (e.g., water, urban infrastructure):

• “Good to the Last Drop” (a course on water)*—addressing the relationship between society and the environment, how we obtain our water and maintain its purity, the importance of water as an area of conflict between peoples, and the disparity between the quality and quantity of water available to developed nations and that available in the developing world; a pressing regional issue, this topic is fraught with case-study and project possibilities.

• “Computational Tools for Environmental Studies”—featuring lab exercises on light, heat, energy, and GIS mapping of energy and environmental flows; planning and management problems; covers underlying geographic concepts and encompasses computer lab tutorials and case studies; exploring topics including transportation issues and land use.

Courses that Fulfill Major Requirements But Will Be Open to Students in Any Field:

• “Green Chemistry”—covering issues including water pollution and the integration of environmentally-friendly technologies into pollution-heavy industries; will include Oxford Union style debates.

• “Environmental Architecture”—focusing on sustainability via integrated and flexible service infrastructure alternatives for clean water, storm runoff, sewage, power, voice and data transmissions, and transportation; addressing remedies for the problem of the right hand not knowing what the left hand is doing, of roadways torn up for water service one month and then torn up for sewage the next. This course and others like it will innovatively broaden the focus of sustainability studies to encompass the built environment.

Electives (Formerly for Juniors and Seniors) to Be Offered in Freshman/Sophomore Sections:

• “Management, Environment and Ethics”—drawing on philosophy to examine the major issues in environmental ethics and the obligations of organizational managers with respect to conservation,
sustainability, socially responsible management, economic development, and international environmental exploitation.

• “Technology and the Environment”—after three successful years as a general upper level elective for students of all majors educating students about the interactions between technology and the environment, a section of this course will be offered to first- and second year students.

Project Courses:

• “Powering the Campus of the Future”*—impacting an understanding of energy use on the university campus and its environmental ramifications, leading up to generating multi-disciplinary solutions; featuring undergraduate research into small campus interventions, fully engaging students in local solutions to global problems.

Assessment/Evaluation

Over the past decade of teaching environmental courses, we have continually learned from our students and revised our ways of teaching, assignments, and presentation of material. Instruments developed include pre- and post-tests for environmental literacy. We will conduct course and student evaluations (including student journals after the course) and program evaluation to assessing the success of this campus-wide initiative in achieving the objectives described above and to see which course models work best in our context and why. Courses will be revised following assessment.

Dissemination

Course material will be implemented on the web with a view to program sustainability at Carnegie Mellon and dissemination of model material. This will include teachers’ notes to facilitate adaptation. Textbooks such as *Engineering and the Environment* by Edward Rubin and *Search for the Ultimate Sink* by Joel Tarr and online sites such as Chris Hendrickson’s *Green Design* and Indira Nair’s *Environmental Decision Making, Science and Technology* have already supported teaching in other campuses. Faculty Development Workshops, conferences, and journal papers will be other venues for dissemination of material and findings.