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TechTalk
SERVING THE MIT COMMUNITY

Engineered yeast improves ethanol production

Anne Trafton
News Office

MIT scientists have engineered yeast that can improve the speed and efficiency of ethanol production, a key component to making biofuels a significant part of the U.S. energy supply.

Currently used as a fuel additive to improve gasoline combustibility, ethanol is often touted as a potential solution to the growing oil-driven energy crisis. But there are significant obstacles to producing ethanol: One is that high ethanol levels are toxic to the yeast that ferments corn and other plant material into ethanol.

By manipulating the yeast genome, the researchers have engineered a new strain of yeast that can tolerate elevated levels of both ethanol and glucose, while producing ethanol faster than unengineered yeast. The work is reported in the Dec. 8 issue of Science.

Fuels such as E85, which is 85 percent ethanol, are becoming common in states where corn is plentiful; however, their use is mainly confined to the Midwest because corn supplies are limited and ethanol production technology is not yet efficient enough.

Hal Alper

Boosting efficiency has been an elusive goal, but the MIT researchers, led by Hal Alper, a postdoctoral associate in the laboratories of Professor Gregory Stephanopoulos of chemical engineering and Professor Gerald Fink of the Whitehead Institute, took a new approach.

The key to the MIT strategy is manipulating the genes encoding proteins responsible for regulating gene transcription and, in turn, controlling the repertoire of genes expressed in a particular cell. These types of transcription factors bind to DNA and turn genes on or off, essentially controlling what traits a cell expresses.

The traditional way to genetically alter a trait, or phenotype, of an organism is to alter the expression of genes that affect the phenotype. But for traits influenced by many genes, it is difficult to change the phenotype by altering each of those genes, one at a time.

Targeting the transcription factors instead can be a more efficient way to produce desirable traits. "It is the makeup of the transcripts that determines how a cell is going to behave and this is controlled by the transcription factors in the cell," according to Stephanopoulos, a co-author on the paper.

The MIT researchers are the first to use this new approach, which is akin to altering the central processor of a computer (transcription factors) rather than indi-

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PHOTO / **MARIA NEMCHUK, BROAD INSTITUTE**

Mapping malaria

Researchers from the Broad Institute of MIT and Harvard have created a map charting the genetic variability of the malaria parasite. From left, Sarah Volkman, a research scientist at the Harvard School of Public Health, Dyann Wirth, co-director of the Broad Institute Infectious Disease Initiative, and Pardis Sabeti, a postdoctoral associate at the Broad. See story on page 4.

'Learning Without Barriers': iCampus celebrates innovation

Robin H. Ray
News Office Correspondent

The seven-year, $25 million iCampus partnership between MIT and Microsoft, which has borne fruit across the globe, was celebrated with a symposium at the Tang Center Dec. 1 and 2.

Called "Learning Without Barriers/ Technology Without Borders: Celebrating the MIT-Microsoft iCampus Alliance," the symposium brought together industry leaders, educators and government officials to discuss the progress that iCampus has facilitated in educational technology, to reflect on the challenges facing science, technology, engineering and math (STEM) education, and to sample the remarkable initiatives that are being undertaken amid a climate of ever-accelerating technological change.

Tom Magnanti, dean of engineering, and Rick Rashid, senior vice president for research at Microsoft, delivered the symposium's opening remarks to a crowd of some 150 participants. Magnanti observed that a national self-examination was underway, as statistics point to a steady decline in the percentage of U.S. students concentrating in engineering and computer science, while elsewhere in the world the numbers are rising. This trend, coupled with the continuing failure to attract talented female and minority students to these fields and to retain those who express early interest, has grave implications for the United States' long-term competitiveness and the ability of the economy's tech sector to grow and thrive. As Rashid commented during the morning panel discussion, "It's reasonable to start thinking about panicking."

But there are also many signs of dynamic innovation in STEM education, including numerous projects sponsored by the iCampus alliance, that show promise

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MIT musicians pick season's hits among classical, jazz and rock

Mary Haller
Office of the Arts

Faculty from MIT's music section and the Media Laboratory offer the recordings listed below as great gifts to give and receive this holiday season.

Classical: Piano

David Deveau, senior lecturer in music, has established himself as a pianist, radio personality, recording artist and international competition judge. Deveau recommends:

Beethoven: Piano Concertos 2 and 3 (Deutsche Grammophon)—Martha Argerich, piano, with Claudio Abbado and the Mahler Chamber Orchestra. "This recording is simply astonishing. It's music-making of technical perfection, fantasy and the loftiest artistry."

Bach: Six Partitas for Solo Keyboard (Dorian label)—Andrew Rangell, piano. "Glenn Gould has been my gold standard for most Bach, but in the partitas, Rangell (based in Boston) is superb as well. He is an original, sometimes maddening, but always provocative and rewarding."

Brahms: Piano Concertos 1 and 2; Variations on a Theme by Handel, Op. 24; Variations on a Theme by Paganini, Op. 35 (London/Decca Records)—Julius Katchen, piano, London Symphony Orchestra. "The late Julius Katchen is simply riveting in these pieces. Those looking for mellow, sunbathed Brahms should look elsewhere. These interpretations are white-hot."

Classical: New Vocal Releases

Ellen T. Harris is Class of 1949 Professor of Music at MIT. Harris is a musicologist working in the area of Baroque opera and vocal performance practice with a special emphasis on the music of Handel. She recommends:

Handel: "Le Cantate per il Cardinal Pamphli" (Glossa)—"Soprano Roberta Invernizzi is spectacular, but every musician on the disc is a virtuoso."

"Sings Peter Lieberson: Neruda Songs"

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Stephen Meyer, expert on interaction of science, economics and politics, dies at 54

Stephanie Schorow
News Office Correspondent

Stephen M. Meyer, MIT political science professor, an expert in national security issues and a passionate advocate of global biodiversity, died Dec. 10 at the age of 54. The cause was cancer.

Meyer, the director of the MIT Project on Environmental Politics and Policy and a member of the MIT Council on the Environment, focused his teaching and research on the interaction of science, economics and politics in policymaking, particularly in the areas of natural resource exploitation, land use and wildlife habitat preservation.

Stephen M. Meyer

A researcher with a wide range of interests, Meyer concentrated on arms control, Soviet military programs and weapons technology when he first joined the MIT faculty in 1980. In 1984, he published his first book, "The Dynamics of Nuclear Proliferation" (University of Chicago Press.)

More recently, he turned his attention to environmental issues, publishing "Environmental Protection and Economic Prosperity" (MIT Press) in 2004. In September Meyer published "The End of the Wild" (Boston Review), a call to action to preserve what is left of species biodiversity, including the creation of transregional "meta-reserves." The book strikes a somber note, arguing that "'the extinction crisis'—the race to save the composition, structure and organization of biodiversity as it exists today—is over, and we have lost."

Meyer received his M.A. and Ph.D. in political science from the University of Michigan. He joined MIT as an assistant professor in 1980 and earned tenure in 1990. In 1997, he became a faculty associate with the Tufts School of Veterinary Medicine.

Meyer also worked in a wide range of nonacademic positions, beginning in the 1980s as a consultant to the RAND Corporation and the U.S. government. From 1992 to 1993, he was the principal investigator for the National Council on Soviet and East European Studies. In the late 1990s, he served on committees of the Massachusetts Division of Fisheries and Wildlife and the Massachusetts Department of Environmental Protection. In 2002 he became a principal investigator of the National Science Foundation in the area of dynamics of community-based environmental protection. In 2005 he was awarded the Francis W. Sargent Conservation Award by the Massachusetts Division of Fisheries and Wildlife.

In 2004, Meyer was honored with the Arthur C. Smith Award, which is given to MIT faculty members for meaningful contributions and devotion to undergraduate student life at MIT.

Meyer also served on the board of advisors of Advocates for the Future from 1999 to 2002, the editorial board of International Studies Quarterly from 1990 to 1996, and the Committee on Science, Arms Control and National Security of the American Association for the Advancement of Science from 1989 to 1992. He was an adjunct research fellow at the Center for Science and International Affairs at Harvard University from 1980 to 1995.

Meyer, a resident of Sudbury, is the author of numerous journal articles, research papers and book chapters on issues of arms control and the environment. His MIT activities ranged from a seat on the MIT ROTC Committee from 1987 to 1991 to a position on the executive committee of the Center for International Studies from 1988 to 1995.

In September, even while struggling with cancer, Meyer agreed to write an essay about the issues he explored in "The End of the Wild" for the Boston Globe, using speech-to-text software because, as he told the Globe editors, his hands were paralyzed. In an e-mail to editors, published by the Globe on Sept. 3, Meyer wrote, "This will undoubtedly be the last article I ever publish and I'm happy about the message it carries."

In the article, Meyer concluded: "The global biodiversity collapse underway is unstoppable. Yet we can influence how it plays out in our own backyards. Obviously we should protect ourselves from insect-borne disease. But our solutions must be effective, and we must thoroughly examine the consequences. This means becoming more aware of the diversity of life sharing space with us and how our individual actions matter. It would be a shame if fireflies, spring peepers and lady slippers become mere museum displays to our grandchildren."

Meyer is survived by his wife, Deborah M. Dineen; a son, Seth Meyer; his parents, Harvey and Rebecca Meyer of Worcester; a brother, Kenneth Meyer of Henderson, Tenn.; a sister, Deborah Blumenthal of Rockville, N.Y.; and nephews.

A memorial visitation will be held Wednesday, Dec. 13, from 3 to 7:30 p.m. at the Duckett–J.S. Waterman & Sons Home of Memorial Tribute, 656 Boston Post Rd. (Rte. 20), Sudbury. In lieu of flowers, the family requests donations be sent to the Dr. Stephen M. Meyer Environmental Preservation Fund, c/o Lincoln-Sudbury Employees Federal Credit Union, 278 Old Sudbury Rd., Sudbury, MA 01776.

MIT assists investigation into fire at One Broadway

The Cambridge Fire Department, the State Fire Marshal and the U.S. Occupational Safety and Health Administration (OSHA) are currently investigating the cause of Friday's electrical fire at One Broadway, where an NStar transformer exploded, resulting in one fatality and forcing hundreds of other workers to vacate the building.

MIT is working closely with the investigators and is providing round-the-clock assistance to these efforts.

"We are doing everything possible to assist all those affected by the fire and to get the building operating again as soon as is possible," said Kirk Kolenbrander, vice president for Institute affairs and secretary of the Corporation.

An NStar employee and Roxbury native, Kevin Fidalgo, died as a result of the explosion. More than 100 people were treated for smoke inhalation at area hospitals.

MIT has owned the 17-story building at One Broadway since 1998. The building tenants include small technology firms and some MIT offices, including MIT OpenCourseWare and parts of the MIT Sloan School of Management.

The transformer exploded around 11 a.m. Friday, Dec. 8.

The Institute's emergency response team, including the MIT Environmental Health and Safety Office, MIT Campus Police and MIT Medical, provided assistance at the scene of the fire, working closely with the Cambridge Fire Department and other local rescue agencies.

MIT officials are conducting a full evaluation of the MIT-owned equipment in the building and will provide further details once their review is complete. In addition, on-site cleaning is underway, and engineers are performing appropriate environmental tests to help guide the cleanup.

Plans are in motion to provide temporary work arrangements for MIT employees who have been displaced. Administration officials are hopeful that space will be found for all Institute employees by the end of the week.

MIT community members should check the MIT News Office web site, web.mit.edu/newsoffice, for periodic updates.

SENSEable City Lab reveals 'friendspotting,' new social networking application

MIT researchers today unveiled a new social networking application that will make it possible for anyone on the Institute's 168-acre campus to locate anyone else, via the person's laptop.

Known as iFIND, the new technology was developed by researchers in the Institute's SENSEable City Laboratory.

iFIND will give all 20,000 members of the MIT community the ability to accurately calculate their location on campus, using WiFi access points, and to choose if, when and with whom they want to share it. It could become another case of campus culture having a major impact on the real world, like Facebook or YouTube, researchers said.

Carlo Ratti, director of the SENSEable City Lab, described this new form of social networking as "friendspotting": "Imagine coming out of a class in a faraway corner of the MIT campus and instantly knowing which friends are nearby, or being able to dynamically schedule an appointment with a faculty member based on his or her proximity to you," he said.

With almost 3,000 WiFi access points, the MIT campus is one of the most densely networked areas in the world. Such connectivity has changed the nature of social encounters on campus. Untethered to Ethernet cables, students, faculty and staff spend longer hours away from their offices and workstations. Cafes, lounges—sometimes just a lawn under a tree or a bench overlooking the Charles—are becoming normal workspaces.

In such a wired yet diasporic environment, new social issues emerge: How can you know where your friends are? How can you increase the chances of casual encounters with classmates? How can meetings be more effectively coordinated, in real time?

"Our goal was to create a tool that would allow friends to keep track of friends and increase serendipitous connections," said Ratti, whose research projects have explored the connection between wireless technologies and physical space.

iFIND is unique compared with similar applications that are being developed for the market, in part because of the extreme precision of its positioning system. More significantly, iFIND has been built with particular attention to privacy and data storage issues. There is no centralized storage of data, and everything happens on encrypted peer-to-peer transmissions among users.

"The system is device-centric, not network-centric. All the intelligence is inside the client application instead of on a central server, so nobody can track your position unless you want them to, and you decide how to exchange information with the outside world," said Ratti.

iFIND's distributed platform gives users full control over the sharing and anonimization of their data—something that could help solve today's growing concerns over privacy. iFIND currently deals with location data, but a whole array of additional personal information could be managed using the same interface and platform.

Future applications of iFIND will include the ability to select third parties as "friends" and let them share data anonymously. Thus, an iFIND user could "let the police department know where you are in case of emergency, but without revealing your identity," said Francois Proulx, a visiting student from the École de Technologie Supérieure in Montreal and an iFIND project leader.

iFIND's locationing platform was made possible by the WiFi initiative at MIT, spearheaded by Information Services and Technology (IS&T), which in 2005 realized its goal of making MIT a fully wireless campus.

"Our goal is to ensure that the MIT campus has the most up-to-date wireless technology to encourage the implementation of new integrated communications applications such as iFIND," said Jerrold M. Grochow, vice president for IS&T. "MIT's network infrastructure is capable of supporting any number of these types of experimental services."

Anyone with an MIT e-mail address can use iFIND.

No faculty meeting Dec. 20

The remaining scheduled faculty meeting dates for the 2006-07 academic year are:

Feb. 21, 2007
March 21, 2007
April 18, 2007
May 16, 2007

All faculty meetings are held at 3:30 p.m. in Room 32-141, except for the February meeting, which will be held in the Kirsch Auditorium (Room 32-123).

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Student 'Generator' develops ways to improve sustainability

Sasha Brown
News Office

The inaugural meeting of MIT Generator drew close to 100 MIT students from dozens of departments who gathered Nov. 14 to brainstorm and find ways to address issues of energy and the environment on campus.

Comprised of several environmental student groups and many individuals who are dedicated to increasing sustainability on campus, the MIT Generator represents an attempt "to find some semblance of one student voice," said graduate student Elsa Olivetti of materials science and engineering, one of the coordinators of the group.

The idea for the MIT Generator came just after MIT President Susan Hockfield's September letter to the community detailing the planned construction of new buildings for the Media Lab, the Sloan School and the Center for Cancer Research.

To the organizers, it seemed like an opportune time to open a discussion on green building. "There was an appetite in the student body to do something about campus sustainability," Olivetti said.

The name was part of the vision, said one of the event organizers, urban studies and planning graduate student Beaudry Kock. "It was about sharing ideas, seeing the Institute as a whole as a generator."

The first meeting—"Walking the Talk"—was exciting, Olivetti said. A three-hour session, the event featured speakers, including event leader and Sloan student Jason Jay and junior Anna Jaffe, chair of the Undergraduate Association Campus Sustainability Committee.

Steven Lanou, deputy director of the Environmental Programs Office's sustainability program, and Peter Cooper from the Department of Facilities discussed MIT's current greenhouse gas emissions and offered suggestions for reducing them.

After the talks, the large group split into smaller working groups with several themes. "It was all very practical," said Kock. "But some of the groups were really about the big picture."

The working groups focused on campus vision, energy audits and assessment, conservation efforts and transportation. At the end of the evening, all of the groups reconvened and reported on their discussions. "I was impressed by the level of interest and the staying power our discussion held," said Olivetti, who was surprised to see the evening stretch until close to 10 p.m. "It just shows the level of interest."

Several of the working groups have met again since the Nov. 14 event and they plan to continue their work together. "Students need to find ways to make this work applicable to what they are studying in school," said Olivetti. "That will make it more sustainable over time."

The organizers hope that the MIT Generator will become an annual event that will continue to draw more interest and new faces. In February, a second event that the group is calling "Re-Generator" will convene. "Our role is to keep momentum going," Olivetti said.

For more information, please go to sustainability.mit.edu/Generator.

Parkinson's disease may be curtailed by processes in yeast, fruit flies

Carol Cruzan Morton
HHMI Bulletin

Yeast might not be the most obvious experimental model for neurodegenerative diseases. For one thing, yeast cells don't have brains.

But these single-celled creatures get sick and die from the same toxic culprit that mucks up dopamine-producing neurons in Parkinson's disease. Now, a multi-institutional team led by Susan Lindquist, MIT biology professor and Whitehead Institute member, has found a way to reverse the damage in yeast. Even better, the team confirmed the same defect and cure in dopamine-producing neurons of fruit flies, roundworms and rats.

PHOTO / **JASON GROW/HHMI BULLETIN**

Susan Lindquist called in colleagues to see if her findings in yeast would hold up in animals with neurons and brains.

The findings reveal how simple yeast may speed up the search for new therapeutics for complex brain diseases that are hard to study in people. "We put a human gene into an organism that separated from us in evolution one billion years ago, and we found the same biochemical activity," says Lindquist, who is also a Howard Hughes Medical Institute investigator. "This is a new way to understand the biology and a potential mechanism for discovering drugs."

Three years ago, researchers in Lindquist's lab at the Whitehead Institute showed how yeast can serve as "living test tubes" by supplementing them with the gene encoding the human protein alpha-synuclein—a major contributor to compromised brain function in people with Parkinson's disease. One copy of the gene didn't hurt the yeast, but two copies proved fatal. "That's when we decided to use the yeast for genetics and for drug screening," says Lindquist.

In work reported in the July 21 issue of Science, Lindquist and her colleagues investigated whether extra amounts of any yeast gene could offset the effects of excess alpha-synuclein. They set about testing 5,000 yeast genes one by one.

The sought-after response emerged after they had tested a third of the genes in the yeast genome. Yeast bogged down by alpha-synuclein perked up when they had extra copies of genes associated with the movement of proteins from one cellular compartment to another. More specifically, these genes affect the flow of tiny fatty bubbles known as vesicles from the endoplasmic reticulum (ER), where newly made proteins are customized for special duties, to the Golgi complex, where the proteins are further modified, repackaged and addressed for delivery. An extra copy of one particular gene rescued the yeast from alpha-synuclein overload—and, later, its counterpart did the same for roundworms, fruit flies and rat neurons.

"It's sort of like traffic on city streets, which is normally controlled by stoplights," says Lindquist. "Here, it's like someone crashed at the intersection and nothing is getting through." The extra ER-Golgi trafficking gene acts like a police officer directing cars past the wreck. "Our idea is that [the extra alpha-synuclein] is doing something generally toxic to all cells," she says. "It's just that the dopamine-producing neurons are more sensitive and die earlier."

One hazard for these cells is the dopamine. As soon as the unstable neurotransmitter is made, vesicles must quickly package it and shuttle it out of the neuron. If dopamine accumulates inside the neuron, it can degrade into destructive by-products, such as the reactive oxygen species found in Parkinson's patients.

Collaborator (and first author of the Science paper) Antony Cooper at the University of Missouri–Kansas City determined that the first signs of blocked ER-Golgi traffic happen early on in yeast with an overabundance of alpha-synuclein. He also noted that the genetic boosts were rescuing yeast by, in essence, turbocharging ER-Golgi traffic to override obstruction caused by the protein.

"At that point it became really interesting," Lindquist says, "but it was just yeast."

So Lindquist called fruit fly neurogeneticist Nancy M. Bonini, an HHMI investigator at the University of Pennsylvania, to see if the findings would hold up in animals with neurons and brains. Bonini had developed a Parkinson's model by overexpressing alpha-synuclein in dopamine-producing fly neurons. She found that the gene that made the most difference in the yeast also appeared to suppress toxicity in the fly model.

"Although a yeast cell is not a neuron," Bonini says, "and nothing takes the place of (studies in) humans, this is an example of fundamental cell biology leading to a new insight that puts us in a much better position to pioneer a foundation for new therapeutic approaches."

Lindquist brought in two more collaborators late last year. Jean-Christophe Rochet at Purdue University tested the gene in midbrain neurons cultured from rat embryos, with the same results. University of Alabama researchers tried identical experiments in a roundworm model of Parkinson's disease that had been developed in the lab of Guy A. Caldwell.

"Lo and behold, it worked like a charm," says Caldwell. "It's a beautiful continuum going from a single cell to a mammalian system. It tells us this pathway is evolutionarily conserved."

"Now we're off to the races," says Lindquist. Participating researchers are following up on promising results in their respective animal models, exploring additional features of the biology in the more complex organisms and testing small molecules from the yeast drug screen as potential new drugs.

MIT-CIMIT winner will research ways to assess neuromuscular disease

The Center for Integration of Medicine and Innovative Technology (CIMIT) and the MIT School of Engineering recently announced the award of the first MIT-CIMIT Medical Engineering Fellowship. Olumuyiwa Ogunnika, a graduate student in the Department of Electrical Engineering and Computer Science at MIT, will use the $50,000 award to support research toward a device for assessing neuromuscular disease.

Thomas L. Magnanti, dean of the MIT School of Engineering, said of the new joint award, "Since medicine and health care are among the most critical issues that we all face, we are delighted to partner with CIMIT in offering the new MIT-CIMIT Medical Engineering Fellowship. It not only provides support for one of our outstanding students to pursue advancements in this arena, but it also sends the message that medical engineering is important to all of us."

The award was announced at the CIMIT Innovation Congress held in Boston in November.

Ogunnika's current project involves the development of an integrated circuit for a handheld electrical impedance probe for the assessment of neuromuscular disease. His other interests are in the application of analog and mixed-signal circuit design techniques to solving biomedical instrumentation and diagnostic problems.

"I see tremendous opportunity for fruitful collaboration between engineers and clinicians, leading to significant advances in diagnostic technology for a wide variety of diseases," Ogunnika said.

Born in Brooklyn, N.Y., Ogunnika, known as Muyiwa, grew up in Nigeria. After returning to the United States, he earned a bachelor of engineering degree in electrical engineering from the City College of New York in 2001 as valedictorian of his class. He held positions at Intel, IBM and the Los Alamos National Laboratory before coming to MIT.

PHOTO COURTESY / **DEPT. MECHANICAL ENGINEERING**

Olumuyiwa Ogunnika

Political scientists comment on Iraq

Stephanie Schorow
News Office Correspondent

The Iraq Study Group, headed by former Secretary of State James A. Baker, released its report to the White House on Dec. 6. That day, four MIT foreign policy experts presented key points on the the Iraq situation. Below are excerpts from their comments.

Barry Posen

Barry R. Posen is the MIT Ford International Professor of Political Science and director of the MIT Security Studies Program.

• The United States should set a date certain for the disengagement of its combat forces from Iraq and announce it. The U.S. presence there stimulates nationalist and religious resistance from Sunni and Shia and at the same time protects all the parties from the full consequences of their political intransigence toward each other. There is no magic formula, but the disengagement date should be soon enough so that it seems real to the parties, and delayed long enough so that we can plan and conduct the disengagement carefully. I like Jan. 1, 2008.

• The United States and other interested parties should look into the possibility of setting up an international trusteeship for Iraqi oil revenues.

• A conference of interested parties–regional states and other powers–should be convened to try to contain any civil war to Iraq, and if possible to limit its duration and intensity.

Barbara Bodine

John Tirman is executive director of the MIT Center for International Studies and coauthor and coeditor of "Terror, Insurgency and the State" (Penn Press, 2007).

• The United States must recognize that it now may be an impediment to stability. The colossal amount of killing, now numbering in the hundreds of thousands, was stirred by the invasion and a ferocious counterinsurgency strategy that has failed.

• We should not abandon Iraq altogether, however, and should be willing to invest many tens of billions in reconstruction—accountable and under control of Iraq—once the killing subsides.

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Genetic map offers new tool for malaria research

Researchers find nearly 47,000 genetic variations in parasite responsible for one death every 30 seconds

An international research team has completed a map that charts the genetic variability of the human malaria parasite, Plasmodium falciparum. The work, published in the Dec. 10 advance online edition of Nature Genetics, has already unearthed novel genes that may underlie resistance to current drugs against the disease.

The study reveals striking variation within the pathogen's genome, including an initial catalog of nearly 47,000 specific genetic differences among parasites sampled worldwide. That's more than double the expected level of diversity in the parasite's DNA. These differences lay the foundation for dissecting the functions of important parasite genes and for tracing the global spread of malaria.

The scientists who created the map are from the Broad Institute of MIT and Harvard, the Harvard School of Public Health and Cheikh Anta Diop University in Senegal, where malaria is endemic.

Eric Lander

"Malaria remains a significant threat to global public health, driven in part by the genetic changes in the parasite that causes the disease," said senior author Dyann Wirth, a professor at the Harvard School of Public Health and co-director of the Broad Institute's Infectious Disease Initiative. "This study gives us one of the first looks at genetic variation across the entire malaria parasite genome—a critical step toward a comprehensive genetic tool for the malaria research community."

Plasmodium falciparum—the deadliest of the four parasites that cause malaria in humans—kills one person every 30 seconds, mostly children living in Africa. Despite decades of research, the genetic changes that enable it to escape the body's natural defenses and to overcome malaria drugs remain largely unknown.

To gain a broad picture of genetic variability—worldwide and genome-wide—the scientists analyzed more than 50 different P. falciparum samples from diverse geographic locations. This includes the complete genome sequencing of two well-studied samples, as well as extensive DNA analyses of 16 additional isolates.

By comparing the DNA sequences to each other and to the P. falciparum genome sequenced in 2002, the researchers uncovered extensive differences, including 47,000 single-letter changes called single nucleotide polymorphisms (SNPs). Although there are probably many more SNPs to be found, this initial survey provides a launching point for future systematic efforts to identify parasite genes that are essential to malaria.

"The roles of most of the malaria parasite's genes are still not known," said Sarah Volkman, a research scientist at the Harvard School of Public Health. "An important application of this new tool will be in pinpointing the genes that are vital to the development and spread of malaria."

Volkman and Pardis Sabeti, a postdoc-

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PHOTO / **DONNA COVENEY**

MIT professor of chemical engineering Gregory Stephanopoulos, left, postdoctoral associate Hal Alper and professor of biology Gerald Fink in the lab. The researchers have engineered a new strain of yeast that can produce ethanol more rapidly and efficiently.

BIOFUELS

Continued from Page 1

vidual software applications (genes), says Fink, an MIT professor of biology and a co-author on the paper.

In this case, the researchers targeted two different transcription factors. They got their best results with a factor known as a TATA-binding protein, which when altered in three specific locations caused the over-expression of at least a dozen genes, all of which were found to be necessary to elicit an improved ethanol tolerance, thus allowing that strain of yeast to survive high ethanol concentrations.

Because so many genes are involved, engineering high ethanol tolerance by the traditional method of overexpressing individual genes would have been impossible, says Alper. Furthermore, the identification of the complete set of such genes would have been a very difficult task, Stephanopoulos adds.

The high-ethanol-tolerance yeast also proved to be more rapid fermenters: The new strain produced 50 percent more ethanol during a 21-hour period than normal yeast.

The prospect of using this approach to engineer similar tolerance traits in industrial yeast could dramatically impact industrial ethanol production, a multistep process in which yeast plays a crucial role. First, cornstarch or another polymer of glucose is broken down into single sugar (glucose) molecules by enzymes, then yeast ferments the glucose into ethanol and carbon dioxide.

Last year, four billion gallons of ethanol were produced from 1.43 billion bushels of corn grain (including kernels, stalks, leaves, cobs, husks) in the United States, according to the Department of Energy. In comparison, the United States consumed about 140 billion gallons of gasoline.

Other co-authors on the Science paper are Joel Moxley, an MIT graduate student in chemical engineering, and Elke Nevoigt of the Berlin University of Technology.

The research was funded by the DuPont-MIT Alliance, the Singapore-MIT Alliance, the National Institutes of Health and the U.S. Department of Energy.

Chemists propose methods for storing solar energy

Chemistry's role in bridging the gap between solar energy's limited present use and enormous future potential was the topic of a recent article by MIT Professor Daniel G. Nocera and a colleague.

In 2001, approximately 86 percent of the world's energy was obtained from fossil fuels. While fuel reserves are sufficient to support an energy demand that is expected to triple by 2100, the more immediate problem lies in stabilizing excess atmospheric carbon dioxide, a key contributor to global warming, by adopting more carbon neutral power.

Daniel G. Nocera

The sun's vast energy could be an ideal power source. More energy from sunlight strikes the Earth in one hour than is consumed by the planet in one year. Yet in 2001 solar energy accounted for less than 0.1 percent of total electricity.

The major hurdle to overcome is developing a cost-effective method of storage. "We need energy when the sun doesn't shine," said Nocera, the W.M. Keck Professor of Energy and professor of chemistry.

Nocera and Nathan S. Lewis of Caltech suggest that we borrow from nature and store solar energy in the form of chemical bonds, as plants do in photosynthesis. The mechanism would involve splitting water to generate oxygen and storable fuels such as methane or other hydrocarbons.

In an October issue of the Proceedings of the National Academy of Sciences, the two propose several possible reactions. They note, however, that advances in chemistry such as the development of suitable catalysts for water-splitting are crucial for solar energy to reach its full potential.

–Elizabeth Thomson

PHOTO / **JOHN TYLKO**

For spacious skies

MIT alum Nicholas J.M. Patrick (S.M. 1990, Ph.D. 1996, mechanical engineering) and his six astronaut colleagues were launched aboard Discovery on a mission to the International Space Station on Dec. 9. While at MIT, Patrick was a research assistant in the Human-Machine Systems Lab in the Department of Mechanical Engineering. He was selected as a NASA astronaut in 1998. Discovery also carried key elements of MIT's SPHERES experiment developed by the Space Systems Lab in the Department of Aeronautics and Astronautics.

Beyond silicon: New MIT transistor technology may power next-generation microelectronics

MIT engineers have demonstrated a technology that could introduce an important new phase of the microelectronics revolution that has already brought us iPods, laptops and much more.

The work will be presented at the IEEE International Electron Devices Meeting Dec. 11-13 by Dae-Hyun Kim. Kim is a postdoctoral associate in the laboratory of Jesús del Alamo, an MIT professor of electrical engineering and computer science and member of MIT's Microsystems Technology Laboratories (MTL).

"Unless we do something very radical pretty soon, the microelectronics revolution that has enriched our lives in so many different ways might come to a screeching halt," said del Alamo.

The problem? Engineers estimate that within the next 10 to 15 years we will reach the limit, in terms of size and performance, of the silicon transistors key to the industry. "Each of us has several billion transistors working on our behalf every day in our phone, laptop, iPod, car, kitchen and more," del Alamo noted.

As a result, del Alamo's lab and others around the world are working on new materials and technologies that may be able to reach beyond the limits of silicon. "We are looking at new semiconductor materials for transistors that will continue to improve in performance, while devices get smaller and smaller," del Alamo said.

One such material del Alamo and his students at the MTL are investigating is a family of semiconductors known as III-V compound semiconductors. Unlike silicon, these are composite materials. A particularly hot prospect is indium gallium arsenide, or InGaAs, a material in which electrons travel many times faster than in silicon. As a result, it should be possible to make very small transistors that can switch and process information very quickly.

Del Alamo's group recently demonstrated this by fabricating InGaAs transistors that can carry 2.5 times more current than state-of-the-art silicon devices. More current is the key to faster operation. In addition, each InGaAs transistor is only 60 nanometers, or billionths of a meter, long. That's similar to the most advanced 65-nanometer silicon technology available in the world today.

"The 60-nanometer InGaAs quantum-well transistor demonstrated by Professor del Alamo's group shows some exciting results at low supply voltage (e.g. 0.5V) and is a very important research milestone," said Robert Chau, senior fellow and director of transistor research and nanotechnology at Intel, a sponsor of the work.

Del Alamo notes, however, that InGaAs transistor technology is still in its infancy. Some of the challenges include manufacturing transistors in large quantities, because InGaAs is more prone to breakage than silicon. But del Alamo expects prototype InGaAs microdevices at the required dimensions to be developed over the next two years and the technology to take off in a decade or so.

"With more work, this semiconductor technology could greatly surpass silicon and allow us to continue the microelectronics revolution for years to come," del Alamo said.

In addition to Intel, this research is sponsored by the Microelectronics Advanced Research Corporation. The MIT transistors were fabricated by pulling together the capabilities of three MIT laboratories: the Microsystems Technology Laboratories, the Scanning-Electron-Beam Lithography Facility and the Nanostructures Laboratory. Del Alamo notes that one reason for the exceptional performance of these transistors is the high quality of the semiconductor material, which was prepared by MBE Technology of Singapore.

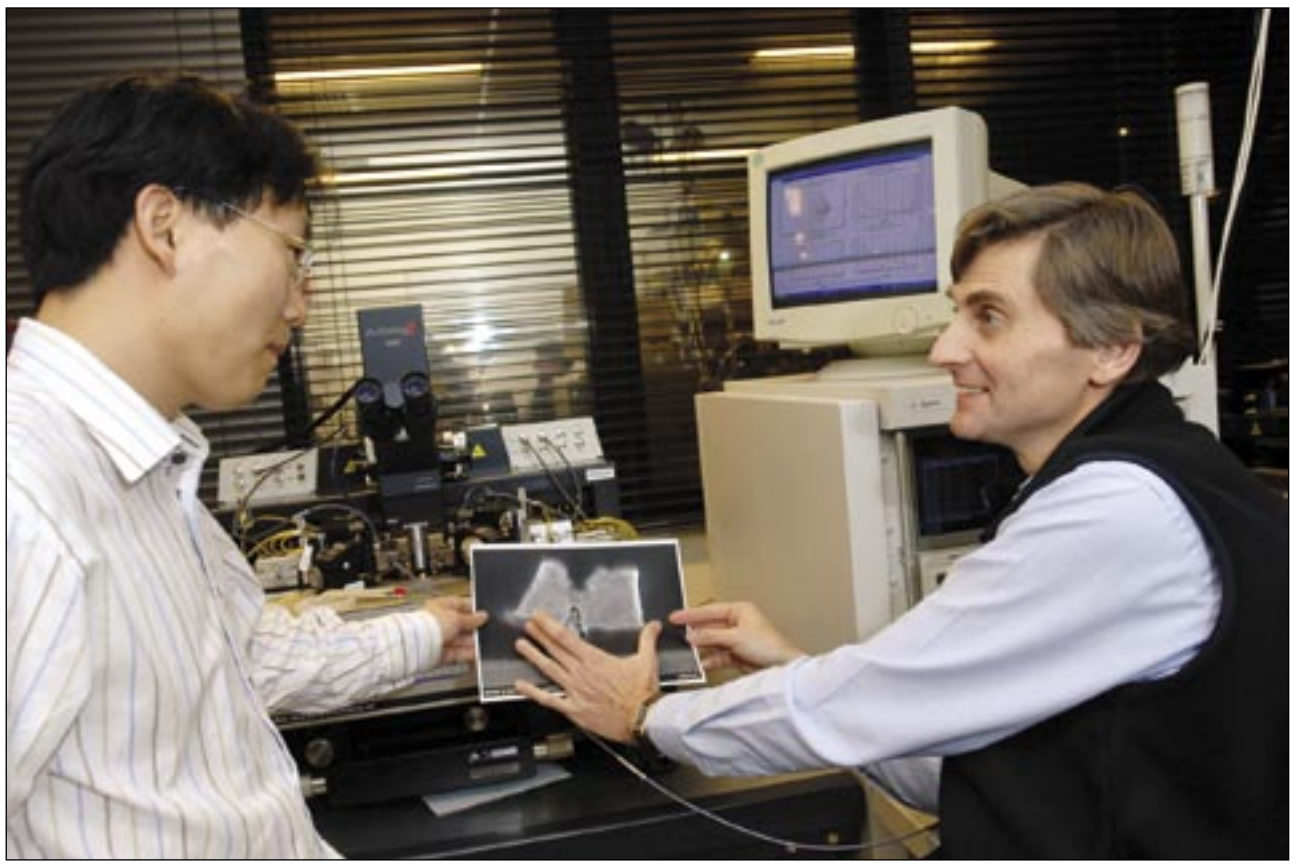


PHOTO / **DONNA COVENEY**

Postdoctoral associate Dae-Hyun Kim, left, and Professor Jesús del Alamo look at a cross-section of the new transistor they have been developing. Behind them is the test equipment used to measure its characteristics.

Virtual lab partners and plush robo-pet are fruits of iCampus

Robin H. Ray
News Office Correspondent

The iCampus celebration, "Learning Without Barriers/Technology Without Borders," featured not only a symposium to honor the MIT-Microsoft alliance, but also live demonstrations of some educational technology initiatives that emerged from the eight-year partnership.

The MIT Museum offered compelling glimpses of technologies that promise to revolutionize social arenas, from classrooms to hospital wards. These include Technology-Enabled Active Learning (TEAL); iLabs; Classroom Learning Partner (CLP) software; and the Huggable, a robotic companion animal.

Peter Dourmashkin, senior lecturer in physics at MIT and associate director of the Experimental Study Group, was on hand to present TEAL. The TEAL classroom, Dourmashkin explained, started with real estate: Instead of having the lecturer poised before an inert mass of students, followed at some later date by a separate "hands-on" lab, the TEAL class is based on tables of nine students—three groups of three—with the professor and teaching assistants alternately lecturing and mingling at the tables as students work with test apparatus linked to laptops. The walls are lined with projection screens as well as traditional chalkboards, enabling everyone to view sophisticated visualizations and simulations that bring the material to life.

PHOTO / **DONNA COVENEY**

Hayes Raffle, grad student at the Media Lab, demonstrates an iCampus project—a programmable moose. Twisting its extremities generates both action and 'learning.'

"Our model was a music class," Dourmashkin said, "in which faculty can see how everybody learns." Students learn from one another as well as from the instructor, and no one gets to hide in the back of the auditorium, passive and unengaged. TEAL has been used in Physics 8.02 (Electricity and Magnetism) since 2005, and the road to change has not been without bumps. "We have to work hard at training our faculty, even the Nobel Prize winners," Dourmashkin said. Among other things, the TEAL instructors have learned that it's a good idea to mix up the groups halfway through the semester, to break up unhealthy work relationships and give everyone a fresh start. Nevertheless, he and his colleague John Belcher have demonstrated a 20 to 30 percent improvement in students' conceptual understanding of the course material, relative to their peers. (You can read more about TEAL and see a class in action at icampus.mit.edu/teal.)

Global Lab Partners

One of the star achievements of the iCampus alliance, iLabs, was demonstrated by Jesús del Alamo, professor of electrical engineering. This technology allows instructors and students anywhere in the world to access electrical lab equipment set up at an iLab server; all they need is an Internet connection. Students in Singapore, Greece, Sweden and Africa have taken advantage of the iLab, including one configured for MIT Course 6.002 (Electronics and Circuits). (Curricula and

See **iCAMPUS** Page 6

MIT ranks 12th in black enrollment

Sasha Brown
News Office

MIT has made huge diversity gains this year, according to the Journal of Blacks in Higher Education's 14th annual survey of the percentages of black first-year students at the nation's highest-ranked universities and liberal arts colleges.

This year's freshman class of 1,000 includes 81 black freshmen—8.1 percent. This is up from 55 blacks in the 2005 entering class.

"Our survey obtained information on the number of African-American applicants, their acceptance rates, enrollment numbers and yield rates (the percentage of students who eventually enroll in the college at which they were accepted)," the article said.

Among the 30 highest-ranked universities in the country, MIT ranked 12th in terms of black enrollment.

The University of North Carolina at Chapel Hill was number one with 12.3 percent of its 2006 freshman class.

"This recent progress is an outward reflection of our vigorous and sustained commitment to ensure that talented students from all walks of life have access to MIT," said Karl Reid, executive director of special programs for the School of Engineering. "While we are proud that African-Americans are coming to MIT in almost record numbers, we are even more proud that they, like all our students, are thriving both academically and socially at MIT."

PHOTO COURTESY / **HOFBURG PALACE, PRESIDENTIAL OFFICE OF AUSTRIA**

Exner Medal

Shuguang Zhang, associate director of MIT's Center for Biomedical Engineering, received Austria's 2006 Wilhelm Exner Medal for outstanding contributions to science and technology from the president of Austria, Heinz Fischer, pictured left. Zhang, right, was honored for his work with self-assembling peptides—microscopic strings of amino acids with seemingly inexhaustible possibilities for producing new materials. Two other MIT scientists have won the Exner Medal: Charles H. Townes (1970), a physicist who served as provost of MIT; and August (Gus) F. Witt (1975). Zhang is the first Chinese scientist to receive the Exner Medal.

PARTNERSHIP

Continued from Page 1

of reversing the slide. Rashid noted that "the iCampus program is really a watershed program for us," one that is inspiring Microsoft to be in contact with more and more universities.

'Sage on a stage' no more

The keynote address given by John Seely Brown, formerly chief scientist at Xerox and currently "chief of confusion," according to his web site, was singled out by many as a high point of the symposium. His wide-ranging talk, "Relearning Learning—Applying the Long Tail to Learning," dealt with the difficult job of preparing students for a rapidly evolving world.

With today's markets and technologies mutating at aggressive speeds, Brown said, "It makes no sense to train someone for a career; at most, a career trajectory." The Cartesian model of education, in which knowledge is perceived as a substance to be decanted from the teacher's mind to the students', served the United States well when we were a nation of farmers and factory workers. That model is meaningless in the world that students now face. Rather, Brown believes, we must move toward an "atelier" model of education, in which work is undertaken in an open, shared environment, where students can see each other's work develop from idea to final design, hear the critiques of that work, and learn from each member of the group how he or she incorporates criticism and suggestion.

This, of course, demands that the educators change as well, that they cease being the "sage on a stage" and become something more like a mentor. Brown cited studies showing that these more socially connected educational environments, when implemented in science and engineering classes, also boost the retention of groups often characterized by large attrition rates, e.g., women and minority students. He noted how technology can be leveraged to tap exciting pools of talent and innovation around the world, and to spark a new culture of teaching and learning.

A discussion followed on the "roles of academia, industry and government in addressing competitiveness through education and technology," moderated by Deborah Wince-Smith, president of the Council on Competitiveness. The panel represented the highest levels of all three sectors: Tufts University President Lawrence Bacow; Diane Jones, associate director for science at the White House Office of Science and Technology Policy; Rep. Vernon J. Ehlers of Michigan's 3rd District; Richard Lampman, senior vice president for research at Hewlett-Packard; and Rashid.

There was broad criticism of some of the government's efforts in boosting STEM education, for example, the unevenness of science funding from cycle to cycle and the dismal state of teacher training in these areas. But there was also recognition that the federal government is paying increasing attention to the problem and searching hard for intelligent solutions.

Legos to lasers

In the afternoon session, educators took the floor, presenting creative educational strategies and models from the country's leading universities. Irene Georgakoudi of Tufts' engineering department enthralled the audience with a demonstration of how freshmen in her introductory engineering course use Legos to build lasers. Peter Chen from the University of Michigan showed how he harnessed students' love of music in an introductory computer science class, assigning groups of four students the task of developing a music synthesizer from concept to written specs in a single semester. Shekhar Garde of Rensselaer Polytechnic Institute demonstrated a musical film he developed, aimed at teaching the concept of atoms and molecules and the three states of matter to 5- to 10-year-olds. (You can view the trailer and read more about the project at www.molecularium.com.)

Friday's session closed with an address by MIT President Emeritus Charles Vest, who with Microsoft Chairman Bill Gates initiated the iCampus collaboration in 1999, and with reflections by current MIT President Susan Hockfield.

Said Hockfield, "iCampus has launched us on a voyage of discovery…It has allowed people to see an opportunity and run with it." Noting that iCampus had engaged more than 400 faculty and researchers at MIT, she cited such successful projects as iLAB, iGEN, and Visualizing Cultures. While Hockfield conceded that the United States "needs to do a better job of inspiring young people to study science, math and technology," Tufts President Bacow spoke for many when he said, "We should never forget that the higher education system that we have in this country, for all of its failings…is the envy of the rest of the world. We are clearly doing many things right."

iCAMPUS

Continued from Page 5

course materials can also be downloaded via MIT OpenCourseWare.) Remote participants can set up experiments and change the parameters to suit their needs, then receive the raw data in real time. "That's the beauty of the iLab," said del Alamo. The new and improved version, 6.1, was on view for the first time at the symposium.

Notes from underground

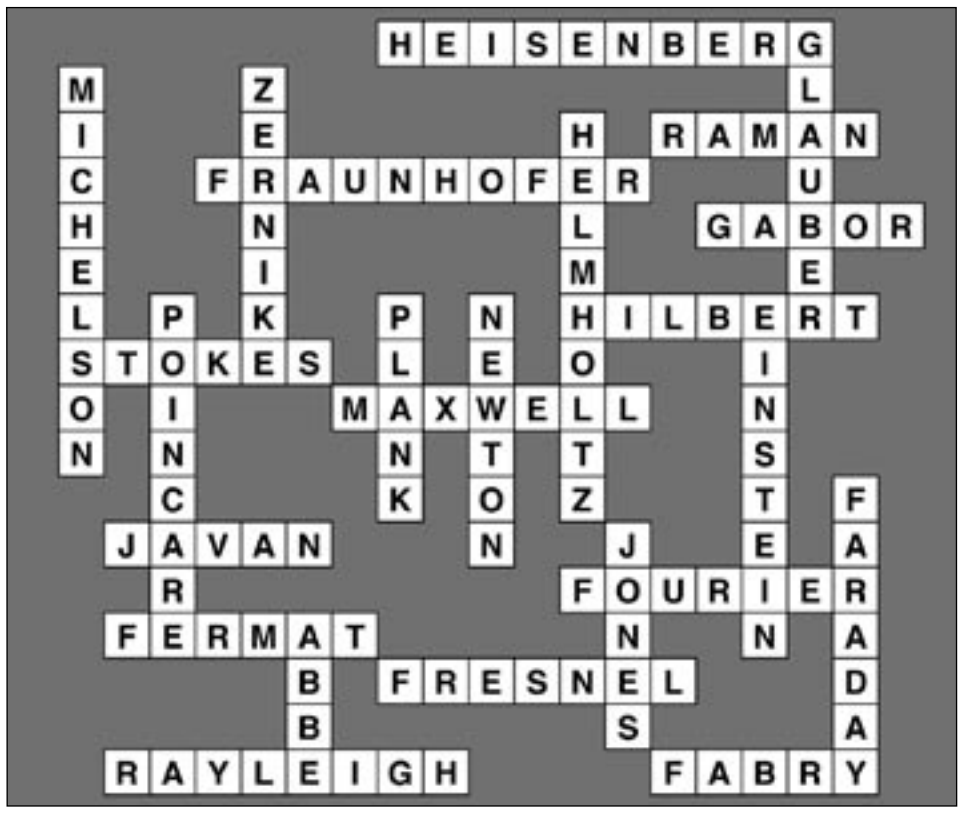
Elsewhere at the museum, Kimberle Koile, of the Computer Science and Artificial Intelligence Laboratory, showed off a new wireless technology for classroom teachers. Classroom Learning Partner (CLP) software, running on tablet PCs, allows teachers to get instant and anonymous feedback on how well the class is assimilating curriculum materials. The tablet PCs can display complex diagrams, maps and other visually dense materials, but more importantly, they are equipped to interpret both sketches and handwriting. Teachers therefore can ask students concept questions; their handwritten answers are instantly graphed in a histogram. As Koile noted, "Teachers can figure out instantly how well students are understanding the material." Koile is currently using CLP in an introductory computer science course at MIT, but she also successfully tried the technology out in her son's first-grade class in Lexington.

The Huggable

One demo drew an interested crowd of school kids. This was the Huggable, the plush product of a collaborative effort in the Media Lab that was supported by an iCampus grant. On hand to explain its functionality, which is still in development, was Dan Stiehl, research assistant in robotic life at the Media Lab. As Stiehl explained, the medical profession has long recognized the therapeutic value of companion animals, but many patients who would benefit from animal company are in environments that cannot support pets: places like hospitals, nursing homes and rehab facilities. The Huggable is essentially a robotic companion animal that is not only cute and soft but responsive, measuring how much and how it is being handled. Its eyes can act as remote cameras, and it can also gather auditory and motion data from the patient, determining, for example, whether the child holding it is rocking back and forth in a manner suggesting anxiety or fear. Because the bearlike toy can be linked electronically to the nurses' station, Stiehl said, "The Huggable is a team member," extending the reach of busy hospital staff. The first pilot trials will get underway in 2007 in Scotland, in collaboration with Highlands and Islands Enterprises.

Famous optics people

Solution to the optics puzzle, *Tech Talk*, Dec. 6:



IRAQ

Continued from Page 3

• We must also be mindful of the longer term issues that could keep Iraq roiled for many years. Things we can do to stabilize Iraq would include giving up regime-change fantasies and improving relations with Iran, dedicating all U.S. resources to a just settlement of the Israeli-Palestinian conflict, and working with Turkey, Syria and Iran to improve the lot of their Kurdish populations.

Barbara Bodine is a visiting scholar at the MIT Center for International Studies. A former career member of the Senior Foreign Service, she has spent much of her 30-year diplomatic career in the Middle East and the Arabian Peninsula.

• The partition of Iraq is neither inevitable nor advisable. First, it is not the option of choice within Iraq or by Iraqis, including many Kurds, who realistically prefer a Quebec-like status within a functioning Iraq to an enclave status adjoining a failed state, or two. Second, it is not possible, despite the grotesque sectarian violence. Iraqi society remains a mosaic of nearly 30 ethnic and sectarian groups. Third, it would not solve the violence and could exacerbate it. Competition for control of resources and major multi-ethnic/sectarian cities—Mosel, Kirkuk, Basra and Baghdad, most notably—would be fierce.

• Regarding regional players: All of Iraq's neighbors recognize the danger a failed and violent Iraq poses; none want to see it fragment. They would welcome a regional, diplomatic and political approach led by the United States. They will try to shape one on their own if we do not.

Cindy Williams is a principal research scientist of the MIT Security Studies Program. Formerly she was an assistant director of the Congressional Budget Office.

• End the futile attempt to create a unity government in Iraq. Work instead toward a loose confederation with weak central authority, regionalized military forces and regional collection and control of taxes. Have an outside authority collect and divide Iraqi oil income by region, based on population.

To read the complete text of their comments, please go to web.mit.edu/newsoffice/2006/iraq-plan.html.

MALARIA

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toral fellow at the Broad Institute, are first authors on the paper.

One of the map's strengths is its ability to reveal evolutionary differences among parasites. This information can shed light on the genes responsible for malaria drug resistance—a major obstacle to adequate control of the disease.

Using the map to compare parasites exposed to different antimalarial drugs, the scientists identified a novel genome region that is strongly implicated in resistance to the drug pyrimethamine, and also confirmed a region of the genome known to be involved in chloroquine drug resistance.

"The same genetic principles used to study human evolution can provide important clues about malaria," said Sabeti. "This tool has already yielded insights into the genetic changes that correlate with different drug treatments, pointing us to genes that may contribute to drug resistance."

The map can also define the genetic landscapes of different parasite populations. Applying it to parasites from various continents, the scientists discovered greater DNA variability among P. falciparum samples from Africa relative to those from Asia and the Americas. This knowledge guides the selection of genetic markers to track the transmission of distinct parasites, particularly ones that are virulent or drug resistant. It also lays the groundwork for connecting parasite genes with traits that vary geographically and bolster malaria's foothold in many parts of the world.

"Genomic tools have largely been applied to First World diseases up to now. This project underscores the power and importance of applying them to the devastating diseases of the developing world," said Eric Lander, one of the study's authors and the director of the Broad Institute. "By joining forces among scientists in the U.S., Africa and elsewhere, it should be possible to rapidly reveal the genetic variation in malaria around the world. "Knowing the enemy will be a crucial step in fighting it," said Lander, who is also a professor of biology at MIT and a member of the Whitehead Institute for Biomedical Research.

The work is one of three large-scale studies of the parasite's DNA that appear together in Nature Genetics. It was supported by the Bill and Melinda Gates Foundation, the Burroughs-Wellcome Fund, the Exxon Mobil Foundation, the National Institutes of Allergy and Infectious Disease Microbial Sequencing Center and the National Institutes of Health.

MIT musicians perform at MFA

Joanna Michalowski
Office of the Arts

Two MIT-based musical groups, each drawing from a different cultural tradition, will perform over the next two weeks at the Museum of Fine Arts in Boston, as part of its "MFA for the Holidays" series (Dec. 9-17), featuring an array of eclectic performances taking place each day at various locations within the museum.

The pair of MIT student-led musical groups, Oori and KlezMITron, will be among the performers featured in the nine-day series of events.

Appearing on Thursday, Dec. 14, from 1:30 to 2:30 p.m. in the Koch Gallery, Oori will perform a traditional Korean art form known as pungmul, an energetic performance art that incorporates exhilarating drumming, circle dancing and singing.

Composed of students from MIT, Harvard, Boston University and other schools, as well as community members from the greater Boston area, Oori (a Korean term meaning "us") "follows the theme of pungmul by embracing everyone and excluding no one," said Minyoung Jang, president of the group and a senior biology major.

Originally performed during celebrations such as harvest and religious folk rituals, pungmul utilizes four basic percussive instruments: the jang-goo (an hourglass-shaped drum), kwaeng-ga-ri (a small gong), jing (a larger gong) and buk (a barrel drum). Jang, who has participated in the group since she was a freshman, recalls the first few times she saw pungmul performances before coming to MIT. "I really loved the energy. They embodied the phrase, 'bursting with joy.'"

Performing in the museum's Lower Rotunda on Sunday, Dec. 17, from 2:30 to 4 p.m. is KlezMITron (previously MIT Klez), a klezmer group comprised of two violins, a piano and bass, played by Scott Arfin, a Ph.D. student in electrical engineering and computer science. Klezmer music, which originated centuries ago in Eastern Europe, is a traditional but secular music of the Jewish people that was performed during joyous occasions, particularly weddings.

Klezmer has experienced "a renaissance in the United States in the past 20 years or so," said Arfin. While KlezMITron usually performs traditional klezmer music, modern day klezmer artists, he says, perform traditional tunes with both traditional and modern interpretations such as fusion with jazz and bluegrass. The music is "designed for dancing and celebration rather than listening, but modern klezmer is becoming more and more common in the concert hall," he said.

While some music is derived from liturgical melodies, klezmer music is never performed during worship and therefore remains a secular art form, existing solely for the purpose of celebration.

Admission to these events is free with museum admission. Through MIT's university membership at the MFA, MIT students can enjoy the museum's regular exhibitions and cultural programs for free with a current student ID.

PHOTO / **DONNA COVENEY**

MIT Museum curator of science and technology Deborah Douglas examines a simple microscope from the exhibit, 'Singular Beauty,' with the owner of the collection, Raymond V. Giordano.

Museum displays 'Singular Beauty' of microscopes

Tiny instruments, invented in 1600s, are still used in research

The MIT Museum is currently showcasing the exquisite beauty of the simple microscope, the portable single-lens instruments invented in the 17th century and made famous by naturalists such as Antoni van Leeuwenhoek, Carl Linnaeus and Charles Darwin. Titled "Singular Beauty," it is the first comprehensive exhibition of this instrument by an American museum. It runs through Sept. 16, 2007.

"The microscope is one of the iconic instruments of the life sciences. While a display of this type is of great interest to historians and collectors of scientific instruments, what is less obvious is how fascinating these instruments are to those on the cutting edge of microscopy research," said MIT Museum curator of science and technology Deborah Douglas, underscoring the value of displaying historical scientific instruments.

The exhibition features images from six MIT laboratories and displays 127 instruments from the rich collection of Raymond V. Giordano. Along with Douglas, Giordano co-curated the exhibition and authored the catalog. A noted appraiser of scientific instruments and books, Giordano has collected simple microscopes for 30 years.

"Besides its historical aspect, the simple microscope, in its many variations, is a pleasure to handle and study. Clearly instrument makers used their ingenuity to advance the field, and importantly, to gain a competitive edge. Today we can marvel at their accomplishments—optical, mechanical and aesthetic," Giordano said.

The exhibit, called "Singular Beauty," offers a variety of ingenious instruments. Examples range from one of the early simple microscopes of the type designed by the Dutch naturalist van Leeuwenhoek to the pocket instruments made by the American optical firm Bausch & Lomb. Most of the instruments are tiny, some less than an inch across, but even the largest can be easily carried. These elegant tools are made of wood, silver, brass, ivory, horn and glass. In addition to the microscopes, the exhibition includes reproductions of illustrations from historic scientific texts, catalogs, broadsheets and paintings.

A small display of images of contemporary microscopy at MIT is also on view in the gallery. This display was researched and co-curated by MIT student Iolanthe Chronis, Class of 2008, with the support of the MIT Undergraduate Research Opportunities Program.

Postcard sale will benefit homeless women

Put your creativity to work! "Postcards from MIT" is an art project in which all members of the MIT community—faculty, staff, students and alumni/ae—are invited to create and submit a piece of artwork on a postcard. The only requirements are that the postcard must be 4 inches by 6 inches and it must be an original piece of artwork. The artist should only sign the back of the card, not the front. And the artwork should NOT be framed. The artwork can be a photograph, oils, pencils, crayons, watercolors, digital art, fabric, acrylics, pen or other art material. Please do not make a color copy of the original art for your submission.

The submission deadline is Jan. 26.

The result will be a show and sale of all the postcards at the Stata Center Student Street on Feb. 23 from 6 to 8 p.m. All postcards can be purchased at the event.

All works will be for sale to benefit Rosie's Place. The price of the postcards is $10 for students and $15 for all other members of the MIT community.

The sale is sponsored by the Campus Activities Complex.

For more information, visit people.csail.mit.edu/sally/MITPostcards/.

AMPS videographer, former Zoom cast member, will give IAP talk, 'Zoom–Lost and Found'

Sasha Brown
News Office

In the early 1970s, few shows were hotter for children than PBS's "Zoom," whose rallying cry to "come on and Zoom" has been heard ever since in the minds of adults who grew up in that era.

MIT field videographer Thomas White of Academic Media Production Services (AMPS) was one of the first cast members of the popular show. He will give a talk on his experiences, "Zoom—Lost and Found," at MIT on Jan. 20.

WGBH in Boston began producing "Zoom" in the 1970s. "It was billed as sort of a children's 'Laugh-In,'" said White, who was one of hundreds of children to audition for the show.

The fast-paced, nonlinear show with seven real kids, not actors, won over audiences and made the show number one in its time slot for years. White, a native of Dorchester, was just 12 years old.

Prior to his audition for "Zoom," White had been a performer in a street puppet theater. He used his puppets to nail the role on the show. "The other kids seemed scared," White said with a laugh, recalling the auditions at the Newton YMCA. "I just got up there with my puppets."

White and the other children selected for the series had no idea what to expect. But the format was very kid-friendly. Audience members sent in suggestions for recipes, games and activities, and the seven Zoom kids performed them in a series of sketches. Over time, children learned the songs and the signature moves of the cast members, launching the show into a kind of cult status.

"It was the first show that had no adult figures," White said, speculating on why the show struck such a chord with the under-12 set. "We did not play characters. We were just ourselves," he said.

PHOTO COURTESY / **WGBH EDUCATIONAL FOUNDATION**

Thomas White as a Zoomer, age 12.

For White and the other cast members, it was the opportunity of a lifetime. "I loved being in the studio and working with the crew," White said. The cast members became very close, White said. With rehearsals all week long and taping on the weekend, they saw each other quite a bit and spent time at one another's homes.

Although White said he never felt ostracized at school because of his television fame, some of the other cast members were not so lucky. "Some of the kids took some razzing and beating," White said. "But mostly people were nice about it."

The experience bonded them for life, White said. As the cast members have grown, they have all stayed close, holding reunions and get-togethers with other casts from later seasons.

The "class" now includes dozens of younger children from the newer shows, which started again in 1999. But when the Zoomers get together, there is always a common bond. "We all have something very real in common," White said. "I have seen all the original cast members at least once in the last 10 years."

On Jan. 20, White will share his stories from "Zoom" with members of the MIT community as part of the January Independent Activities Period. His talk will be in Room 32-124 at 1 p.m.

PHOTO / **DONNA COVENEY**

Ken Stone, director of the MIT Hobby Shop, front left, and a group of students built storage units for Project Hope in Dorchester. The students are, left rear, Ilan Moyer, junior in mechanical engineering, Folkers Rojas, junior in nuclear engineering, Alexis Dale, sophomore in brain and cognitive science, and Dayan Paez, junior in mechanical engineering.

Hobby Shop aids shelter makeover

Sasha Brown
News Office

Thanks to the MIT Hobby Shop and a group of dedicated students, several families living in the Project Hope shelter in Boston will have a sturdy storage unit for their belongings.

Project Hope is a multiservice Boston agency dedicated to helping families move past poverty. It provides low-income mothers with access to education, jobs, housing and emergency services. Over the past month, the Project Hope Shelter has been refinished, repainted and generally revamped as part of WCVB-TV Channel 5's Extreme Makeover: Hometown Edition.

The Project Hope makeover, which aired in November, renovated the entire Dorchester shelter, including 11 bedrooms, two bathrooms, two family rooms, two play spaces, a meeting room, four offices, a hallway and three flights of stairs, all in two weeks. Only storage was missing, said Kenneth Stone, director of the MIT Hobby Shop.

It seemed like an ideal project for the MIT Hobby Shop, Stone said, and although the MIT portion was not completed in time to air, the students who worked on the project did so sporting blue T-shirts from Extreme Makeover.

"It could be just a door or a frame, but to someone else it means so much," said Folkers "Eddie" Rojas, a junior in nuclear engineering, as he finished the edges of one of the unit doors.

The project was an opportunity to do something good and also to do work he loves. "The Hobby Shop gives me the chance to produce a finished good," said Rojas, who had worked construction in the past. He said he finds comfort in working with wood. "You have to learn the wood and know it. Each piece is unique."

Ilan Moyer, a junior in mechanical engineering, was drawn to both the cause and the project itself. "It seemed really interesting and I like to be able to create things," he said. "When I am in the Hobby Shop, I am applying all of the ideas I learn as theory in my classes."

Hobby Shop director Kenneth Stone said he was not surprised by the dedication he saw from the six students who collectively worked more than 20 hours over three days to put the units together. "It has been much easier because of the help from the students," Stone said. "MIT students are so amazing. If they have a spare hour, they will just come down and pitch in."

Much of the work was completed over Thanksgiving break and the several days that followed, said Stone.

Once complete, each of the six birch storage units will be 2 feet deep by 8 feet high. Stone hoped the project would be complete by the end of this week so that installation could take place before finals start on Dec. 18.

Stone and a few of the students planned to travel to the shelter in vans, unload the units and construct them on-site.

"It really is a wonderful project," Stone said.

Four centuries' slings and arrows enrich architectural drawing

Amy Farnsworth
Office of the Arts

It's four centuries old and has been owned by a succession of architects and owners, but the Italian Renaissance drawing on display in the Compton Gallery (Room 10-150) is now a part of MIT's history.

"FRONT + BACK: Investigating a Renaissance Drawing," which will be on exhibit through Dec. 22, combines art and science to explore the history, techniques and stories behind one 16th-century architectural drawing donated to the MIT Museum three years ago.

The exhibit is the culmination of a four-year collaboration between Gary Van Zante, curator of architecture and design at the MIT Museum, and Richard Tuttle, professor of art at Tulane University.

MIT students Svea Heinemann, Sun Na and Jennifer Tran assisted with research for the exhibition. Van Zante wanted architecture students and practitioners embedded in digital practice to learn about architectural representation from a centuries-old, hand-drawn, handmade artifact, and to apply years of research and veneration to a contemporary context.

"This exhibition is contrary to what is usually presented in a museum: It is about one object, not many, and about an object that would not normally be considered beautiful because it is so damaged," Van Zante said. "For museums, especially art museums, it is often a matter of quality. To me, the importance of this drawing was what it could teach us, and the evidence of wear and tear, the stains and repairs, are all part of its story."

The 21-inch-by-34-inch drawing is one of the oldest architectural drawings in the MIT Museum's collection.

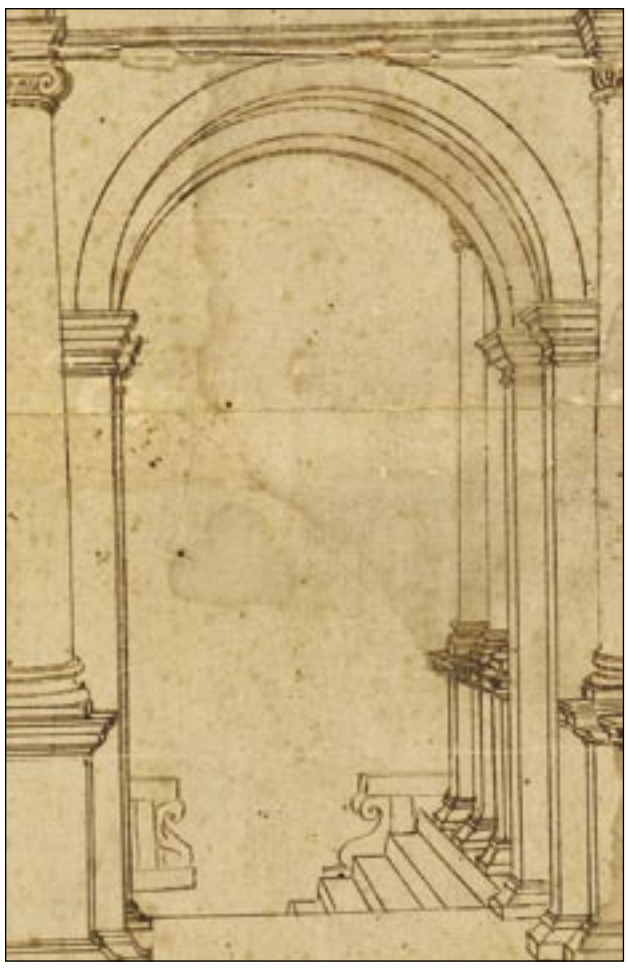

PHOTO / **OFFICE OF THE ARTS**

The scars of 400 years add value to architectural drawing.

Music staff picks Hanukkah hits

Staff members from the music and theater arts section and the Office of the Arts offered up these picks.

"The Odd Potato"—Judd Hirsch narrates this Hanukkah story with music performed by 20 Tony Award winners, including Elaine Stritch, Sutton Foster, Hal Linden and Hal Prince. It's produced by Variety—The Children's Charity, and a portion of the proceeds benefit children with special needs. Also, it's available from Broadway Cares/Equity Fights AIDS, one of the nation's leading industry-based organizations raising funds for the care and comfort of those living with HIV/AIDS.

The Klezmer Conservatory Band: "Oy Chanukah!" (Rounder Records, 1987)—Originally produced as a radio show in association with Boston's WGBH Radio, this recording features the Klezmer Conservatory Band and snippets of oral history by special guest contributors.

"A Taste of Chanukah" (Rounder Records, 1999)—Recorded live in Boston's Jordan Hall, this compilation of Hanukkah tunes features folk musician and Broadway star Theodore Bikel, with musical director Hankus Netsky, students from the New England Conservatory, cantor Morton Shames and the Boston Community Gospel Choir. The "taste" of Hanukkah is literal, as the recording also features a demonstration of how to make latkes (potato pancakes).

MUSIC

Continued from Page 1

(Nonesuch)—"This disc captures the luminous voice of Lorraine Hunt Lieberson singing the love poetry of Chilean Pablo Neruda. The Boston Symphony Orchestra, conducted by James Levine, is achingly beautiful."

Cherubini Requiem/Boston Baroque (Telarc)—"The requiem that was written to commemorate the beheading of Louis XVI during the French Revolution, it was played at Beethoven's memorial service. It is here recorded for the first time on period instruments."

Classical and Rock

Tod Machover, professor of media arts and sciences, has composed five operas and leads the group that invented Hyperinstruments. Machover recommends:

Natura Renovatur: "String music by Giacinto Scelsi" (ECM)—"This spectacular CD features solo cello and string ensemble music by Scelsi (1905-1988), a reclusive Italian aristocrat whose radical music explores exciting sonorities and textures."

William Byrd: "The Complete Keyboard Music" (Hyperion)—"Byrd has always been the "3rd B" for me; his keyboard music is the only oeuvre that matches the other two B's—Bach and Beethoven—in richness, range and sheer beauty."

The Who: "Endless Wire" (Republic)—"Who would have thunk it?! This CD is an explosive blast from Who remaining members Pete Townshend and Roger Daltry, updating the edgy sound of their youthful work and adding an entirely new dimension of acoustic beauty and very strong texts."

Chamber Music

Marcus Thompson, Robert R. Taylor Professor of Music, heads programs in chamber music and performance studies. As an internationally acclaimed violist, he has performed throughout the Americas, Europe and the Far East. He recommends:

Beethoven: Op. 18 #6 in B flat, Op. 59 in B flat and Op. 59 #1 in F ("Razumovsky") (Telarc CD 80229)—"This displays the quality I prize most in chamber music performance and composition: nuance."

Gabriel Fauré: Complete Chamber Music performed by the Nash Ensemble (Brilliant Classics 92337)—"This is a rare compilation of all the chamber works of this master of harmonic and tonal shading."

Jazz/Gospel/Folk

Pamela Wood, senior lecturer in music and coordinator of sight-singing classes, is also a soprano whose performances have been acclaimed in concerts around the world. Wood recommends:

Bobby McFerrin: "Bang! Zoom" (Blue Note, 1996)—"It's sunshine on a disc! Bobby McFerrin, inimitable composer, conductor, shares his masterful vocal improvisation."

Richard Smallwood: "Memorable Moments" (EMI Gospel, 1999)—"I'm repeatedly inspired at depth by Smallwood's virtuosity as a classically trained pianist, singer, composer who is working in the field of gospel music."

Bessie Jones: "Put Your Hand on Your Hip and Let Your Backbone Slip" (Rounder Records, 2001)—"This is a unique collection of songs, singing games and stories from the Georgia Sea Islands. For decades, Miss Bessie was the living repository of this body of folk literature, often performing with the Georgia Sea Island Singers."