

increased knowledge results in measurable improvements in McMaster's recycling of waste.

Through collaboration, information sharing, and peer support, these students were able to achieve their individual as well as group goals and objectives. The second GUCEL project, Green Jobs: Bridging the Gap, began in January and is currently under way.

#### The Sustainable Future Program

Initiated in January 2012, the idea of creating an interdisciplinary course on sustainability was proposed based on work being undertaken by the Task Force on Sustainability within the Faculty of Engineering. Popular support for the idea of a course led to the creation of a working group composed of stakeholders from each of the various faculties, along with members of the university administration. The goal was to develop an interdisciplinary course that would engage students in learning about sustainability through experience, research, and community involvement. The group's early discussions led to the focus on providing students with a solid understanding of sustainability from an interdisciplinary perspective, while also including experiential education, community engagement, and student-directed learning. The group realized it would take more than one standalone course to achieve this overall goal.

Throughout calendar 2012, the inaugural course, Sustain 2A03—The Sustainable Future Project, took place. A course instructor was brought onboard to develop the course content. Community outreach began with the goal of obtaining support and mentors for students' experiential-learning projects.

The primary goal of creating a standalone course on sustainability rapidly evolved into the project's becoming a program within a larger framework. The goal of this broader

#### Objectives for the Sustainable Future Program

- Teach students about sustainability from an interdisciplinary perspective.
- Provide the opportunity for self-directed, interdisciplinary, and experiential learning.
- Support student learning within the university and local community through:
  - Engaging undergraduate students in meaningful, experiential research.
  - Fostering opportunities for students to place local knowledge and local action within a global context.

program was to guide the direction of the inaugural course, as well as future additional courses.

The first course, Sustain 2A03, was successfully launched in January 2013 and quickly was offered for a second term. Approval to develop a second course under the Sustainable Future Program was granted. In its first offering, Sustain 2A03 engaged more than 250 people as partners and mentors who aided students' experiential learning. In all, 38 initiatives were planned, developed, and implemented by the students in the course. The second course within the Sustainable Future Program, titled Sustain 3A03—Societal Tools for Systemic Sustainable Change, was offered for the first time in September 2013.

The development of these courses was made possible through the support of many faculty—especially the Faculty of Engineering, which provided funds to administer the two courses—and staff members involved in the planning and implementation of the courses, along with members of the community who helped guide students in their experiential learning. The hard work of the students enrolled in the inaugural course, as well as the informative feedback they provided throughout, has been integral to the program's success and continued development.

For further information, see the following: McMaster Office of Sustainability, <http://asp.mcmaster.ca/>; McMaster University 2012 Sustainability Annual Report, <http://asp.mcmaster.ca/documents/Reports/Annual%20Report%202012.pdf>; McMaster GUCEL Program, <http://asp.mcmaster.ca/documents/Reports/Annual%20Report%202012.pdf>; McMaster Sustainable Future Program, <http://asp.mcmaster.ca/sfp.html>; Sustain 3A03 Course Report, <http://asp.mcmaster.ca/documents/Reports/3A03%20CR.pdf>.

Please note that the thoughts and opinions expressed within this vignette are those of the authors, and do not necessarily reflect those thoughts and opinions of McMaster University.



#### Sustainability Research Through the Lens of Environmental Ethics

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Two core courses in the curriculum of the University of Dayton's Sustainability, Energy, and the Environment minor, Sustainability Research I and II, were developed out of the frustration one author, Daniel Fouke, experienced while teaching a traditional course on environmental ethics for the Department of Philosophy. The often-overwhelming nature of environmental problems tended to demoralize both the instructor and the students. Seeking a way to

integrate ethical analysis of complex problems with the search for solutions, two courses were proposed that would be team-taught by a philosopher and a scientist or an engineer. Development of the courses was initially funded through a course-development fellowship from the college of Arts and Sciences.

The rationale for these courses is the recognition that technical and scientific knowledge cannot, by itself, provide reasons for utilizing that knowledge for ethical purposes. Similarly, ethical reasoning cannot operate in a vacuum. That is, individuals cannot have a duty to do what it is impossible to achieve. The courses facilitate understanding of how science, technology, and ethical analysis have a symbiotic relationship in assessing solutions to environmental problems—knowing our duties toward the natural world requires understanding what science tells us about the nature of environmental problems and then evaluating the strengths and limitations of technological solutions.

In Sustainability Research I, projects focus on institutional sustainability using the University of Dayton as a case study. Sustainability Research II is structured around projects developed in cooperation with community partners off campus. Research projects in both courses vary by semester according to what students choose to pursue, but topics include renewable energy, energy efficiency, purchasing policies that promote sustainability, effective means of promoting recycling, the benefits of sustainable landscaping, and the value of increasing biodiversity in institutional landscapes.

In the second course, students come to understand and articulate how local practices are affected by economic, moral, and aesthetic values, as well as political structures, and they learn that all local environmental problems have global consequences. Students come to appreciate the necessity of integrating knowledge across disciplines in order to engage in practical, ethical action on a local level, and they learn to analyze the practices and policies of a campus, city, or neighborhood while conducting their research. They present ethical, aesthetic, and economic analyses and arguments for implementing particular sustainable alternatives. Along the way, students learn how to work with institutional actors such as local officials and community organizations to achieve change, and how to persuasively present research findings to these individuals or organizations by combining moral and economic arguments with technical information.

On a practical level, in both classes sessions alternate between teamwork on projects, during which the instructors advise students on their projects and help them to deal with any problems they are confronting, and class-discussion

days, when students prepare summaries of the assigned readings or participate prior to class in online discussions. The readings for the courses are tailored to the problems the research projects are designed to solve, along with more general readings on sustainability, the social and natural sciences, and environmental ethics. Additional assessment comes through a paper individual students write on ethics, sustainability, and educational or civic institutions. Project results are presented at a public forum on campus and delivered as a final product to relevant officials in the university administration or to community partners. Individual students are also required to submit evaluations of their own work and that of the other members of their research team, and at the end of the semester, to write letters of reflection for next year's class, perhaps the most powerful form of assessment. Following are a few excerpts from those letters.

From an engineering student (male): "Welcome to one of best educational experiences you will come across while at the University of Dayton. The class you are about to take is not a typical research class, or ethics class for that matter. This class gives you the opportunity to connect with your fellow classmates differently than any other group project or assignment. Depending on how much effort your group puts into the class, the end results can be something that can be recognized campus or city-wide!"

From a business major (female): "Initially, I chose to take this course as part of my minor, Sustainability, Energy, and the Environment. ... Before taking this class I knew little to nothing about the importance of trees and the free ecosystem services they provide, the role of universities in land conservation, how ecosystems work as communities and how a single disturbance can throw them off entirely, how sustainable land management can cut costs and save labor hours, the importance of native plants and animals, and the risks of invasive species, among other things. In addition to all of these things, I learned about our moral obligation as humans to take care of the environment, not only because it is valuable to us but because it has value in itself. This part of the course was very different and really opened my eyes to a whole new way of seeing the environment. ... When I walked into the classroom on the first day ... I was immediately intimidated. ... My professors were a Philosopher and an Engineer; I have never loved Philosophy and I know nothing of Engineering. ... For all I knew, these people thought I was dumb; isn't that what Engineers think of Business majors? Needless to say, I was wrong. I ended up having the same amount of prerequisite knowledge to be a useful part of the class as everyone else and I fit in just fine."

Finally, from a second engineering major (female): “This ... course is totally unlike any you have ever taken before. The professors act more as guides rather than traditional professors. You can converse about any topic, but they leave most of the learning and teaching up to you individually. In this class you will explore ideas that you have never even considered, diving deep into moral and ethical obligations in relation to the environment. These discussions can be challenging and you may not see where others are coming from, but if you keep an open mind and stay true to your opinions, it will allow for a more fruitful discussion. ... This semester I truly took a responsibility for what I learned in class ... (working) on a project that analyzed water usage at the University of Dayton, from past to present and created solutions for the future. I truly took responsibility and felt possessive of the subject I studied and found out so many things about myself and the University of Dayton that I had never known.”

Although there are challenges to teaching a course of this type, ranging from institutional hurdles in organizing team-teaching in an equitable fashion, to the legwork necessary for coordinating and developing potential projects with university divisions and community partners, the clear benefits that arise from allowing students to follow their passion and take charge of the learning process are clear rewards for the initial effort. 

### **Creating Value Through Prizes for Undergraduate Research in Sustainability**

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**G**ale-Cengage Learning, a leading e-research and educational publisher, has established a successful prize program recognizing undergraduate interdisciplinary research into sustainability issues, in collaboration with several universities. The research awards offered by this program support institutional faculty and student needs in teaching and learning, particularly regarding the growing need to recognize interdisciplinary research. Collaborations involve Temple University, the University of Delaware, the College of Wooster, and, most recently, Pennsylvania State University.

#### *Temple University*

Gale-Cengage Learning approached Temple University Libraries in 2010 with a proposal to fund a prize to be awarded by the libraries for undergraduate research on sustainability and the environment. With another well-established library prize already in place, Gale's offer represented a new

opportunity for the libraries to expand their recognition of outstanding undergraduate research that encourages the development of students' competencies in information literacy. The libraries accepted the offer and a reception each spring features presentations by student winners and their faculty mentors. It is a celebration of the partnership among librarians, university administration, faculty, and students in students' learning.

The traditional Library Prize for Undergraduate Research receives entries primarily from students in the humanities and social sciences. Partnering with Gale on the added Library Prize on Sustainability and the Environment has enabled the libraries to reach out to students in science, engineering, and other areas in which students study sustainability and the environment. The libraries have welcomed this opportunity to support and highlight student research excellence.

In addition to supporting student-learning goals, the Library Prize on Sustainability and the Environment enables librarians to demonstrate campus leadership on these important issues and creates an opportunity for librarians to work with Temple's Office of Sustainability. The director of that office serves on the panel judging entries in the award competition each year, along with faculty members and librarians, and thus sees a full range of student research on these topics. The prize also supports the university's goals as part of the American College and University President's Climate Commitment to accelerate educational efforts about climate change.

#### *University of Delaware*

The Sustainability Prize was established by the University of Delaware's Undergraduate Research Program and Gale to encourage undergraduate research and projects in the area of sustainability. The sustainability prize is an integral component of the Summer Scholars Programs at the university. More than 300 students are eligible to apply for the award, and they may be from any discipline. Their projects may encompass research and/or service. This prize is awarded in conjunction with Gale providing access to GREENR for University of Delaware students and faculty. This database supports sustainability research and reference topics on the environment, energy, and natural resources.

Established in academic year 2010-2011, four projects were selected to receive awards. Student Matthew Fischer was the first-place prize winner for a paper entitled Kinetics of Arsenite Oxidation by Manganese Oxide Minerals: Importance for Water Quality and Environmental Sustainability. In 2012, four prizes were given and the first-place winner was Taylor Smith for a project titled Biochemical Processes Utilizing Electrogenic Bacteria. The 2013 first-place awardee was