

Helping budding entrepreneurs bring ideas to life

Engineering course empowers students seeking social change

HILARY PARKER

The laboratory course taking place in the basement of Princeton's Friend Center is not a traditional one — in lieu of microscopes, there are discussions of microfinance, and students seek to create not chemical changes, but social ones.

"A Collaboratory for Social Entrepreneurship," which provides an opportunity for undergraduate and graduate students to design and develop social change organizations, is taught by Gordon Bloom, the Dean's Visiting Professor in Entrepreneurship in the Keller Center for Innovation in Engineering Education. Some 75 students are diving into 20 projects that target some of the largest challenges facing society today, including poverty, disease, security and energy.

The course, nicknamed the "SE Lab," was conceived by Bloom during his time on the Stanford University faculty. He then taught it at Harvard University's Kennedy School of Government before he came to the Keller Center at Princeton. Throughout the semester, students explore the theoretical framework of social entrepreneurship through readings, discussions, case studies and guest lectures, while developing their own plans.

One morning in late September, Bloom led the students in an analy-



Visiting professor Gordon Bloom (center) talks with seniors Fatu Conteh (left) and Kate Hsieh during a session of "A Collaboratory for Social Entrepreneurship," in which students are designing and developing organizations to tackle some of society's biggest challenges.

sis of the problems addressed and social value created by four pioneers of social entrepreneurship, including Nobel Peace Prize-winner Muhammad Yunus, the father of microfinance, and Bill Drayton, founder of Ashoka: Innovators for the Public.

"We're not talking about opportunity discovery, but opportunity creation, which implies that you're really in control," Bloom said to the

packed classroom. "I think, for our class, this is a good thing. And I think, for the world, this is a good thing."

Creating opportunities is exactly what the students, drawn from 16 majors and varied personal backgrounds, are doing in their projects.

Veda Sunassee, a senior majoring in politics who is from Mauritius — a tiny island nation in the Indian Ocean — said his interest in the class

stemmed from his own nonprofit work. During time off from Princeton in his sophomore year, Sunassee founded the Young Volunteers Association in his native country to promote civic engagement, and last summer he interned at the Ashoka global office in Washington, D.C.

"We have in Professor Bloom a very articulate, experienced and passionate guide and mentor for this class, which in itself is not only an incubator for entrepreneurial and innovative ideas but also a laboratory — to borrow Professor Bloom's terminology — to execute the idea," he said.

Engineering school freshman Eden Full was still in high school when she invented a system for rotating solar panels to face the sun without using electricity. She founded a venture, Roseicollis Technologies, to advance the use of the invention to promote sustainable energy collection in developing areas. In the SE Lab, Full is working with four other students to create a business model for implementing the invention in Indonesia.

"In class, we are studying about a lot of other social enterprises and what makes them successful," said Full. "What I have found to be very interesting is that we are actually applying these models to our own projects. Most,

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Student-initiated course shapes environmental business ideas

USHMA PATEL

Since childhood, junior Jason Baum has been aware of environmental issues, switching off lights when leaving a room and turning off the water while brushing his teeth.

He arrived at Princeton with an interest in one day starting his own environmental company. To prepare, he looked for a course in environmental entrepreneurship but found that it was absent from the curriculum. Now, after a year of planning with the Program in Environmental Studies and lecturer and entrepreneur Gregory van der Vink, Baum is among the 22 students taking the seminar "Environmental Entrepreneurship" this fall.

"The first day, I just couldn't believe it as I looked around the room. We got right into gear that day, and we're making serious progress," said Baum, an economics major pursuing a certificate in environmental studies. "It's something I greatly value and appreciate about Princeton. If you want to learn about something and have substance behind it, you can make it happen."

All students are allowed to submit a request for a student-initiated course to the Office of the Dean of the College with the support of a department or program. Baum learned of the option his freshman year when taking a student-initiated course on reporting on environmental issues. "Environmental Entrepreneurship" is the fourth student-initiated course within the Program in Environmental Studies since fall 2006.

Professor David Wilcove, director of the environmental studies program, said the program's faculty and staff members enjoy helping students who

are willing to do the legwork to find a professor and a critical mass of students for the course.

"A growing number of Princeton students are deeply interested in environmental issues and, much to my delight, they do not hesitate to come forward with interesting suggestions for courses," said Wilcove, who has joint appointments in the Department of Ecology and Evolutionary Biology and the Woodrow Wilson School of Public and International Affairs. "If the students are that eager to learn about a subject, we try to be as supportive as possible."

Working with van der Vink, Baum was responsible for creating a syllabus and sample reading list that matched the academic rigor of a 300-level course. During that process, Baum researched graduate-level business courses at other academic institutions. The existence of numerous business plan competitions on and off campus also motivated Baum, so the focus of the class is that each student must develop a professional, ready-to-pitch business plan as his or her final project.

Baum, who also is president of the student group Princeton Environmental Action, wanted the class to offer "not just an exam that you turn in and forget about but a finished product that ... could be a business and make a difference in the world."

By coincidence, a group of Princeton alumni with a similar goal came forward. The class of 1976's Spirit of Service '76 group is raising \$20,000 in award money for a campuswide "green" business plan competition in February, which van der Vink announced on the first day of class. The Spirit of Service '76, which also will offer mentoring by alumni later

in the process, is coordinating the competition with the Keller Center for Innovation in Engineering Education, the Pace Center, the Princeton Environmental Institute and the student-led Princeton Entrepreneurship Club.

With that reward as an additional inspiration, van der Vink is leading his students through the intricacies of developing business plans that will attract investors. "My goal is to create 22 business plans that the class of 1976 and private investors will see as irresistible business opportunities," he said.

"We're doing this in two steps. What are the guiding principles of an environmental company, and how does one actually launch and run a business?" he said.

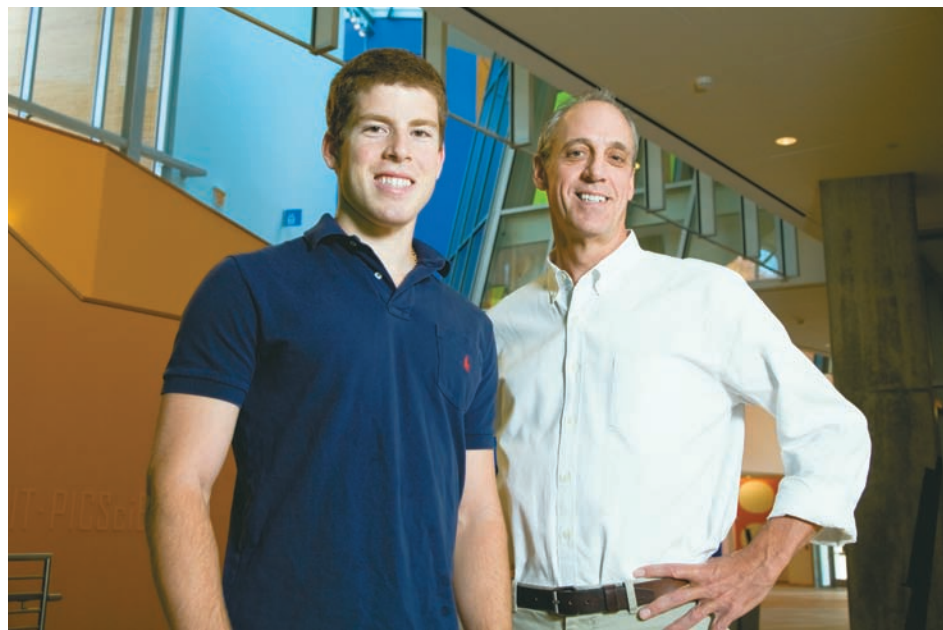
Van der Vink, who heads an international environmental consulting and development company called Terrametrics LLC, had the students begin with three proposals. One of

those proposals had to be an international project, reflecting his view that some of the greatest challenges are in fostering environmentally sustainable economic growth in the developing world.

"The expectation is that whatever business they develop, it must make a tangible contribution to environmental stewardship and provide measurable humanitarian benefits. It's supportive of the University's [informal] motto of 'in the nation's service and in the service of all nations,'" said van der Vink, who received his Ph.D. in geosciences from Princeton in 1983 and has been a visiting lecturer in that department since 1991.

He balances that idealism with realism. The students' business plans must show how they will make their business financially profitable and sustainable within three years. Students must describe how they will manage

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Junior Jason Baum (left) channeled his passion for environment issues into a new student-initiated course "Environmental Entrepreneurship," which is taught by lecturer and entrepreneur Gregory van der Vink.

Cancer

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the Department of Chemistry, the Princeton Institute for the Science and Technology of Materials, and the Princeton Center for Theoretical Science. “As you go back and forth to refine the experiments and the theoretical models, you’re coming to a real understanding of cancer. And that is what we’d ultimately like to do.”

The experimental microhabitats, being developed jointly between the labs of Austin and James Sturm, a professor of electrical engineering and the director of the Princeton Institute for the Science and Technology of Materials, are constructed on chips of silicon or polydimethylsiloxane (PDMS), a silicon-based plastic. Featuring a series of wells just 10 to 100 microns in size (a human hair is roughly 100 microns in diameter), the devices allow for the growth of distinct but interconnected populations of cells. Ultrasmall channels link the compartments together, providing avenues for cells in different communities to move and interact with one another. A given chip might contain tens to hundreds of interconnected wells, each capable of housing hundreds of cells.

A series of pumps and valves on the chips will enable the delivery of a variety of mechanical and chemical stressors, such as extreme pressure or chemotherapeutic agents, to different populations of cells living under a

range of different conditions, including gradients of temperature and resource availability.

“A tumor is a heterogeneous thing with many different metapopulations of cells inside it,” Austin said. “We’re trying to represent the biological environment of a tumor and hopefully understand the rules by which a tumor evolves.”

Experiments will be conducted at Princeton using both bacterial cells, which form biofilms analogous to human tissue that can be used as model systems, and human cancer cell lines. The research team currently is developing technologies to make the microscopes fully controllable remotely, allowing team members at partner institutions to conduct experiments and obtain real-time data via the Web.

The Princeton Physical Sciences-Oncology Center’s research will build on previous experiments by Austin and his collaborators using a silicon microhabitat to study the evolution of *E. coli* bacteria. The research team already is culturing prostate cancer cells on silicon and PDMS chips, using pumps and valves to refresh the growth medium.

To create the most realistic rep-

resentations of human tissue, the microhabitats in development will be far more complex than the currently existing chips. One key challenge to address will be optimizing the use of biological matrices on the chips to make them extremely favorable for the growth of mammalian cells, triggering rapid evolution in a relatively short



From left, electrical engineering graduate student Kevin Louterback, postdoctoral research associate Liyu Liu, physics graduate students David Liao and Guillaume Lambert, and postdoctoral research fellow Andre Estevez-Torres discuss their research in Web-based meetings with scientists at partner institutions in the Princeton Physical Sciences-Oncology Center.

period of time. This process also may require the development of novel three-dimensional fabrication techniques.

Additional members of the research team include David Botstein, the director of Princeton’s Lewis-Sigler Institute for Integrative Genomics, who will lead the center’s outreach and education efforts; David Haussler, a professor of biomolecular

engineering and the director of the Center for Biomolecular Science and Engineering, and Nader Pourmand, an assistant professor of biomolecular engineering, both of the University of California-Santa Cruz; Robert Getzenberg, the director of research of the James Buchanan Brady Urological Institute at the Johns

Hopkins Hospital; and Beverly Emerson, a professor in the Regulatory Biology Laboratory at the Salk Institute for Biological Studies.

The other centers in the National Cancer Institute’s new network will be based at Arizona State University, Cornell University, the H. Lee Moffitt Cancer Center

& Research Institute, Johns Hopkins University, the Massachusetts Institute of Technology, Memorial Sloan-Kettering Cancer Center, Northwestern University, the Scripps Research Institute, the University of California-Berkeley, the University of Southern California and the University of Texas Health Science Center at Houston. ♥

Social

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if not all, of these projects formed in the class will probably end up launching, and it is truly amazing to see so many unique ideas get off the ground.”

Other projects range from a garbage-to-methane energy venture in a Karachi, Pakistan, slum to an education innovation effort in Colombia. A number of projects focus on improving human health, including an AIDS and breast cancer initiative in Kenya and a mobile phone-enabled malaria information system in Tanzania.

“I love the diversity in our class,” Full said. “There are students taking economics, engineering, molecular biology and so many other disciplines. Yet we all come together to form these plans to tackle some of the world’s largest issues.”

Bloom said this process of students joining forces echoes Princeton’s Grand Challenges Program for energy, development and health, which links

many parts of the University. He also is connecting students to alumni through an environmental initiative with the class of 1976 and a social entrepreneurs competition sponsored by the classes of 1956 and 1981. Reaching beyond Princeton, Bloom and his students have brought in guest speakers, including Iqbal Quadir, the founder of GrameenPhone in Bangladesh and the Massachusetts Institute of Technology’s Legatum Center for Development and Entrepreneurship, and Harold Rosen, the founder of the Grassroots Business Fund, a World Bank spinoff that supports business enterprises in developing nations.

In one SE Lab project, Bloom has joined with Wole Soboyejo, professor of mechanical and aerospace engineering, to co-advise four Woodrow Wilson School of Public and International Affairs graduate students conducting a water filtration project in Nigeria. The students also are investigating possible pilots of the system in their countries of origin — Pakistan, India, Mexico and El Salvador.

In encouraging students who are eager to effect change, Bloom also seeks to promote changes in higher education.

“My own personal experience was that universities were pretty traditional places and it was difficult to be innovative there,” he said. “And

Gordon Bloom, the Dean’s Visiting Professor in Entrepreneurship in the Keller Center for Innovation in Engineering Education, will deliver a lecture on “Social Entrepreneurship: A Rising Generation Changing the World” at 4:30 p.m. Thursday, Nov. 19 in Room 104, 58 Prospect Ave.

Students from Bloom’s class, “A Collaboratory for Social Entrepreneurship,” also will present their entrepreneurial endeavors during the lecture, which is sponsored by the Keller Center.

students love to be innovative. After my own sense of frustration due to lack of support in launching different projects, I vowed I would try to provide opportunities for students to have ways to turn their visions into reality.”

Bloom, who is at Princeton for the 2009-10 academic year, is the third holder of the Dean’s Visiting Professorship in Entrepreneurship, which was inaugurated in 2007. His interest in entrepreneurship is informed by his own work in the private and nonprofit sectors in the United States, Europe and Asia as CEO of a medical technology company and an international strategy consultant.

Bloom praised the Keller Center for its focus on social entrepreneurship and initiative to develop leaders in an increasingly technological world.

“It’s part of a big wave of interest in universities in making research and teaching relevant to global problem-solving,” he said. “My strong belief is that the students are the engine — just give them opportunity.” ♥

Environmental

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risk and other potential cultural and political barriers to their project. To give students some insight into the funding side of the equation, van der Vink is inviting several venture capitalists and international investment specialists to the class for question-and-answer sessions.

“There are many creative ideas [among the students]. Now the difficult part begins — taking those ideas and turning them into realistic, financially viable projects,” he said. “How do you access tribal lands in the Sahel? How do you hire, train and manage 200 people in Burkina Faso?”

The students, who were selected by application to the course, have responded enthusiastically. The group includes sophomores, juniors

and seniors majoring in subjects from philosophy to politics and from math to history. Van der Vink draws on this diversity by encouraging group discussions and requiring that each student distribute his or her assignments to every other member of class each week — a type of peer review.

“The work exponentially improves over the course of the semester because everyone takes the best ideas from the week before and advances them in their own way. The best paper each week becomes the bar above which all the other papers must begin the next week,” he said.

In one recent session, van der Vink surprised his class with an impromptu competition, giving each student 90 seconds to pitch their businesses and allowing students to vote on the winning proposal.

In another session, each student gave a more detailed presentation of a potential project, such as a latex

company in Liberia, an organic candy company, a car-sharing service in Brasilia and a construction materials disposal and recycling service. In the lively discussions that followed, other students offered comments on weaknesses and potential improvements. Along the way, van der Vink interjected with questions about the project’s costs, revenue sources and competitors; he also offered insights and humorous anecdotes from his own experience on alternate business models and current trends in green building and green thinking.

“I’ve learned a lot of skills I can apply to a lot of places,” said junior Julie Phillips, an ecology and evolutionary biology major pursuing a certificate in environmental studies. “We’re all working toward applying to the fund being offered by the class of 1976, so it’s pretty realistic. We’re aiming for something that could really happen.”

The course is helping senior Chandler Clay plan her future running an environmentally sustainable event-planning business. Clay, an economics major pursuing a certificate in environmental studies, has enjoyed how the class emphasizes creativity and original thought.

“We are essentially making our own curriculum, because our only assignments are to improve upon our business plans,” she said. “I am getting a lot of great feedback from my classmates on how to improve it, but I am mostly looking forward to putting it into practice.”

Since the class began, Baum has returned to his regular role as a student, researching ventures such as wetlands reclamation consulting and landfill gas reuse.

“It’s interesting to see what I created and now to take a step back and just be a part of the group,” he said. “I’m happy with that.” ♥