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TechTalk
SERVING THE MIT COMMUNITY

Ethanol study shows biofuel benefits

Nancy Stauffer
MIT Laboratory for Energy and the Environment

Controversy over the benefits of using corn-based ethanol in vehicles has been fueled by studies showing that converting corn into ethanol may use more fossil energy than the energy contained in the ethanol produced. Now a new MIT analysis shows that the energy balance is actually so close that several factors can easily change whether ethanol ends up a net energy winner or loser.

Regardless of the energy balance, replacing gasoline with corn-based ethanol does significantly reduce oil consumption because the biomass production and conversion process requires little petroleum. And further MIT analyses show that making ethanol from cellulosic sources such as switchgrass has far greater potential to reduce fossil energy use and greenhouse gas emissions.

The Bush administration is pushing the use of ethanol as a domestically available, nonpetroleum alternative to gasoline. But most U.S. ethanol is now made from corn, and growing corn and converting the kernels into ethanol consume a lot of energy—comparable to what is contained in the ethanol produced. Making ethanol from corn stalks, other agricultural wastes and wild grasses would consume less energy, but the technology for converting them to ethanol may not be economically viable

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PHOTO / **DONNA COVENEY**

MIT professor Jefferson Tester headed a panel studying the potential of geothermal energy.

Geothermal energy may help meet U.S. electricity demand

A comprehensive new MIT-led study of the potential for geothermal energy within the United States has found that mining the huge amounts of heat that reside as stored thermal energy in the Earth's hard rock crust could supply a substantial portion of the electricity the United States will need in the future, probably at competitive prices and with minimal environmental impact.

An 18-member panel led by MIT prepared the 400-plus page study, titled "The Future of Geothermal Energy." Sponsored by the U.S. Department of Energy, it is the first study in some 30 years to take a new look at geothermal, an energy resource that has been largely ignored.

The goal of the study was to assess the feasibility, potential environmental impacts and economic viability of using enhanced geothermal system (EGS) technology to greatly increase the fraction of the U.S. geothermal resource that could be recovered commercially.

Although geothermal energy is produced commercially today and the United States is the world's biggest producer, existing U.S. plants have focused on the high-grade geothermal systems primarily located in isolated regions of the west. This new study takes a more ambitious look at this resource and evaluates its potential for

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Jeffrey L. Newton is appointed vice president for resource development

Jeffrey L. Newton

Jeffrey L. Newton, currently dean for resource development and alumni relations at Harvard Medical School, will join MIT as vice president for resource development on March 19.

President Susan Hockfield announced Newton's appointment in an e-mail letter to the MIT community on Jan. 17.

In her letter, Hockfield noted that MIT's strength in teaching and research depends critically on private support, and she characterized Newton's appointment to the leadership role in resource development as one that "positions us to maintain the strong momentum established during the Institute's recently completed campaign and to move our fundraising efforts to even greater levels of achievement."

For his part, Newton said, "I am enormously excited to join MIT. The Institute's development staff has a well-deserved reputation for excellence, and it is a privilege to have the opportunity to work with them in support of programs of teaching and research that have an impact around the world."

Newton has led fundraising activities at Harvard Medical School since 2003. His accomplishments there have included reorganizing the development staff to maximize return on investment and preparing the school to participate in a projected university-wide campaign. His efforts to pro-

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Pamela Dumas Serfes is new executive director of news and communications

Pamela Dumas Serfes

Pamela Dumas Serfes, currently interim director of the MIT News Office, has been appointed to a newly established leadership position, executive director of news and communications, effective Jan. 1.

Kirk D. Kolenbrander, vice president for Institute affairs and secretary of the Corporation, made the announcement in an e-mail on Thursday, Jan. 18.

Dumas Serfes brings to her new role "extensive prior experience in university communications and the deep knowledge of MIT she has gained during her years here, as well as enthusiasm and high professional standards," Kolenbrander wrote.

As executive director of news and communications, Dumas Serfes will "plan and coordinate the dissemination of MIT news to the campus, the media and the broader community. As one of the Institute's chief communications strategists, she will be charged with advancing proactive news and communications efforts to increase the visibility of MIT and its programs of teaching and research," Kolenbrander wrote.

Dumas Serfes said, "I am excited to work in tandem with my colleagues in the News Office and across campus to enhance public awareness of the Institute and increase understanding of the extraordinary work that goes on here."

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Ted Childs Jr. will give keynote talk at Martin Luther King Jr. breakfast

Ted Childs Jr., the former IBM vice president whom Fast Company called "the most effective diversity executive on the planet," will be the guest speaker at MIT's 33rd annual Martin Luther King Jr. breakfast to be held in Walker Memorial at 7:30 a.m. on Friday, Feb. 16.

The annual celebratory breakfast, organized by the Martin Luther King Jr. Planning Committee, features a keynote speaker, remarks by President Susan Hockfield, student speakers and music by the MIT Gospel Choir. Past keynote speakers have included Coretta Scott King, Tavis Smiley, Gwen Ifill and Donna Brazile.

A native of Springfield, Mass., Childs was responsible for IBM's worldwide workforce diversity programs and policies; he oversaw a campaign to increase the number of woman and minority executives at IBM during his tenure.

Between January 1996 and December 1999, the number of women executives at IBM soared from 185 to 508, and the number of minority executives increased from 117 in 1995 to 270 by the end of 1999.

"I'm intensely proud of that," Childs told Fast Company in June 2000.

Childs, 61, is currently principal of his own diversity consulting company. He has also served as executive assistant to Benjamin L. Hooks, executive director of the NAACP. He served on the New York State Governor's Advisory Council on Child Care and co-chaired the Jewish Women's Work Family Advisory Board.

During his time at IBM, Childs took an approach of "constructive disruption," organizing task forces to look at IBM from the perspective of different groups—African-Americans, Asians, disabled people, gays and lesbians, Hispanics, Native Americans, white males and women. That work focused on developing employee talent and strengthening recruiting and mentoring strategies.

Ted Childs Jr.

Childs approaches diversity as a requirement for global competitiveness. "We've moved beyond the moral imperative to the strategic imperative," he told Fast Company. "What I want most is what's hardest to get: for business to see the link between diversity and competitiveness. Because if we don't understand that, we're not going to win."

Childs, who grew up in Springfield, Mass., is a graduate of West Virginia State University and is now a member of the university's board of directors. He is a member of the Executive Leadership Council, the Conference Board's Work Force Diversity Council, and the NAACP Legal Defense and Educational Fund Board of Directors.

He has been highly involved in child-care and aging issues: In 1995, he served as a delegate to the 1995 White House Conference on Aging, and in 1997, he was appointed an advisor to the U.S. Treasury Secretary's Working Group on Child Care.

In 1998, the National Association of Child Care Resource and Referral Agencies presented him with its Lifetime Achievement Award. In 2003, the Human Rights Campaign presented Childs and IBM with its Corporate Leadership Award, and the Thurgood Marshall Scholarship Fund awarded Childs its Alumni Leadership Award.

Childs was installed as a fellow in the National Academy of Human Resources in 2001, and he has received honorary doctorates from Pace University, West Virginia State University and Our Lady of the Elms College. He holds life membership in the NAACP, the National Council of Negro Women, the Omega Psi Phi fraternity, the National Organization of Women, the Sierra Club and the Bass Anglers Sportsmen Society.

Topics of Childs' talk will include the link between diversity and global competitiveness, the business case for diversity, the promise of diversity and changes in the American marketplace, and success in the global workplace.

For more information please go to: http://web.mit.edu/mlking/www/event_index.html.

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mote the school's strength in basic science to attract the support of non-alumni and institutions have led to record levels of support.

Newton, who holds degrees in history from Kenyon College and Brown University, began his career in resource development at The Johns Hopkins University, where he was associate director for foundation and corporate relations from 1989 to 1993. During a decade working at the University of Miami, he served as executive director of corporation and foundation relations, assistant vice president for development and alumni relations, and assistant vice president for medical development and alumni affairs at the university's school of medicine.

Throughout his career in development, Newton has "demonstrated superb abilities in crafting development strategy, appealing to principal donors, training and deploying a strong staff, and working as a member of institutional leadership teams. He brings an exceptional range of skills that will enable him to lead our outstanding development staff to even greater levels of accomplishment," Hockfield wrote.

In her letter, Hockfield thanked Stephen A. Dare for his "exemplary service" as interim vice president for resource development. "Under his leadership," she wrote, "our remarkable Resource Development team has continued to make important progress on new initiatives in areas including cancer, energy, and student life and learning throughout this period of transition, serving MIT with extraordinary enthusiasm and dedication."

Hockfield also thanked the advisory group of faculty and staff who provided "essential input to the search process"—Professors Sallie (Penny) Chisholm, Charles L. Cooney, Tyler E. Jacks, Marc A. Kastner and Philip S. Khoury, and staff members Monica L. Ellis and Elizabeth M. Ogar.

No Tech Talk next week

There will be no Tech Talk on Wednesday, Jan. 31. The next Tech Talk will be published on Feb. 7. For ongoing MIT news updates, please go to the News Office web site, web.mit.edu/newsoffice/.

DUMAS SERFES

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She will also "continue to oversee the activities of the News Office while working to coordinate communications activities across campus to ensure a common vision and a team approach in presenting MIT news and messages to diverse constituencies and audiences. She will continue to convene both the Communications Operating Group and the Information Group, which bring together stakeholders in communications roles from throughout the Institute," Kolenbrander wrote.

Dumas Serfes joined MIT in May 2003 as director of communications and donor relations in Resource Development. Since December 2005, she has served as interim director of the MIT News Office, while maintaining her involvement in developing communications strategy for Resource Development.

Prior to joining MIT, she served for 10 years as the communications director of Randolph-Macon Woman's College in Lynchburg, Va. Prior to that, she worked at her alma mater, the University of Maine, where she served in a number of roles, including director of marketing for enrollment management, assistant dean of students and director of new student programs. She was instrumental in developing the university's first women's center and was named co-chair of U. Maine's Council on Women. Dumas Serfes is a native of Bangor, Maine.

Dumas Serfes' "successful leadership of the News Office, emphasizing an integrated approach to the promotion of major institutional initiatives, has reflected a deep commitment to MIT and a consistent commitment to excellence in media relations," Kolenbrander wrote.

Tenants return to One Broadway

After receiving all necessary approvals from city and state officials, tenants began moving back into One Broadway on Jan. 12. They had been temporarily displaced by an electrical fire caused by a transformer explosion on Dec. 8. The building is now fully re-occupied.

MIT is grateful to the many members of the Cambridge community whose round-the-clock assistance allowed for a safe and quick return to the building.

For more information regarding One Broadway, please go to www.mitimco.org/onebroadway.html.

DIGITALK: WHERE IT'S AT

IS&T Community Forum

Information Services and Technology (IS&T) will host its annual community forum on key strategic initiatives on Tuesday, Feb. 27 from 1 to 2:30 p.m. in W20-306. This forum will give community members an opportunity to hear about IS&T's FY08 strategic and operational plans, ask questions, and provide input. Among the planned topics of discussion are recent organizational changes, including IS&T's role in providing academic computing services, IT governance, and the future of the MIT network, with an update on Voice Over Internet Protocol services. For more information, check the IS&T web site at web.mit.edu/ist/ later this month.

Grant Submissions via CoeusLite™

Grants.gov is dramatically changing the way research applications are submitted for federal support. Online submissions via the Grants.gov portal are replacing paper applications.

MIT's preferred mechanism for submission to Grants.gov is Coeus, a grants management system developed at MIT and used at more than 40 universities. The Office of Sponsored Programs (OSP), in collaboration with IS&T, is now providing training on CoeusLite, a web-based version of Coeus. Using CoeusLite, individuals can create proposals, route them for approval and ultimately submit them to any of 26 federal funding agencies via Grants.gov.

MIT has submitted almost 100 applications using Coeus during the Grants.gov ramp-up process, as sponsors convert to paperless submission standards. The next major submission, on Feb. 5, will be for NIH's funding mechanism, now a required Grants.gov application. To learn more, visit coeus.mit.edu.

Xgrid@MIT

The Laboratory for Nuclear Science (LNS) is using an Apple Xgrid cluster for high-energy and nuclear physics calculations. With Xgrid—a distributed computing architecture built into Mac OS X—LNS researchers can run computationally intense queries across multiple computers at once. Over the past year, LNS has harnessed the spare cycles of 30 PowerPC and Intel machines, including its own and some in the Department of Urban Studies and Planning. Since Xgrid is preinstalled on new Macintoshes, adding machines to the cluster is a cinch.

If you'd like to run your own queries on Xgrid@MIT or donate computer cycles, check out deltag5.lns.mit.edu/xgrid/. You can even download a Dashboard widget tachometer with real-time cluster stats.

New books at the Libraries

Now you can get up-to-date information by e-mail, RSS feed, or on the Libraries' web site about the newest books, music CDs and DVDs arriving at the MIT Libraries. New titles are posted weekly at libraries.mit.edu/help/rss/barton/ for more than 60 subjects, from "graphic novels and manga" to "nanoscience and nanotechnology." You can choose to subscribe to RSS feeds by subject or browse through subject areas on the web site. Links to catalog records in Barton, the Libraries online catalog, are provided for each title.

For humanities titles, also check out the Humanities Library's virtual browsery at libraries.mit.edu/browsery/. A new blog format lets you browse online for books in the "physical" browsery, link to book reviews, see other books by the same author and comment and discuss books with others in the MIT community.

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Graduate dean search committee formed

Chancellor Phillip L. Clay has announced the formation of the committee that will advise him in the search for a new dean for graduate students. The current dean, Isaac M. Colbert, is stepping down at the end of June.

Clay said, "Dean Colbert has been vigorous in leading our efforts to strengthen graduate student life. The next dean will be able to build on those accomplishments."

Phillip L. Clay

The Graduate Students Office plays a "critical role for graduate students. While departments play the central role in managing graduate education, the GSO manages the graduate commons—from housing and nondepartmental scholarships to counseling and international student support," Clay said.

The committee that will advise Clay on the search for a new dean will be chaired by Stephen C. Graves, the Abraham Siegel Professor of Management, and will also include Professors Diane E. Davis, Thomas J. Greytak, Roger G. Mark, Melissa Nobles and Christine Ortiz, as well as Elizabeth M. Hicks, executive director of Student Financial Services. Additionally, the Graduate Student Council will nominate a student member of the committee.

Clay noted that the office coordinates the activities of a number of offices across campus with respect to graduate students. The GSO itself plays an important role in recruitment and support of minority students and is the liaison with foundations and agencies that provide support to MIT for graduate students. The dean, who is a member of the Institute's Academic Council, manages the review of new programs and enforces relevant rules regarding graduate students.

MIT and the Graduate Student Office "look to the next dean to continue these roles and to work with faculty, students, departments and others even more closely to strengthen support for graduate students and to enhance graduate community," Clay said.

The new dean, who is expected to be a member of the faculty, will also participate in the recently launched Campaign for Students.

The advisory committee is expected to submit a short list of candidates in mid-April.

CEHS hosts gene-environment symposium

The MIT Center for Environmental Health Sciences (CEHS) will host a Gene-Environment Interaction Symposium featuring talks by MIT experts on Jan. 26 in the Stata Center (Room 32-141).

The symposium will run from 8:45 a.m. to 4 p.m., starting with remarks from Claude Canizares, vice president for research and associate provost.

Speakers include Eric Lander, director of the Broad Institute of MIT and Harvard, who will speak on genomics and human health, as well as Leona D. Samson, director of CEHS.

The afternoon portion features lectures on cell signaling networks and biological activity relationships by Assistant Professor Forest White of the Division of Biological Engineering and on infectious disease and responses to environmental exposures by David Schauer, professor of biological engineering and comparative medicine.

Associate Professor Bevin Engelward of Biological Engineering will speak on genetic and environmental causes of genomic rearrangements. Later, Professor Linda Griffith, director of the MIT Biotechnology Process Engineering Center, will speak on cell and tissue engineering for toxicology.

To register for the symposium please visit cehs.mit.edu/symposium/registration.pdf.

—Sasha Brown, News Office

Sengupta wins $4M breast cancer award

Shiladitya Sengupta, assistant professor of medicine at the Harvard-MIT Division of Health Sciences and Technology and Brigham and Women's Hospital, has won one of three 2006 Era of Hope Scholar Awards from the Department of Defense Breast Cancer Research Program.

Sengupta will receive $4.1 million in funding over five years.

The award recognizes scientists early in their careers "who have shown a strong potential for leadership in the breast cancer research community as well as a vision for the eradication of breast cancer, particularly through innovative projects and multi-institutional collaborations," according to the DOD.

Earlier this year Sengupta and his colleagues announced in the journal Nature their creation of an anticancer drug-delivery device dubbed the nanocell. This novel technology has the potential to eliminate the devastating systemic toxicity caused by chemotherapy by directing drugs to act only where they are needed.

The Era of Hope award will allow Sengupta to continue work on inventive solutions to breast cancer. It will also further the efforts of the HST-BWH Center for Biomedical Engineering, which is committed to using novel technologies to improve medical diagnostics and therapeutics, especially focusing on global health.

—Elizabeth Dougherty, Harvard-MIT Division of Health Sciences and Technology

Deborah Fitzgerald is named Kenan Sahin Dean of SHASS

Deborah K. Fitzgerald, professor of the history of technology in the Program in Science, Technology, and Society, has been appointed Kenan Sahin Dean of the School of Humanities, Arts and Social Sciences (SHASS).

Deborah K. Fitzgerald

Provost L. Rafael Reif made the announcement in an e-mail to the MIT community on Jan. 24. In his letter, he noted that Fitzgerald will continue to lead the 56-year-old School of Humanities, Arts and Social Sciences, having served "with distinction" as its interim dean since former Dean Philip S. Khoury was appointed associate provost in July 2006.

Fitzgerald said of her new role, "I am deeply honored to be asked to serve as dean of SHASS. It is a tremendous privilege to represent my colleagues in the school and to chart a course that both honors our scholarly traditions and embraces new ideas and practices in our disciplines and our school. I very much look forward to the challenges and opportunities ahead."

Fitzgerald's appointment will "continue a tradition of strong leadership in the school. I look forward to working with her to further strengthen our exceptional programs in the humanities, arts and social sciences," Reif wrote.

Reif described Fitzgerald as an "extraordinarily committed member of the school and MIT communities." She has chaired the Gender Equity Committee in the school and has been involved with a variety of Institute-wide committees, including those on academic performance, discipline and graduate school policy. As a member of the Task Force on the Educational Commons, she chaired the subcommittee that developed the recommendations for changes to the HASS requirement that appeared in the task force's recent report.

A leading historian of American agriculture, Fitzgerald is the author of "Every Farm a Factory: The Industrial Ideal in American Agriculture" (2003). Educated at Iowa State University and the University of Pennsylvania, she was on the faculty in the history of science at Harvard University before coming to MIT in 1988. From 1996 to 2001, she chaired the Ph.D. program in history, anthropology and science, technology and society, which is administered by the Program in Science, Technology and Society jointly with the history faculty and the anthropology program. Before her appointment as interim dean, she had served as associate dean of SHASS since April 2005.

Reif also praised the "careful search process," chaired by Pauline R. Maier, the William R. Kenan Jr. Professor of History, and including faculty representation from across the school. He thanked Maier and her colleagues on the advisory committee for their service: Professors Stephen Ansolabehere, Jonathan Gruber, Sally Haslanger, Diana Henderson, James Howe, Henry Jenkins III, Helen Elaine Lee, Richard K. Lester, David A. Mindell, Janet Sonenberg, Donca Steriade and Jing Wang.

Science writer receives physics prize

Marcia Bartusiak, a visiting professor in MIT's graduate program in science writing, joins venerable physicists in receiving the American Institute of Physics' Gemant Award. The Gemant Award annually recognizes the accomplishments of a person who has made significant contributions to cultural, artistic or humanistic dimensions of physics.

Bartusiak is the author of numerous popular books on astronomy and cosmology, including "Einstein's Unfinished Symphony," "Thursday's Universe," "Through a Universe Darkly" and most recently, "Archives of the Universe."

The citation for her award reads, "The Andrew W. Gemant Award is presented to Marcia Bartusiak for a body of work that has won high praise from critics, scientists and general audiences alike. Her books have been widely read, translated into four languages and have been especially successful in transmitting physics and astronomy to the public. Her reputation for detail and accuracy coupled with her clear writing and thorough understanding of the science and personalities behind the topic has made her an eloquent spokesman for what is important in science."

Bartusiak received the 2006 Gemant award on Sunday, Jan. 7, at this year's American Association of Physics Teachers and American Astronomical Association joint meeting. In addition to receiving a $5,000 cash award, Bartusiak will also designate an academic institution to receive a grant of $3,000 to further the public communication of physics.

Other members of the MIT faculty who have received the prize include the late Institute Professor Emeritus Philip Morrison and Professor Alan Lightman of the Program in Writing and Humanistic Studies.

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much larger-scale deployment.

"We've determined that heat mining can be economical in the short term, based on a global analysis of existing geothermal systems, an assessment of the total U.S. resource and continuing improvements in deep-drilling and reservoir stimulation technology," said panel head Jefferson W. Tester, the H.P. Meissner Professor of Chemical Engineering at MIT.

"EGS technology has already been proven to work in the few areas where underground heat has been successfully extracted. And further technological improvements can be expected," he said.

The expert panel offers a number of recommendations to develop geothermal as a major electricity supplier for the nation. These include more detailed and site-specific assessments of the U.S. geothermal resource and a multiyear federal commitment to demonstrate the concept in the field at commercial scale.

The new assessment of geothermal energy by energy experts, geologists, drilling specialists and others is important for several key reasons, Tester said.

First, fossil fuels—coal, oil and natural gas—are increasingly expensive and consumed in ever-increasing amounts. Second, oil and gas imports from foreign sources raise concerns over long-term energy security. Third, burning fossil fuels dumps carbon dioxide and other pollutants into the atmosphere. Finally, heat mining has the potential to supply a significant amount of the country's electricity currently being generated by conventional fossil fuel, hydroelectric and nuclear plants.

The study shows that drilling several wells to reach hot rock and connecting them to a fractured rock region that has been stimulated to let water flow through it creates a heat-exchanger that can produce large amounts of hot water or steam to run electric generators at the surface. Unlike conventional fossil-fuel power plants that burn coal, natural gas or oil, no fuel would be required. And unlike wind and solar systems, a geothermal plant works night and day, offering a noninterruptible source of electric power.

Tester and panel member David Blackwell, professor of geophysics at Southern Methodist University in Texas, also point out that geothermal resources are available nationwide, although the highest-grade sites are in western states, where hot rocks are closer to the surface, requiring less drilling and thus lowering costs.

The panel also evaluated the environmental impacts of geothermal development, concluding that these are "markedly lower than conventional fossil-fuel and nuclear power plants."

"This environmental advantage is due to low emissions and the small overall footprint of the entire geothermal system, which results because energy capture and extraction is contained entirely underground, and the surface equipment needed for conversion to electricity is relatively compact," Tester said.

The report also notes that meeting water requirements for geothermal plants may be an issue, particularly in arid regions. Further, the potential for seismic risk needs to be carefully monitored and managed.

According to panel member M. Nafi Toksöz, professor of geophysics at MIT, "geothermal energy could play an important role in our national energy picture as a noncarbon-based energy source. It's a very large resource and has the potential to be a significant contributor to the energy needs of this country."

Toksöz added that the electricity produced annually by geothermal energy systems now in use in the United States at sites in California, Hawaii, Utah and Nevada is comparable to that produced by solar and wind power combined. And the potential is far greater still, since hot rocks below the surface are available in most parts of the United States.

Even in the most promising areas, however, drilling must reach depths of 5,000 feet or more in the west, and much deeper in the eastern United States. Still, "the possibility of drilling into these rocks, fracturing them and pumping water in to produce steam has already

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Biologists identify 5,000 new RNA molecules in C. elegans genome

David Cameron
Whitehead Institute

The last few years have been very good to ribonucleic acid (RNA). Decades after DNA took biology by storm, RNA was considered little more than a link in a chain—no doubt a necessary link, but one that, by itself, had little to offer. But with the discoveries of RNA interference and microRNAs, this meager molecule has been catapulted to stardom as a major player in genomic activity.

The dirt-dwelling C. elegans, just one millimeter long, is useful for biological research: Forty percent of its genes match those of humans.

Now, a team of scientists led by David Bartel, a professor in MIT's Department of Biology, has discovered an entirely new class of RNA molecules.

Reporting in the journal Cell, the team describes identifying more than 5,000 of these new molecules, termed 21U-RNAs, in the C. elegans worm. These new RNAs are named after their distinctive features: Each molecule contains 21 chemical building blocks (or nucleotides), and each begins with the chemical uridine, represented by the letter U (the only RNA nucleotide not also found on DNA). In addition, each of the 5,000 different 21U-RNA molecules comes from one of two chromosomal regions.

Further, "we can predict where additional 21U-RNA genes might reside," says Bartel, who is also a member of the Whitehead Institute for Biomedical Research and a Howard Hughes Medical Institute investigator. "Combining these predictions with the 5,000 (21U-RNAs) that we experimentally identified, we suspect that there are more than 12,000 different 21U-RNA genes in the genome." Because each gene typically produces a unique 21U-RNA, a very large diversity of molecules is made.

"There are so many 21U-RNA genes spread out over such a wide swath of the genome, but they all share common requirements for expression and common structural features," says Bartel lab Ph.D. student J. Graham Ruby, lead author on the paper.

Although the researchers haven't yet identified a particular function for these molecules, they believe that this uniform structure strongly indicates an important role.

MIT Institute Professor and Nobel laureate Phillip Sharp, a biologist who was not part of the research team, supports this hypothesis. The fact that 21U-RNAs share this "common structure and origin suggests an important function," he says. "It requires function to conserve specificity."

Other members of the research team are affiliated with the Broad Institute of MIT and Harvard and Pennsylvania State University. This research was supported by the Prix Louis D from the Institut de France and a grant from the National Institutes of Health.

PHOTO COURTESY / **NASA**

Star power

Jeffrey Hoffman, a professor of the practice in MIT's Department of Aeronautics and Astronautics, will be inducted into the U.S. Astronaut Hall of Fame on May 5.

Hoffman was a project scientist at the Center for Space Research in 1978 when he was among the first group of astronauts chosen for NASA's new space shuttle program.

This year's other two inductees—Michael Coats and Steven Hawley—were also members of NASA's 1978 astronaut class. That class, nicknamed the "Thirty-Five New Guys," was the first selected to fly shuttle missions.

Hoffman, 62, is a veteran of five shuttle flights, including a make-or-break mission to repair the myopic Hubble Space Telescope in 1993.

Hoffman and three other astronauts staged an unprecedented five spacewalks in five days to fix the four-story telescope, which now is responsible for more than 40 percent of the scientific discoveries made by NASA researchers.

Hoffman's first flight, aboard Discovery in April 1985, included the first contingency space walk in shuttle program history and a brake failure and blown tire during the landing at Kennedy Space Center.

He also flew two flights to test the Italian-made Tethered Satellite System. The highly experimental missions ultimately proved that electricity could be generated by dragging a tethered satellite through Earth's magnetic field.

In 1997, Hoffman moved to Paris to serve as NASA's prime liaison with the European Space Agency. In 2001, he came to MIT, where he is a professor of aerospace engineering and teaches courses in space operations and spacecraft design.

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for another five or so years.

Does using corn-based ethanol in place of gasoline actually make energy consumption and emissions go up, as some researchers claim? Why do others reach the opposite conclusion? And how much better would ethanol from "cellulosic" feedstocks such as switchgrass be?

To answer those questions, Tiffany A. Groode, a graduate student in MIT's Department of Engineering, performed her own study, supervised by John B. Heywood, Sun Jae Professor of Mechanical Engineering.

Using a technique called life cycle analysis, she looked at energy consumption and greenhouse gas emissions associated with all the steps in making and using ethanol, from growing the crop to converting it into ethanol. She limited energy sources to fossil fuels. Finally, she accounted for the different energy contents of gasoline and ethanol. Pure ethanol carries 30 percent less energy per gallon, so more is needed to travel a given distance.

While most studies follow those guidelines, Groode added one more feature: She incorporated the uncertainty associated with the values of many of the inputs. Following a methodology developed by recent MIT graduate Jeremy Johnson (Ph.D. 2006), she used not just one value for each key variable (such as the amount of fertilizer required) but rather a range of values, along with the probability that each of those values would occur. In a single analysis, her model runs thousands of times with varying input values, generating a range of results, some more probable than others.

Based on her "most likely" outcomes, she concluded that traveling a kilometer using ethanol does indeed consume more energy than traveling the same distance using gasoline. However, further analyses showed that several factors can easily change the outcome, rendering corn-based ethanol a "greener" fuel.

One such factor is the much-debated co-product credit. When corn is converted into ethanol, the material that remains is a high-protein animal feed. One assumption is that the availability of that feed will enable traditional feed manufacturers to produce less, saving energy; ethanol producers should therefore get to subtract those energy savings from their energy consumption. When Groode put co-product credits into her calculations, ethanol's life-cycle energy use became lower than gasoline's.

John B. Heywood

Another factor that influences the outcome is which energy-using factors of production are included and excluded—the so-called system boundary. A study performed by Professor David Pimentel of Cornell University in 2003 includes energy-consuming inputs that other studies do not, one example being the manufacture of farm machinery. His analysis concludes that using corn-based ethanol yields a significant net energy loss. Other studies conclude the opposite.

To determine the importance of the system boundary, Groode compared her own analysis, the study by Pimentel and three other reputable studies, considering the same energy-consuming inputs and no co-product credits in each case.

"The results show that everybody is basically correct," she said. "The energy balance is so close that the outcome depends on exactly how you define the problem." The results also serve to validate her methodology: Results from the other studies fall within the range of her more probable results.

Growing more corn may not be the best route to expanding ethanol production. Other options include using corn stover (the plants and husks that are left on the field), or growing an "energy crop" such as switchgrass. While corn kernels are mostly starch, corn stover and switchgrass are primarily cellulose. Commercial technologies to make ethanol from cellulose are not yet available, but laboratory and pilot-scale tests are generating useful data on processing techniques. So how do cellulosic sources measure up in terms of saving energy and reducing greenhouse gas emissions?

Using her methodology, Groode performed an initial analysis of switchgrass and, drawing again on Johnson's work, corn stover. She found that fossil energy consumption is far lower with these two cellulosic sources than for the corn kernels.

Farming corn stover requires energy only for harvesting and transporting the material. Growing switchgrass is even less energy intensive. It requires minimal fertilizer, its life cycle is about 10 years, so it need not be replanted each year, and it can be grown almost anywhere, so transport costs can be minimized.

Groode and Heywood now view the three ethanol sources as a continuum. In the future, cellulosic sources such as corn stover and ultimately switchgrass can provide large quantities of ethanol for widespread use as a transportation fuel. In the meantime, ethanol made from corn can provide some immediate benefits.

"I view corn-based ethanol as a steppingstone," said Groode. "People can buy flexible-fuel vehicles right now and get used to the idea that ethanol or E85 works in their car. If ethanol is produced from a more environmentally friendly source in the future, we'll be ready for it."

This research was supported by BP America.

A report on Groode's work, titled "Review of Corn Based Ethanol Energy Use and Greenhouse Gas Emissions," can be downloaded at lfee.mit.edu/metadot/index.pl?id=2234.

Nanocomposite research yields strong and stretchy fibers

Lycra®-like materials, inspired by spider silk, could make tougher fabrics, packaging materials

Anne Trafton
News Office

Creating artificial substances that are both stretchy and strong has long been an elusive engineering goal. Inspired by spider silk, a naturally occurring strong and stretchy substance, MIT researchers have now devised a way to produce a material that begins to mimic this combination of desirable properties.

Such materials, known as polymeric nanocomposites, could be used to strengthen and toughen packaging materials and develop tear-resistant fabrics or biomedical devices. Professor Gareth McKinley, graduate student Shawna Liff and postdoctoral researcher Nitin Kumar worked at MIT's Institute for Soldier Nanotechnologies (ISN) to develop a new method for effectively preparing these materials. The research appears in the January issue of Nature Materials.

Engineers are already able to create materials that are either very strong or very stretchy, but it has been difficult to achieve both qualities in the same material. In the last few years scientists have determined that the secret behind the combined strength and flexibility of spider silk lies in the arrangement of the nanocrystalline reinforcement of the silk while it is being produced.

"If you look closely at the structure of spider silk, it is filled with a lot of very small crystals," says McKinley, a professor of mechanical engineering. "It's highly reinforced."

The silk's strength and flexibility come from this nanoscale crystalline reinforcement and from the way these tiny crystals are oriented towards and strongly adhere to the stretchy protein that forms their surrounding polymeric matrix.

Liff, a Ph.D. student in mechanical engineering, and Kumar, a former MIT postdoctoral associate, teamed up to figure out how to begin to emulate this nano-reinforced structure in a synthetic polymer (A polymer or plastic consists of long chains composed of small repeating molecular units). Numerous earlier unsuccessful attempts, tackling the same issue, relied on heating and mixing molten plastics with reinforcing agents, but Liff and Kumar took a different approach: They focused on reinforcing solutions of a commercial polyurethane elastomer (a rubbery substance) with nanosized clay platelets.

They started with tiny clay discs, the smallest they could find (about 1 nanometer, or a billionth of a meter thick and 25 nanometers in diameter). The discs are naturally arranged in stacks like poker chips, but "when you put them in the right solvent, these 'nanosized poker chips' all come apart," said McKinley.

The researchers developed a process to embed these clay chips in the rubbery polymer—first dissolving them in water, then slowly exchanging water for a solvent that also dissolves polyurethane. They then dissolved the polymer in the new mixture and finally removed the solvent. The end result is a "nanocomposite" of stiff clay particles dispersed throughout a stretchy matrix that is now stronger and tougher.

Importantly, the clay platelets are distributed randomly in the material, form-

See **NANOCOMPOSITE** Page 8

PHOTO / **DONNA COVENEY**

Graduate student Shawna Liff works with new material composed of nanoparticles embedded in a polymer that could be used in fuel cells.

MIT develops measures to predict performance of complex systems

Michelle Gaseau
Lean Aerospace Initiative

Taking a cue from the financial world, MIT researchers along with experts in industry and government have developed a list of 13 measures that engineers can use to predict how well a system—or project—will perform before it is even finished.

Known as leading indicators, analogous measures are regularly used by economists, investors and businesses to help predict the economy's performance.

The idea behind the new set of leading indicators is to improve the management and performance of complex programs before they are delivered, in a more predictive way than simple business metrics.

"Leading indicators can provide important insights for managers of complex programs, such as those in the aerospace industry, and can allow them to make real-time adjustments to project activities, staffing and schedules to ensure a project stays on track," said Donna Rhodes, a principal researcher for MIT's Lean Aerospace Initiative (LAI).

The MIT leading indicators project, co-led by Rhodes and industry colleague Garry Roedler of Lockheed Martin, began in 2004 following an LAI/U.S. Air Force workshop on systems engineering that established the groundwork for the project. Systems engineering is an interdisciplinary approach to creating successful systems by focusing on variables including customer needs, system requirements, design synthesis and system validation, all while considering the complete problem.

A leading indicator may be an individual measure, or collection of measures, that is predictive of future system performance before the performance is realized.

Thirteen ways of looking at a system

The 13 leading indicators defined by the MIT team include risk-handling trends. This indicator would be used by management to determine whether a project team is proactively handling potential problems (or risks) at the appropriate times with the goal of minimizing or eliminating their occurrence. If the actions to address a given project risk are not taken, then there is a higher probability that the risk will be realized, resulting in negative impact to project cost, schedule, performance or customer satisfaction. The insight gained through the use of this indicator can help identify where additional effort may be needed to avoid preventable problems or reduce impacts.

Several major aerospace companies worked to validate the 13 indicators in pilot programs during 2006, which helped refine them. Then, working in collaboration with the International Council on Systems Engineering (INCOSE), the leading professional society for systems engineering practitioners, the MIT team published a guidance document about the work. That document has been made available to the larger systems engineering community.

According to Rhodes, "The leading indicators project is an excellent example of how academic, government and industry experts can work together to perform collaborative research that has real impact on engineering practice."

The other leading indicators identified by the team are: system definition change; backlog trends; interface trends; requirements validation trends; requirements verification trends; work product approval trends; review action closure trends; risk exposure trends; technology maturity trends; technical measurement trends; systems engineering staffing and skills trends; and process compliance trends.

Discovery could lead to new therapies for diabetes, lupus and arthritis

David Cameron
Whitehead Institute

Autoimmune diseases such as type 1 diabetes, lupus and rheumatoid arthritis occur when the immune system fails to regulate itself. But researchers have not known precisely where the molecular breakdowns responsible for such failures occur.

Now, scientists from MIT, the Whitehead Institute and the Dana-Farber Cancer Institute have identified a key set of genes that lie at the core of autoimmune disease, findings that may help scientists develop new methods for manipulating immune system activity.

Richard Young

"This may shorten the path to new therapies for autoimmune disease," said Whitehead member and MIT professor of biology Richard Young, senior author on a paper that appeared online in Nature on Jan. 21. "With this new list of genes, we can now look for possible therapies with far greater precision."

The immune system is often described as a kind of military unit, a defense network that guards the body from invaders. Seen in this way, a group of white blood cells called T cells are the frontline soldiers of immune defense, engaging invading pathogens head-on.

These T cells are commanded by a second group of cells called regulatory T cells. Regulatory T cells prevent biological "friendly fire" by ensuring that the T cells do not attack the body's own tissues. Failure of the regulatory T cells to control the frontline fighters leads to autoimmune disease.

Scientists previously discovered that regulatory T cells are themselves controlled by a master gene regulator called Foxp3. Master gene regulators bind to specific genes and control their level of activity, which in turn affects the behavior of cells.

In fact, when Foxp3 stops functioning, the body can no longer produce working regulatory T cells. When this happens, the frontline T cells damage multiple organs and cause symptoms of type 1 diabetes and Crohn's disease. However, until now, scientists have barely understood how Foxp3 controls regulatory T cells because they knew almost nothing about the actual genes under Foxp3's purview.

Researchers in Young's lab, working closely with immunologist Harald von Boehmer of the Dana-Farber Cancer Institute, used a DNA microarray technology developed by Young to scan the entire genome of T cells and locate the genes controlled by Foxp3. There were roughly 30 genes found to be directly controlled by Foxp3 and one, called Ptpn22, showed a particularly strong affinity.

"This relation was striking because Ptpn22 is strongly associated with type 1 diabetes, rheumatoid arthritis, lupus and Graves' disease, but the gene had not been previously linked to regulatory T-cell function," said Alexander Marson, an M.D.-Ph.D. student in the Young lab and lead author on the paper. "Discovering this correlation was a big moment for

See **DISCOVERY** Page 6

PHOTOS / **DONNA COVENEY**

Inside the Institute

'The Heart of MIT,' an exhibit of two decades of photography by Donna Coveney, MIT News Office, opens to the public on Monday, Jan. 29, in the Compton Gallery. Left: Frank Stella, in front of his artwork, 'Loohooloo,' 1995; right: MIT Glass Lab, 1988. See story on page 8.

IAP class finds greatness in grainy cell-phone photos

Stephanie Schorow
News Office Correspondent

Someday, perhaps, a Pulitzer Prize committee will add a category for cell-phone photographs. But for now, photographer and new-media artist Gary Duehr has a message for would-be digital shutterbugs: Accept the medium for what it is. And what it is may seem awful.

Yet, what makes cell-phone photography so terrible—the grainy, muted colors, the blurry, off-kilter shots of friends, family or strangers on the street—is also what make them so great, Duehr insists.

"Open yourself to the world of really crappy cell-phone photos," Duehr told a group of about 10 people at the Compton Gallery as part of the (paradoxically titled) Independent Activities Period workshop, "Take Better Pictures With Your Cell Phone (And Win Big)." "I want you to appreciate the virtue of taking really bad pictures with cell phones."

Indeed, Duehr quickly gave participants assignments. Soon the participants were capturing close-ups ranging from wires on the ground to a jacket thrown over a chair to shadows on the wall. They snapped the faces of passersby in Building 10. They did self-portraits at arm's length.

Despite a few technical hurdles and glitches, they practiced e-mailing or downloading photos to computers, processing images with Photoshop and printing them.

But on the road to bad, something good happened. Wonderful images emerged on plain paper: intriguing landscapes of light and dark, moody portraits of people and captivating patterns.

Duehr, whose work has been featured in numerous galleries, was delighted. So was Jon Bijur, who has helped organize the Mili-MIT Museum Cell Phone Photography Contest, the museum's first cell-phone photo contest, which is being held this month. (That's the "win big" part of the IAP workshop title.) "The goal is to have as many people enter as possible," said Bijur, the museum's educational service coordinator.

Duehr, an award-winning artist and manager of the Broomfield Art Gallery, is himself new to the cell-phone medium. In February he started taking photos with his cell phone. "I've loved it," he told workshop participants.

He specializes into taking pictures of pictures. He has enlarged his photos until the subjects were almost unrecognizable. "I thought they got really interesting." He remains fascinated photos that contain "just enough pixels to tell what's there." He doesn't hold back from the shutter trigger: "I tend to take (photos) like candy."

The ubiquity of cell phones—most with cameras—has turned many callers into would-be snap-shooters. Electrical engineering junior Gabriel Lopez was asked directions to the cell-phone workshop, then thought, "Oh, cool," and decided to participate himself.

Retired University of Massachusetts professor of mechanical engineering Turgay Erturk wanted to explore the possibilities of a recent phone purchase; he captured an evocative portrait of a student eating alone. "This is a good learning process," he declared. John MacNeil, a graduate student in technical policy, wanted to learn how to manipulate colors and found a dynamic landscape in the folds of a vacuum cleaner bag. "This is my only camera," he explained.

> *I want you to appreciate the virtue of taking really bad pictures with cell phones.*
>
> **Gary Duehr**

For others, the new medium has enhanced, not replaced, the old one. Fourteen-year-old Emily Whitlow, whose mother works at MIT, also loves shooting photos with her Nikon film camera. "I like black and white," she said.

Duehr also discussed legal aspects of cell-phone photos, including recent court cases about publishing photos taken in public places. Yet cell-phone photos have an aura of the forbidden: "There's a secret quality about them," he said. They make the private public; the phone camera video of the Saddam Hussein hanging is one example.

Raju Patel, co-director of the Massachusetts Space Grant Program, hopes to master enough skills to snap web-site quality photos. After all, she may not always carry a camera, "but I always have my cell phone."

The Mili-MIT Museum Cell Phone Contest is open to the MIT community through Jan. 29. Prizes include photo printers and gift certificates; an award ceremony will be held Feb. 2. For information, go to: poq.csail.mit.edu:3333/.

"Take Better Pictures With Your Cell Phone" will be repeated Jan. 26 from 2 to 4 p.m. in the Compton Gallery. Duehr's work can be seen at www.garyduehr.com.

GEOTHERMAL

Continued from Page 3

been shown to be feasible," Toksöz said.

Panel member Brian Anderson, an assistant professor at West Virginia University, noted that the drilling and reservoir technologies used to mine heat have many similarities to those used for extracting oil and gas. As a result, the geothermal industry today is well connected technically to two industry giants in the energy arena, oil and gas producers and electric power generators. With increasing demand for technology advances to produce oil and gas more effectively and to generate electricity with minimal carbon and other emissions, an opportunity exists to accelerate the development of EGS by increased investments by these two industries.

Government-funded research into geothermal was very active in the 1970s and early 1980s. As oil prices declined in the mid-1980s, enthusiasm for alternative energy sources waned, and funding for research on renewable energy and energy efficiency (including geothermal) was greatly reduced, making it difficult for geothermal technology to advance. "Now that energy concerns have resurfaced, an opportunity exists for the U.S. to pursue the EGS option aggressively to meet long-term national needs," Tester observed.

Tester and colleagues emphasize that federally funded engineering research and development must still be done to lower risks and encourage investment by early adopters. Of particular importance is to demonstrate that EGS technology is scalable and transferable to sites in different geologic settings.

In its report, the panel recommends that:

—More detailed and site-specific assessments of the U.S. geothermal energy resource should be conducted.

—Field trials running three to five years at several sites should be done to demonstrate commercial-scale engineered geothermal systems.

—The shallow, extra-hot, high-grade deposits in the west should be explored and tested first.

—Other geothermal resources, such as co-produced hot water associated with oil and gas production and geopressured resources should also be pursued as short-term options.

—On a longer time scale, deeper, lower-grade geothermal deposits should be explored and tested.

—Local and national policies should be enacted that encourage geothermal development.

—A multiyear research program exploring subsurface science and geothermal drilling and energy conversion should be started, backed by constant analysis of results.

Besides Tester, Blackwell, Toksöz and Anderson, members of the panel include: geomechanics expert Anthony Batchelor, managing director of GeoScience Ltd. in the United Kingdom; reservoir engineer Roy Baria from the United Kingdom; geophysicists Maria Richards and Petru Negraru at Southern Methodist University; mechanical engineer Ronald DiPippo, an emeritus professor at the University of Massachusetts at Dartmouth; risk analyst Elisabeth Drake at MIT; chemist John Garnish, former director of geothermal programs of the European Commission; drilling expert Bill Livesay; economist Michal Moore at the University of Calgary in Canada, former California energy commissioner and chief economist at the National Renewable Energy Laboratory; commercial power conversion engineer Kenneth Nichols; geothermal industry expert Susan Petty; and petroleum engineering consultant Ralph Veatch Jr. Additional project support came from Chad Augustine, Enda Murphy and Gwen Wilcox at MIT.

DISCOVERY

Continued from Page 5

us. It verified that we were on the right track for identifying autoimmune-related genes."

The researchers still don't know exactly how Foxp3 enables regulatory T cells to prevent autoimmunity. But the list of the genes that Foxp3 targets provides an initial map of the circuitry of these cells, which is important for understanding how they control a healthy immune response.

"Autoimmune diseases take a tremendous toll on human health, but on a strictly molecular level, autoimmunity is a black box," said Young. "When we discover the molecular mechanisms that drive these conditions, we can migrate from treating symptoms to developing treatments for the disease itself."

Other MIT authors of this paper are Garrett M. Frampton, a graduate student in the Department of Biology; Kenzie D. MacIsaac, a graduate student in the Department of Electrical Engineering and Computer Science; and Ernest Fraenkel, an assistant professor in the Division of Biological Engineering who is also affiliated with MIT's Computer Science and Artificial Intelligence Laboratory.

This work was supported by a donation from E. Radutsky and by the Whitaker Foundation and the National Institutes of Health.

From Russia with–what? Love? Icy indifference?

An IAP seminar explores U.S.-Russian relations since the 'Bill and Boris show'

Stephanie Schorow
News Office Correspondent

The question—as posed in the title of the Independent Activities Period seminar—was "Putin's Russia: Friend or Foe?"

The answer—as seminar participants discovered on Jan. 17—may depend on the definitions of "friend" and "foe."

Whatever the definitions, exploring the friend-foe question is not only crucial to the United States and Russia but also "crucial to world stability," said Carol Saivetz, a visiting scholar at MIT's Center for International Studies and the seminar leader. From the violence in the Persian Gulf to the radiation poisoning of former Russian spy Alexander V. Litvinenko in London, shifts in the relationship between the United States and Russia can have ripple effects throughout the globe.

How then, she asked, "do we measure our friendship or enmity with Russia?"

Saivetz began the seminar by reading a headline in a Russian newspaper: "Russians Sold Defensive Missiles to Iran." Rather than use that as an answer, Saivetz peeled back the layers of history that have formed Russia's foreign policy since the collapse of the Soviet Union and probed whether the United States has correctly interpreted and responded to those policies.

Saivetz, a research associate at Harvard's Davis Center for Russian and Eurasian Studies, noted that in the chaos after the Soviet collapse in the 1990s even Russians admitted their lack of a foreign policy. Later, Russia-watchers referred to the "Bill and Boris show," reflecting the working relationship between Bill Clinton and Boris Yeltsin.

But now, particularly with the ascension of Vladimir Putin, Russia's foreign policy has become "more opaque," leaving scholars wondering about the role of such factors as ideology, domestic agendas, business interests, energy policies and national pride. Moreover, noted Saivetz, who is writing a book on Putin's foreign policy, if democracies tend not to fight other democracies—as is conventional wisdom—then Putin's increasing curtailment of civil liberties may have an effect on U.S.-Russian relations.

However, she asked, does the United States need friends? Are all our allies our friends?

"Right now, friendship means sharing a mutual enemy," said Daniel L. Mokrauer-Madden, a junior majoring in math and physics. But he also said, "If we call Russia our friend, then what is our friend doing to our other friends?"

Perhaps, Saivetz suggested, Russia and the United States interpret friendship differently.

IMAGE / **AGÊNCIA BRASIL**

President Vladimir Putin of the Russian Federation.

IMAGE / **NARA**

Former Russian President Boris Yeltsin and former U.S. President Bill Clinton, shown here in Istanbul, had a friendly diplomatic working relationship.

Certainly, security has a different meaning today, said Peter Watkins, a fellow at the Weatherhead Center for International Affairs at Harvard University, who came to Saivetz's seminar. In the Cold War, a security threat was something with the ability to "wipe us out," he said. Now "people are developing a broader sense of security, such as economic security, energy security."

For Russians, Saivetz said, "having an empire was part of the national psyche." Today, leaders want a seat at the table in setting world policy, and Putin seemed willing to play by the rules of democratic nations because adherence to such policies is donning the "school tie" that makes him part of the club of world powers.

Recall, Saivetz said, that on Sept. 12, 2001, Putin assembled his top advisors to determine Russian policy after the terrorist attacks of Sept. 11. A majority wanted Russia to remain neutral, a few suggested supporting President Bush, and a few even recommended siding with the Taliban. Putin chose to support Bush.

Certainly, Watkins observed, Sept. 11 vindicated what Russia, beset by Chechen rebels, had been warning about Islamic terrorists.

Subsequently, however, the United States has abrogated the Anti-Ballistic Missile Treaty and invaded Iraq against the wishes of Putin. This may lead him to believe that he'll never be a member of the club and might as well shrug off democratic rule, Saivetz said.

Thus, Russia, too, is deciding whether the United States is a friend or foe.

The second half of "Russia: Friend or Foe?" will be held Wednesday, Jan. 24, from 2 to 3:30 p.m. in the Center for International Studies.

LeaderShape calls students to action

Sasha Brown
News Office

Senior Ruth Misener attended LeaderShape in 2006 because of the passion a friend had for the program, but she is returning in 2007 to share her own.

"I'm going back to LeaderShape this year because I want to see more people make the same self-discovery journey I made," Misener said of the annual six-day leadership development and community-building program that takes place every Independent Activities Period. This year it runs from Jan. 19 to 24.

MIT LeaderShape is a partnership between MIT and LeaderShape Inc., a nonprofit organization in Champaign, Ill. LeaderShape Inc. provides the complete curriculum for MIT LeaderShape and for other campus-based LeaderShape sessions nationwide.

The program, which came to MIT in 1995, is designed to develop a number of skills in problem solving, professional ethics and decision-making. But it does more than that, says program director Tracy Purinton, from the Division of Student Life.

"It is about students and faculty learning and living together," Purinton said of the program that takes place at the Wonderland Conference Center in Sharon, Mass.

A variety of topics and activities are covered over the six-day period, including action planning, team building, group decision-making and conflict resolution. It is open to all undergraduates. The students and faculty work in small clusters as well as all together. Over the course of the week, many strong bonds are formed, Purinton said.

"This is an oasis for them to have time to reflect," Purinton said. "It has really changed the Institute in a number of positive ways."

Each participant creates an individual plan of action designed to bring positive change to the campus community. The plan is then carried out during the following academic year.

Over the years, LeaderShape action plans have produced such innovations as Alternative Spring Break, a program that allows students to use their spring break to do volunteer work projects; the five nonacademic freshman pre-orientation programs; and varsity women's ice hockey.

The 70 participants attending LeaderShape this week applied last October. They are coming for a number of reasons. Freshman Wendy Chen is hoping to continue the leadership experience she had in high school. "These activities made me a more responsible person who can guide a group of students," Chen said. "LeaderShape will supply me with valuable knowledge to take leadership to a higher level and lead the world in the future."

Senior Nicholas Pearce is hoping to take the skills he gains in LeaderShape out into the real world next year. "I have had a lot of student leadership experiences with campus organizations as well as with student government and the faculty governance structure," he said.

"Currently, I am working on the Student Leadership Development initiative and am interested in learning leadership in the setting that LeaderShape provides," Pearce said.

"I've been here almost 50 years, and I've been almost everything—an undergraduate, a Ph.D. student, a professor, president. But I never really understood how magnificent our young people are until now, after having spent six days away with them at MIT LeaderShape," said President Emeritus Paul Gray, who formerly participated as a cluster facilitator.

"At MIT, they spend all their time trying to be what we put forward as the model: the intensely rational, smart, driven person. Too often, they don't get to be or explore all those other things that are life," Gray said.

Misener hopes that, by returning to LeaderShape this year in a mentoring capacity, she can help the new participants grow. "If I can be of any help to them in their quest to learn more about themselves, so much the better," she said.

MIT Sloan grad pushes fashion forward

Patricia Favreau
MIT Sloan School of Management

ABC-TV's "Desperate Housewives" and MIT Sloan may not appear to have much in common. But that changed late last year, when one of the characters on the show sported a "doorbell friendly" robe designed by an entrepreneurial M.B.A. student from MIT's Sloan School of Management.

Juli Lee

IMAGE COURTESY / **JULI LEE**

A 'doorbell friendly' Juli Lee design for Julianna Rae.

"Doorbell friendly" is a term coined by Juli Lee (M.B.A. 1995), founder and chief designer of Julianna Rae, a women's intimate apparel design and retail company. Julianna Rae has grown more than 300 percent in Internet sales alone since Lee launched it in 2004.

Lee's Julianna Rae garments have also appeared in gift baskets at Robert Redford's Sundance Film Festival, and one of her robes hung visibly in Donald Trump's penthouse in "The Apprentice."

Lee attributes her success to both having identified an untapped market segment in intimate apparel—women ages 30 through 60—and to having honed her business skills through the MIT Sloan program and business experience.

While her career trajectory is remarkable, Lee's leading role in the style industry is not unique. In fact, her success reflects a growing trend—M.B.A.s and fashion industry executives are collaborating more as supply-chain management grows as important as cutting-edge designs in the global fashion market.

MIT Sloan has also taken on the world of style. In 2004, a group of M.B.A. students founded the Retail and Consumer Goods Club, which now boasts a membership of 60 students and presents such high-profile guest speakers as André Leon Talley, editor-at-large of Vogue magazine.

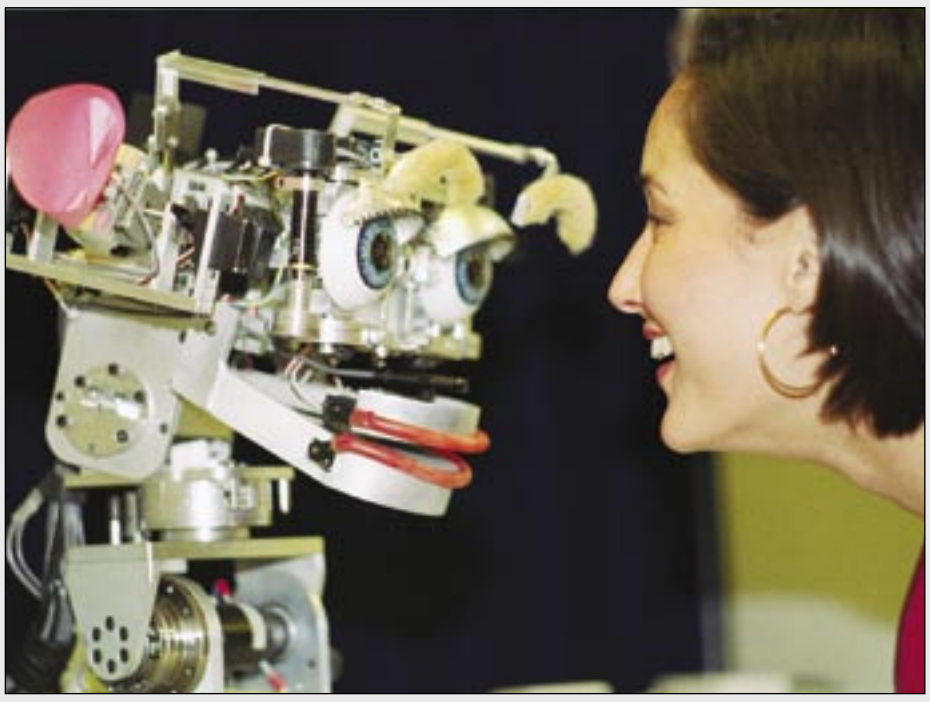
Moria Flynn, an M.B.A. student, serves as co-president. "Large retailers are starting to appreciate us more. They are offering more attractive packages to recent M.B.A. graduates."

Lee's road was not so linear. She earned the S.B. degree in computer science and electrical engineering in 1989, then worked in merchandizing and account management for a private label company whose sole client was Victoria's Secret. Frustrated with the lack of upward mobility, Lee returned to MIT to earn her M.B.A. at Sloan with a focus on strategy and operations.

Lee's M.B.A. led to retail and consumer goods account management, web site content development, data storage and business roles in technology startups. She then moved to clothier Robert Scott David Brooks to lead its private label division. "The fashion industry was still essentially a traditional, old-fashioned business where people worked their way up the ranks," says Lee. "In 1999 my manager asked me why I needed a computer."

Partnering with two business school colleagues, Lee next funneled all her M.B.A. and career experience into funding, building and marketing Julianna Rae. "A business school education definitely led to my creating a more efficient product-development cycle," she says.

‘Heart of MIT’ opens in Compton Gallery



Cynthia Breazeal, MIT Media Lab, faces Kismet, a robot that mimics emotion (2000).

Donna Coveney of the MIT News Office has photographed the daily routines, special celebrations, noted visitors and community events of the Institute for the past 20 years. Her images of MIT have appeared in Tech Talk, on the News Office web site and in countless publications around the world.

“The Heart of MIT: Twenty Years of Photography by Donna Coveney,” a retrospective showing both black and white and color photographs, opens on Monday, Jan. 29, in the Compton Gallery.

“I really like having the opportunity to spend time with some of the most interesting people on the planet and having them invite me to come play in their sandbox,” said Coveney.

Faculty, students and staff are doing “great things—designing inexpensive water filters and better wheelchairs or discovering a way to stop bleeding in 15 seconds. People all over MIT are doing amazing things to make life better for all of us and having fun meeting the challenges in the bargain,” the photographer said.

The gallery is located in Room 10-150 and the exhibition will be on view Jan. 29 to Sept. 30. Hours are weekdays from 9:30 a.m. to 5 p.m.

PHOTOS / **DONNA COVENEY**

The Dalai Lama poses with members of the MIT Police Department. They are (from left): Sgt. Craig Martin, Sgt. Cheryl Vossmer, Sgt. Richard Sullivan, Det. Sgt. Mary Beth Riley, Deputy Chief John Driscoll, Patrol Officer Bob Wilcox, Officer Billy Boulter (kneeling), Sgt. Janet Colwell-Popp, Lt. Al Pierce (rear) and Det. Jay Perault (2003).

Journalist Gwen Ifill, who delivered the keynote speech at the annual Martin Luther King Jr. breakfast two years ago, shares conversation with Ayanna Samuels, a graduate student in aerospace engineering and the Technology and Policy Program (2005).

NANOCOMPOSITE

Continued from Page 5

ing a structure much like the jumble that results when you try to stuff matches back into a matchbox after they have all spilled out.

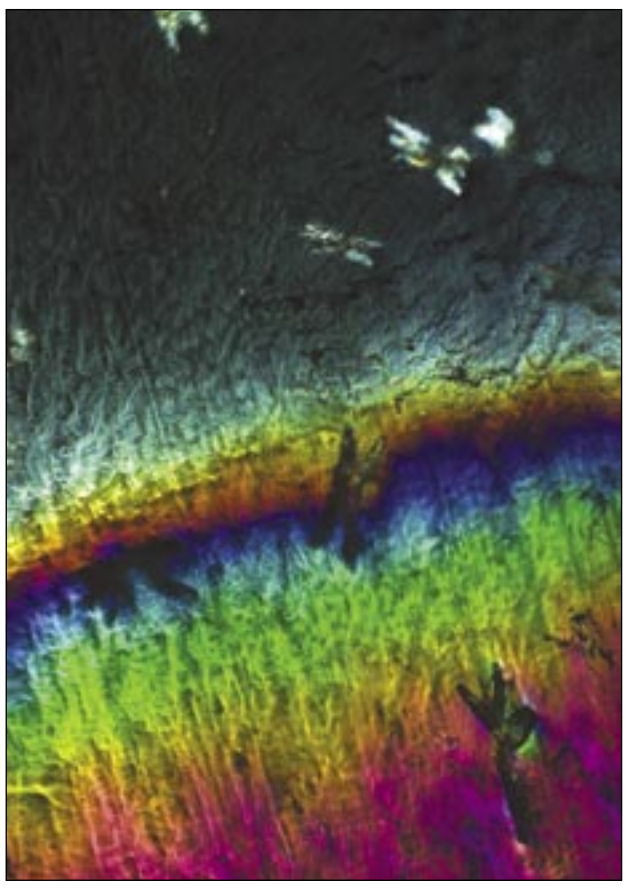
Instead of a neatly packed arrangement, the process results in a very disorderly “jammed” structure, according to McKinley. Consequently the nanocomposite material is reinforced in every direction and the material exhibits very little distortion even when heated to temperatures above 150 degrees Celsius.

In a Nature Materials commentary that accompanied the research paper, Evangelos Manias, professor of materials science and engineering at the University of Pennsylvania, suggests that “molecular composites” such as those developed by the MIT group are especially suitable for new lightweight membranes and gas barriers, because the hard clay structure provides extra mechanical support and prevents degradation of the material even at high temperatures. One possible use for such barriers is in fuel cells.

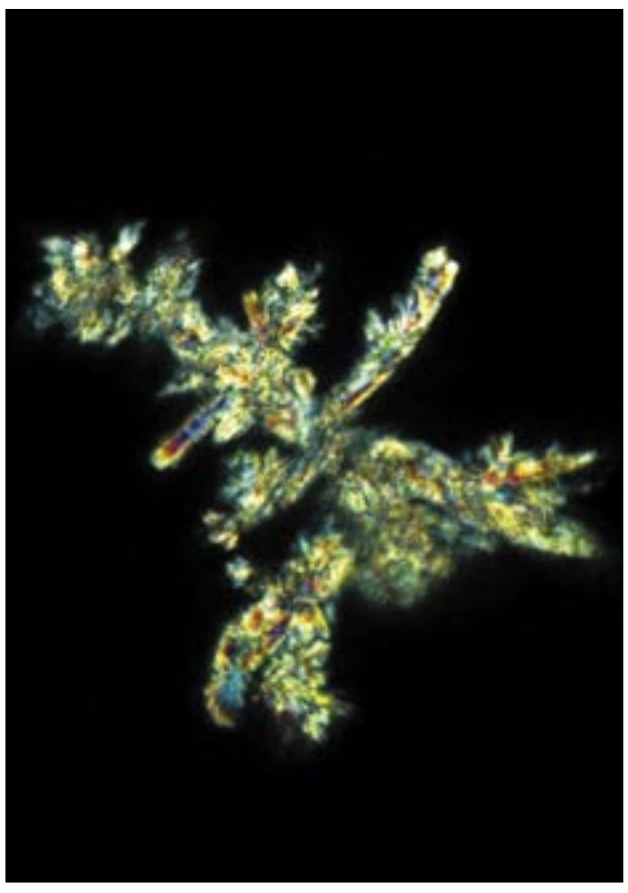
The U.S. military is interested in such materials for use in possible applications such as tear-resistant films or other body-armor components. The military is also interested in thinner, stronger packaging films for soldiers’ MREs (meals ready to eat) to replace the thick and bulky packaging now used.

Fabric companies have also expressed interest in the new materials, which can be used to make fibers similar to stretchy compounds such as nylon or Lycra®. The new approach to making nanocomposites can also be applied to biocompatible polymers and could be used to make stents and other biomedical devices, McKinley said.

The research was funded by the U.S. Army through MIT’s Institute for Soldier Nanotechnologies and by the National Science Foundation. McKinley’s team was assisted by technical staff at the ISN, including research engineer Steven Kooi, who helped prepare special samples for transmission electron microscopy.



MIT engineers have produced a new strong, stretchy nanocomposite material. This micrograph shows the results of tensile stretching: The unstretched region (above grip line) exhibits bright domains, indicating order and alignment of the polyurethane and nano-clay. Upon stretching, the dark, disorganized polymer chains become aligned and brighten in color due to polymer alignment, while the bright ordered domains become disordered or darken (below grip line). The image width is 0.48 millimeters.



A zoomed view of a bright, ordered domain in the nanocomposite. Upon heating to temperatures above 120 degrees Celsius, the bright domains disappear. But upon annealing the material at 60 degrees Celsius for 68 hours, the bright domains re-appear. The image width is 0.18 millimeters.

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