Volume 51 – Number 29
Wednesday, June 6, 2007

TechTalk
SERVING THE MIT COMMUNITY

MIT readies for Commencement day

President Emeritus Vest, new head of National Academy of Engineering, will speak

MIT President Emeritus Charles M. Vest will deliver the principal address at MIT's 141st Commencement exercises, to be held Friday, June 8, at 10 a.m. in Killian Court.

During the ceremony, 2,135 undergraduate and graduate students are scheduled to receive 1,083 bachelor's degrees, 1,015 master's degrees, 279 doctorates and 10 engineer's degrees.

In making the announcement, MIT President Susan Hockfield said, "I am very pleased that Chuck Vest has agreed to give the 2007 Commencement address at MIT. During his 14 years as MIT's president, he quietly put his stamp on almost every aspect of the Institute and its life. At the same time, he achieved national and international recognition for his thoughtful insights into the crucial issues facing higher education and research in the United States and in our globalizing world. As he anticipates the next chapter of his career in Washington, it is the perfect moment for him to share with our graduates his reflections on the role of MIT in the world."

Charles M. Vest

In April, Vest was elected to a six-year term as president of the National Academy of Engineering, effective July 1.

Vest earned his B.S. degree in mechanical engineering from West Virginia University in 1963 and his M.S. and Ph.D. degrees from the University of Michigan in 1964 and 1967, respectively. He is the recipient of 10 honorary doctoral degrees and is a life member of the MIT Corporation, the Institute's board of trustees.

As president of MIT from 1990 through 2004, Vest placed special emphasis on enhancing undergraduate education, exploring new organizational forms to meet emerging directions in research and education, building a stronger international dimension into education and research programs, developing stronger relations with industry and enhancing racial and cultural diversity at the Institute.

Vest has also worked to bring issues concerning education and research to

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Model for tracking flu progression may reduce death toll

Engineer survived 1968 pandemic

Anne Trafton
News Office

Nearly 40 years ago, MIT Professor Richard Larson spent a week sick in bed with the worst illness he'd ever had—the particularly virulent strain of flu that swept the globe in 1968. "That was the sickest I'd ever been," Larson recalled. "I really thought that was the end." It took him two or three months to recover fully from the illness.

Richard Larson

Known as the Hong Kong flu, the virus killed 750,000 people worldwide, the second worst influenza pandemic the world has seen since the infamous 1918-1919 epidemic of so-called Spanish flu.

Now, many experts fear the world is on the brink of another deadly flu pandemic. And Larson wants to be sure that people are ready to deal with it.

To that end, he and his colleagues have developed a mathematical model to track the progression of a flu outbreak, and their results show that the death toll of an epidemic could be greatly reduced by taking steps such as minimizing social contacts and practicing good hygiene, such as frequent handwashing.

The report, "Simple Models of Influenza Progression within a Heterogeneous Population," was published in the May-June issue of Operations Research, which

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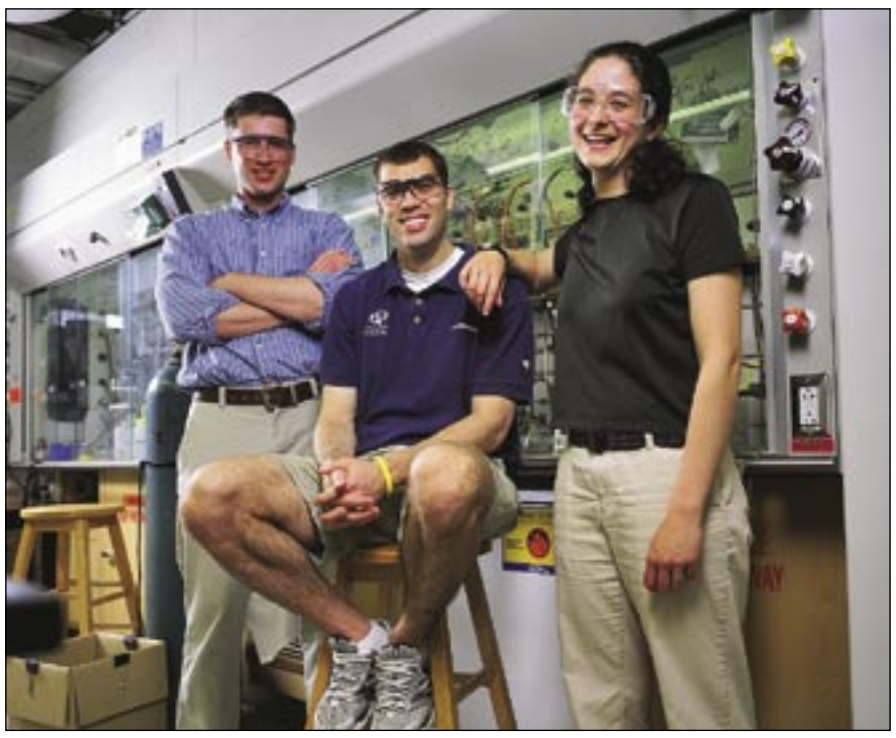

PHOTO / **MARK MORELLI**

Savings bank

From left, Jim Doughty, environmental health and safety coordinator for the School of Science, chemistry graduate student Ryan Altman and materials science and engineering graduate student Elsa Olivetti are among those spearheading a laboratory education campaign that promises significant savings and a chance to improve MIT's energy and carbon footprint. See story on page 3.

Women's Technology Program graduates members of first class

Erin Michael Salius
School of Engineering

When seniors Alisha Schor, Emily Slutsky and Kyung Jin Chang step to the stage to accept their S.B. degrees at the 141st Commencement ceremony on June 8, they will be among six seniors making history as the first members of MIT's Women's Technology Program (WTP) to graduate from the Institute.

It was only five short years ago, in the summer of 2002, that they initially arrived on campus to participate in the inaugural session of WTP, a four-week academic and residential experience where pre-college female students explore engineering through hands-on classes, labs, and team-based projects. At the time, having just finished their junior year in high school,

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Green ribbons signify responsibility pledge

Stephanie Schorow
News Office Correspondent

Wearing a little green ribbon during the 2007 Commencement ceremonies may not change the world. But, say MIT organizers of "The Graduation Pledge of Social and Environmental Responsibility," the effort might change a few minds. And that might start students thinking in new directions.

Something like that happened to Christopher J. Sequeira, a graduate student in the Department of Aeronautics and Astronautics and the Technology and Policy Program, who is coordinating the pledge effort.

As a member of the MIT Student Pugwash organization—which encourages students to understand how their work impacts society—Sequeira learned about the graduation pledge in a lecture last fall from a professor who led the pledge in the 1980s.

"Maybe it's time to do it again," thought

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PHOTO / **CHRIS SEQUEIRA**

Grad student Chris Sequeira is coordinating MIT students' pledge of responsibility.

Solar power helps rekindle Great Dome lighting tradition

A new lighting scheme will turn the iconic Great Dome of Building 10 into a "nighttime beacon."

Using the same amount of electricity needed to run two hair dryers, a total of 12 new fixtures will illuminate the dome, the Roman numerals that spell out 1916 (the year the building opened) and the limestone façade of Building 10.

MIT President Susan Hockfield will flip the switch on the new lighting at a June 9 ceremony at 10:30 p.m. The event, which comes at the conclusion of a full day of Tech Day activities that will bring 3,300 alumni and alumnae to the campus, will take place in Killian Court. All members of the MIT community are invited to attend the lighting ceremony.

The new lighting system incorporates energy-saving light-emitting diode (LED) fixtures made possible through the generosity of an anonymous donor. The efficient new system will replace now-defunct fixtures and tree-mounted lights.

The donor has also provided funding for a new 40-kilowatt photovoltaic array that will connect to MIT's electrical grid and provide 10 times more power than the dome lighting will use, according to the chief engineer on the project. The purchase of this solar panel array has also received support from a grant from the Massachusetts Technology Collaborative.

"Our stated goal for this project was to achieve an energy-neutral balance," said Ronald J. Adams, senior electrical engineer in the Department of Facilities. "Thanks to the donor and the grant, we have achieved that. In fact, we have far exceeded our goal."

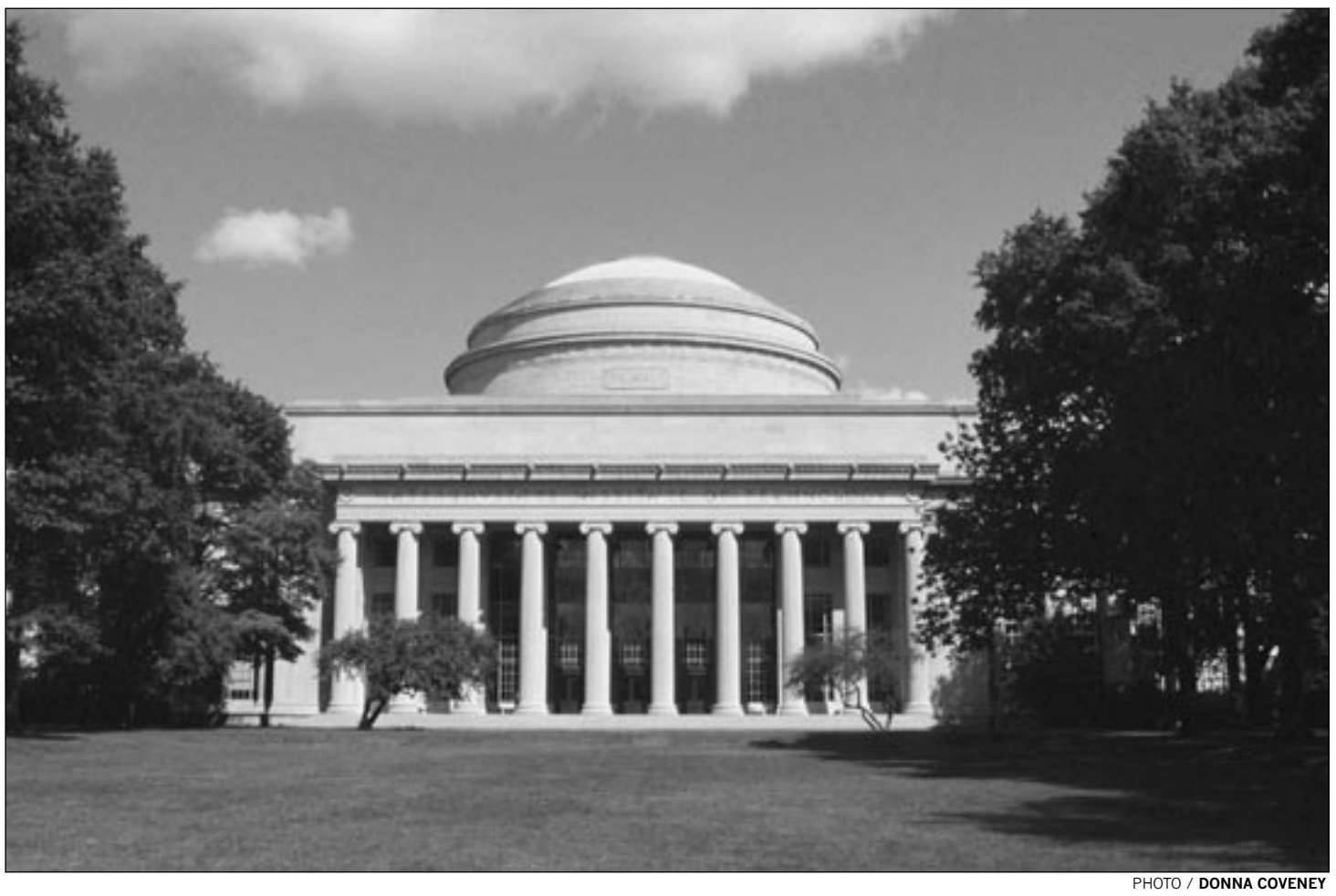

PHOTO / **DONNA COVENEY**

The Great Dome of Building 10 will once again be lit at night, thanks to an anonymous donor's gift of a high-efficiency lighting scheme and a state grant for a new solar array.

Tech Day focuses on improving today's energy sources and tools

Nancy DuVergne Smith
MIT Alumni Association

Energy—particularly the opportunity for near-term efficiencies and sustainable change—takes center stage at Tech Day 2007, to be held in Kresge Auditorium on Saturday, June 9. Tech Day is the intellectual highlight of Tech Reunions 2007, which is expected to draw more than 3,200 alums and guests to dinners, tours and performances on campus June 7-10.

Faculty speakers will explore political contexts as well as improvements in current resources and building construction. These research thrusts are part of the MIT Energy Initiative (MITEI), which draws on the resources of more than 50 departments, labs and centers to help develop sustainable energy resources to power the world.

Tech Day on June 9 is the intellectual highlight of Tech Reunions 2007

At Tech Day, political science professor Nazli Choucri will describe the political, economic and strategic contexts of diverse energy challenges and the international coordination necessary to secure sufficient energy for the future.

John M. Deutch '61, Institute Professor in the Department of Chemistry, will examine issues related to improving the use of fossil fuel and nuclear energy as renewable energy sources are developed. Deutch's recent work has explored national security consequences of U.S. oil dependence, nuclear options, China's energy options and the biomass movement. Deutch is author of "Making Technology Work: Applications in Energy and the Environment" and served as an advisor to Presidents Carter, Reagan and Clinton.

Deutch co-authored "The Future of Nuclear Power," one of the Institute's major energy reports, with MITEI Director Ernest J. Moniz, the Cecil and Ida Green Professor of Physics. The report documented the changes required in government policy and industry practices that would enable nuclear power to play a significant role in reducing carbon emissions and providing energy resources.

Improvement in the built environment is the subject of John Fernandez '85, associate professor in the Department of Architecture's building technology group. Fernandez will explore the ecology of contemporary construction. His effort involves identifying the consumption profile and resource requirements of existing buildings and formulating design strategies for reuse and recycling of building materials and components. He is actively working with the construction industry and the design profession to establish common ground for construction ecology partnerships. This work is described in his recent book, "Material Architecture: Emergent Materials for Innovative Buildings and Ecological Construction."

Participants at the reunion celebration, who come from as far away as Brazil and Japan, are signed up for more than 139 reunion events on and off campus. All alums and members of the campus community are invited to the Pierce Boathouse Sunday morning beginning at 7:30 a.m. to cheer on competing class rowers, from the classes of 1952 to 2002.

Cambridge First Day honors five

The 15th annual Cambridge First Day celebration at MIT will honor five local organizations that are working to preserve and bring vitality to Cambridge history.

MIT President Susan Hockfield will present Cambridge First Day Awards on June 12 to the Cambridge African American Heritage Alliance; the Cambridge Historical Society; the magazine Growing up in North Cambridge; the Longfellow Community School Oral History Project; and the Longfellow National Historic Site and Friends of the Longfellow House.

In addition to the awards, each honoree will receive $1,000 to support their continued work and a bound City Council resolution.

Cambridge Mayor Kenneth E. Reeves, Cambridge City Manager Robert W. Healy and Cambridge Historic Commission Executive Director Charles M. Sullivan will join Hockfield in the program.

The event begins at 11:30 a.m. in Morss Hall at Walker Memorial and will be followed by an informal buffet luncheon.

Jointly planned and hosted by MIT and the city since 1997, Cambridge First Day focuses on a different theme each year. The celebration has honored dozens of Cambridge businesses, organizations and individuals representing many different sectors of the community over the last 15 years for their lasting contributions to the collective quality of life in Cambridge.

Annual plant sale follows Commencement

The MIT Community Service Fund will host its annual fundraising sale of the plants displayed on the Commencement podium and surrounding stage on Friday, June 8 at 3:30 p.m. in Killian Court. Proceeds from the sales of the plants, which are made available through the generosity of the Office of Conference Services and Special Events, support service to the local community by MIT staff and student volunteers.

AWARDS AND HONORS

The Department of Aeronautics and Astronautics announced the following awards on June 1.

Vickie Kerrebrock Award—to a student, staff or faculty member in recognition of his or her contribution to Course 16 spirit of community:

—The 2006-2007 student officers of the MIT Student Section of the American Institute of Aeronautics and Astronautics: Ashley Cousineau 2007, Darrell Cain 2008, Rachel Ellman 2007, Ruijie He 2007, Valentina Lugo 2007, Ryan McLinko 2009, Carolyn O'Brien 2009, Viviana Serra 2007, Pranay Sinha 2009, Kathleen Voelbel 2007

—H. Lauren Gallant, aero-astro administrative officer

The Spirit of XVI Award—For exceptional efforts and achievements that have furthered the mission and enhanced the quality of life in the aero-astro department:

—Beth Marois, student services coordinator

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Seniors describe four years at MIT as full of surprises and challenges

Ruth Walker
News Office Correspondent

There were, not surprisingly, some surprises along the road to graduation for the dozen and a half students Tech Talk profiled as "hometown heroes" when they entered as freshmen in 2003.

Jose Medrano of Pico Rivera, Calif., is one who found himself in a whole new field.

As an incoming freshman, he had indicated an interest in chemical engineering. "But biology had the most impact. That completely blew me away. I was so fascinated I ended up majoring in it."

Particularly meaningful for him was getting to study cutting-edge biological research techniques with the very professors who had developed them.

One thing that stood out to him was how the nature of the academic work evolved over time. The introductory courses, he suggested, were more like high school courses. "But as you progressed, it was less book work and more thinking. It was less about 'What is the right answer?' and more about 'How did you get that answer?' It was more like being a scientist," he said.

Biology was where Joseph Goldbeck, of Boiceville, N.Y., started out. "But by the end of freshman year I'd decided that brains were a lot more interesting," he said. So his major is in the Department of Brain and Cognitive Sciences.

One theme that pops up in conversations with these seniors is how demanding they found their work to be, and not just during the tough first year. Goldbeck said he kept asking himself, "There's more?" He concluded that his time at MIT has been "hard but fun."

David Rush, of Boise, Idaho, came in with a plan to major in electrical engineering, and he stuck with it—"a challenge, but satisfying in the end."

His biggest surprise was being honored, with his lab partner, for the best undergraduate lab of the year in electrical engineering and computer science. "My partner is a really, really smart guy, and he kept saying, 'It's too simple,'" Rush said. So the two made their project more complicated—and took the top honor.

The project was a juggling simulator. Rush came to MIT as a juggler but had no idea that juggling would be such an important part of his time here. "I never thought I'd start the MIT Juggling Club, but I did"—halfway through freshman year.

Anna Massie, of Louisville, Colo., came to MIT planning to major in aeronautics and astronautics, and she has done so. But she's refined her career goal in light of changed realities. At one point she thought she might have a go as an astronaut. But now she declares herself more geared toward small satellite developments. "It's going to take a long time to get humans back into space," she said.

MIT "can definitely be a very tough place," Massie said, especially for those who don't take enough breaks from their work. She's observed her peers and noted that some people "just don't change," bearing up well under the strain of all the work, "while others head out looking so bogged down," despite being very bright and knowledgeable.

Moneer Helu, of Birmingham, Ala., who majored in mechanical engineering, had two big surprises at MIT. She explained in an e-mail, "The first surprise was that I was up to the extreme challenge that is MIT…. I've quite literally had an extremely thrilling time here." The other surprise was finding that MIT maintains a noncompetitive atmosphere. As she arrived at the Institute, she wrote, "everyone assured me that I'd find myself working with others and that I'd always be able to find help among my classmates. I quickly dismissed these statements…but in reality that is what occurs, and that is one of the best things about MIT."

Kevin Krsulich, of Rockville Centre, N.Y., majored in physics with a minor in math. He wrote in an e-mail, "I don't know about surprise, but I would certainly say something that I would not have foreseen in my freshman year was that I became a father in the summer following my sophomore year. My son, Charles, will be 2 this July."

Emily Gullotti of Stonington, Conn., arrived on campus four years ago swearing to herself that she would not follow in the footsteps of her father, John Gullotti (S.B. 1978). But then she took a course in metallurgy and loved it. "It's in your blood!" he told her. And so like him, she's getting a degree in materials science and engineering.

For Gullotti, one of the surprises at MIT was that for the first time she found herself in an environment where, as she put it, "everyone is like me." When she goes out to dinner with friends, she likes not being the only one at the table who can easily figure out how to split the check.

Students find energy answers are blowing in the wind

Deborah Halber
News Office Correspondent

Four students who spent the spring semester determining whether MIT should install rooftop wind turbines uncovered both good news and not-so-good news.

The group was blown away by MIT students' overwhelming support of wind power on campus. The problem is that even an MIT-owned 29-story apartment building—the best option for locating a wind turbine—does not get a whole lot of wind. Still, Team Wind recommended placing a 12-foot diameter wind turbine on the building to help make a dent in MIT's electric bill, offset carbon dioxide emissions and serve as an educational resource for future projects related to energy and wind.

First-year students Richard Bates, Samantha Fox, KT McCusker and Katie Pesce were among a dozen MIT students in a class—offered for the first time last semester—that investigated ways to help MIT and the City of Cambridge reduce energy use and greenhouse gas emissions.

On May 11, Team Wind, as the four called themselves, presented their results assessing the economic, technical, aesthetic and policy issues connected with installing small and micro-sized wind turbines on MIT buildings to capture wind energy. In the audience were MIT and Cambridge decision-makers who could help implement the proposed projects.

Nowhere near the scale of commercial turbines with 100-meter-wide blades, the Skystream 3.7 made by Arizona-based Southwest Windpower has compact 12-foot rotors.

The Skystream system has an installed cost of around $7,900, although it has never been installed on a building before, and would be eligible for around $2,700 in rebates through the Massachusetts Technology Collaborative. It would provide 2,600 kilowatt hours (kWh) of energy annually. The cost to MIT would be nine cents per kWh compared with 15 cents per kWh from a utility company. A turbine installed on Eastgate would have a payback time of 11 years, the group calculated.

"It has high value proportional to its size and the potential for good cost savings," said Dan Wesolowski, a materials science and engineering graduate student who served as a teaching assistant and helped develop the course. Nevertheless, it would take a wind turbine one year to offset the amount of greenhouse gases than MIT produces in six minutes.

The students measured wind speeds at seven campus locations before settling on Eastgate tower, which houses graduate students and their families in 203 apartments at the east end of campus. The building is close to the Charles River, generally considered a good option for wind power density. A site needs class 3 wind power density, translating to mean wind speeds of around 12 mph, to be economically attractive. MIT's campus is largely class 1.

The new class, "Energy, Environment and Society," focused on solving real-world problems. Jeffrey I. Steinfeld, professor of chemistry and director of the Laboratory for Energy and Environment (LFEE) education program; Jefferson W. Tester, the H.P. Meissner Professor of Chemical Engineering; and Amanda Graham, manager of the LFEE education program, designed and led the class, aided by three graduate student teaching assistants.

"We feel strongly that having students develop projects leading to real-world products rather than more abstract outcomes provides a very different learning experience," Graham said. "The students meet the people who care about the material they generate, and there's a sudden shift in their investment and motivation that we hope will deepen their experience and commitment and extend their learning."

The d'Arbeloff Fund for Excellence in Education supported the development of this class.

PHOTO / **DONNA COVENEY**

Fourth-year Ph.D. student in materials science Dan Wesolowski, left, discusses wind direction and velocity on a rooftop with mechanical engineering sophomore Richard Bates. They and other students put equipment on a number of roofs around the Institute for a month to determine the viability of using wind turbines to generate power. MIT's co-generation plant is visible behind them.

Closing fume hoods could save $1 million

Deborah Halber
News Office Correspondent

A device that sucks up noxious fumes also devours almost $1.4 billion worth of potential energy savings each year.

Fume hoods, widely used by high-tech industries, hospitals and universities, help keep workers from breathing harmful chemical vapors but can use a lot of energy. A single fume hood running 24 hours a day uses as much energy as a single-family home.

Leon Glicksman

The possible energy savings for the more than 750,000 hoods across the United States is $1.39 billion annually, according to Lawrence Berkeley National Laboratory in California.

According to a student's comprehensive analysis of fume hood use in MIT chemistry laboratories, MIT stands to save up to $1 million annually in energy costs.

Lab rat

During his senior year at MIT, Steven T. Amanti spent days and nights in the chemistry building.

That would not be unusual for a chemistry student. But Amanti was a mechanical engineering major working under Leon R. Glicksman, professor of building technology and mechanical engineering. Amanti prowled MIT's Building 18 because he was investigating a case of inadvertent energy abuse.

Amanti has moved on, but his senior thesis, "Potential Energy Savings on the MIT Campus," is still very much on the minds of MIT students, staff and administrators. His data led to an ongoing effort to cut electricity use through increased awareness of campus-wide use of fume hoods.

Fume hoods line the walls of more than a dozen labs in

See **FUME HOODS** Page 9

S-Lab stimulates sustainability at MIT Sloan

Teresa Hill
Laboratory for Energy and the Environment

Insights and energy from several engineering disciplines, architecture, urban planning, management, public policy and the humanities inspired the 60 students enrolled in Sloan's innovative new Laboratory for Sustainable Business (S-Lab) this year. Teams collaborating with 14 clients to craft business approaches to environmental and social issues showcased their final projects in the lobby of Building E52 on the afternoon of May 16.

Coordinator Sarah Slaughter, an expert in sustainable infrastructure and construction, said that S-Lab "was a life-changing experience for many of the students, giving them an opportunity to make real change happen…in environmental restoration, economic development and social equity." Eight Sloan faculty co-taught the course, using case material, internship experience and integrated analytic tools and frameworks to identify business opportunities presented by the real-world challenges of sustainable energy, the impacts of globalization on social structures and the widening gap between the world's "haves" and "have-nots."

PHOTO COURTESY / **MIT SLOAN**

Margo Corral

The experimental offering drew students from several MIT departments, including advanced undergraduates and master's and doctoral candidates, and students from other area universities. The initiative represents a new wave of concern over environmental and social responsibility at business schools in the United States and abroad, many of which now have course requirements in those areas. The Sloan subject focused on sustainable business planning in recognition of the key role climate change is playing in both public and private sector policy and practice.

According to Richard Locke, the Alvin J. Siteman Professor of Entrepreneurship and professor of political science, the S-Lab approach is unique in that it synergizes multiple disciplines. "Up until now we have considered aspects of sustainability—climate, energy, water, food, poverty and social development—in isolation," he says. "S-Lab is developing an integrated framework to consider the system-wide dynamics of human society, along with tools and methodologies for measuring and monitoring sustainability efforts and their applications."

Acting as entrepreneurs, students used interactive computer-based simulations to invest in firms using renewable resources in a framework of existing policies and business models. The simulations enable them to see how changes in any set of factors might affect sustainability and profitability. "Students engaged in deep learning," observed Slaughter, as they "worked with the organizations to identify the nature of sustainability and developed new systematic approaches to help each organization reach its sustainability objectives."

Primed with this innovative learning, the wisdom of eight faculty members, extensive case study and theoretical reading, and the practices reported by guest speakers, students worked in teams to develop solutions to real-world sustainability challenges presented by participating groups. These included large established firms, such as Disney Imagineers, Intel and Nike. Start-up and small firm participants were GoLoco, a social network facilitating ride sharing; Mibanco, a Latin American microcredit group; Good Energies, a fund investing in renewables; Greenfuel Technologies, a biofuels firm; the Spark Group, an investor in schools and microfinance in Chennai (formerly Madras), India; and Merida, a maker of natural fiber floor coverings.

NGOs and government groups included the World Bank; the Universidad Francisco Marroquin program in microfinance; Health Care Without Harm, an organization for improving the environmental quality of buildings; and Friends of Petit-Anse, a Haitian group empowering the poorest of the poor. The Sloan School and the MIT Energy Initiative's Campus Energy Task Force also worked with S-Lab students on

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PHOTO / **STUART DARSCH**

Pascal Marmier

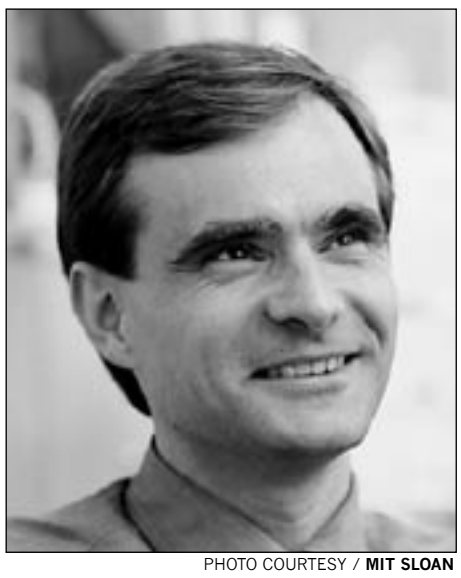


PHOTO COURTESY / **MIT SLOAN**

Simon Johnson

PHOTO / **L. BARRY HETHERINGTON**

Nhan Ghiang

MLK scholar sheds light on chemical energy flow

Deborah Halber
News Office Correspondent

Elucidating the dynamics of molecules that are both long-lasting and elusive is the goal of Wilton Virgo, recently named a Martin Luther King Jr. Visiting Scholar.

"Metastability" is molecules' ability to persist for a long time in one chemical state.

Virgo's research focuses on gas molecules in long-lived, highly reactive states called metastable triplet states. "The molecules I study are intriguing because they act as chemical protagonists in reactions initiated either by ultraviolet light or by molecular collisions. I want to illuminate the process of chemical energy flow in the molecule in order to understand the driving force behind chemical reactions," he said.

"Our research investigates how metastable molecules are involved in both intramolecular and intermolecular energy flow," he said. "This is a major goal of the chemical dynamics field."

In nature, molecules want to be in their most stable, lowest energy state, called the ground state. Usually, excited molecules can give up their energy by emitting light in the form of fluorescence and making a transition to the ground state.

"In our field, metastable states of molecules possess excess electronic energy but cannot dispose of that energy because the transition to the ground state is optically forbidden," Virgo said. The molecule is like a reactive bundle of energy that has no way of getting to the ground state.

"The energy in the molecule can't be lost spontaneously via fluorescence, but it can be used to drive chemical reactions when the excited molecule collides with a normal molecule in its ground energy state. The metastable molecule can give its energy to other molecules via collisions, causing chemical reactions to take place," Virgo said.

Despite their key role in chemical reactions, these molecules can easily elude detection. "My research involves inventing new, sophisticated techniques using lasers, molecular beams and detection of the metastables on metal surfaces," he said.

Virgo arrived at MIT in January 2006 as a postdoctoral associate in the laboratory of Robert W. Field, the Haslam and Dewey Professor of Chemistry.

Virgo earned his undergraduate degree in chemistry at Princeton University. He worked as a professional associate at Brookhaven National Laboratory in 2001 and received his Ph.D. degree from Arizona State University in 2005.

PHOTO COURTESY / **WILTON VIRGO**

Wilton Virgo was recently named a Martin Luther King Jr. Visiting Scholar.

D'Arbeloff, Alumni fund innovative courses

More than $1.1 million has been awarded to 22 faculty groups developing new subjects, thanks to the d'Arbeloff Fund for Excellence in Education and the Alumni Funds from the Classes of 1951, 1955, 1972 and 1999. Both funds are administered by the Office of Faculty Support.

Dean for Curriculum and Faculty Support Diana Henderson said, "These awards reflect a broad and profound commitment to educational innovation among many of our faculty."

The d'Arbeloff Fund for Excellence in Education supports projects designed to enhance and potentially transform the academic experience of MIT's undergraduate students. The new d'Arbeloff award recipients include:

Building a Constructive Culture

Biological Engineering: Professor Drew Endy, Instructor Natalie Kuldell, Principal Research Engineer Randy Rettberg; Political Science: Professor Ken Oye—This project-based introduction to biological engineering design will motivate students to master discipline-specific knowledge in context and solve a personally compelling design challenge.

When Engineering Gets Big: Building Faster Highways Inside Cities and Computers

Materials Science and Engineering: Professor L.C. Kimerling, Rachael Kemper; Microphotonics Center: Sajan Saini; Civil and Environmental Engineering: Professors Herbert Einstein and Andrew Whittle—This subject introduces students to the complexities of Big Engineering: large-scale ventures that integrate multiple science-engineering disciplines, interacting over an extended production timeline.

Music and the Supernatural: Witches, Magi and Ghosts

Music and Theater Arts: Professor Ellen Harris and Lecturer Charles Shadle; Anthropology: Professor James Howe—The new subject focuses on the relationship between music and the supernatural as reflected in key musical works of the Western tradition from the 17th to the 20th centuries.

Through the generous support of the Classes of 1951, 1955, 1972 and 1999, the Alumni Class Funds provide resources to MIT faculty for innovative educational projects, particularly to enhance undergraduate education. This year's awards include:

Art Work-Out: Visual Arts in the Gym

Architecture: Professor Wendy Jacob, Lecturer Andrea Frank—This project will assist in the development of a new Visual Arts Program introductory studio subject that will use MIT's sports arenas (gyms, pools and playing fields) as sites for artistic production.

The New Third World Challenge

Architecture: Research Associate Reinhard Goethert—Goethert will re-center the course "The New Practitioner" to identify proactive strategies for approaching the problem of Third World urban growth, combining presentations of experts with a workshop in a Third World country.

Mapping Controversies

Program in Science, Technology, and Society: Professor Vincent Antonin Lepinay—The goal of "Mapping Controversies" is to teach undergraduate students how to account for and map techno-scientific controversies.

Reviving World Literatures

Literature: Professors Mary Fuller, Alisa Braithwaite, Sarah Brouillette—The goal of the project is to enhance literary study for MIT students by emphasizing cross-cultural understanding.

The Fisher Files Podcast

Professor Peter Fisher, Physics—Fisher's project would produce 12 weekly programs devoted to time management, organization and life skills, oriented to those in an academic environment.

More information can be found at the Office of Faculty Support web site: web.mit.edu/facultysupport/programs.html.

DNA-damage test could aid drug development

Eric Bender
Whitehead Institute

In the daunting marathon that leads to successful drugs, promising drug candidates must pass toxicity tests before entering clinical trials. Researchers from MIT and the Whitehead Institute have developed a cell culture test for assessing a compound's genetic toxicity that may prove dramatically cheaper than existing animal tests. This assay would allow genetic toxicity to be examined far earlier in the drug development process, making it much more efficient.

Like the current FDA-approved test, the new test looks for DNA damage in red blood cells formed in the bone marrow of mice. The precursors to red blood cells are handy for this because such cells normally lose their nucleus during the last stage of red cell formation, and DNA-damaged precursors generate red blood cells containing an easily detected "micronucleus" consisting of fragments of nuclear DNA. Unlike the current procedure, which injects the compound into a live mouse, the new assay is a cell-culture system that could allow hundreds or thousands of tests to be performed from the bone marrow of a single mouse, and potentially from human bone marrow.

Joe Shuga, the graduate student in chemical engineering who developed the assay, is in the unusual position of being a graduate student in three labs, those of Professors Linda Griffith, Harvey Lodish (a Whitehead member) and Leona Samson. "We're all faculty in the biological engineering department, and collaborative projects like this are what the department was intended to do," says Griffith, senior author of a paper on the work published online in the Proceedings of the National Academy of Science the week of May 14.

PHOTO / **DONNA COVENEY**

From left to right, Professors Linda Griffith and Leona Samson with Harvey Lodish of the Whitehead Institute and graduate student Joe Shuga.

"This is an example of taking fundamental lab science and doing something useful with it," says Lodish, whose lab has extensively studied the process by which red blood cells are generated. Shuga first worked with postdoctoral researcher Jing Zhang in the Lodish lab to adapt techniques from an established cell-culture system based on mouse fetal liver cells to create a new system based on adult red cell precursors from mouse bone marrow. Shuga patiently optimized the system, which allows the precursor cells to proliferate and differentiate in the normal way, dividing four or five times before losing their nucleus and becoming immature red blood cells.

Shuga then studied the way these developing cells reacted to three toxic DNA-damaging agents whose effects had been studied by Samson's lab and found the results correlated well with results from the existing test. Additionally, he experimented with mutant mice created by Samson's lab that are deficient in certain DNA-repair systems. The bone marrow cells derived from these mice, and the cells cultured from that bone marrow, proved more sensitive to the toxic agents than were the cultured cells from normal mice, further confirming the results.

With the new assay, "instead of testing one chemical and one dose in one animal, you'll be able to take one animal, get the bone marrow out and test a thousand different conditions," says Samson, the American Cancer Society Research Professor. "You'll be able to look in more detail at different doses given at different times in the cell differentiation process."

"This is a much cheaper assay that's at least as predictive as previous assays," emphasizes Griffith, "and drug developers can afford to use it a lot earlier in the drug development process."

It also could help to avoid issues with animal testing. "The European Union is trying to minimize animal testing," Shuga points out. "A ban on animal testing of cosmetic products goes into effect in 2009."

Next steps in the research, which may be carried out by industry partners, will be to test the assay in rats and other organisms, and with a wide variety of other toxic chemicals.

"This research is the first stage in a new type of clinical drug toxicity test," says Lodish. "And although we haven't done it, you may be able to extend the technique to humans. Humans are the gold standard in that one

See **DNA** Page 8

Brain uses both neural 'teacher' and 'tailor' in learning

While most people need peace and quiet to cram for a test, the brain itself may need noise to learn, a recent MIT study suggests. In experiments with monkeys, the researchers found that neural activities in the brain gradually change, even when nothing new is being learned. Challenging the monkeys to adjust their task triggered systematic changes in their neural activities on top of this background "noise."

The researchers said their findings suggest a new theory of how the brain learns.

"What surprised us most was that the neural representation of movement seems to change even when behavior doesn't seem to change at all," said Sebastian Seung, professor of physics and computational neuroscience and a Howard Hughes Medical Institute investigator. "This was a surprising degree of instability in the brain's representation of the world."

Seung and Institute Professor Emilio Bizzi led the study, which was published in the May 24 issue of the journal Neuron. Lead author on the study was Uri Rokni, a postdoctoral fellow in Seung's laboratory.

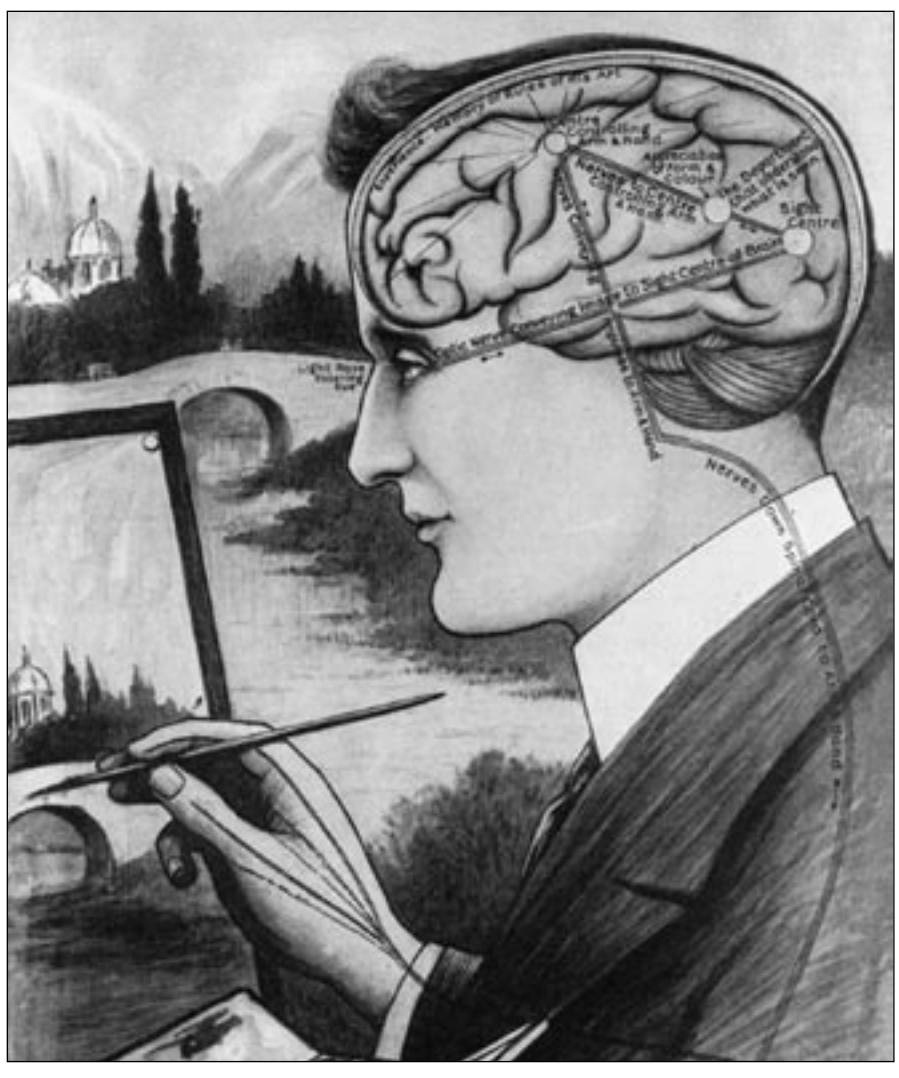
In earlier work, Bizzi and colleagues measured neural activities in the motor cortex while monkeys manipulated a handle to move a cursor to targets on a screen. In control experiments, the monkeys had to move the cursor to targets in the same way they had been trained. In learning experiments, the monkeys had to adapt their movements to compensate for novel forces applied to the handle.

The scientists found that even when the monkeys were performing the familiar control task, their neural activities gradually changed over the course of the session.

To explore the significance of these background changes, Rokni analyzed the data from the learning component of Bizzi's experiments. He found he could distinguish learning-related neural changes from the background changes that occurred during the control experiments. From this analysis, Rokni developed a working theory that combined the concepts of a redundant neural network and that of a "noisy" brain.

"A good analogy to redundant circuitry, which accomplishes the same behavior by different wiring configurations, would be a piece of text, in which you can say the same thing with different words," Rokni explained. "Our theory holds that the learning brain has the equivalent of a 'teacher' and a 'tinkerer'—a learning signal and noise in the learning process, respectively.

"In producing a specific piece of text, the tinkerer just randomly changes the words, while the teacher continually corrects the text to make it have the right meaning. The teacher only cares about the meaning and not the precise wording. When the teacher and tinkerer work together, the text keeps changing but the meaning remains the same. For example, the tinkerer may change the sentence, 'John is married,' to 'John is single,' and the teacher may correct it to 'John is not single.'



"In the same way, learning in the brain has two components—error-correction and noise—so that even though the neural representation keeps changing, the behavior remains fixed. We think the tinkerer, that is the noise, is not merely a nuisance to the teacher but is actually helping the teacher explore new possibilities it wouldn't have considered otherwise."

To test this idea, Rokni constructed a mathematical model of a redundant cortical network that controls movement and used it to simulate the learning experiment with the monkeys. In this model, learning of the connections between neurons was assumed to be a considerably noisy process. "When we ran the simulation long enough, the performance became good, but the neural representation kept changing, very similar to the experiments," Rokni said.

According to Rokni, the concepts of redundant networks and "noisy learning" have important implications for neurobiology. "I don't think this concept of redundancy—that the brain can say the same thing in different ways—has really been fully appreciated until now," he said.

"More practically, people who are constructing devices that translate brain signals to operate such external devices as neural prostheses will have to take such constantly changing neural representations into account," said Rokni.

—Courtesy Howard Hughes Medical Institute

Systems model shows sustained policy incentives, carbon taxes will widen alternative vehicle use

Nancy Stauffer
MIT Energy Initiative

Imagine a vehicle that runs on hydrogen or biofuels and offers the same features, performance and price as today's gasoline vehicle. Could it capture half the market? Not likely, concludes a new MIT analysis of the challenges behind introducing alternative-fuel vehicles to the marketplace—not even if it's three times more fuel-efficient.

One of the barriers is this Catch-22: Until a high number of alternative fuel (AF) vehicles are already on the road, people won't consider buying one.

The researchers' conclusions are not all gloomy. If policy incentives are kept in place long enough, adoption will reach a level at which the market will begin to grow on its own. But "long enough" may be a surprisingly long time.

Given today's environmental pressures and energy security concerns, we need to move away from fossil-fuel-powered vehicles. But repeated attempts to introduce other technologies during the past century have nearly all failed. Dethroning the gasoline-consuming internal combustion engine (ICE) has proved difficult.

PHOTO / **MARK MORELLI**

Jeroen Struben, left, and John D. Sterman, of MIT Sloan, stand with an alternative vehicle in the MIT Museum.

"The challenge is not just introducing an AF vehicle," said postdoctoral associate Jeroen Struben of the Sloan School of Management, who has been examining the mechanisms behind such market transitions. "Consumer acceptance, the fueling infrastructure and manufacturing capability all have to evolve at the same time."

Thus, consumer exposure to AF vehicles is just one feedback loop that can affect adoption. Similarly, fuel suppliers won't build AF stations until they're certain of future demand; but until the fuel is widely available, consumers won't buy the vehicles. And manufacturers won't be able to make AF vehicles cheaper and better until their production volume is high; but high-volume production won't happen until such improvements are in place to attract buyers.

Then, of course, there's the status quo to be overcome—the well-established and highly attractive gasoline-ICE vehicle and the fueling infrastructure, energy supply chain and other industries that support it.

Understanding market behavior

To analyze the behavior of this system over time, Struben and Professor John D. Sterman of the Sloan School have developed a system dynamics model that simulates how markets for AF vehicles may (or may not) grow. The model can track the fate of various vehicle platforms, including conventional and advanced ICE, hybrids and plug-in hybrids, hydrogen fuel cells and biofuels. Decisions made by consumers, fuel suppliers and auto manufacturers change the market, consumer opinion, vehicle attributes and other factors, which then feed back to alter the decisions people make tomorrow.

Finally, the model accounts for the peculiarities of human behavior. "Our model doesn't assume that everybody is a perfectly rational economic agent," said Sterman. "Instead, we try to model how people actually make decisions such as which cars to buy and when and where to drive them. Emotion and social status matter, along with the economics." Thus, people's buying decisions may not reflect the actual features of an AF vehicle but rather what they have heard or read about it. Drivers who are worried about locating fuel for their AF vehicles may fill their tanks early—a behavior that reduces the vehicles' effective range and may cause unanticipated side effects such as crowding at filling stations.

Analyses to date show that a key factor slowing AF-

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MLK materials scientist developed solder's 'holy grail'

Deborah Halber
News Office Correspondent

Ainissa G. Ramirez is passionate about shattering the stereotype of scientists as serious and dull. Ramirez wants to show kids what she knows firsthand: Science can be fun.

Ramirez, who has recently been named an MIT Martin Luther King Jr. Visiting Professor, created the successful and engaging Science Saturdays lecture series at Yale University for school children. Ramirez, an associate professor of mechanical engineering at Yale, also hosts the campus-based show, which introduces middle-school-age children to scientists—explaining who they are, and how and why they study what they study.

Ainissa Ramirez

According to Ramirez, a materials scientist who has developed novel materials for microelectromechanical systems (MEMS) by exploring how materials thinner than a human hair behave mechanically. "Science is for everyone and those who do it come in all colors, shapes and sizes. I am committed to getting the word out so that more New Haven children can benefit from this program," she said. The scientists participating in the program are of various backgrounds, ages and disciplines, and they speak on topics such as "Why Birds Are Dinosaurs" and "What Frogs Are Telling Us."

Ramirez, who received a Ph.D. degree in materials science and engineering from Stanford University, researches the development of thin film NiTi shape memory alloys for MEMS systems. MEMS, which integrates mechanical elements, sensors, actuators and electronics on a silicon

See **RAMIREZ** Page 11

CRE redefines housing affordability

Ruth Walker
News Office Correspondent

Brookline—town of chic boutiques—an "affordable" community?

Yes, it is, relatively speaking. That's according to new data presented by Henry Pollakowski, principal research associate for MIT's Center for Real Estate, and his colleagues at the Third Annual Housing Affordability Conference in Kresge Little Theatre on May 22.

Pollakowski, along with Jeff Zabel of Tufts University, introduced a new index of housing affordability weighted to reflect a community's proximity to jobs, the quality of its schools and its proportion of publicly accessible open spaces.

"This is not the way it's usually done," Pollakowski acknowledged.

The basic concept is that a house out in the far suburbs may be less expensive but will probably require its owner to make a long daily commute, given that jobs remain concentrated in the central cities—such as Boston. So the affordability of the remote location is offset in part by commuting costs. And if poor schools hold down a town's housing prices, that affordability will be offset by either private school fees or lower earnings over a lifetime by the homeowner's children.

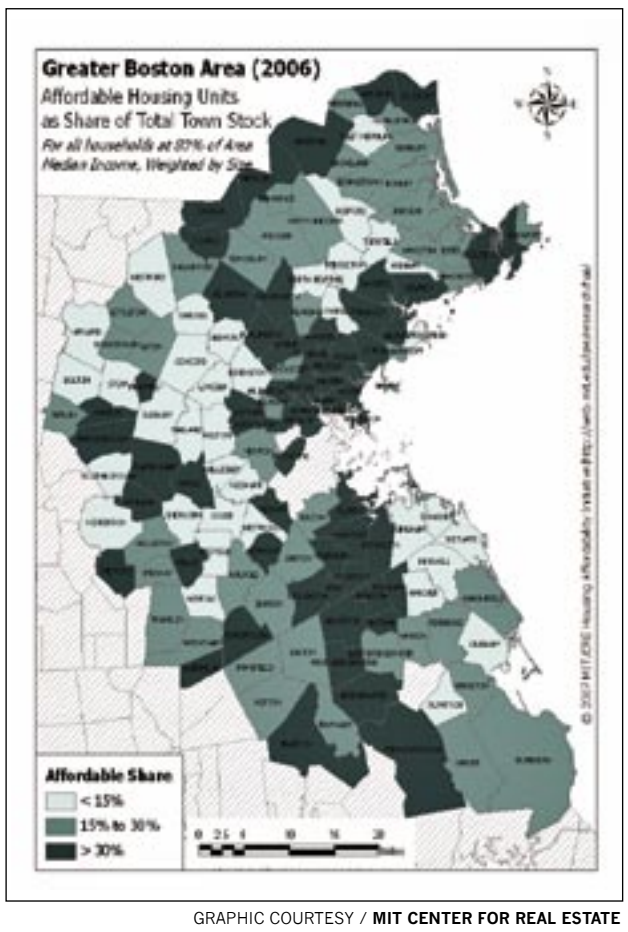
Houses in Brookline may not be inexpensive, but once there, residents have access to good schools and employment opportunities. Brookline also offers good access to open spaces, which is the researchers' proxy for good environmental quality.

On a map produced by Pollakowski, Brookline is colored dark teal green—indicating that more than 30 percent of its housing units are affordable to those earning 80 percent of the median income.

"We are well on our way to completing an index for all of New England," Pollakowski told his audience.

The research team, which is headed by Lynn Fisher, assistant professor of urban studies and planning, used rates of passage of the 10th-grade MCAS exam as the metric for determining good schools. Because good schools correlate strongly with low crime rates, the school ratings were a useful indicator for safe neighborhoods, even for households without children.

The researchers' methodology involves starting with U.S. census data on available housing stock and drawing housing values from assessor's parcel report data con-



GRAPHIC COURTESY / **MIT CENTER FOR REAL ESTATE**

On Pollakowski's map, Brookline is colored dark teal green—indicating that more than 30 percent of its housing units are affordable to those earning 80 percent of the median income.

tributed by the Warren Group, one of the sponsors of the research. "This is a lot of work, which is probably why it hasn't been done before," Pollakowski said.

He described a plan for an online user interface

See **HOUSING** Page 8

MIT researchers probe bone's tiny building blocks

Team's results could lead to new composites that mimic bone's capacity to 'fail gracefully'

Deborah Halber
News Office Correspondent

In work that could lead to more effective diagnoses and treatments of bone diseases using only a pinhead-sized sample of a patient's bone, MIT researchers report a first-of-its-kind analysis of the mechanical properties of bone.

The work, reported in the May 21 advance online edition of Nature Materials, sheds new light on how bone absorbs energy.

The researchers' up-close-and-personal look at bone probes its fundamental building block—a corkscrew-shaped protein called collagen embedded with tiny nanoparticles of mineral—at the level of tens of nanometers, or billionths of a meter. A human hair, by comparison, is 80,000 nanometers in diameter.

"If you want to investigate the origins of the strength and toughness of a material, you probe it at smaller and smaller length scales," said co-author Subra Suresh, Ford Professor of Engineering, with appointments in materials science and engineering, biological engineering, mechanical engineering and the Harvard-MIT Division of Health Sciences and Technology. "The methodologies used in this research can be employed to assess the quality of bone with extremely high precision by providing new and detailed structural and mechanical information on the nature of its fundamental constituents."

The insights gained from the work could also lead to the creation of new, tougher materials, he said.

The study was led by Christine Ortiz, associate professor of materials science and engineering. "The structure, quality and integrity of bone change dramatically with age and disease, hence understanding the origins of the mechanical properties of this major load-bearing, structural tissue in our body is extremely important from a medical standpoint," Ortiz said.

Using a table-top instrument called a molecular force probe, which uses an extremely small probe tip to poke out a tiny fragment of bone, Ortiz and colleagues mapped the stiffness of bovine shin bone into complex, colorful, two-dimensional contour maps similar to those used by geographers.

The team found that the mechanical properties of bone vary greatly within a single region only two micrometers (millionths of a meter) wide. Because a variety of disorders tied to disease or aging lead to changes in bone structure, the researchers' discovery of the nonuniformity of bone's mechanical properties at very small length scales could lead to improved diagnoses of diseases. For example, if specific nanoscale patterns of stiffness within bone structure are tied to disease or aging, these could potentially be identified earlier or provide more conclusive evidence of a disorder.

The researchers also formulated a computer model to study the effects of their experimental results on larger-scale biomechanical properties. For example, using the model they found that the nonuniform stiffness patterns were advantageous to bone's ability to absorb energy.

"We tend to think that if a material is nonuniform, it is not as tough," Suresh said. "This work shows otherwise. Our thesis is that nature, by making bones

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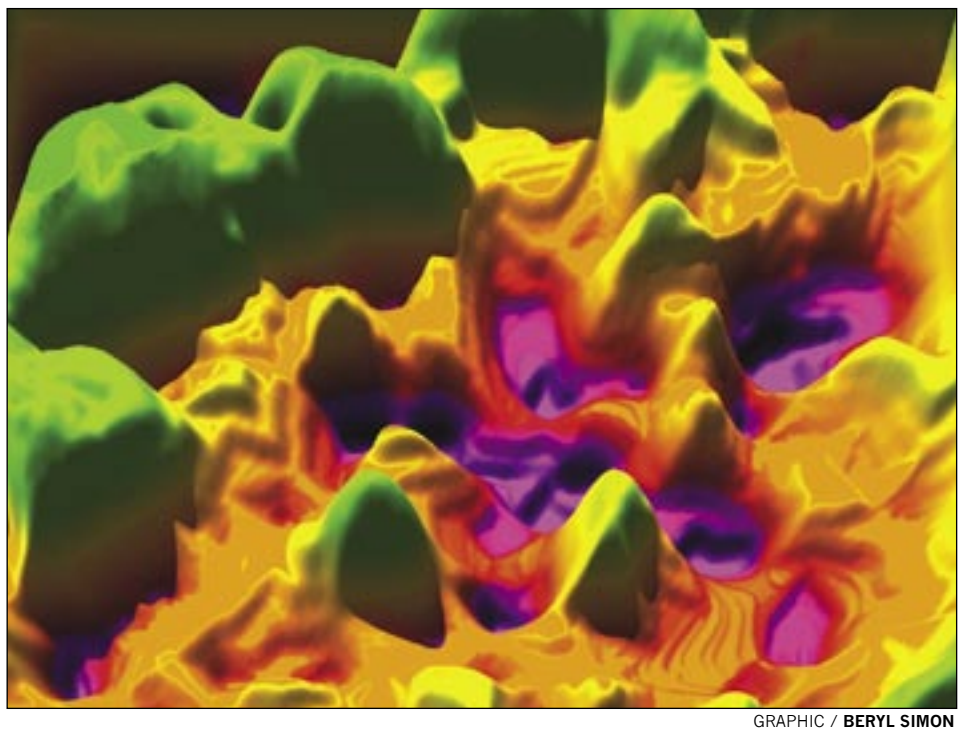
Page 10



GRAPHIC / **BERYL SIMON**

MIT researchers created this nanoscale map of the stiffness of bone.

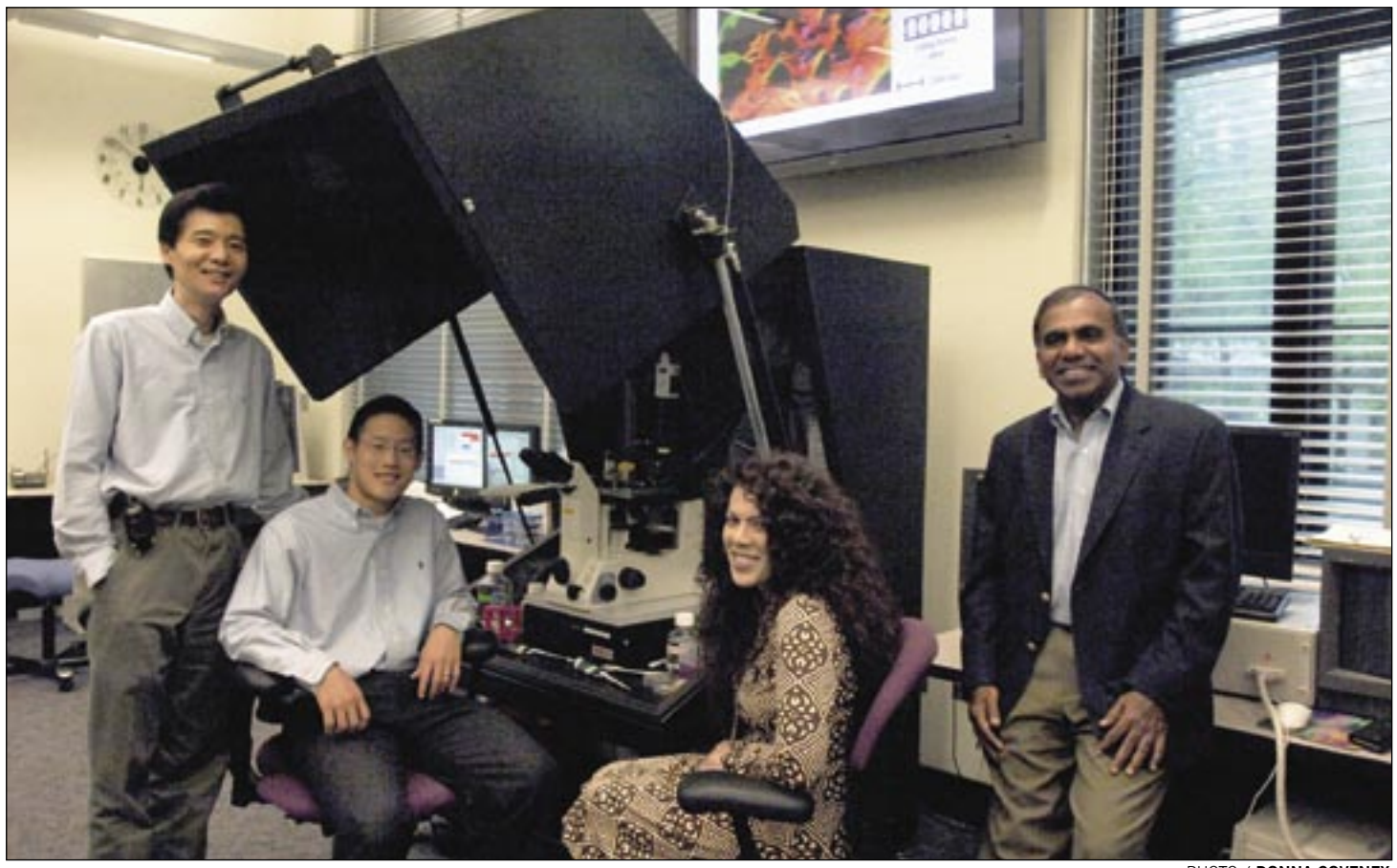


PHOTO / **DONNA COVENEY**

Research scientist Ming Dao, MIT affiliate Kuangshin Tai, Professor Christine Ortiz and Professor Subra Suresh, with equipment they used to study bone regrowth.

Students take Porsche to Electric Avenue

Nancy Stauffer
MIT Energy Initiative

For the past six months a team of MIT students has spent hundreds of hours—many late at night—converting a sleek Porsche 914 into an electric vehicle. Their goal? To demonstrate the viability of advanced electric vehicle technology and to help clarify what research and development has yet to be done.

The Porsche was donated by Professor Yang Shao-Horn of mechanical engineering, who with her husband, Quinn Horn, bought it on eBay and made it available to students interested in converting it to an electric-powered vehicle. In addition to providing an unusual opportunity for hands-on learning, the project will ultimately yield information valuable to Shao-Horn's research on advanced batteries. Specifically, she and her team in the Electrochemical Energy Laboratory will be able to measure the conditions that batteries encounter inside an operating vehicle.

"In the laboratory we work on materials to make batteries safer, last longer and have higher energy," she said. "But we are also interested in gaining a good perspective on the system view. What's involved in building an electric vehicle, and what's required of the batteries?"

The student project took off a year ago when Valence Technology, Inc., agreed to donate 18 high-tech rechargeable batteries valued at $2,030 each, plus a battery-management system. While today's electric cars generally operate on conventional lead-acid batteries, Valence provided its enabling lithium phosphate rechargeable batteries, which are lighter, last longer, charge faster, have a longer lifetime and don't pose a safety risk.

Leading the assembly team in the Sloan Automotive Laboratory is senior Emmanuel Sin, who was awarded the Peter Griffith Prize for an "outstanding experimental project and thesis" by the Department of Mechanical Engineering in May.

Sin's main collaborators on the project are sophomore Ryan King of mechanical engineering; freshman Jeremy Kuempel; graduate student Gerardo Jose la O', who initiated the project; and graduate student David Danielson, who obtained funding for supplies and tools from Maniv Energy Capital. Both la O' and Danielson are in the Department of Materials Science and Engineering.

To make the conversion, the students replaced the original engine with an electric motor, 12 of the batteries, the battery-management system, various relays and a controller that makes all the components work together. Things haven't always gone smoothly. "There's been a lot of adapting things that don't work as they're designed," said King. "We had to come up with some creative solutions."

In the next few weeks they hope to put the Porsche through its paces. For example, they'll determine its acceleration and top speed and will see how far it will go on a single charge.

According to their best estimates, the car should produce 50 to 60 horsepower, have a top speed of 70 to 100 miles per hour, and travel 100 miles or more on a single charge. Plugging it into a wall socket should fully recharge the batteries in four to five hours.

PHOTO / **DONNA COVENEY**

Mechanical engineering graduate student Craig Wildman, background, mechanical engineering sophomore Ryan King, center, and freshman Jeremy Kuenpel work on remodeling a Porsche in Sloan Automotive Lab. They are installing the motor controller into the rear trunk compartment of the vehicle.

PHOTO COURTESY / **MIT SLOAN**

Rebecca Henderson

PHOTO COURTESY / **MIT SLOAN**

Ali Basmaa

S-LAB

Continued from Page 4

campus-level problems.

Students were eager to explain their processes and results. Department of Urban Studies and Planning (DUSP) graduate student Sharleen Leurig worked on a project for Intel, which is not usually pegged as an environmental company, but, like a growing number of influential firms, is giving serious thought to its environmental footprint. S-Lab enabled Leurig to "add business concepts to the DUSP emphasis on regulatory, scientific and resource aspects of environmental management." Her team, advised by Slaughter, developed a set of sustainability indicators for Intel's construction and materials division. Other team members included Sloan graduate students Sylvia Dizon, Elizabeth Prior and Stephen Rockwell.

Disney Imagineers are interested in making the energy use of the firm's theme parks more sustainable. The S-Lab team compared various alternative energy options with the needs of the company and determined that, like many very large firms, Disney's greatest contribution at present would lie in the purchase of carbon offsets. At the same time, alternative energy demonstration projects at the parks and other initiatives, in, for example, trash reduction and disposal, could raise public awareness among thousands of visitors. Sloan student Lina Montesalve used her team's colorful poster filled with familiar Disney characters to demonstrate how the team reached this conclusion. The team was advised by Rebecca Henderson, the Eastman Kodak Leaders for Manufacturing Professor of Management.

A new small company creating natural fiber floor coverings, Merida challenged an S-Lab team to develop a business strategy that would enable managers to operate sustainably in this competitive field. Advised by Locke, Team Merida included two Sloan fellows—Pascal Marmier, a lawyer from Switzerland, and Zairo Cheibub, an academic from Brazil; Nhan Ghiang of the systems design and management graduate program; and physician Basmaa Ali, a graduate student at Sloan. Part of the challenge was to develop a definition of sustainability for the company to use in gauging its effectiveness.

According to Slaughter, "The commitment and enthusiasm of the faculty and students was invigorating, engaging an ever-widening community for sustainability." In addition to Locke, Henderson and Slaughter, S-Lab faculty included Simon Johnson, professor of entrepreneurship and chief economist of the International Monetary Fund; Nelson Repenning, associate professor of management; Anjali Sastry, assistant professor of management science; senior lecturer Jeff Shames; and John Sterman, the Jay W. Forrester Professor of Management and director of the MIT System Dynamics Group. The teaching assistants were management student Margo Corral and technology policy student Pragnya Alekal, both looking forward to receiving the S.M. in June. "It was exciting," said Sterman. "We're looking forward to offering S-Lab again next year."

HOUSING

Continued from Page 6

being developed in conjunction with the Department of Urban Studies and Planning: "What we're aiming for is for somebody to be able to go online, tap in the number of people in their household and their income and out will pop a map, which will tell you how many units exist in the metropolitan area that will be affordable to you…. This is very exciting."

Not so exciting, from the perspective of those hoping for greater housing density in the suburbs, were the statistics presented on suburban residential land use.

"Density has been getting lower and lower. We found only four communities where that was not the pattern," Pollakowski said.

Between 1998 and 2004, nearly 40,000 new single-family houses were built in the metro area outside Boston proper. The median lot size was 0.86 acres—and the average was somewhere between 1.1 and 1.2 acres.

"That's nearly 50,000 acres—about the size of the city of Boston," Pollakowski said. "This gives an indication of the way land is being tied up in ways that are not likely to change."

DNA

Continued from Page 5

wants an assay that directly predicts toxicity in humans, not animals, and you could obtain human bone marrow that's left over from medical procedures."

"If you could change the micronucleus assay to have a human cell readout, that would be pretty amazing," says Samson. Down the road, she suggests, such a test might offer a new way to examine how different individuals respond to chemotherapeutic agents.

"The presumption is that, for some biological processes, in vitro human models could be closer to in vivo human than in vivo mouse," notes Shuga. "That premise will be tested in coming years as new systems become available."

Shuga has additional affiliations with the Whitehead Institute and MIT's Center for Environmental Health Sciences (CEHS); Samson is director of CEHS and has an appointment in MIT's Department of Biology; Lodish also has an appointment in biology; and Griffith has appointments in biology and in the Department of Mechanical Engineering.

This work was funded by the Cambridge-MIT Institute, Amgen, the National Institutes of Health and the National Science Foundation.

Summons wins Humboldt Award

Roger E. Summons, a professor in the Department of Earth, Atmospheric and Planetary Sciences, will receive a Humboldt Research Award from the Alexander von Humboldt-Stifung Foundation in Germany. The award is conferred "in recognition of lifetime achievements in research."

Awardees are invited to carry out research projects of their own choice in cooperation with colleagues in Germany. The idea is to promote international scientific cooperation.

Summons' research interests include the biogeochemistry of geologically significant microbes, microbially dominated ecosystems, and organic and isotopic indicators of climate change, biotic evolution and mass extinction.

CMI students celebrate exchange program

More than 400 students have participated in the Cambridge-MIT Exchange (CMI), which began in 2000. The exchange is now firmly established as an integral part of MIT undergraduate programs, now administered by MIT Study Abroad.

Professor Edward Crawley, executive director of CMI and professor of aeronautics and astronautics, reflected on the exchange and its achievements since its inception.

"The exchange was the first of its kind for either institution," Crawley explained. "It was an exchange of not only students, but also of programs. As the first designed exchange, CMI students knew ahead of time what courses they would get credit for and how those fit into their degree."

CMI's second key accomplishment was the increased collaboration between faculties. "Exchange students at both universities have been able to show that there are other ways to teach and learn. The outcome has been positive; teaching and learning styles have been examined and improved," Crawley said.

The cultural influence of CMI exchange students has also been key to the program's success, Crawley stressed.

– Ssegawa-Ssekintu Kiwanuka

RIBBON

Continued from Page 1

Sequeira, 24, who is graduating in February 2008.

The Graduation Pledge of Social and Environmental Responsibility was launched in spring of 1987 at Humboldt State in Arcata, Calif., by students then concerned about the nuclear arms race. The pledge itself is simple: "I pledge to explore and take into account the social and environmental consequences of any job I consider and will try to improve these aspects of any organization for which I work." Students recite the pledge and wear a green ribbon at graduation ceremonies.

The concept soon spread to other schools, including MIT. In 1988, the Coalition to Humanize MIT implemented the pledge in collaboration with the newly formed Graduation Pledge Alliance, Sequeira said. Pledges were also taken at MIT in the early 2000s.

Sequeira wanted to revive the concept. The 2007 effort was implemented by a coalition of MIT groups, including Pugwash, Muslim Students Association, Laboratory for Energy and the Environment, Technology and Culture Forum, and Students for Global Sustainability. On May 16, MIT pledge-takers were honored in a ceremony and received certificates and wallet cards. About 50 of them—a mix of graduates and undergraduates from a variety of disciplines—will walk across the stage on Commencement on June 8 wearing green ribbons. Organizers hope to express to students that they can make positive impacts in the world by first being mindful of their actions.

The pledge now addresses nanotechnology, biotechnology, climate change and other issues. The goal is to emphasize that "science and technology are driven by human values and affect human values," Sequeira said, adding, "The nuclear issue hasn't gone away."

His work for Pugwash and the pledge has changed Sequeira's own mindset and challenged him to look at aeronautics in new ways, going beyond building a better airplane to aviation fuel efficiency, sustainable design and the impact of air travel on people and the environment. The new mindset "has opened up my job prospects a lot," he said.

He hopes to set the groundwork for other students to organize a larger pledge effort in 2008.

MIT's pledge effort web site is at sustainability.mit.edu/Pledge.

VEHICLE

Continued from Page 6

vehicle adoption is the long lifetime of today's vehicles. People buy cars infrequently, so it will be a long time before a given consumer is exposed to enough AF vehicles to feel comfortable buying one. Even an AF vehicle that's as attractive (objectively) as a gasoline-ICE vehicle won't catch on without strong and lasting promotion campaigns.

Concern about finding fuel also slows adoption. In a simulation representing California, entrepreneurs opened AF stations in urban areas but not in less-populated rural areas where demand is initially lower. Urban AF drivers must then avoid the rural areas, reducing the appeal of AF vehicles and slowing their sales everywhere.

Another counterintuitive result: Tripling the fuel efficiency of the AF vehicle should attract more buyers. But since drivers then need much less fuel, energy suppliers build fewer AF stations, lowering the appeal of these efficient cars. The net result? Sales may actually decline.

Self-sustaining markets

Despite such findings, Sterman sees reason for optimism: There are tipping points. With policy incentives that push the new technology forward and sufficient coordination across decision-makers, eventually enough AF vehicles will be on the road that all the decision-makers will buy in and the AF market can become self-sustaining.

The researchers are not ready to make policy recommendations, but their analyses provide initial insights. They clearly illustrate the effectiveness of carbon emission taxes, but they also produce some more-unexpected findings. For example, given the importance of vehicle lifetime, providing incentives to scrap current vehicles may be more effective than direct efforts to get more AF vehicles on the road. Likewise, providing subsidies for building AF stations will help, but giving bonuses for building and especially keeping them in remote areas may be critical.

Most important, for markets to reach the tipping point, policy incentives may have to be kept in place for many decades, even through periods of declining fuel prices. Withdrawing the policies too soon will result in yet another failed attempt to shift the market away from gasoline-powered ICE vehicles.

This research was supported by the Project on Innovation in Markets and Organizations at the MIT Sloan School of Management, the National Renewable Energy Laboratory and Shell Hydrogen.

PHOTO / **DONNA COVENEY**

PHOTO / **DONNA COVENEY**

Wheels within wheels

A team of students in Course 2.009 (Product Engineering Processes) built the Revolution bicycle, designed to help developmentally disabled children learn to ride a bike. Above right, senior mechanical engineering majors Michal Ruchelsman, on bike, and Andrew Harlan, pushing, demonstrate how the bike works. As the rider pedals, an instructor walks behind holding the rear handlebars positioned behind the seat. Both sets of handlebars are linked mechanically. Above, left, senior Helen Tsai works on the bicycle. Members of the 'Bluesteel' team, which designed the bike, received a $5,000 award in the IDEAS Competition. Other MIT members of the team are senior Elysa Wan, junior Albert Hernandez, senior Mark Cote, senior Jorge Renjifo-Mundo and Lou Goldish, senior business developer in the Office of the Provost. 'For three years at MIT the academic rigors made it hard to see light at the end of the tunnel. This is a great way to end…it was an incredible experience working with these students,' said Ruchelsman. 'I never thought I'd be able to see the satisfaction of my work, and the impact I can have on other people's lives, after just four years. Some people don't see that in a lifetime. It made all the sleepless nights worthwhile.'

FUME HOODS

Continued from Page 3

Building 18. There are 156 hoods on the upper five floors alone. Almost all chemistry experiments take place in the hoods, which are packed with gyrating test tubes, beakers filled with multicolored liquids and other chemistry equipment. Sliding glass door sashes open and close to provide access to the workspace.

What Amanti found was that on average, 67 hoods were left open at night and 88 were open during the daytime. Of the open hoods, only five were in use at night and 48 were in use during the day. In fact, 45 percent of the entire electrical load in the building was due to fume hood fans, including ones left open when not in use.

Timothy Swager

The hoods are attached to a building-wide ventilation system that sucks away chemical fumes. When a sash is closed, a valve attached to the hood decreases the flow of air to the hood. When enough sashes are shut, the fan assigned to those hoods also slows down into a more energy-efficient mode.

"If the unused hoods were closed, the consumption of electricity, steam and chilled water would be decreased by approximately 17 percent and save the Institute $350,000 a year in utility costs," Amanti wrote in his 2006 thesis.

Habit-forming

Amanti's research came to the attention of Timothy M. Swager, chemistry department head, who shared the report at a department retreat. He also brought it to the attention of Jim Doughty, environmental health and safety coordinator for the School of Science. With the help of Facilities, the Environment, Health and Safety (EHS) Office, and the Laboratory for Energy and the Environment (LFEE), Doughty prepared a presentation, made in November 2006, to raise awareness of energy use tied to fume hoods.

Graduate student Elsa Olivetti of materials science and engineering, one of the coordinators of student energy initiatives on campus, was a member of the team, which also included Doughty; Amanda Graham, LFEE education manager; Steven M. Lanou, deputy director of environmental sustainability for the Environmental Programs Office; Peter L. Cooper, manager of sustainability engineering and utility planning for the Department of Facilities; Richard J. Wilk, administrative officer for the Department of Chemistry; and Pamela Greenley of the EHS Office.

Olivetti, chemistry department representatives and an outside contractor did their own calculations. They found there are 1,200 hoods on campus, around half of which have variable air volume. Judicious use of these hoods could result in a savings of up to $1 million a year.

Chemistry graduate student Ryan Altman said that prior to the public education campaign, fume hood energy use "wasn't something we even thought about. It wasn't a consideration." Now Altman, an EHS lab representative on the research team of Stephen L. Buchwald, the Camille Dreyfus Professor of Chemistry, is conscientious about his own use of the equipment. He tries to ensure that his entire lab is aware of the effort, through e-mails, signs and word of mouth.

"The biggest challenge is to get it to be on people's minds to shut their hoods when they go home at night, so we are trying to bombard them with the message from all different venues," Doughty said. He is collecting data on current fume hood energy use to show how it is changing over time.

Altman said that when he tells labmates about the problem, people are concerned. "When I tell them the statistics and facts, they're surprised and shocked. They're willing to do something to help. It's just a matter of instilling good habits to replace the bad ones," he said.

Improving energy efficiency through fume hood use is one of the many campus opportunities being explored by the MIT Energy Initiative's Campus Energy Task Force to reduce MIT's energy and carbon footprint.

Prof sees vibrant life for environmental studies

Professor David H. Marks, the first director of the Laboratory for Energy and the Environment (LFEE), is stepping down as co-director in July to pursue duties in the Department of Civil and Environmental Engineering and the Engineering Systems Division and continue to work on projects at the LFEE, formed in 2001. He spoke recently with Teresa Hill, of LFEE, on his experiences and his vision for sustainability studies at MIT.

PHOTO / **DONNA COVENEY**

David H. Marks

Q: What now supports sustainability studies at MIT?

A: With the evolution of the MIT Energy Initiative, energy studies are really taking off. We are now working to combine the less-energy-specific environmental projects with other activities to create a new, closely related organization for sustainability studies at MIT.

Q: Can you give us some background on efforts to establish a focus on cross-disciplinary environmental studies at the Institute level?

A: Environmental studies have been really coming together since the mid-1990s. The MIT Environmental Council was formed in the early 1990s and has met monthly since then.

The Institute brought in about $5 million over eight years from the Kann Rasmussen Foundation, which was used to support the Chlorine Study, the Energy Futures project, and the group that initiated the Alliance for Global Sustainability. In 1997, a grant from Ford made it possible to set up the Center for Environmental Initiatives.

Q: Does support for research also stimulate educational initiatives?

A: Through the initial Program in Environmental Engineering Education and Research, begun in the early 1990s, we worked hard to bring environmental awareness into the education of not only future environmental professionals but also all MIT students. Environmental literacy is important in every field. Also in 1997, the Martin Family Foundation established a doctoral fellowship program that supports around 25 one-semester fellowships. Between 1997 and 2006, the Wallenberg Foundation brought a wonderful group of Swedish postdocs to LFEE, to the benefit of everyone involved.

Q: What has been the level of investment in these activities?

A: Between 1992 and the present, we've raised $60 to $70 million in support of this work, all from private, industrial and foundation sources. With those funds we've supported faculty and student research, workshops and larger-scale meetings, communications—the entire array of activities required for a vibrant academic sector.

Q: Is interdisciplinary study of large-scale systems, such as the environment, a tough sell in an atmosphere emphasizing highly specialized and focused research?

A: The objective of interdisciplinary studies is to encourage the best possible research at the personal, disciplinary level of each investigator while fitting that work into the context of wider concerns that will be, of necessity, interdisciplinary. Not an easy trick, but I think we've done it suc-

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INFLUENZA

Continued from Page 1

came out June 4.

"We can't reduce to zero the chance that any of us will get the next bad flu. But there is compelling evidence that we can reduce the chances of our loved ones and ourselves getting the flu by a significant factor," said Larson, the Mitsui Professor of Engineering Systems and of civil and environmental engineering.

The H5N1 strain of flu, also known as avian flu, has infected birds throughout Asia and Europe, with a few known cases among humans. So far, the disease has not mutated to a form where it can jump easily between humans, but if that happens, the disease could spread around the world in days or weeks.

Larson's research team decided to model the progress of such an epidemic, taking a unique approach. Unlike most existing models, theirs takes into account people's different levels of social activity and susceptibility to the flu.

One of the report's key findings is that "social distancing"—reducing the frequency and intensity of person-to-person contact—could be an effective way to limit the spread of the disease.

Influenza is normally spread by person-to-person contact, so people who have more contact with others have a higher risk of catching the disease and then spreading it. However, most existing influenza models assume that all individuals within a population have the same degree of social contact. They also assume that social behavior does not change over the course of the epidemic.

Such models "didn't do justice to the complexity of the problem," Larson says.

He and his team developed a dynamic mathematical model that assumes a heterogeneous population with different levels of flu susceptibility and social contact. They then used the model to compare different scenarios: one where people maintained their social interactions as the flu spread, and others where they did not.

Their results showed that reducing the social contacts of people who normally have the most interactions could dramatically slow early growth of the disease. Most of the disease is spread by a minority of the population—the people with the most daily human contacts. Focusing on these individuals and reducing their daily contacts can change an exponentially exploding disease into one that dies out over time.

A key feature of the model deals with "R_0," a popular parameter of most other models, which is defined as the average number of new infections caused by a recently infected person in a population of susceptible individuals. An R_0 greater than 1.0 leads to exponential increase in the number of cases.

However, because R_0 is an average over the entire population, it does not reflect that fact that only a fraction of the population is responsible for the majority of new infections. Averages can be misleading—for example, when a billionaire enters any establishment, on average everyone there instantly becomes at least a millionaire.

The researchers believe that splitting R_0 into components, one for each level of activity or propensity to become infected, provides better policy guidance. In Larson's model, every population component is assigned different values for R_0, depending on factors such as that component's frequency of human contact and susceptibility to infection if exposed to the flu. Each of these factors can be at least partially controlled, suggesting that our individual and collective behaviors in response to the flu can greatly influence the number infected.

The researchers also found a striking difference in death toll depending on how early in the epidemic social distancing measures went into effect. For example, in a hypothetical population of 100,000 susceptible individuals, 12,000 fewer people were infected if social distancing steps were taken on day 30 of an outbreak instead of day 33. But intervention on the first day is best.

This finding is consistent with historical research reported in April by two research teams, one led by the National Institute of Allergy and Infectious Diseases and one from the United Kingdom, that demonstrated that those communities in 1918 that took aggressive social distancing actions early usually suffered less from the Spanish Flu than those who waited and debated.

The findings strongly suggest that influenza emergency plans should include measures to reduce social contact, such as encouraging people to work from home and avoid large gatherings, Larson said. This is especially important because it generally takes at least six months from the time of an outbreak to develop an effective vaccine. Those who must continue to work, such as doctors and other health care workers, should be the first to receive any available avian flu vaccine that might be developed, he said.

Larson says that large institutions like MIT, as well as state and local governments, should have emergency plans ready to put into action as soon as the first case of human-to-human H5N1 influenza is reported.

"We need to be aggressive. We need to be assertive. Don't dilly-dally, don't have a lot of political debate and foot-dragging," he said. "If people do take it seriously, the number of deaths could be greatly reduced. A key is to start taking aggressive steps well before the flu is at your doorstep."

Larson became interested in modeling influenza after reading a book about the 1918 outbreak, which killed between 50 and 100 million people around the world. He had never heard much about the epidemic, which in the United States claimed more victims than World War I.

"Reading the history of it, I became fascinated," he said. "The wonderful thing about being in OR (operations research) is you can go into any problem you think is important and relevant and really contribute to it."

Larson said he hopes that other operations researchers will take up influenza research and develop more detailed models.

"Any mathematical model of the disease is bound to be incorrect," Larson wrote in the Operations Research paper. "But we are not seeking multidecimal accuracy but rather insights on how to limit the spread of the disease. We firmly believe that fresh eyes from the OR community can play a significant role in this quest."

Other members of the MIT research team include undergraduate Kelley Bailey; Stan Finkelstein, senior research scientist in the Engineering Systems Division; Karima Robert Nigmatulina, graduate student in the Operations Research Center; Robert Rubin, faculty member at the Harvard-MIT Division of Health Sciences and Technology; and Katsunobu Sasanuma, a graduate student in the Engineering Systems Division and the Operations Research Center.

The research was funded in part by an IBM Faculty Research Award.

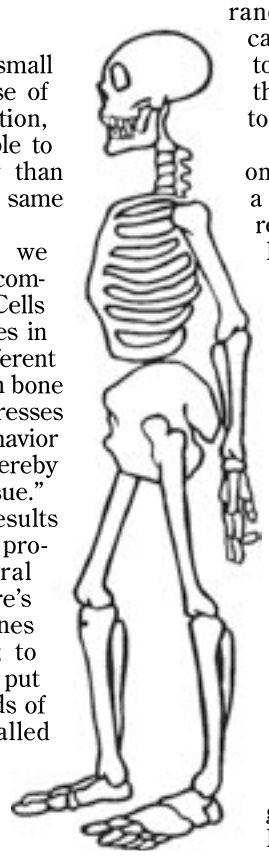
BONES

Continued from Page 7

nonuniform at extremely small length scales over the course of millions of years of evolution, has designed bone to be able to absorb much more energy than a uniform material with the same properties."

"I was surprised that we observed such beautiful and complex patterns," Ortiz said. "Cells sense and respond to stresses in their environment. Since different local mechanical properties in bone change the magnitude of stresses around the cell, the cells' behavior can be altered in response, thereby affecting the health of the tissue."

In addition, the team's results could lead to new ways of producing improved structural composites that mimic nature's clever design that allows bones to resist sudden fractures; to "fail gracefully," as Suresh put it. For example, certain kinds of a new class of materials called nanocomposites are composed of a polymer or metallic matrix filled with nanoscale particles



randomly distributed or periodically spaced. "There may be ways to disperse particles nonuniformly that may lead to improved material toughness," Suresh said.

Ortiz and Suresh's colleagues on the work are Kuangshin Tai, a recent MIT Ph.D. graduate; research scientist Ming Dao of the Department of Materials Science and Engineering; and Ahmet Palazoglu of the University of California at Davis.

Ortiz is currently looking at stem-cell-based, tissue-engineered bone in collaboration with Dan Gazit at the Hebrew University of Jerusalem to see how similar it is to native bone. She is also applying the new analysis and related imaging and simulation techniques to different types of mineralized biological materials such as armored scales from ancient fish and seashells.

This work was supported by the Whitaker Foundation, the U.S. Army Research Office, the MIT Institute for Soldier Nanotechnologies and the National Institutes of Health.

LFEE

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cessfully, for example, in our studies of air quality issues in Mexico City; electricity futures for Shandong Province, China; sustainable building designs for China; and wells-to-wheels analyses of alternative vehicle technologies and fuels.

Q: What's your vision for sustainability research and education at MIT?

A: MIT's new focus on energy has given legitimacy to the idea of sustainable systems. Twenty years from now I expect to see, first, a very high level of environmental literacy among MIT graduates as they go forth to work in the world's industries, governments and universities. Second, MIT will be producing a much larger core of professionals in areas directly bearing on sustainability—now it's about 5 percent of our graduates. Third, and following from the first two, the products of MIT research and education will exert a much greater influence on sustainability-related national and international policy and in the training of future generations.

Right now, Professor Maria Zuber, head of the Department of Earth, Atmospheric and Planetary Sciences, is chairing a committee thinking about a sustainability presence at MIT that will form a necessary complement to the MIT Energy Initiative. The group is exploring institutional options that map best onto MIT's strengths and objectives. We're doing terrific things here—people need to know.

A longer version of this article appeared in the LFEE newsletter, Energy and Environment.

PHOTO / **DONNA COVENEY**

Maria Zuber

CLASSIFIED ADS

Tech Talk runs classified ads in the first issue of each month. Members of the MIT community may submit one classified ad per month. Ads should be 30 words maximum; they will be edited. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Wednesday the week before publication.

FOR SALE

Trek hybrid bicycle w/ kickstand, light & weatherproof cover. Navigator 200, 16.5. V. good cond. Cost $350, will sell for $150. Sue Corkin, 617-548-4482, corkin@mit.edu.

Spring sale, fire wood: 1 cord $235, 1/2 cord $125, 1/4 cord $70. All hard woods, split & ready to go. Call Joe at 617-823-9930.

Spotless stainless steel electric "Incinolet" toilet, rarely used. Needs no water or wastepipe. Used in RVs, boats, garages. Original cost $1,500. Asking $500. Call Jack at 781-646-5361.

Herman Miller Levity Tower Workstation. Originally $2,500, selling for $500. Contact MIT Student Furniture Exchange at fx@mit.edu or x3-4293.

VEHICLES

2004 Yellow Nissan Xterra, 29,500 miles, 4WD, 3.3Liter 6-cylinder, automatic, exc. cond., priced to sell, $16,500. Contact Brad at Bjacobs.bl@gmail.com or 717-795-8514.

1998 Ford Explorer Sport, 4WD, V6, 5-speed manual, 82,000 miles, exc. cond., oil changed every 3,000 miles. Detailed maintenance log, invoices for all new parts. Original owner. $5,000. Call 781-444-0424.

1996 VW Cabrio Conv., $3,200, 154K, manual, black w/tan int., A/C, AM/FM & 10-CD, Lojack incl., runs great, small amount of cosmetic rust (front ext.) E-mail cara_j@mit.edu.

VACATION

Northeast Kingdom VT. "Hilltop Cabin/House" 46 acres,surrounded by 10,000 acres state wildlife land. 2000+ ft. above sea level, fully-equipped views,hiking,fishing. Beaches & boating nearby. $450/week, call Joe 1-617-823-9930.

Truro - Two vacation rentals: 6BR, 4BA home, sleeps 14, great for large groups, office retreats, seminars. Various dates available, $4,000/week. Also, 2BR, 1BA home, $1,200/week, various dates. Call John Foley at 508-246-2689.

Summer rental on the Cape. 3BR, 2BA, deck, outside shower, nice yard, quiet neighborhood, great for walking, bike riding w/kids. Rent by the week or long weekends. $750/wk. Contact isabell@mit.edu.

HOUSING

Acton, MA - 2BR condo for sale $214,900, two updated full baths, updated kitchen, private patio, extra storage. Two parking spaces, wonderful schools, great commuter location. Call Ann Shaw at 978-273-1963.

Saugus - Sunny 1BR, first floor, off-street parking, washer/dryer h/u in basement, on bus line (#430) to Malden Station, $750/mo, no utilities. Avail. June 1. Call 781-883-8130.

No. Andover, seller to pay $1,500 towards condo fees or closing costs. Fabulous young 2 BR, 2 BA top floor unit; frml LR w/ tray ceiling; CA, W/D, wooded views, balcony, prvt storage; great location; clubhouse, fitness & more. $318,000. Call Silvija at 978-302-0477.

Everett - $210,000, 2BR condo in rehab'd brick school building. 5 miles from MIT on bus line. $279 condo fee inc. heat/hw. 1.5BA, washer & dryer. Call 781-883-7640.

3BR West Cambridge, 1.5 BA, 2 floors, fireplace, hdwd floors, $1900. 1BR Inman Sq., 1st floor, new kitch. & bath, hdwd floors & nice back yard, $1000. 2BR Inman Sq., 2nd floor, new bath. & kitch., v. nice cond., backyard, $1400. Call 781-589-0178.

MISCELLANEOUS

4/24, a pair of light-brown/beige-rimmed eyeglasses was found at the Stata Center garage, Level P1, Row G, near the elevator. Please claim them at Campus Police.

Writing papers over the summer? MIT-based editor w/ extensive experience can correct grammar, improve style & enhance the clarityof your document. Reasonable rates. Fast turn-around time. E-mail wordplayer06@yahoo.com.

PHOTO COURTESY / **WTP**

Christina Gillis, right, was a WTP student in mechanical engineering in summer 2006.

PHOTO COURTESY / **WTP**

Incoming freshman Kristen Whaley, left, and Andrea Wang work on their final WTP projects.

WTP

Continued from Page 1

these young women had trouble imagining themselves as students at MIT—let alone graduating with bachelor's degrees from the School of Engineering.

For Slutsky, the worry was that she wouldn't be capable of tackling the notoriously rigorous freshman curriculum or adjusting to a new "environment of intense intellectual expectations." Fortunately, though, before she had even decided which universities to apply to, "WTP made attending MIT a realistic option" for her by providing an early glimpse of what it's really like to be a student at the Institute.

"WTP was my first experience within a challenging, college setting," she said when asked how the program helped prepare her for the success she ultimately achieved as a nuclear science and engineering major. "The reward came from meeting the challenges placed before me. Throughout the month, I faced frustrations and insecurities so far beyond what I faced in high school. At the conclusion of the month, I was able to feel like I pushed my boundaries, that I took myself outside of my intellectual, as well as social, comfort zones and was made the stronger, the more confident, for it."

That feeling of personal empowerment that comes from exceeding one's own expectations is exactly what the program strives to promote among the students who participate. When WTP was proposed in 2001 by then-senior Doug Ricket (M.Eng. 2002), its goal was to encourage high school-age women to envision themselves in careers that are typically dominated by men.

Discouraged by the "low number of female students and instructors" in the electrical engineering and computer science department at MIT, Ricket started WTP. He hired a team of MIT women, including graduate and undergraduate students, to help combat the erroneous but prevalent assumption many adolescent girls hold that they won't succeed as engineers. The students served not only as instructors and residential tutors for the electrical engineering, computer science and math classes that were offered that first summer but also as role models for teenagers who might be wondering whether or not they would fit in at the Institute.

As Schor attests with a smile, the plan worked for her: "WTP gave me comfort in accepting my admission here, because my main hesitation was that people would be 'too nerdy,' but the residential tutors I had were all great and mostly normal!" In fact, she confesses that it was a WTP instructor who inspired her to major in mechanical engineering as an undergraduate: "She told me that you get to build things in all of your MechE classes."

But over and above the insider knowledge she acquired from the program's staff, Schor says the best part of WTP was the camaraderie that developed among the participants themselves. "It was a great experience to work with people with the same academic desires and abilities as me, and to feed off of each other. Every group member was equally capable of generating new and creative solutions to problems and had the motivation to do so, which was different than my high school experience."

No doubt this enthusiasm for teamwork will serve her well in Tarragona, Spain, where she has taken a job with the Dow Chemical Corporation that starts in the fall—just after she spends one more summer in WTP, this time as a residential tutor for the program's new mechanical engineering track.

Although Slutsky will not be joining her WTP classmate Schor on staff (she'll be busy preparing to attend Georgetown University's master's program in health physics), she clearly believes in the benefits of the program: "I would recommend WTP to any woman who wants to spend a month evaluating her personal and intellectual comfort zones, and then challenging herself against high-reaching goals and aspirations that she had previously dismissed as unattainable. WTP is a woman's opportunity to develop, fine-tune and cultivate an invaluable confidence in herself."

To find out more about WTP, please go to wtp.mit.edu.

International advisory group will assess, support MIT projects

MIT has established a new International Advisory Committee (IAC) to assess and support MIT's international activities, Provost L. Rafael Reif announced.

The IAC will help to ensure that MIT's growing international activities "continue to advance our core missions of teaching, research and service," Reif wrote in an e-mail to the MIT faculty.

Reif charged the committee with designing a strategy to target countries and regions where MIT should focus its international efforts and identifying cross-cutting topics and themes. The IAC will also advise Reif and President Susan Hockfield on how to ensure that all international initiatives and partnerships proposed by the MIT faculty serve the Institute's core mission.

"If we are to remain a leader in education and research in a globalizing world, we must maintain a pipeline to the world's best students, wherever they may reside. We must increase opportunities for our students to have diverse international educational experiences. We must engage actively in the world's most exciting research fields, wherever they may be found," Reif wrote. "It is increasingly clear that to accomplish all of this will require a more clearly articulated international strategy."

"Since the early 1990s, our society has come to realize the critical importance of international engagement to long-term competitiveness and global security. The establishment of the IAC reflects the fact that MIT itself, over the same period, has become in many critical respects a global university," said Associate Provost Philip S. Khoury, one of the co-chairs of the new committee.

Also co-chairing the committee is Claude R. Canizares, vice president for research and associate provost. Committee members are Professors Suzanne Berger (School of Humanities, Arts, and Social Sciences), Diane E. Davis (School of Architecture and Planning), Steven D. Eppinger (MIT Sloan), Daniel Roos (School of Engineering), Robert J. Silbey (School of Science), George C. Verghese (School of Engineering) and Victor W. Zue (School of Engineering).

Ex officio members are Chancellor Phillip L. Clay, Dean for Undergraduate Education Daniel E. Hastings, Vice President for Resource Development Jeffrey L. Newton and incoming Chair of the Faculty Bish Sanyal.

The committee will report regularly to Hockfield, Reif and the Faculty Policy Committee, and will report from time to time to the MIT faculty on its progress.

Ford-MIT Alliance is renewed

The Ford-MIT Alliance has been renewed for a third five-year term ($15 million total) beginning January 2008. The alliance reports to Chancellor Phillip L. Clay, with Professor John Heywood, faculty director, Simon Pitts, alliance director for Ford, and Elaine Savage, MIT's executive director, managing a research portfolio of more than 20 projects including active safety, energy, powertrain and other areas. The alliance interacts with a visiting executive committee three times annually.

Phillip L. Clay

RAMIREZ

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substrate, enables the development of "smart" products in which the computational ability of microelectronics is augmented with microsensors and microactuators.

Before joining the faculty at Yale in 2003, Ramirez worked as a member of the technical staff at Bell Labs' Lucent Technologies in Murray Hill, N.J., for four years. At Bell Labs, she developed an advanced solder, now being commercialized by Adhera Technologies, that can bond directly to glass and ceramics.

MIT's Technology Review, when naming Ramirez one of the world's 100 Top Young Innovators (TR100) in 2003, called her discovery a "holy grail" of metallurgy: a universal solder that can bond metals to ceramics, glass, diamonds and particularly the oxide materials used in semiconductor fabrication. Researchers have been seeking this kind of compound because existing solders have failed in electronic and optical devices.

"I've brought excitement to unsexy materials like solder," Ramirez said.

PHOTO / **DONNA COVENEY**

Gary Cunha of Facilities tightens cables that hold up the sail, which protects faculty from the sun and rain at Commencement.

COMMENCEMENT

Continued from Page 1

broader public attention and to strengthen national policy on science, engineering and education. He chaired the President's Advisory Committee on the Redesign of the Space Station and serves on the President's Committee of Advisors on Science and Technology. He chaired the U.S. Department of Energy Task Force on the Future of Science Programs at the DOE, was vice chair of the Council on Competitiveness for eight years and is a past chair of the Association of American Universities.

Commencement speakers

Hockfield will deliver the traditional charge to the graduates. Other Commencement speakers will include Eric Weese, president of the Graduate Student Council, and Susan J. Shin, president of the Class of 2007.

The Rev. Johanna Kiefner, MIT Lutheran chaplain, will deliver the invocation.

Hockfield will also present the following degrees: bachelor of science, bachelor of science/master of science, bachelor of science/master of engineering and advanced degrees in the School of Science, the Woods Hole Oceanographic Institution and the Whitaker College of Health Sciences and Technology.

Provost L. Rafael Reif will award advanced degrees in the Schools of Architecture and Planning; Engineering; Humanities, Arts, and Social Sciences; and the MIT Sloan School of Management.

Admission for ticketed guests begins at 7:30 a.m. Graduates will robe and assemble on the first floor of Johnson Athletic Center beginning at 7:30 a.m. Between 8 a.m. and the beginning of the academic procession, families and guests may enjoy a live view of the graduates robing and assembling via television feed to Killian Court.

Following the exercises, a reception will be held for graduates and their guests on the West Campus Plaza.

Time and venue

A special hooding ceremony for Ph.D. and Sc.D. recipients will take place on Thursday, June 7, at 11 a.m. in Rockwell Cage. Admission for guests begins at 10 a.m.; tickets are not required. Chancellor Phillip L. Clay will preside.

Commencement exercises require complex and precise planning and the comings and goings of guests must be free of obstruction or interference.

In accordance with this policy, Killian Court will only be accessible to members of the graduating class, faculty, stage assembly and ticket-holders. Access to Johnson Athetics Center will also be limited. In both Killian Court and Johnson, visitors will be required to pass through security checkpoints.

For more specific details, please see the Statement by the Chancellor's Committee on Protocol for Demonstrations at Commencement and Other Academic Exercises. Questions regarding locations for demonstrations may be directed to Gayle Gallagher, executive officer for Commencement, at gayle@mit.edu.

For those unable to get into Killian Court, a live online webcast of the Commencement exercises will be available on and after June 8.

Parking

For guests attending the Commencement exercises on Friday, complimentary parking will be available in the Albany Street Garage on Albany Street.

Members of the MIT community who normally park in the Albany Street Garage should review the campus changes that are in effect during Commencement time.

Paid parking will also be available in the Marriott Hotel Parking Garage (entrance at the corner of Ames Street and Broadway) and the Technology Square Parking Garage (entrance on Broadway) on Thursday and Friday.

In the event the Commencement exercises in Killian Court are canceled due to severe weather conditions, the speeches will be held in Rockwell Cage for the stage assembly and graduates only. Guests may view the speeches on closed-circuit television in viewing locations throughout the campus.

Complete Commencement information is available at web.mit.edu/commencement/2007/.

PHOTO / **DONNA COVENEY**

Spring forward

Rhododendrons bloomed near the President's Courtyard, welcoming the Institute community to Commencement.