“Greening of the Undergraduate Curriculum”, the environmental education project at Carnegie Mellon, funded by the Henry Luce Foundation is in the middle of its first year of implementation. As the funding came through in summer 2003, when the classes for the Fall semester had already been assigned, the first version of the courses under the Luce grant began to be taught in Spring 2004. A significant amount of planning went into the course design by the instructors and in group meetings, discussions, and assessment workshops conducted by the assessment experts at the Eberly Center for Teaching Excellence (“the Teaching Center”) at Carnegie Mellon.

This report describes the progress and achievements of the project for the period from August 2003 to July, 2004.

General Philosophy and objectives
We have articulated overarching educational objectives of the Greening of Education project by aiming to make education ecological in the broadest sense-- by inviting students towards knowledge of the self, of the environment, of the underlying principles, and the processes of learning and doing and understanding. This is to happen in the context of the different subject areas they are being taught early in the curriculum, so that this ecological knowledge is integrated into their thinking as they progress through their specialized learning in the subject areas. Understanding has been defined beautifully by Wiggins and McTighe in Understanding by Design\(^1\): When we truly understand, they write, we (1) can explain, (2) can interpret, (3) can apply, (4) have perspective, (5) can empathize, and (6) have self-knowledge (page 44). It is uplifting to think that each of the courses we teach can be the grounds to make this happen.

To plan a course around this thinking, we have sought to design the Greening courses to include three very general features that can form foundations for ecological thinking.

(1) Systems thinking –connections and influences between ideas, people, and communities; (2) Life cycles and respect for the role of time in nature, human activities, and our lives; and (3) Self as agent and knowledge and uncertainty as a basis for decision making.

Each Greening course may approach these in different ways, and this aspect of seeing the concepts in diverse contexts and with diverse approaches can be a powerful pedagogy\(^2\).

Courses Taught
Seven courses were taught in the Spring 2004 semester and nine courses will be taught in Fall 2004. We already have several courses being planned for Spring 2005, in addition to the repeating of the courses taught in Spring 2004. Most of these courses fulfill degree and/or elective requirements, in addition to meeting university-wide goals in environmental education;

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\(^2\) [http://telstar.ote.cmu.edu/environ/](http://telstar.ote.cmu.edu/environ/) a website for our course, “Science and technology for the Environment” has discussions of teaching systems thinking including the use of concept maps.
we anticipate that they will continue being offered after the funding has ended. The courses and
departments are listed in Attachment 1.

**Institutional and Pragmatic Goals:**
The institutional and pragmatic goals outlined in the original proposal and accomplishments in
each of those categories to date are being achieved, and exceed our expectations. In the short
time since the project began, a number of remarkable outcomes have resulted, in addition to the
courses being taught to almost 300 students during in the Spring 2004 semester. Sharing of
curriculum and course materials, resources, and pedagogy, systematic assessment, and the
beginning of a scholarship of teaching on the topic of environmental literacy are some of these
outcomes. The building of a strong community among the faculty teaching environmental
“Luce” courses and our collaborative work on defining environmental literacy and the pedagogy
and knowledge base for teaching it are unexpected outcomes. These are now described.

An overall lesson is the amplification of learning and teaching that is achieved when a group of
committed educators are brought together and receive material support and encouragement. The
collaborative culture of Carnegie Mellon, combined with dedicated teachers has been greatly
enriched by the Luce grant in producing these remarkable outcomes. This is a model for the kind
of educational outcomes that can result from such grants.

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

1. **Outcome: A Learning Community**
A unique and important aspect of these courses is the learning community formed by the
professors. This project has provided a framework in which these professors, most of whom had
never met each other prior to this, can share their ideas and experiences teaching environmental
concepts. Such a communal and ongoing discussion is rare and has been an unexpected benefit
of the grant. Now that we are heading into our second semester we see that the faculty who
taught last semester will continue to be involved in future semesters. Faculty have been
continuing to join us in meetings and discussions even if they are not teaching a course at the
time. We see this as an indication that we have begun to develop a network of faculty who are
committed to the goals of environmental education and feel encouraged and supported by the
resources and sharing opportunities the Luce project provides.

2. **Outcome: A Learning Experience for Faculty-- Improved pedagogy through a sharing of
ideas and methods**
The faculty group is dedicated and excited about their teaching as well as about the wealth of
ideas that come up as a result of the regular meetings. Each teacher is working hard to re-
evaluate and improve their own understanding of how to convey the knowledge as well as
desired outcomes to students. They are interested in improving and critiquing their own teaching
methods. We have also been dealing in depth with questions such as how to define, teach for,
evaluate performance and assess the learning in these courses. As a result of these discussions
among these faculty who are content experts in their individual domains and two outstanding
evaluation experts from the Teaching Center, there has been an exciting exchange of ideas.
Courses are taking new directions in small ways, due to this exchange, we have sharing of ideas
and lecturers and faculty are beginning to call upon each other’s expertise and insights in forging
new directions in this interdisciplinary field. Very subtly, this also has begun to lead to faculty
understanding and respecting the perspectives of other disciplines, an imperative for truly
interdisciplinary teaching and learning.

3. Outcome: Systematic Assessment of Learning Objectives
In the Spring semester the group took part in an assessment workshop that led to individual
design of a student pre- and post-test for each course. The pre and post tests administered to the
students in the Spring 2004 courses gave us interesting insights into the prior knowledge students
bring to these courses and on how to improve the tests in order to identify successful elements of
each course. All the faculty welcomed giving these tests as they provided an opportunity for
them to define expectations they have for the students as well as for themselves. We also offered
the services of another assessment specialist, Sarah Eldridge, to provide faculty with a form of
self-critique, and are in the processing of evaluating whether this is a fruitful direction to enhance
student learning.

Faculty who had just concluded their Spring courses, faculty who are planning Fall 04 courses,
and our assessment experts from the Teaching Center participated in an intensive 3- hour
workshop in May in which we met within a structured discussion, led by the assessment experts.
The faculty reflected on what they learned throughout the semester, how well they achieved their
goals as well as the project goals, and what suggestions they have for us to improve our process.
As a group we also successfully developed a set of six core questions to use on our future pre
and post tests.

These shared questions will enable us to extract useful information for the project as a whole and
to contribute toward the design of an environmental literacy rubric.

4. Outcome: Scholarship of Teaching and Pedagogy: Definition of Environmental Literacy
The faculty group discussions have led to many new ideas. We have begun to articulate what we
mean by environmental literacy and are working to develop some standard practices and
curricular and pedagogical frameworks, which other educators can adapt. We will develop a set
of concepts that will define a basic understanding of environmental literacy so as to create a
consistent knowledge base among the students who take a Luce course, and would define a
scaffolding for others designing courses with environmental literacy as the learning objective.
This is described in slightly more detail below.

5. Outcome: Definition of Environmental Literacy
We have been dealing in depth with questions on how to define, teach for, evaluate performance,
and assess the learning of environmental literacy in general, and how to measure the impact of
specific courses on students’ environmental literacy. This type of work is important if this
teaching is to continue and the principles –pedagogical, curricular and institutional – are to be
disseminated so that other faculty here and elsewhere could learn from our cumulative
experience. Our faculty are discussing these challenges with enthusiasm and deep interest. For us
to gain perspective on the successes of these courses we are working to create a rubric and a set
of standard, yet flexible, questions that will help to determine the student experience in each
course.
6. **Outcome: Website for the Luce Courses:** In progress

The website is being redesigned and will be running by August before the start of the fall semester. The website contains all past and present course information, an image library of student projects, a password protected section for professors to view pre and post test results, a message board for comments, an announcement section for relevant lectures and events on campus, and a resources database that includes books, articles, videos, and websites. We are particularly excited about the resource section as professors have expressed that they need a comprehensive location to search for relevant resources. Many of our professors have always had an interest in teaching environmental topics, but only now through the Luce project are they beginning to really saturate their curriculum with these topics. These professors in particular look to us and the other faculty for advice, ideas and resources. The website will provide the professors with a location to look for new material as well as post questions to the group. URL: http://www.cmu.edu/education/greening/

2. **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.

- **Seven courses (nine sections) were taught in Spring ’04:**
  - Three of the courses were core curriculum courses, which students within that major must take (Concept Studio II/III: EcoArt, Architectural Materials and Assembly Studio, and Design History II). The Art and Design courses were also open to non-majors to diversify the student group and provide varied viewpoints and experiences. Interpretation and Argument (four environmental sections) is a university-wide required course with an eclectic mix of students. With these core courses we see the opportunity to reach students who might not necessarily choose to take an environmentally themed course.
  - Two courses (Technology and the Environment, taught by a civil engineering professor, and Mapping the Terrain: Environmental Thinking and Art Practice, taught by an art professor) are electives that give students a chance to continue environmental learning at an early freshman/sophomore stage.

One way in which we were able to gauge the knowledge and interest gained by students during this first semester was by looking at their pre and post tests. We were able to get an idea of their basic level of environmental literacy and detect common misconceptions especially, in answers to a question that asked students to define terms such as sustainability, resources and ecology. The pre-tests showed that very few students understood the concept of sustainability; frequent answers were “long-lasting, durable, efficient and Recyclable.” On the post test answers we could identify more in-depth thinking that seemed to reflect a better understanding such as “a continuous cycle that works w/ the natural environment, instead of creating waste it replenishes” and “meeting currents needs without compromising future needs.” Many of the improvements on the terminology questions were quite obvious and on each post test we could see that the answers showed a higher and more confident level of understanding. One question asked, what daily habits you might change that would have a better impact on the environment, and the majority of
students said they would “recycle more, drive less, use less water, electricity and plastic, generate less trash, turn off computer when not using it.” On the post tests there were some more creative confident answers such as: “Show an up-to-date flyer/article about the environment to one person a day and just have a short but sincere conversation about it.” On the post-test we also saw an increase of detailed answers that listed specific systems and concepts such as insights into alternate forms of fuel (“ethanol”) and the impact of CFC’s on the ozone layer. We found these pre and post tests to be very useful and received encouraging feedback from the faculty. Since May, we have redeveloped the questions and are in the process of creating a better organized method of compiling the test results.

The first pilot round of tests provided us and the faculty with surprising and valuable information. We are looking forward to implementing the new test system in our Fall ’04 courses.

Seven courses will be taught in Fall ’04:

- Again, we will have the Interpretation and Argument course (2 sections) and the Eco Art Studio course. One new interdisciplinary course includes Science Technology for the Environment which will be open as an elective to all freshman and sophomore students. We are bringing back to life an Environmental Ethics course that will also be a freshman and sophomore elective. Design History I, which is a required course for design majors and a pre-cursor to last semester’s Luce course design history II, will take on more topics related to the environment than any other year. The environmental engineering course is also a required course for engineering students and we would like to see in the semesters to come if engineering students are more inspired to pursue an environmental engineering path. We have another dedicated group of faculty to work with this upcoming semester and have already begun to integrate them with our past and future faculty in order to maintain this exciting network of incredible teachers.

Upcoming courses for Spring ‘05:

- For the Spring ’05 semester we have five new courses planned so far (not including repeats). These courses include Ecological Economics, Geology, History of Water, Environmental Challenges and Solutions: Moving Toward Sustainability, and a course called Hidden connections. The Challenges and Solutions course will take an interdisciplinary, solution-oriented approach to the analysis of diverse environmental issues through four modules: Sustainability & Consumption, Sustainable Water Use, Sustainable Agriculture, and Ecological Economics & Sustainable Futures. The Hidden Connections seminar will explore the relation between our understanding of ourselves and our environment in light of the emerging understandings of the relatedness of mind, matter, and living systems. Currently, Carnegie Mellon has no courses that reflect the subject matter of these courses which is why we are particularly excited to offer these opportunities to students.

Attachment 1 provides details of the courses taught in Spring 2004 and to be taught in Fall 2004.
3. **Opportunity to showcase the Luce courses**

Steinbrenner Institute for Environmental Education and Research (SEER) is a new center at Carnegie Mellon. The mission of SEER is “to help to change the ways the Carnegie Mellon community and the world thinks and acts about the environment, through our educational and research methods and results, through the issues we raise, and through the outcomes we produce.” ([http://www.cmu.edu/environment/](http://www.cmu.edu/environment/)). For its opening event in October 2003, SEER invited the Greening project to display the courses in the form of a poster. The faculty wrote the material for the poster describing the courses with pictures that highlighted student projects. A reduced version of the poster is included as Attachment 2.

We plan to work closely to develop synergy between the SEER education projects such as a newly launched “Environment across the Curriculum” and the Greening project, and look forward to a productive collaboration.