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## Fulfilling Needs Through Innovation: Sustainable technology programs

by Tim Binkert

The growing importance of sustainable technology is evidenced by a number of initiatives, including research centers, conferences, courses, and curricular programs. This article spotlights two sustainable technology-based programs, funded in part by NCIIA, that are making progress toward creating a sustainable, equitable future: MIT's D-lab and Stanford's d-school.

### D-lab: Focusing on international development

Created in fall 2002 by MIT Instructor and former Peace Corps Volunteer Amy Smith, D-lab is a year-long series of classes and field trips that educates students about technical, social, and cultural aspects of development work in selected countries, and then provides the opportunity for field work and implementation. The program begins in the fall, when D-lab students focus on issues of appropriate technology and partner with community organizations in developing countries to apply what they learn. Then, during the winter, students visit their partner organizations to implement their projects and identify other possibilities for collaboration. In spring they learn about the design process and apply it to create solutions to the problems identified on their field trips. Finally, over the summer they return to their field sites to implement their designs, conduct field tests, and get user feedback.

An example of how D-lab works comes from the first run of

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## From the Executive Director: New Frontiers

This issue of NCIIA News highlights projects that are entering new frontiers of research and social change. Our featured E-Team, Brown University's Axon Labs, is commercializing a product that taps into brain function and sleep research, with an alarm clock that tracks sleep stages and awakes its user feeling refreshed. MIT's D-lab and Stanford's d-school are pioneering user-centered approaches to sustainable technologies, working with world populations experiencing great, fundamental need. This educational arena is a new frontier for the NCIIA as well, as we expand our focus to include programs and projects that improve the environment and the human condition through technological innovation and creative entrepreneurial approaches.

This year's Annual Meeting provides an excellent opportunity for NCIIA program participants and guests to explore and recommend ways that the NCIIA can support its member institutions as they pursue the development of sustainable innovation and entrepreneurship curricula and projects. We hope to learn what kinds of programs are already in place that can provide examples and guidance to others, as well as the types of resources that can help get new programs launched.

Numerous conference sessions provide opportunities to learn and to share your ideas, including, on Thursday, Invention to Venture: Natural Capitalism and Sustainability (panel), The Ruthless Pursuit of Affordability (workshop), and Design Strategies for Sustainable Innovation (panel); on Friday, Course Materials with an International Development Focus (workshop) and Spotlight on Global Sustainability and Affordable Design (posters); and on Saturday, Ingredients for a Successful Appropriate Technology Curriculum (workshop).

This is an exciting time of change and growth at the NCIIA. We look forward to your contributions.

Sincerely,



Phil Weilerstein,  
Executive Director

## Featured E-Team

### Where's the sleep? Axon Labs may have found it

by Tim Binkert

We are a tired country. In 1910, the average American slept nine hours a night, but over the course of the 20<sup>th</sup> century that number dwindled steadily, and in 2000 we slept a mere 6.9, stretching the day to add more than 158 hours to our annual work total. As a result of getting less sleep, we suffer from sleep deprivation over time and all of the problems that come with it: decreased efficiency, impaired judgment, more accidents, lower productivity, weight gain, decreased motivation, and sleep inertia, a feeling of exhaustion and lethargy that lasts for hours after waking and negatively affects mood, basic mechanics, and reflexes.

An E-Team from Brown University is looking to combat all this tiredness. Formally incorporated as Axon Sleep Research Laboratories, Inc., this E-Team has developed SleepSmart, a smart alarm clock that employs cognitive neuroscience research to ensure the user wakes up feeling refreshed. SleepSmart's technology is based on tracking sleep cycles: light, deep, and rapid eye movement (REM). Recent research has shown that how you feel when you wake up doesn't depend on how long you sleep, but rather on which cycle you wake from: when awoken from deep or REM sleep, you feel groggy, but when woken from light sleep, no matter how many hours you slept, you wake up recharged, invigorated, energetic, and alert. SleepSmart monitors the sleeper's brain activity and wakes the user during light sleep.

The device consists of a headband containing electrodes, and a small base station alarm clock. After setting the latest possible wakeup time, the user goes to sleep wearing the headband around the forehead. The band wirelessly transmits brain activity to the alarm clock, and sets an optimal wakeup window based on the information. The alarm goes off during the last light sleep phase before the desired waking time.

The idea for the device came from perhaps the most sleep-deprived among us: a student. After a difficult exam, Bryant University finance major Samee McDannel complained to her friend that feeling groggy had made her test go poorly. Why, she asked, wasn't there some sort of device that could wake you up feeling refreshed? Inspiration struck, and soon McDannel was in discussions with Daniel Rothman, a Bryant cognitive science major. Rothman invited computer science major Eric Shashoua from Brown to join the team, and suddenly the conversational musings turned into a company with the potential to produce a marketable product.

The team has been busy ever since. After assembling a group of engineers to work on a prototype, and a handful of entrepreneurs to help on the business end, Axon incorporated, filed a preliminary patent, created a Web site (axonlabs.com),

added an experienced and capable board of directors, signed an industrial design contract, and closed its first round of funding with over \$250,000 raised.

Most of that money, according to Shashoua, has gone toward prototyping. "We're taking fifteen years of research on sleep inertia and applying it to create a unique device," he says. "That takes some time." The team has made significant progress toward a working prototype: preliminary hardware design was completed in September 2004, after which the team miniaturized the circuit board and paired with Herbst-Lazar-Bell, a top design firm, to work on the industrial design aspect of the product. The team now has several generations of prototypes behind it, and, according to Shashoua, "has a very good idea of what the final commercializable device will look like."

The team is also ramping up its marketing efforts. "Axon believes SleepSmart's likely early adopters are people who get little sleep but have high demands on their bodies and minds, namely business travelers, lawyers, and students," says Shashoua. The team plans to distribute SleepSmart through a variety of channels, from specialty retailers such as Sharper Image and Brookstone, to specialty catalogues, mass retailers, and the Internet. Shashoua estimates the product will sell for \$200-250, and be available in stores by early 2006.

What's next for Axon? "We estimate we are six months away from completing all testing, industrial design work, and minimization work on our product, from which point we will need an additional \$1.5 million in funding to launch and begin manufacturing and marketing," says Shashoua. "The next round of funding will go toward completing product development and generating a number of surveys for our initial target market. In September we plan to produce 1,000 units and do a test run here in New England."

The team is actively pursuing its second round of funding, having been in conversations with angel groups and private investors in the Rhode Island area. They are welcoming of anyone with an interest in the company.

Over the long run, Axon hopes to become a dominant force in the emerging high-tech sleep products industry. Shashoua envisions applications for SleepSmart in the military, athletic, and medical fields, and expects that Axon will generate additional products as new research becomes available. The company intends to continue exploring and utilizing the vast world of brain research relating to sleep, cognition, memory, and other new developments in this rapidly growing field.

# NCIIA Grant Awards: December 2004

## Advanced E-Team Grants

### **The Helping Hand**

Rowan University, \$14,400  
Anthony Marchese

### **A Novel Device to Perform Cardiac Resynchronization Therapy for the Treatment of Congestive Heart Failure**

Stanford University, \$18,369  
Paul Wang

### **Digital Receipt Team**

Stanford University, \$16,895  
David Kelley

### **Chest Protector**

University of Miami, \$11,095  
Peter Tarjan

### **Expandable Wheelchair**

Portland State University, \$15,500  
Faryar Etesami

### **Interactive Guest Paging System**

Florida Institute of Technology, \$11,500  
Ken Ports

### **Wireless Crop Protection**

University of California, Berkeley, \$20,000  
Alice Agogino

### **EEG Keyboard**

Johns Hopkins University, \$14,400  
Nitish Thakor

### **The Wi-Fi Enabled Portable Internet Radio**

Case Western Reserve University, \$20,000  
Cyrus Taylor

### **SWIG**

Pennsylvania State University, \$6,000  
Dennis McLaughlin

### **Early Detection of Acute Renal Failure**

Johns Hopkins University, \$12,000  
Robert Allen

### **Converting Coconuts into Value-Added Products in Developing Countries**

Baylor University, \$19,000  
Walter Bradley

### **Soda Sentry**

Lehigh University, \$15,241  
Todd Watkins

### **Development and Commercialization of Novel Linear Displacement Sensor**

Georgia Institute of Technology, \$14,800  
Pat Dickson

## Course and Program Grants

### **Urban Studies Entrepreneurship Programs**

Merrimack College, \$6,500  
Gina Vega

### **Learn, Serve and Prosper – Implementing Socially Responsible Entrepreneurial Projects**

Cal Poly, Pomona, \$25,200  
Jawaharlal Mariappan

### **Community Engaged Entrepreneurship**

San Jose State University, \$27,500  
Malu Roldan

### **Student Entrepreneurship Through Interaction with Physicians- A Problem Selection Paradigm Driven by Medical Needs**

Brown University, \$35,000  
Gregory Crawford

### **An Innovation Curriculum: Introduction to Innovation and Innovation Teams**

University of Colorado at Colorado Springs, \$24,000  
Terrance Boulton

### **New Elements for International Idea to Product (I2P) Program**

University of Texas at Austin, \$25,000  
Steven Nichols

### **Multidisciplinary Entrepreneurship Thematic Learning Community (E'Ship TLC)- Creating Opportunities for Entrepreneurship Education from Top to Bottom**

University of Kansas, \$7,000  
Elizabeth Friis

### **Economic Development and Technology Entrepreneurship**

University of Southern Mississippi, \$24,000  
Ken Malone

### **Service Through Design and Entrepreneurship Certificate**

Pennsylvania State University, \$33,500  
Thomas Colledge

### **Design for Sustainability: Courses of Study for Electrical Engineers**

Auburn University, \$7,000  
John Hung

### **Autovation: A Course in Automotive Innovation and Entrepreneurship**

Clemson University, \$21,200  
David Bodde

### **A Course in Appropriate Technologies for the Developing World**

University of Colorado, Boulder, \$37,500  
Bernard Amadei

### **Design for the Developing World**

Duke University, \$39,500  
Robert Malkin

the program in fall 2002, in a course that became known as “The Haiti Class.” Students were briefed on problems currently facing Haitian people (such as water quality, school lighting, and cooking fuel shortages), studied the language and culture of Haiti, and then traveled to the country itself, visiting various locations to work with Peace Corps volunteers and attack technological problems head-on.

To address the three related issues of deforestation in Haiti, the shortage of affordable cooking fuels, and health problems stemming from inhaling wood smoke from indoor cooking fires, students came up with the idea of making clean-burning charcoal briquettes from waste material. If high-quality charcoal can be made using waste material, the team reasoned, then no trees need be used. A supply of raw material (waste) is constantly and cheaply available, and less damage is done to people’s health by burning cleaner materials. The team chose to use fibrous sugarcane waste, known as bagasse, as the central material. Cassava flour was discovered to work well as a binding agent, and sugarcane charcoal was born.

After testing, the team realized that conditions in Haiti demand more durable, denser sugarcane charcoal briquettes; they are currently investigating alternative binders or combinations of binders that will help to increase briquette strength and reduce the cost of production. The sugarcane charcoal project exemplifies the D-lab approach: students familiarize themselves with a region, identify a problem, and invent an appropriate solution. Smith’s students get hands-on design education while at the same time fulfilling community needs—key elements of well designed and executed sustainable technology curricula. D-lab has already begun to address community needs in Brazil, Haiti, Honduras, and India.

## **d-school: The total design experience**

A new project is underway at Stanford University, called the “d-school.” The basic idea behind the d-school is to provide a common home for faculty and students from various academic disciplines with a common interest in designing solutions for social and industrial problems, sustainable and appropriate technology among them. The school will sponsor courses and provide project and research space for faculty and students from all academic departments and disciplines.

The university has already run several prototype d-school courses. One example: in spring 2003, faculty from engineering and business departments taught teams of engineers and MBAs working with the Light-up the World Foundation to develop inexpensive prototypes of LED-based lamps for developing countries. These lamps are bright enough to read or work by, at a fraction of the cost of kerosene or other fuel-based lighting.

Several students from this class have since formed a company, Ignite, Inc., to bring the LED lamps to market.

Another d-school prototype course, “Entrepreneurial Design for Extreme Affordability,” launched in January 2005. To realize the course’s theme, teams of engineering and MBA students design products, implementation plans, and user experiences for rural family agriculture. The projects enable small-plot (1/8-acre to 4-acre) farmers to increase their income through more productive farming. Students in the class are working closely with Paul Polak, president of International Development Enterprises (IDE), a successful non-profit organization whose low cost drip irrigation and treadle pump systems have been widely used in developing countries. Students are attempting to improve upon or replace some aspect of the current IDE water systems. Much like MIT’s D-lab, the course is intensely focused on the user: the goal is not necessarily to invent a complete water system, but rather to deeply understand a specific set of users and a specific environment in order to innovate for their needs.

Programs like D-lab and d-school respond to user needs and tap into student innovation to provide students with unique educational experiences, while creating far-reaching and lasting change.

### **Paul Polak on the Ruthless Pursuit of Affordability**

“Eight hundred million of the current 1.1 billion people earning less than \$1-a-day live in rural areas in developing countries. More than 550 million of them earn a living from agriculture. Poverty eradication depends on increasing their income from farming, and a revolution in water is needed to develop and mass disseminate a whole range of new affordable small plot irrigation technologies.

This is part of the ruthless pursuit of affordability: challenging today’s designers to create pro-poor products for their profit potential, worldwide benefit, and global poverty reduction capability. Stanford’s course in its design school, and MIT’s design-lab and others like it, are making great strides in helping turn the revolution of design into reality.”

# ***Invention to Venture***

## **Workshops in technology entrepreneurship**

United States colleges and universities have a tremendous untapped entrepreneurial resource in their students as well as their faculty. Invention to Venture helps students, faculty, and regional industry find common ground in technological innovation, and lights the path to entrepreneurial success.

In the 2004/05 academic year, 15+ universities will host Invention to Venture introductory workshops. We also coordinate specialized workshops at venues such as the Sustainable Resources conference and professional society meetings.

Invention to Venture workshops...

- are designed for sophisticated, technology-oriented undergrad and graduate students along with interested faculty and alumni looking to develop technology-based products and businesses.
- provide an overview of the commercialization process and connect academic and business communities.
- serve as a guide for technology business plan development and a vehicle for tech entrepreneurs to identify resources to start their ventures.
- complement the extensive grant program that NCIIA already provides for student inventors and faculty courses in innovation and entrepreneurship.



To learn more about I2V and how to host or sponsor a workshop, visit

**[www.invention2venture.org](http://www.invention2venture.org)**

# NCIIA NEWSLETTER

Next NCIIA grant deadline:  
**May 13, 2005**

Use our online grant application tool!  
[www.nciia.org](http://www.nciia.org)

In 2005, the National Collegiate Inventors and Innovators Alliance (NCIIA) will award approximately \$1 million in Lemelson Foundation grants to colleges and universities to develop and support the creation of programs and projects in invention, innovation, and entrepreneurship education. We believe that invention, innovation, and entrepreneurship are essential components of the higher education curriculum and vital to the nation's economic future. We work with colleges and universities to build collaborative experiential learning programs that help nurture a new generation of innovators and entrepreneurs with strong technical and business skills.

The NCIIA is increasingly interested in and welcomes proposals for commercially viable projects that are technologically innovative and show promise to improve the environment and the human condition. Such projects should follow a sustainable entrepreneurial model. We are also particularly interested in supporting E-Teams whose demographic makeup reflects the balance and diversity of the teams home institutions.

To obtain the full RFP and apply on-line, visit [www.nciia.org](http://www.nciia.org) or e-mail [info@nciia.org](mailto:info@nciia.org).

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