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TechTalk

SERVING THE MIT COMMUNITY

MIT radar technology fights breast cancer

Allyson T. Collins
News Office Correspondent

Treating breast cancer with a type of heat therapy derived from MIT radar research can significantly increase the effectiveness of chemotherapy, according to results from the fourth clinical trial of the technique reported online Nov. 25 in the journal Cancer Therapy.

In this study, large tumors treated with a combination of chemotherapy and a focused microwave heat treatment shrunk nearly 50 percent more than tumors treated with chemotherapy alone. The microwave treatment is based on technology originally developed at MIT in the late 1980s as a tool for missile detection.

"It appears that heating the tumors drastically increased the effectiveness of the chemotherapy," said Dr. William C. Dooley, director of surgical oncology at the University of Oklahoma and the principal investigator of the study. "The tumors shrank faster and died faster using the additional microwave hyperthermia on top of the chemotherapy."

According to the National Cancer Institute, some 178,000 women and 2,000 men were diagnosed with breast cancer in 2007. An estimated 40,000 women and 450 men will die of the disease this year.

In the latest clinical trial, 15 patients received two microwave heat treatments, known as thermotherapy, along with four rounds of chemotherapy before surgery. The goal was to shrink tumors sufficiently to enable a

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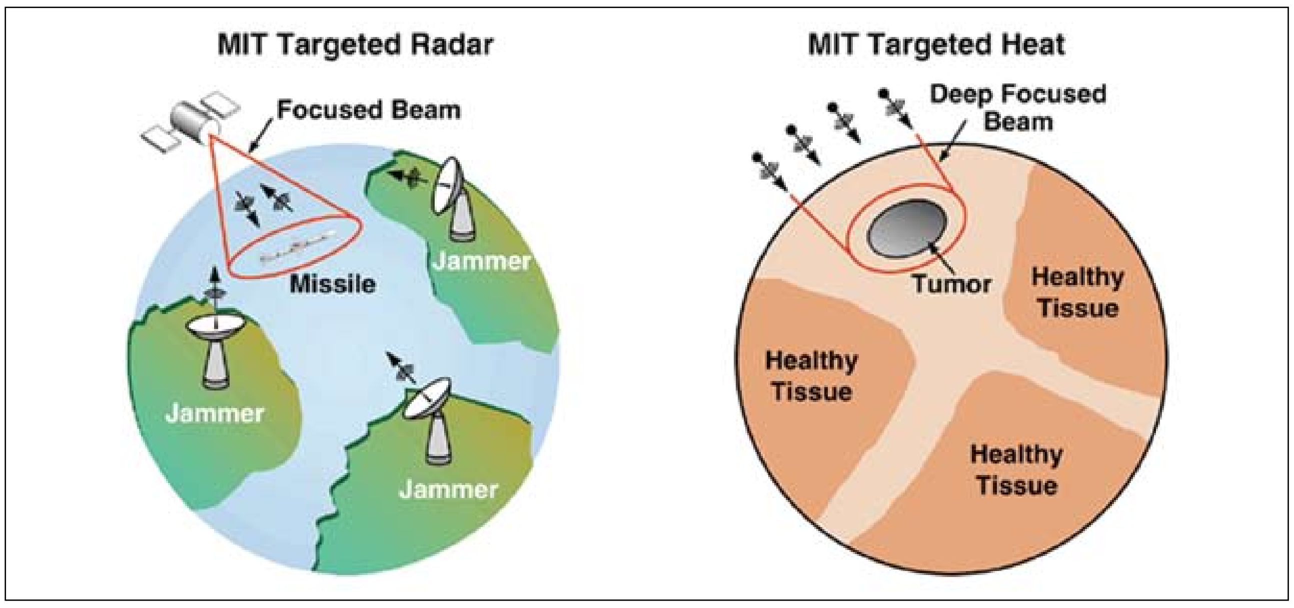

GRAPHIC COURTESY / **MIT LINCOLN LABORATORY**

The image at left shows the process of detecting and destroying an enemy missile using MIT targeted radar. Microwave energy is fixed on a missile while simultaneously nullifying enemy jammers. On right, microwave energy is aimed at a cancerous tumor with a deep focused beam while simultaneously nullifying any energy that would overheat surrounding healthy tissue.

MIT forges new ties with India

Anne Trafton
News Office

President Susan Hockfield led an MIT delegation on a historic trip to India Nov. 16-24, meeting with key government and business leaders and strengthening ties between the Institute and the world's largest democracy.

MIT and India have a long history of shared ventures. The first Indian student entered MIT just 15 years after the Institute opened its doors at the end of the U.S. Civil War. Today, more than 33 MIT faculty members collaborate with colleagues in India, and 229 students from India are enrolled at MIT.

In a talk, "Universities and the Global Knowledge Economy," delivered at a meeting of the Confederation of Indian Industries in Mumbai and attended by about 125 business leaders, Hockfield said she sees the partnership between MIT and India as a natural one.

"MIT and India have a great deal to build on, starting with a century of friendship. I believe the strength of that friendship springs from some important cultural parallels between India and MIT: We both place a premium on analytical thinking. We both prize academic excellence. And we both celebrate the kind of positive, entrepreneurial spirit that makes new ideas come alive," Hockfield said.

Hockfield, the first MIT president to visit India while in office, met with Prime Minister Manmohan Singh during her trip. She also met with business leaders, including steel industry magnate Sir Ratan Tata, Infosys Non-Executive Chairman and Chief Mentor N.R. Narayana Murthy, Chairman of Reliance Industries Mukesh Ambani, and Biocon Chair and CEO Kiran Mazumdar-Shaw.

The delegation hosted a symposium in New Delhi titled "India and MIT: A Conversation About the Future," attended by 150 alumni and leaders from industry, academia and the media. The symposium was webcast and is now available at web.mit.edu/newsoffice/2007/india-tt1114.html.

"The visit provided an excellent opportunity for the MIT delegation to highlight many of the ongoing interactions between MIT and India, and to explore new avenues

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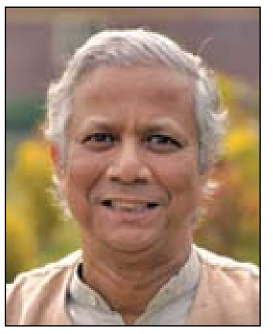
Muhammad Yunus, microcredit pioneer, is Commencement speaker

Anne Trafton
News Office

Muhammad Yunus, winner of the 2006 Nobel Peace Prize, will deliver MIT's 2008 Commencement address on June 6.

Yunus won the Nobel Prize for pioneering the microlending movement, which seeks to improve the lives of the poor by offering credit without collateral. The bank he founded, Grameen Bank, has provided credit to 7.3 million poor people in villages in Bangladesh.



Muhammad Yunus

"Muhammad Yunus has given thousands of people struggling in poverty the tools to transform their lives. In the process, he has proved vividly that economic empowerment is essential to promoting peace and human rights," said MIT President Susan Hockfield. "Like so many members of the MIT community itself, Dr. Yunus is a practical visionary. Our graduates will be inspired to hear how social entrepreneurship and technical expertise can, together, change the world. I can think of no better choice for our 2008 MIT Commencement speaker."

Yunus started making personal loans to poor basket weavers in Bangladesh in the mid-1970s, and in 1983 he founded Grameen Bank, which now operates in nearly 80,000 rural Bangladeshi villages. Ninety-seven percent of the bank's clients are women, and their rate of repayment is 98 percent.

In announcing his 2006 Nobel Peace Prize, the Nobel Committee wrote, "Muhammad Yunus has shown himself to be a leader who has managed to translate visions into practical action for the benefit of millions of people, not only in Bangladesh, but also in many other countries."

"I am thrilled with the selection of Dr. Muhammad Yunus as MIT's Commencement speaker," said Eric Grimson, head of the Department of Electrical Engineering and Computer Science and chair of the Commencement Committee. "I believe his message that technical innovations can be used to impact the daily lives and future well-being of people around the world is one that will resonate strongly with our students. I hope that his speech challenges our graduates to seek opportunities to use their MIT education to make an impact on the lives of others."

Yunus received a Ph.D. in economics from Vanderbilt University in 1970 and taught at Middle Tennessee University from 1969 to 1972. After returning to Bangladesh, he joined the University of Chittagong as head of the economics department.

He also holds honorary doctorate degrees from dozens of universities around the world.

Phi Ho, president of the senior class, said Yunus is a perfect choice to address the graduates.

"Graduates of MIT are global leaders who will, no doubt, go on to catalyze and create impact across many industries. No one else embodies these ideals of global leadership and social commitment more than Dr. Yunus," said Ho.

Martin Holmes, president of the Undergraduate Association, agreed. "Dr. Yunus's development of microcredit has had a tremendous impact by elevating the world's poor—giving opportunity to those who need it most. His contributions to society perfectly align with MIT's core mission and values, and he, like the students of MIT, is a

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MASTER BLASTER
MIT-spawned "Howtoons" teaches kids hands-on science and engineering.
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Marshall Scholar will study medicine, health policy

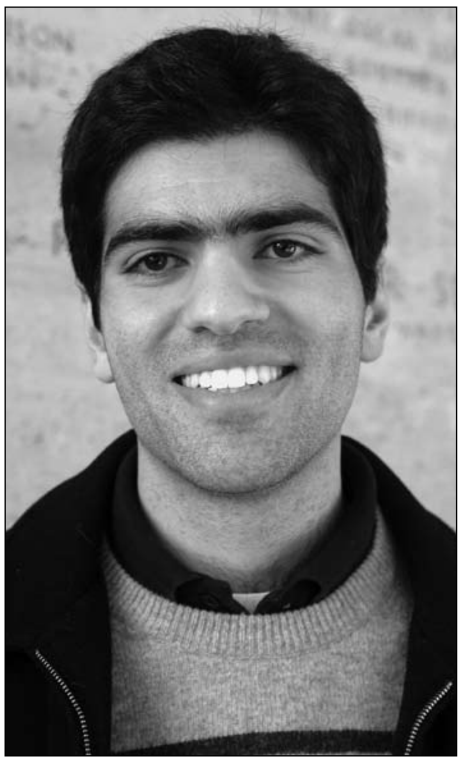

PHOTO / DONNA COVENEY

Ali Alhassani

Sarah H. Wright
News Office

Ali Alhassani, an MIT senior who discovered his passion for medicine and health policy through the friendship of a war-injured Iraqi boy, has been awarded a Marshall Scholarship for 2008.

Alhassani, a Boston native whose parents are Iraqi, is majoring in mechanical engineering with a minor in biomedical engineering and economics. As a Marshall Scholar, he will study health policy, planning and financing at the University of London's School of Hygiene and Tropical Medicine before attending medical school.

"I am excited about studying in the United Kingdom, and every day I am thankful for all of the opportunities MIT has provided for me in pursuing my academic and extracurricular interests," he said.

Ten years from now, Alhassani intends to be a practicing physician as well as an advocate for health policies both domestically and abroad, he said.

His plans for the future came into sharp focus in 2005, when he volunteered to serve as a translator for a 12-year-old boy wounded in Iraq and flown to Boston's Spaulding Hospital for urgent medical treatment.

Alhassani's frequent visits to the hospital inspired him to pursue a career in medicine and in advocacy for humanitarian aid, he told Linn Hobbs, professor of materials science and of nuclear engineering, and chair of the MIT Committee on Foreign Fellowships.

"Alhassani has a record of dedicated service aimed at fostering a better world through mutual understanding and personal ministration. With his impressive academic record and his genuine and diligent drive to help others, he is a rare young man," said Hobbs.

Ali's parents came to the United States from Iraq in order to pursue a better education. They have lived in the Boston area and in Morocco, and Alhassani continues to study Arabic at Harvard.

At MIT, Ali helped found Ascent, a Harvard and MIT student magazine about Islam and the West. He has worked as a research intern for the Accelerated Cure Project, a national nonprofit whose goal is to help find a cure for multiple sclerosis, and as a research assistant for Elazer Edelman, Thomas D. and Virginia W. Cabot Professor of Health Science and Technology, on angiogenesis and cardiac drug delivery. Last summer, he interned at the World Health Organization under the assistant director-general for health action in crises, compiling crisis-analysis profiles. This semester he is co-leading a freshman seminar on AIDS in the 21st century.

Alhassani has also served as a Muslim leader for the Addir Fellowship, an interfaith group sponsored by the U.S. Department of Homeland Security, notes Kimberly Benard, program advisor for the Office of Study Abroad and Foreign Scholarships.

The Foreign Scholarships Committee comprises 17 members of the faculty, student body and academic staff, most of whom are former holders of Marshall, Rhodes, Fulbright and other major foreign scholarships or who administer MIT programs abroad. Additional information is available at web.mit.edu/scholarships.

Marshall Scholarships, first awarded in 1954, are named for Gen. George C. Marshall, architect of the European Recovery Act. The scholarships constitute Britain's official "thank you" for U.S. assistance following World War II. Forty scholarships are awarded annually to U.S. citizens, tenable at any U.K. university.

Zwierlein wins physics award for discovery in superfluidity

Worked with MIT Nobel laureate Wolfgang Ketterle

Martin Zwierlein, assistant professor of physics, was recently awarded one of Germany's premier awards for young scientists.

The 100,000 euro Klung-Wilhelmy-Weberbank Prize for physics was presented to Zwierlein at a ceremony on Nov. 16 at the Free University of Berlin.

Martin Zwierlein

Zwierlein, 30, was honored for work he did in atomic physics as an MIT graduate student. Working with MIT physics professor Wolfgang Ketterle, Zwierlein discovered a new form of superfluidity in ultracold gases, in which pairs of atoms can flow without any friction.

The scientists observed superfluidity in a gas of lithium atoms, a million times colder than interstellar space and a million times thinner than air.

The substance serves as a valuable model system for superconductors and spurs hopes for a material that can transport current at room temperature without the usual energy loss. Indeed, scaled to the density of electrons in a metal, the new form of superfluidity would occur already far above room temperature.

"Germany loses at the moment more than 5 percent of its energy production through frictional losses in the transport of current—in the U.S.A. it is even about twice as much," calculates Zwierlein, a native of Bonn, Germany. "This lost energy would be sufficient to power entire countries. The exchange of normal wires with superconductors would thus allow enormous savings."

Ketterle, winner of the 2001 Nobel Prize for physics, delivered the laudatio (laudatory speech) at the award ceremony, describing the work that led to Zwierlein's prize.

The Klung-Wilhelmy-Weberbank Prize is annually awarded to a top young German scientist, alternating between a physicist and a chemist. Five of the previous awardees have since received the Nobel Prize: The physicists Theodor W. Hänsch, Gerd K. Binnig, Horst L. Störmer and Johann Georg Bednorz, and the chemist Hartmut Michel.

The prize is sponsored by the Otto-Klung Foundation at the Free University of Berlin, the Dr. Wilhelmy Foundation and the Society for the Promotion of Science of the Weberbank Actiengesellschaft.

CORRECTIONS

Due to an editing error in the Nov. 14 issue of Tech Talk, Kai von Fintel, professor of linguistics, was incorrectly listed among assistant and associate professors granted tenure this year. Granted tenure in 2001, von Fintel was promoted from associate professor with tenure to full professor, effective July 1, 2007. Tech Talk regrets the error.

Due to incorrect figures supplied to the MIT News Office, an article in the Nov. 28 issue of Tech Talk contains an error. The article, "MIT study shows families do more than care—they are caregivers," said Massachusetts residents spend 697 million hours a year providing care at an annual market value of $6,914,000. The actual market value should be $6,914,000,000.

AWARDS AND HONORS

Six MIT faculty members have been named fellows by the Institute of Electrical and Electronics Engineers (IEEE). This distinction recognizes important contributions to the advancement or application of engineering, science and technology, bringing the realization of significant value to society. The IEEE fellows are:

Akintunde Ibitayo Akinwande, professor of electrical engineering, for contributions to the development of digital self-aligned gate technology and vacuum microelectronic devices.

Akintunde I. Akinwande

Emery Brown, a professor in the Harvard-MIT Division of Health Sciences and Technology and in the Department of Brain and Cognitive Sciences, for contributions to state-space algorithms for point processes and applications to neuroscience data.

Judy Hoyt, professor of electrical engineering and computer science, for contributions to silicon-based heterostructure devices and technology.

Roger Mark, distinguished professor of health science and technology, for development of physiologic signal databases and automated arrhythmia analysis.

Muriel Medard, associate professor of electrical engineering and computer science, for contributions to wideband wireless fading channels and network coding.

Jacob White, Cecil H. Green Professor of Electrical Engineering and Computer Science, for contributions to simulation tools for RF circuits, electrical interconnects and micromachined devices.

Structural engineer **John Ochsendorf**, Class of 1942 Career Development Professor in the Department of Architecture, is a winner of the 2007-08 Rome Prize Competition sponsored by the American Academy in Rome. He is the first engineer to be awarded a Rome Prize by the Academy.

Currently in residence in Rome, Ochsendorf is collaborating with Italian preservationists to identify assessment methods and repair strategies for historic masonry vaulting.

Earll Murman, Ford Professor of Engineering, Emeritus, in the Aeronautics and Astronautics Department and Engineering Systems Division, has been named to present the SAE International/American Institute of Aeronautics and Astronautics William Littlewood Memorial Lecture at the annual AIAA Aerospace Sciences Meeting and Exhibit. This honor recognizes an individual "who has made significant contributions to the field of air transport engineering."

Judy Hoyt

A team of MIT Sloan and LFM (Leaders for Manufacturing) M.B.A. students took first place at Carnegie Mellon University's 12th Annual International Operations Case Study Competition, held in Pittsburgh. The team members were **Mike Beaser** and **Steve Rulison** from Sloan and **David Larson, Pete Frys** and **Laurel Hoffman** from LFM.

Teams were judged on the soundness of their reasoning, their analysis of the problem and the strength of their business assessment. The Institute team—the third from MIT that has won first place—took home a prize of $10,000.

Conor Walsh and **Nevan Hanumara**, both graduate students in mechanical engineering, reached the finals of this year's Collegiate Inventors Competition, organized by the National Inventors Hall of Fame Foundation. They were honored for their work on a device that makes needle biopsies less invasive. Their machine, called Robopsy, is a lightweight plastic device that holds a biopsy needle and can sit on a patient's chest during a CT scan. The device could make lung biopsies easier and less time-consuming. Robopsy won the grand prize for business venture in the MIT $100K Entrepreneurship Competition in May.

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Gibson details faculty renewal proposal

At the Oct. 17 faculty meeting, Associate Provost Lorna Gibson outlined proposals being considered for a faculty renewal program. Below is a Q&A with Gibson that provides more information.

Q: What exactly is the Faculty Renewal Initiative?

A: This initiative focuses on supporting the transition of retirement-ready faculty (and those beginning to think about retiring) to open up tenure-track slots for recruiting junior faculty. By continually "renewing faculty," MIT will be better able to respond to changing fields of education and research and will be able to move more quickly in building a diverse faculty. In addition, the initiative will provide opportunities for retired faculty to continue their valuable contributions to research, teaching and student-development activities.

Lorna Gibson

Q: How will it work?

A: The details are still being developed, but in general the program would be voluntary and faculty who have reached normal retirement age (65) and have accumulated a certain number of years of service at MIT would be eligible to participate. The program is expected to provide a menu of options and services; under consideration are postretirement resources and support as ways of continuing connections with MIT; transition planning services; posttenure title; financial incentives; gradual reductions in workload leading to retirement; and financial counseling.

Q: When can I find out specifics and when will this program begin?

A: It is hoped that the details will be announced sometime in spring 2008; at that time comprehensive materials will be available. The program itself is expected to take effect around July 1, 2008.

Q: Didn't something like this take place about 10 years ago?

A: In 1996, MIT offered the Early Retirement Incentive Program, which was a one-time voluntary program that provided funds and other financial benefits for faculty who decided to retire. Unlike the 1996 program, the Faculty Renewal Initiative is intended to be an ongoing and sustainable program.

Q: Can staff participate in the Faculty Renewal Initiative?

A: No. This program applies only to faculty. Faculty typically have different modes of transition to retirement than staff and often different postretirement goals. There are a finite number of faculty slots across the Institute and therefore a dynamic process is necessary to make sure there are sufficient openings for new hires.

Q: Who is heading up the Initiative?

A: This is a cross-campus initiative led by Associate Provost Lorna Gibson in collaboration with Vice President of Human Resources Alison Alden. To ensure that the program will cover the needs of retiring faculty, all faculty have been invited to give input. Focus groups of senior faculty from all five schools were organized and have met, with the assistance of the Faculty Policy Committee.

Q: "Retired" means different things to different people. What does it mean in this case?

A: Each retiree will make the transition from tenure to retired in his or her own way, and according to different timetables. The Faculty Renewal Initiative is committed to providing retired faculty with opportunities to remain connected with the MIT community—by continuing to teach, write and pursue research—or by participating in other activities, such as student life, mentoring or community service programs. Options such as access to campus parking and the Internet are being explored. In addition, office space

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Preset patterns discovered in neuronal stem cells could complicate therapy

Deborah Halber
News Office Correspondent

Stem cell therapies for the brain could be much more complicated than previously thought, an MIT research team's latest finding suggests.

In a study published in Public Library of Science (PloS) Biology on Nov. 13, MIT scientists reported that adult stem cells produced in the brain are preprogrammed to make only certain kinds of connections—making it impossible for a neural stem cell originating in the brain to be transplanted to the spinal cord, for instance, to take over functions for damaged cells.

Some researchers hope to use adult stem cells produced in the brain to replace neurons lost to damage and diseases such as Alzheimer's. The new study calls this into question.

"It is wishful thinking to hope that adult stem cells will be able to modify themselves so that they can become other types of neurons lost to injury or disease," said Carlos E. Lois, assistant professor of neuroscience in MIT's Picower Institute for Learning and Memory.

In developing embryos, stem cells give rise to all the different types of cells that make up the body—skin, muscle, nerve, brain, blood and more. Some of these stem cells persist in adults and give rise to new skin cells, stomach lining cells, etc. The idea behind stem-cell therapy is to use these cells to repair tissue or organs ravaged by disease.

To realize this potential, the stem cells have to be "instructed" to become liver cells, heart cells or neurons. The MIT study, which looked only at adult neural stem cells, suggests it will be necessary to learn how to program any kind of stem cell—embryonic, adult or those derived through other means—to produce specific types of functioning neurons. Without this special set of instructions, a young neuron will only connect with the partners for which it was preprogrammed.

The adult brain harbors its own population of stem cells that spawn new neurons for the duration of its life. The MIT study shows that a neural stem cell is irreversibly committed to produce only one type of neuron with a preset pattern of connections. This means that a given neuronal stem cell can have only limited use in replacement therapy.

PHOTO / **DONNA COVENEY**

Carlos Lois and colleagues have found that adult stem cells produced in the brain are preprogrammed to make only certain kinds of connections. Lois is an assistant professor of neuroscience in MIT's Picower Institute for Learning and Memory.

"A stem cell that produces neurons that could be useful to replace neurons in the cerebral cortex (the type of neurons lost in Alzheimer's disease) will be most likely useless to replace neurons lost in the spinal cord," said Lois, who also holds an appointment in MIT's Department of Brain and Cognitive Sciences. "Moreover, because there are many different types of neurons in the cerebral cortex, it is likely that we will have to figure out how to program stem cells to become many different types of neurons, each of them with a different set of prespecified connections."

"In the stem cell field, it is generally thought that the main limitation to achieve brain repair is simply for the new neurons to reach a given brain region and to ensure their survival. Once there, it has been assumed that stem cells will 'know what to do' and will become the type of neuron that is missing. It seems that is not the case at all. Our experiments indicate that things are much more complicated," Lois said.

Lois and colleagues from MIT's departments of brain and cognitive sciences and biology found that the stem cells give rise to neurons that become a very specific neuronal type that is already prespecified to make a defined set of connections and not others.

Even if the stem cells are transplanted to other parts of the brain, they do not change the type of connections they are programmed to make.

"This suggests that we will have to know much more about the different types of neuronal stem cells, and to identify the characteristic features of their progeny," Lois said. "We may need to have access to many different types of 'tailored' stem cells that give rise to many different types of neurons with specific connections. In addition, we may need a combination of several of these tailored stem cells to eventually be able to replace the different types of neurons lost in a given brain region."

Lois' colleagues are Picower Institute postdoctoral fellow Wolfgang Kelsch, lead author of the work, biology undergraduate Colleen P. Mosely and brain and cognitive sciences graduate student Chia-Wei Lin.

This work is supported by the National Institutes of Health.

INDIA

Continued from Page 1

for future engagement. It also created an opportunity for leaders in academia, industry and government in India to initiate a dialogue with MIT that could potentially lead to expanded interactions between MIT and India," said Subra Suresh, dean of engineering, who accompanied Hockfield during this trip. Suresh received his undergraduate degree in 1977 from the Indian Institute of Technology Madras.

MIT unveiled two new initiatives during the weeklong trip: I^3 (International Innovation Initiative), which will fund emerging technologies, and a partnership with the new Translational Health Science and Technology Institute of India (THSTI), which will be modeled after the Harvard-MIT Division of Health Sciences and Technology (HST).

Funded by the Indian government, THSTI will be a multidisciplinary, multiprofessional research and training center with close ties to HST. HST will help recruit and train new faculty members for THSTI, and research and educational collaborations are being planned between the two schools, said director of HST Martha Gray, who was part of the MIT delegation.

"In the past few years, the attention of MIT's faculty and students has been increasingly turning towards having a global impact, and you can't have a global impact if you don't have global partners," Gray said.

Similarly, I^3 will enhance MIT's innovation efforts around the world through partnerships with institutions in India and other countries.

I^3 will be modeled on MIT's Deshpande Center for Technological Innovation, which funds innovative research and helps guide new technologies to the market.

"I^3 provides a streamlined organizational umbrella to strengthen the innovation ecosystem at MIT by applying the best practices of the Deshpande Center to our international activities," said Suresh. He also announced the appointment of Charles Cooney, faculty director of the Deshpande Center and Robert T. Haslam (1911) Professor of Chemical Engineering as the faculty director of I^3.

"I^3 will allow us to apply what we have learned about converting early-stage science and technology into useful solutions to real-world problems," added Cooney.

Cooney, who sits on the board of directors of Indian biotechnology firm Biocon and has visited India at least once a year for the past 15 years, said he learns new things every time he visits.

Last month's trip offered the MIT delegation "a chance to see what it's like to operate in India, from the difficulties of moving around in heavy traffic, to the absolutely staggering opportunities in companies like Infosys and Biocon, where they have amazing facilities," Cooney said.

Alumni Vinay Rai '70, Adi Godrej '63 and Vikram Kirloskar '81 hosted receptions and dinners for the delegation and area alumni in New Delhi, Mumbai and Bangalore, respectively.

In addition to Suresh, Gray and Cooney, the delegation included Esther Duflo, the Abdul Latif Jameel Professor of Poverty Alleviation and Development; Arvind, the Johnson Professor of Computer Science and Engineering; Steven Lerman, dean for

COURTESY / **OFFICE OF THE PRIME MINISTER OF INDIA**

Susan Hockfield, the first MIT president to visit India while in office, met with Prime Minister Manmohan Singh during her trip.

graduate students; Ram Sasisekharan, professor of biological engineering and health sciences and technology; Philip Khoury, associate provost; O'Neil Outar, director of institutional initiatives; Tuli Banerjee, director of the MIT-India Program; and Desh Deshpande, founding donor of MIT's Deshpande Center for Technological Innovation.

Sculpted 3-D particles could aid diagnostics, tissue engineering

Anne Trafton
News Office

MIT engineers have used ultraviolet light to sculpt three-dimensional microparticles that could have many applications in medical diagnostics and tissue engineering. For example, the particles could be designed to act as probes to detect certain molecules, such as DNA, or to release drugs or nutrients.

The new technique offers unprecedented control over the size, shape and texture of the particles. It also allows researchers to design particles with specific chemical properties, such as porosity (a measure of the void space in a material that can affect how fast different molecules can diffuse through the particles).

"With this method, you can rationally design particles and precisely place chemical properties," said Patrick Doyle, associate professor of chemical engineering. Doyle is one of the authors of a paper on the work that appeared in the Dec. 3 issue of the journal Angewandte Chemie, published by the German Chemical Society.

The research team started with a method that Doyle and his students reported in a 2006 issue of Nature Materials to create two-dimensional particles. Called continuous flow lithography, this approach allows shapes to be imprinted onto flowing streams of liquid polymers. Wherever pulses of ultraviolet light strike the flowing stream of small monomeric building blocks, a reaction is set off that forms a solid polymeric particle. They have now modified that method to add three-dimensionality.

This process can create particles very rapidly: Speeds range from 1,000 to 10,000 particles per second, depending on the size and shape of the particles. The particles range in size from about a millionth of a meter to a millimeter.

The team's new process works by shining ultraviolet light through two transparency masks, which define and focus the light before it reaches the flowing monomers. The first mask, which controls the size and shape of the particles, is part of the technique reported last year by Doyle and his students. The second mask, which is based on MIT professor Edwin Thomas' work in multibeam lithography, adds three-dimensional texture and other physical traits, such as porosity.

The collaboration sprung from a conversation between Ji-Hyun Jang, a postdoctoral associate in Thomas' lab, and Dhananjay Dendukuri, a recent Ph.D. recipient in Doyle's lab, who are also authors on the paper.

"It's very easy to integrate the (second) phase mask into the microfluidic apparatus," said Thomas, Morris Cohen Professor of Materials Science and Engineering and head of the Department of Materials Science and Engineering. "Professor Doyle was controlling the overall shape, and now what we're doing is controlling these inner labyrinth networks."

Adding inner texture is desirable because it increases the particles' surface-to-volume ratio, which means if the particle is loaded with probes, there are more potential binding sites for target molecules.

In a paper published in Science earlier this year, Doyle and MIT graduate student Daniel Pregibon showed that the particles can be used as probes to identify DNA and other molecules.

Other applications for the particles include tissue engineering. For example, they could form a scaffold that would both provide structural support for growing cells and release growth factors and other nutrients. The particles can be designed so diffusion occurs in a particular direction, allowing researchers to control the direction of nutrient flow.

Alan Hatton, the Ralph Landau Professor of Chemical Engineering Practice, is also an author on the paper.

This research was funded by the U.S. Army Research Office through the MIT Institute for Soldier Nanotechnologies.

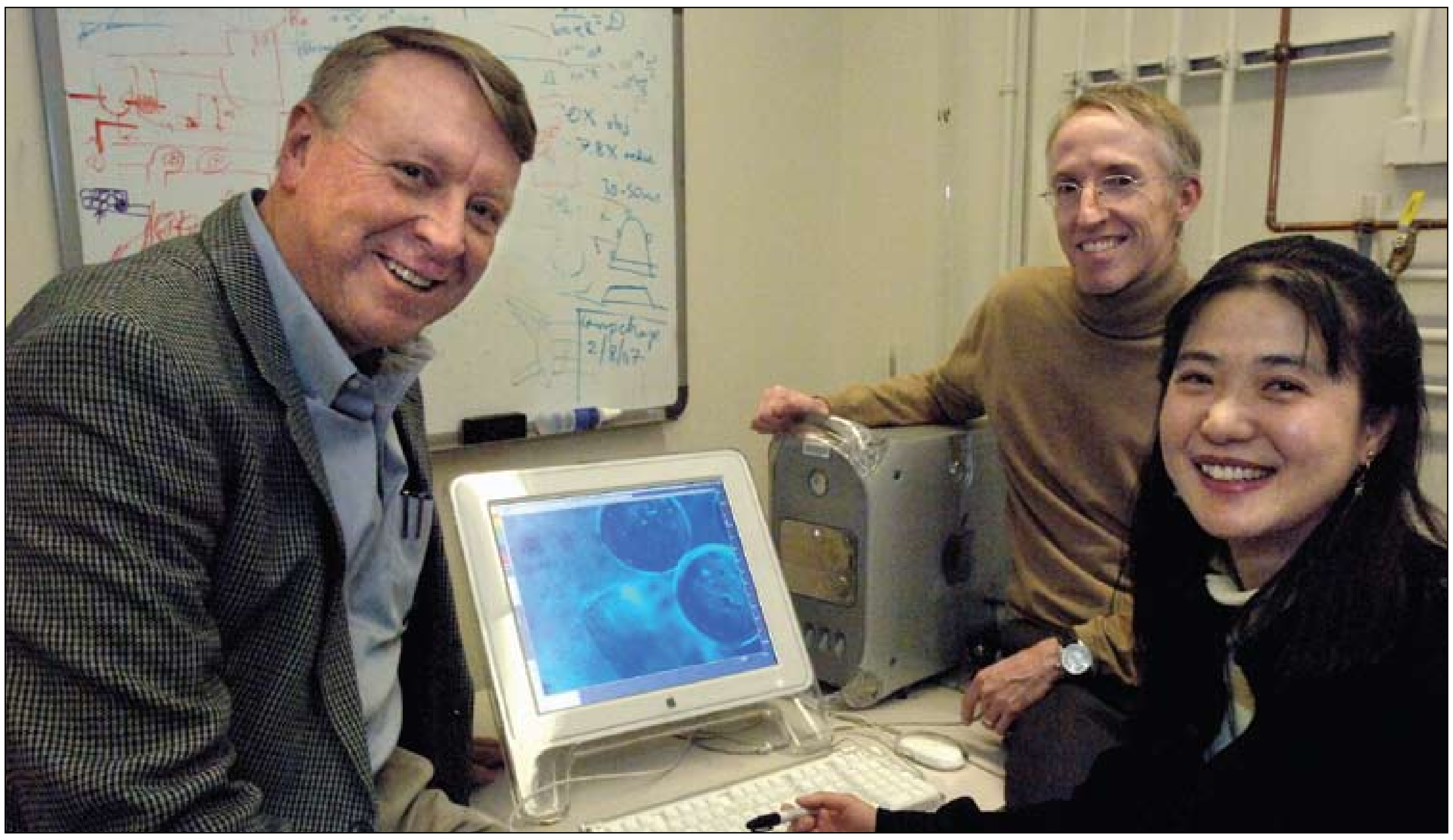


PHOTO / **DONNA COVENEY**

From left, Edwin Thomas, Morris Cohen Professor of Materials Science and Engineering, Patrick Doyle, associate professor of chemical engineering, and materials science postdoc Ji-Hyun Jang. The researchers have designed a technique to control the size, shape and texture of microparticles.

Remote-control nanoparticles deliver drugs directly into tumors

Elizabeth Dougherty
Harvard-MIT Division of
Health Sciences and Technology

MIT scientists have devised remotely controlled nanoparticles that, when pulsed with an electromagnetic field, release drugs to attack tumors. The innovation, reported in the Nov. 15 online issue of Advanced Materials, could lead to the improved diagnosis and targeted treatment of cancer.

In earlier work, the team, led by Sangeeta Bhatia, an associate professor in the Harvard-MIT Division of Health Sciences and Technology (HST) and in MIT's Department of Electrical Engineering and Computer Science, developed injectable multifunctional nanoparticles designed to flow through the bloodstream, home to tumors and clump together. Clumped particles help clinicians visualize tumors through magnetic resonance imaging.

With the ability to see the clumped particles, Geoff von Maltzahn, Bhatia's co-author in the current work, asked the next question: "Can we talk back to them?"

The answer, the team found, is yes. The system that makes it possible consists of tiny particles (billionths of a meter in size) that are superparamagnetic, a property that causes them to give off heat when they are exposed to a magnetic field. Active molecules, such as therapeutic drugs, are tethered to these particles.

Exposing the particles to a low-frequency electromagnetic field causes the particles to radiate heat that, in turn, melts the tethers and releases the drugs. The waves in this magnetic field have frequencies between 350 and 400 kilohertz—the same range as radio waves. These waves pass harmlessly through the body and heat only the nanoparticles. For comparison, microwaves, which will cook tissue, have frequencies measured in gigahertz, or about a million times more powerful.

The tethers in the system consist of strands of DNA, "a classical heat-sensitive material," said von Maltzahn, a graduate student in HST. Two strands of DNA link together through hydrogen bonds that break when heated. In the presence of the magnetic field, heat generated by the nanoparticles breaks these bonds, leaving one strand attached to the particle and allowing the other to float away with its cargo.

One advantage of a DNA tether is that its melting point is tunable. Longer strands and differently coded strands have bonds that require different amounts of heat to break. This heat-sensitive tunability makes it possible for a single particle to simultaneously carry many different types of cargo, each of which can be released at different times or in various combinations by applying different frequencies or durations of electromagnetic pulses.

To test the particles, the researchers implanted mice with a tumor-like gel saturated with nanoparticles. They placed the implanted mouse into the well of a cup-shaped electrical coil and activated the magnetic pulse. The results confirm that without the pulse, the tethers remain unbroken. With the pulse, the tethers break and release the drugs into the surrounding tissue.

The experiment is a proof of principle demonstrating a safe and effective means of tunable remote activation. However, work remains to be done before such therapies become viable in the clinic.

To heat the region, for example, a critical mass of injected particles must clump together inside the tumor. The team is still working to make intravenously injected particles clump effectively enough to achieve this critical mass.

"Our overall goal is to create multifunctional nanoparticles that home to a tumor, accumulate and provide customizable, remotely activated drug delivery right at the site of the disease," said Bhatia.

Co-authors on the paper are Austin M. Derfus, a graduate student at the University of California, San Diego; Todd Harris, an HST graduate student; Erkki Ruoslahti and Tasmia Duza of the Burnham Institute for Medical Research in La Jolla, Calif.; and Kenneth S. Vecchio of the University of San Diego.

The research was supported by grants from the David and Lucile Packard Foundation and the National Cancer Institute of the National Institutes of Health. Derfus was supported by a GREAT fellowship from the University of California Biotechnology Research and Educational Program.

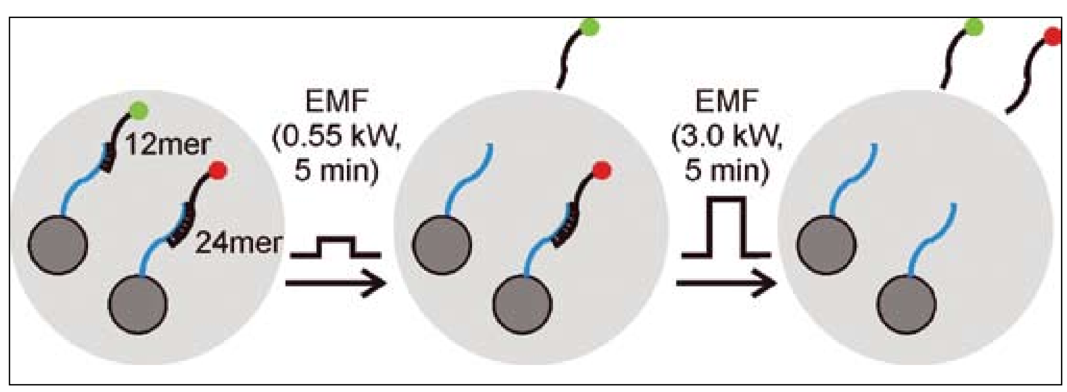


IMAGE COURTESY / **BHATIA/VON MALTZAHN, MIT; DERFUS, UCSD**

These dark gray nanoparticles carry different drug payloads (one red, one green). A remotely generated, five-minute pulse of a low-energy electromagnetic field releases the green drug. A five-minute pulse of a higher-energy electromagnetic field releases the red drug, which had been tethered using a DNA strand twice as long as the green tether, as measured in base pairs.

PHOTO / **DONNA COVENEY**

HST graduate student Geoffrey von Maltzahn and Professor Sangeeta Bhatia examine a medium containing iron oxide particles. Bhatia is leading a team using electric fields to remotely release drugs from nanoparticles inside the body.

MIT identifies proteins key to brain function

Anne Trafton
News Office

In work that could lead to new treatments for brain injury and disease, MIT researchers have identified a family of proteins key to the formation of the communication networks critical for normal brain function.

A team led by Frank Gertler, professor in the Department of Biology, found that a certain family of proteins is necessary to direct the formation of axons and dendrites, the cellular extensions that facilitate communication between neurons.

The work focuses on cellular outgrowths called neurites, which are the precursors to axons and dendrites. Understanding how neurites form could eventually lead to therapies involving stimulation of neurite growth, said Gertler.

"You could use these insights to help repair injuries to the top of the spinal column or treat brain injuries or neurodegenerative disorders," he said.

The researchers developed the first model that allows for study of the effects of this protein family, known as the Ena/VASP proteins. The team reported aspects of their work in the Nov. 11 issue of Neuron and the Nov. 18 online edition of Nature Cell Biology.

The majority of neurons in the cerebral cortex have a single axon—a long, thin extension that relays information to other cells—and many shorter dendrites, which receive messages from other cells. The interconnection of these axons and dendrites is essential to create a functional neural circuit.

In their study, the researchers found that mice without the three Ena/VASP proteins did produce brain cells, but those neurons were unable to extend any axons or dendrites.

It was already known that Ena/VASP proteins are involved in axon navigation, but the researchers were surprised to find that they are also critical for neurite formation, Gertler said.

Ena/VASP proteins are located in the tips of a neurite's filopodia, which are short extensions that receive environmental signals and translate them into instructions for the cell. Those instructions tell the cell whether to continue extending the filopodia by lengthening actin protein filaments, or to stop growth.

Without the Ena/VASP proteins, neurites cannot form, and no connections are made between neurons.

The researchers believe that Ena/VASP proteins control the growth of filopodia by regulating actin filaments' interactions with microtubules in the cell (which form part of the cell skeleton). One theory is that the microtubules might be delivering materials or sending signals to the filopodia through the actin filaments, Gertler said.

Lead authors of the Neuron paper are Adam Kwiatkowski, an MIT Ph.D. recipient, and graduate student Douglas Rubinson. Lead author of the Nature Cell Biology paper is former MIT postdoctoral fellow Erik Dent.

The research was funded by the National Institutes of Health and the Stanley Center for Psychiatric Research at the Broad Institute of MIT and Harvard.

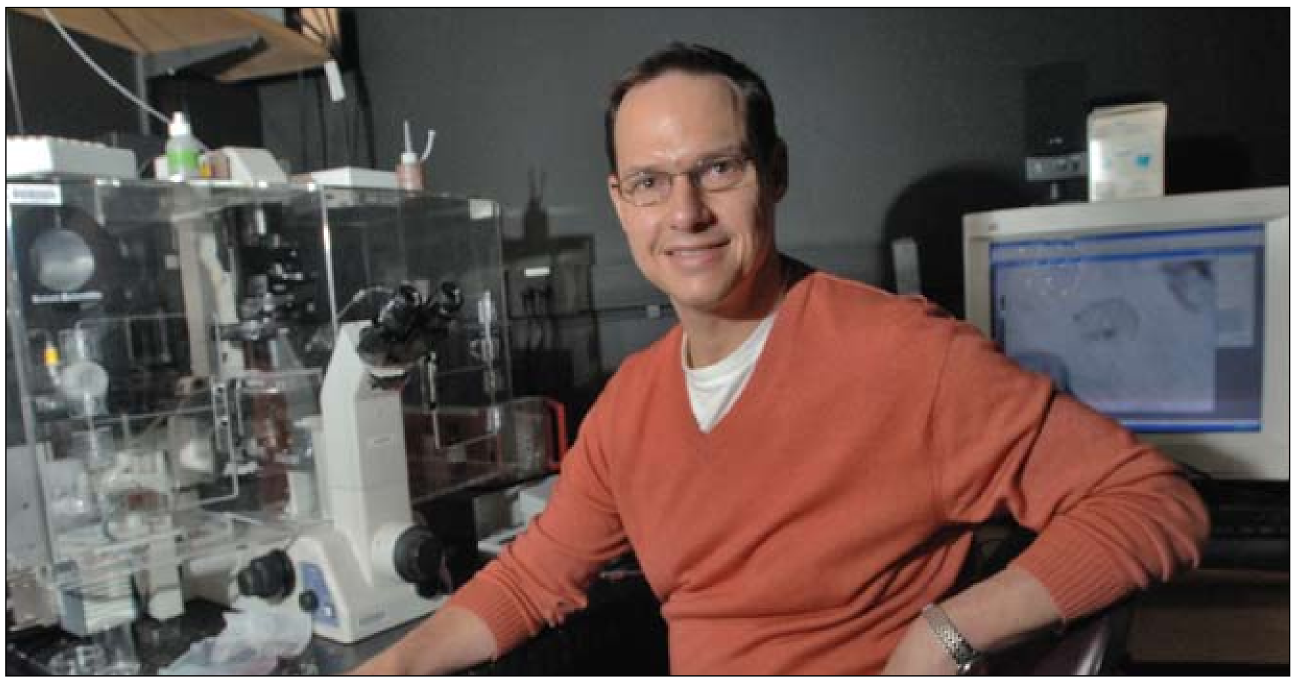


PHOTO / **DONNA COVENEY**

Biology professor Frank Gertler leads a team that has uncovered new insights into the early development of the nervous system.

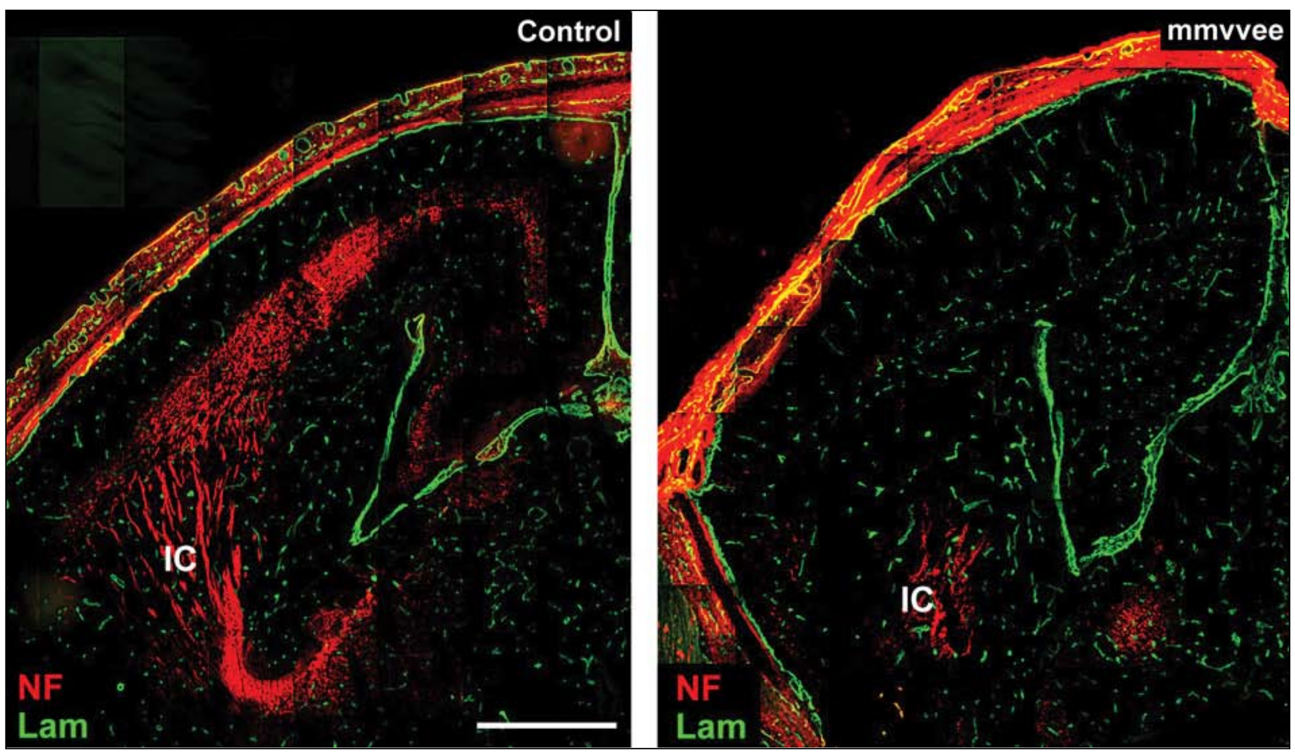


IMAGE / **ADAM KWIATKOWSKI, DOUG RUBINSON, FRANK GERTLER, COURTESY NEURON**

This image of axons in a mouse embryo was taken after 16.5 days of gestation. In a normal mouse, left, axons (red) extend from the cortex upwards toward a part of the brain known as the internal capsule. In a mouse lacking Ena/VASP proteins, right, the axons fail to grow.

Genomic study of malaria reveals distinct classes of parasites

Nicole Davis
Broad Institute

The malaria parasite has been studied for decades, but surprisingly little is known about how it behaves in humans to cause disease. Now an international team, which includes scientists at the Broad Institute of MIT and Harvard, has for the first time measured which of the parasite's genes are turned on or off during actual infection in humans, unearthing surprising behaviors and opening a window on the most critical aspects of parasite biology.

The work is reported in the Nov. 28 advance online edition of Nature.

The study's conclusions spring from the genomic analysis of parasites in their natural state, derived directly from patients residing in Senegal, and also from the researchers' use of innovative computational approaches to interpret their results. These computational methods helped to identify three distinct biological states of the malaria parasite: an active growth-based state, a starvation response and an environmental stress response, presumably related to the body's inflammatory reaction to the parasite.

This physiological diversity was previously unknown and may help explain the widely varying course of the disease in different patients, from mild, flu-like illness to coma and even death.

"For the first time, we have glimpsed the biology of the malaria parasite in one of its most important environments—humans," said co-senior author Aviv Regev, a member of the Broad Institute and an assistant professor of biology at MIT. "Our unique computational approach holds promise not only for understanding the malaria pathogen, but likely other important microbes as well."

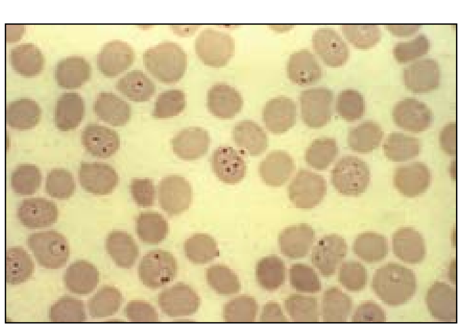


IMAGE COURTESY / **CENTER FOR DISEASE CONTROL**

By observing the malaria parasite in its natural environment—humans—MIT researchers have made surprising discoveries.

In its natural state, the malaria parasite, Plasmodium falciparum, leads a complicated life. It proceeds through a series of distinct developmental stages in humans and mosquitoes, the main vector for disease transmission. Malaria researchers typically circumvent this complexity by studying the parasite in

See **MALARIA**
Page 6

MIT team discovers bacterial surprise: a DNA shift never before seen in nature

Anne Trafton
News Office

A team of MIT researchers and others has discovered that bacteria employ a type of DNA modification never before seen in nature.

The researchers, led by Peter Dedon, professor of biological engineering, and Zixin Deng at Shanghai Jiaotong University in China, published their results in the November issue of Nature Chemical Biology.

For several decades, researchers have known that it is possible to modify synthetic oligonucleotides (short strands of DNA) by adding sulfur to the sugar-phosphate DNA backbone as a phosphorothioate. Researchers often use such modifications in the laboratory to make DNA resistant to nucleases (enzymes that snip DNA in certain locations) as a step toward gene and antisense therapies of human diseases.

Dedon said he and his co-workers were surprised to discover that a group of bacterial genes, known as the dnd gene cluster, gives bacteria the ability to employ the same modification on their own.

"It turns out that nature has been using phosphorothioate modifications of DNA all along, and we just didn't know about it," he said.

The discovery raises many new questions.

"To find that bacteria do it naturally opens up a whole new set of issues to deal with," Dedon said. "What is it doing? Why would bacteria conserve this system which requires five enzymes, each with different co-factors?"

He theorizes that the modification system might serve as either protection against foreign (unmodified) DNA, or as a "bookmark" to assist with transcription or replication of DNA.

The researchers found that the sulfur was incorporated as a phosphorothioate about every several thousand base pairs in the bacterial genome, but they are not sure why it appears in those specific locations. They found the sulfur in many different strains of bacteria, and they believe the gene cluster can be passed between bacteria, much like genes for antibiotic resistance.

Other MIT authors of the paper are lead author Lianrong Wang, a visiting graduate student in the Department of Biological Engineering; Shi Chen, a postdoctoral scientist in the Department of Chemistry; Koli Taghizadeh, a research scientist in the Center for Environmental Health Sciences; and John Wishnok, senior research scientist in the Department of Biological Engineering and the Center for Environmental Health Sciences.

The work was funded by the National Institute of Environmental Health Sciences, the National Cancer Institute, the Ministry of Science and Technology of China, the National Science Foundation of China, the Ministry of Education of China and the Shanghai Municipal Council of Science and Technology.

Interdisciplinary cancer study cited

Elizabeth Thomson
News Office

A UCLA cancer study reported in this month's Nature Nanotechnology validates earlier work by MIT engineers and is emblematic of an explosion in research at the intersections of engineering, the life sciences and medicine, according to MIT Dean of Engineering Subra Suresh.

Since about 2002, Suresh and colleagues have applied state-of-the-art techniques for the study of nanoscale mechanical properties of materials to the study of the physical characteristics of living cells, with a particular emphasis on infectious diseases and cancer. In several papers over the past three years, they have shown that metastatic, or spreading, pancreatic cancer cells are significantly softer (less stiff) than their benign and nonmetastatic counterparts. The results paved the way for a potential new diagnostic test for the disease.

The UCLA work takes the research an important step further. Those researchers, led by James K. Gimzewski, analyzed live cancer cells taken from body cavity fluids from the lung, breast and pancreas of patients with suspected metastatic cancer. Among other things, fluid samples contain both benign and metastatic cells for direct comparison.

Using biomechanical techniques similar to those of the Suresh team, Gimzewski and colleagues found that cancer cells were nearly four times softer than their benign counterparts from the same fluid sample.

Suresh, who wrote an accompanying commentary to the UCLA paper in Nature Nanotechnology, describes such a nanomechanical approach as a potentially powerful means for detecting cancer along with other tools currently used for diagnosis.

"This is a good example of an intersection of engineering with life sciences and medical practice," Suresh, who is also the Ford Professor of Engineering, told the News Office in an interview. "We've brought tools that the medical community is not generally aware of to probe a human disease, in this case cancer."

The UCLA and MIT work toward a potential new diagnostic method for cancer is just one example of what can be achieved when engineers and scientists work together on the study of human diseases, Suresh said, adding that such collaborations between engineers and researchers in the life sciences are part of a rapidly growing trend.

As an example, he cited MIT's recent announcement of plans to build the David H. Koch Institute for Integrative Cancer Research, which will bring together scientists and engineers under one roof to develop new and powerful ways to detect, diagnose, treat and manage cancer.

"The recently announced Koch Institute ... will provide a forum to develop many such interactions among faculty members from the schools of engineering and science," he said.

MALARIA

Continued from Page 5

cultured cells. Yet in this artificial setting, few differences have been found in the genes that are turned on or off in various strains of P. falciparum. That uniformity is surprising, because it fails to explain the drastically different courses experienced by malaria patients.

To explore the basis for these differences, the scientists set out to observe P. falciparum in its natural environment: the human circulatory system. Using small samples of blood collected from more than 40 malaria patients in Senegal, the team worked meticulously to devise a method for isolating genetic material from parasites, allowing them to determine which of the nearly 6,000 P. falciparum genes are switched on or off during infection in humans. Importantly, all of the patients involved in the study harbored similar-looking parasites, yet their symptoms varied widely.

From the parasites in patients' blood, the researchers simultaneously measured the activity level, or "expression," of every P. falciparum gene.

The key to interpreting these results lay in two computational tools first developed to study the genomics of human cancer cells. By adapting these tools for malaria, the researchers were able to identify distinct groups of parasites, each marked by characteristic sets of active and inactive genes.

The biological underpinnings of these groups were made clearer through a second innovative approach: systematically comparing P. falciparum—whose genes and genome are poorly understood—to baker's yeast, an organism that has been extensively characterized at the genetic level. Since the malaria parasite and baker's yeast are both single-celled eukaryotes, it is possible they may share some of the same cellular machinery and could also respond in some similar ways to their surroundings.

In the end, the researchers were able to describe three different classes of parasites, one of which displayed features associated with a well-known form of parasite metabolism. The other groups, however, were very unusual, reflecting modes of parasite behavior that had never before been described.

"For decades, our knowledge of the parasite has been driven solely by studies in cultured cells, not in humans," said co-author Dyann Wirth, a professor at the Harvard School of Public Health and co-director of the Broad Institute's Infectious Disease Initiative. "Our work underscores the importance of studying the malaria parasite in its natural environment and will hopefully spark novel approaches to malaria drug discovery."

Additional authors of this study are from the following organizations: Brigham and Women's Hospital; University of California, Riverside; Novartis Research Foundation; Le Dantec Hospital, Cheikh Anta Diop University, Dakar, Senegal; the Whitehead Institute for Biomedical Research; and the Scripps Research Institute.

Clean Energy Entrepreneurship Prize launches

The MIT Clean Energy Entrepreneurship Prize of $200,000, announced Nov. 28, kicks off a program to help develop and motivate the next generation of energy entrepreneurs. The nationwide competition is sponsored by MIT, NSTAR Electric and Gas Corp., and the U.S. Department of Energy (DOE).

Assistant Secretary of Energy for Energy Efficiency and Renewable Energy Alexander Karsner and NSTAR Chairman, President and CEO Tom May joined President Susan Hockfield in making the announcement.

"Working together with visionary leaders such as Tom May and Andy Karsner demonstrates our shared commitment to catalyzing the development of the next generation of energy entrepreneurs," said Hockfield. "The ultimate goal of this contest is to find innovative solutions to transform today's energy systems into tomorrow's sustainable energy future."

The Clean Energy prize was established by building on the very strong base of two existing and nationally recognized MIT competitions—the MIT $100K Entrepreneurship Competition and the Ignite Clean Energy Competition.

Funding for the award is provided by NSTAR and the DOE. This expanded competition and more significant pool of prize money is designed to accelerate the pace of bringing innovation to market. Entrepreneurial teams of all backgrounds and experience levels are being encouraged to participate, as the competition is open to both student and nonstudent teams that meet eligibility requirements. Teams will undergo a rigorous mentoring, coaching and selection process as the competition progresses.

The semifinalists and finalists from the competition will present and defend a full business plan before a distinguished panel of clean-energy industry experts and venture capitalist judges for the awarding of the MIT Clean Energy Entrepreneurship Prize and runner-up prizes in May.

"DOE is proud to support the work of America's best and brightest on one of our most important and pressing challenges—clean energy," said DOE's Karsner.

"Our customers are looking to meet their energy needs in the cleanest, most efficient way possible and that requires innovation," said NSTAR's May. "We want to help these entrepreneurs get their great ideas off the drawing boards and into the homes and businesses of our customers."

Additional information regarding the MIT Clean Energy Entrepreneurship Prize and the full competition is available at http://mitceep.com. Updates on the progress of teams participating in the competition will be available on the web site over the coming months.

The MIT Energy Initiative (MITEI) is a key driver of the competition. The campus-wide energy initiative is designed to help transform the global energy system to meet the challenges of the future through research, education and outreach activities. "Meeting the world's energy needs requires much more than great ideas—we also need creative approaches," said Professor Ernest Moniz, director of MITEI. "This competition provides another tool to meet the enormous challenges of the 21st century."

Further support for the MIT Clean Energy Entrepreneurship Prize and competition is provided by the Ewing Marion Kauffman Foundation (www.kauffman.org).

RADAR

Continued from Page 1

breast-conserving lumpectomy procedure instead of the expected, and more invasive, mastectomy. Surgeons concluded that 14 of the tumors shrunk enough for this to be possible.

In 1990, Dr. Alan J. Fenn, a senior staff member at MIT's Lincoln Laboratory, adapted the thermotherapy treatment from a system that used focused microwaves to detect missiles and block out interfering enemy signals.

"It's a very simple idea that can be applied to the treatment of many different cancers, including breast cancer," Fenn said.

The microwaves, delivered by two applicators placed near the breast, kill the cancerous tissue while preserving normal breast tissue by targeting tumor cells that contain high amounts of water and ions, Fenn explained. When the microwave energy passes through the tumor, the water molecules begin to vibrate and generate heat through friction. This process eventually elevates the cancer cells to a "high fever" of at least 108 degrees Fahrenheit in most cases, killing them.

"The treatment is well tolerated," said Dr. Mary Beth Tomaselli, medical director at Comprehensive Breast Center in Coral Springs, Fla., and a surgeon who was also a co-investigator in the study. "The patients who have gone through it had minimal side effects and positive results."

This is the fourth clinical trial of the therapy since 1999. In a Phase-I safety trial using microwave heat alone, researchers found that both small and large breast tumors could be decreased in size between 30 and 60 percent. In a Phase-II dose-escalation trial for small tumors, scientists increased the amount of heat until 100 percent of the tumor cells were killed, prior to the patients' receiving a lumpectomy.

Next, researchers treated similar early-stage tumors and noticed that after the surgical removal, none of the patients had tumor cells remaining at the edge of the incision. This is important because additional breast surgery and/or radiation therapy are often recommended for patients that have cancer cells close to the edge of the lumpectomy surgical margin.

The treatment centers for the latest study, which focused on larger tumors, included Harbor-UCLA Medical Center in Torrance, Calif., the University of Oklahoma in Oklahoma City, Comprehensive Breast Center in Coral Springs, Fla., St. Joseph's Hospital in Orange, Calif., and five additional sites. Celsion, a Canadian company, licenses the focused microwave thermotherapy technology from MIT, and has produced 10 clinical systems to date to perform the procedures.

The team has applied for approval for a large-scale clinical trial from Health Canada (the equivalent of the U.S. FDA) and will be applying for the same approval from the FDA. Researchers will then test the treatment in a randomized study of 228 patients who have large breast-cancer tumors. Patients will receive either chemotherapy alone or chemotherapy plus microwave heat treatments at one of six participating medical centers in the United States and Canada.

"The patients who have the best results in cancer treatment, at least with breast cancer, are patients who have a sequence of different therapies, including chemotherapy, surgery, radiation and hormones," said Dr. Hernan I. Vargas, associate professor of surgery at UCLA and lead author of the recent study. "Each one of the treatments adds a little bit. The thermotherapy might be one more tool that helps us fight this disease."

Dr. Jay K. Harness of St. Joseph's Hospital in Orange, Calif., was also an author of the Cancer Therapy article.

YUNUS

Continued from Page 1

problem-solver who addresses the world's challenging issues with ingenious solutions," Holmes said.

Yunus has won dozens of international awards, including the Simon Bolivar Prize, the Indira Gandhi Peace Prize, the Seoul Peace Prize and the Freedom Award of the International Rescue Committee. He has also been appointed as an International Goodwill Ambassador for UNAIDS by the United Nations and inducted as a member of France's Legion d'Honneur.

From 1993 to 1995, Yunus was a member of the International Advisory Group for the Fourth World Conference on Women, a post to which he was appointed by the U.N. secretary general. He has served on the Global Commission of Women's Health, the Advisory Council for Sustainable Economic Development and the U.N. Expert Group on Women and Finance.

In addition to Grameen Bank, Yunus has created numerous other companies in Bangladesh to address poverty and development issues. Those companies are involved in a range of industries, including mobile telephony, Internet access, capital management and renewable energy.

Recent MIT Commencement speakers have included MIT President Emeritus Charles M. Vest, Federal Reserve Chairman Ben Bernanke, former U.S. Sen. George J. Mitchell and National Institutes of Health Director Elias Zerhouni.

GIBSON

Continued from Page 3

for retired faculty is currently offered in some but not all of the schools. Over the next few years we will work to provide office space for retired faculty in the schools that do not currently provide it.

Q: Is this an MIT thing or are other universities doing it?

A: Several of our peer institutions have established a faculty retirement program, including Brown, University of Chicago and Stanford.

Q: Besides the focus groups, how else can faculty provide input?

A: Feedback, comments or questions (which can remain confidential) can be sent to web.mit.edu/facultyrenewal/comments.html. Faculty input has also occurred at meetings of the school councils, at a faculty dinner and the October faculty meeting.

Multimedia artist Joan Jonas wears many hats

Sarah H. Wright
News Office

Architecture professor Joan Jonas, pioneering performance and video artist, picked up a portapak camera in the 1970s and hasn't looked back. A sculptor by training, over the past three decades she has forged a unique artistic genre, mixing humans, animals, ancient stories and high-tech imagery into widely acclaimed multimedia productions.

"The camera became my pencil," she says. "My performances are rituals, and I use technology, everything from a mirror to computers, to develop them."

Jonas has won numerous awards and her video work has been collected by prestigious museums including the Museum of Modern Art, the Whitney Museum and the Centre Pompidou in Paris. The Museum of Contemporary Art in Barcelona features an exhibition of her work through January.

Jonas is modest about this global reach and about the deep complexity of her work. In a recent interview in her office at MIT, she delighted most in discussing the design-and-build, hands-on part of her work—the way she makes hats.

Jonas designs and constructs elaborate, abstract hats for her performances, following an intuitive process that results in headdresses that function as hair coverings and as disguises.

"I use Japanese rice paper—it crunches and makes a good sound. To make the hats, I twist it and mash it into layers. I get the right shape. Sometimes I attach the paper to a straw-hat frame, so I can add rope or wire, so it can stand up," she says, her hands forming a hat in the air as she speaks.

Some look like wacky chef's hats; others, like shaman's gear. Rituals like the Tibetan black hat ceremony and the Hopi snake dance inspired her to build headdresses for her performances, she says.

"A hat transforms you. It's like a mask, but more subtle. I often use masks—my alter ego, Organic Honey, wore a mask—to alter my persona. Now, I also wear hats to cover my hair, so I am not myself in performances," she says.

"Organic Honey's Visual Telepathy" (1972), featuring a plastic mask and a feathered headdress, is one of 10 works, which include more complex installations and single channel videos, in the Barcelona exhibition.

Others include "Songdelay" (1973), filmed in a vacant lot; "Volcano Saga" (1989), with actress Tilda Swinton as a 12th-century Icelandic woman seeking interpretation of four dreams; and "The Shape, the Scent, the Feel of Things" (2004-2007), a representation of the nonlinear thoughts of art historian Aby Warburg, then confined to a sanitarium.

A Hopi snake dance inspired the head-nurse hat that appears in "The Shape, the Feel, the Scent of Things," she says.

A Pippi-Longstocking-meets-Medusa affair, it is a layered tower of pale rice paper with braids of rope sticking out at odd upward angles. Amazingly, the snake hat, along with its ragged-layered robe costume, seamlessly suits the video work's mental hospital setting.

So do other elements that Jonas often uses in "Shape," though none would seem logically to suit the scene at all. These include a stuffed coyote on a low cart (she has cast each of her dogs, Sappho and Zina, in various works); a metal hoop that recurs throughout her work; images of nature, such as moths; and acts of drawing or painting white circles or snakes or animal heads on the ground.

These simple, vigorous drawings, inspired by Maya Deren's films of Haitian voodoo rituals, suggest a ceremony is underway, Jonas acknowledges.

It is reasonable to see these mysterious acts and objects as symbols. But the artist has something more free-form in mind, she says.

"I never use the word 'symbol.' I use 'motifs' so the audience has the freedom to read into the images. I use and reuse props, things I find around me, like the hoop or blocks of wood or a freighter passing by that gets caught by a camera. They don't refer to any fixed thing outside the piece," she says.

Her recent and current works include these motifs, and she uses them plus new editing technology to keep probing the genre she practically invented.

Since the late 1970s, her work has delved into literature, ranging from ancient Icelandic sagas to Irish tales to an upcoming work exploring and representing Dante's "Inferno."

"It's a majestic work, very concentrated, and very interesting to do in the present time," she says.

The Dante piece will take more than six months to produce. Jonas is already gathering images, circling back through earlier projects, like a knitter looking for a lost stitch.

PHOTO / DONNA COVENEY

Joan Jonas, grand dame of video art.

"I've got an image from the 1970s of steam rising from the street in New York. It's very inferno-like," she says.

As for the costumes and hats—of course there will be costumes and hats! Maybe a robe like the black rice-paper winged one Ragani Hass wore in "Shape"? Or a mask-hat with wolf ears, like the one in "Shape"?

Jonas laughs. "Art is spiritual because it gives people pleasure. Hats, costumes, images, space—they're all part of an ongoing experiment."

MIT alum, principal bassoonist will perform solos with MITSO

Sarah H. Wright
News Office

John Miller, MIT alumnus and principal bassoon for the Minnesota Orchestra, will perform a suite of works by American composers with the MIT Symphony Orchestra (MITSO) at 8 p.m. on Friday, Dec. 7, in Kresge Auditorium.

The first MIT graduate to be awarded a Fulbright grant for music performance and to hold a principal chair in a major American symphony orchestra, Miller (S.B. 1964) is returning to a campus he recalls as intellectually inspiring and stimulating.

John Miller

"My most cherished memory of MIT was the palpable feeling of brain power at work. This unseen vibration stimulated me, gave me confidence and made me feel smarter and more capable. It was what I loved most about being at the Institute," he said.

Miller majored in humanities and engineering, which gave him the flexibility to pursue courses in acoustics and the chance to study with such renowned faculty as Amar Bose, who was then professor of electrical engineering and computer science.

As an MIT student, Miller played bassoon professionally with groups including the New England Conservatory. His academic and performance commitments left him little free time: He squeezed in his individual practice after midnight, he said.

He assumed his present position as principal bassoon of the Minnesota Orchestra in 1971, when he also joined the faculty of the University of Minnesota.

On Friday, Miller will perform works for solo bassoon and string orchestra by Alec Wider, Bernard Rogers and Burrill Phillips. MITSO Music Director Adam Boyles will conduct.

Miller describes the pieces he will play as representative of the American Neo-Romantic style of the mid-20th century.

"All three composers were trained at the Eastman School of Music and have somewhat similar voices. Wilder uses the bassoon in a gently nostalgic way, Rogers is seriously oratorical and Phillips is jaunty and bold. They all chose to set the bassoon with string instruments so that its soft-spoken tone could be more effectively showcased," Miller said.

The MITSO program will also include works by Samuel Barber, Ottorino Respighi and Jean Sibelius.

Miller received his early musical training at the Peabody Conservatory in Baltimore and the New England Conservatory in Boston. While in Boston he founded the Bubonic Bassoon Quartet and made the premier recording of the Hummel Bassoon Concerto, released with the Weber Concerto on Cambridge Records.

For more than 20 years he was a member of the American Reed Trio. Among his solo recordings are four concertos by Vivaldi and the Mozart and Vanhal concertos, all conducted by Sir Neville Marriner on two Pro Arte CDs.

One of Miller's educational activities, the Nordic Bassoon Symposium, begun in 1984 as the John Miller Bassoon Symposium, has attracted an international mix of hundreds of professional, student and amateur bassoonists.

Kresge Auditorium, 84 Massachusetts Ave., is handicapped accessible. This event is open to the public, and admission is $5 at the door.

Howtoons characters Celine and Tucker, wearing safety goggles made from plastic soda bottles, launch a rocket that is also made from an old plastic soda bottle. The scene is the culmination of a set of detailed how-to instructions, which the comic presents in graphic form.

'Howtoons' hits bookshelves: MIT's do-it-yourself for kids

David Chandler
News Office

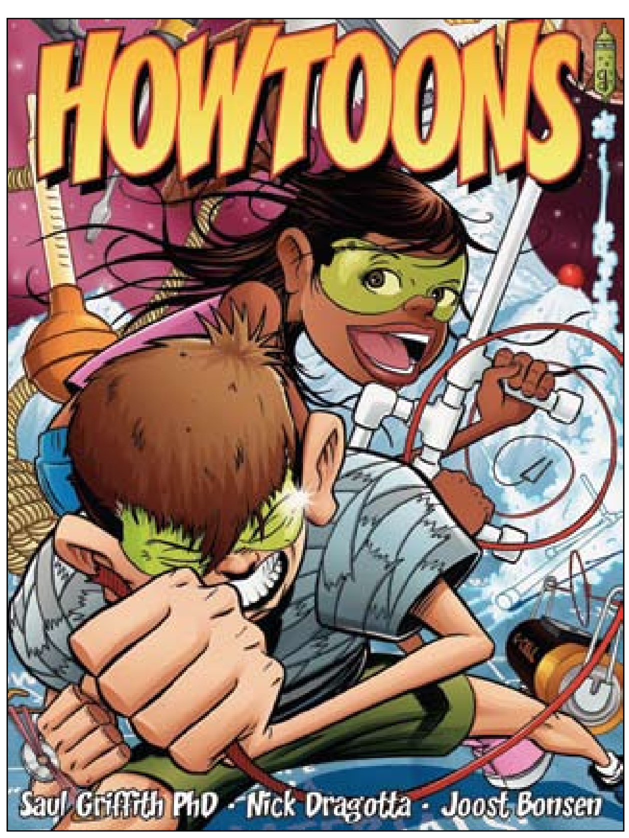
Splurt! Urgghh! Ping! Thump! Boom boom bap!

It's not exactly cutting-edge technology, but those could be the sounds of future scientists and engineers in the making.

In a series of colorful, fun-filled comic-book pages, cartoon kids Celine and Tucker set up a home workshop and then proceed to build a whole series of toys and gadgets out of leftover items. They are the heroes of a just-released MIT-spawned book called "Howtoons" (HarperCollins, 2007), designed to inspire youngsters all over the world with a sense of can-do adventure, and to teach them a few principles of science and engineering—and a sense of the creative possibilities all around them—along the way of just having fun.

Howtoons, which also offers a variety of pictorial home-build projects at howtoons.com, is the brainchild of Joost Paul Bonsen, program director of MIT's new Legatum Center for Development and Entrepreneurship, and writer and engineer Saul Griffith, who earned his Ph.D. at MIT and earlier this year won a MacArthur Foundation "genius" award. "What we hope is that kids everywhere will not look at throwaway stuff the same way ever again," Bonsen says. Instead, they will realize than an old plastic bottle "can be a rocket or a submarine or any number of things."

The idea for Howtoons came about when Bonsen and Griffith were MIT graduate students (Bonsen at the Sloan School of Management and Griffith at the Media Lab). They helped to organize some workshop parties for local schoolchildren and invited MIT professors to come and bring their families. At these workshops, some of the construction projects that ended up in the book evolved spontaneously as people tinkered and experimented with a variety of simple materials. The impetus for developing the concept into a business plan came when they took a class in developmental entrepreneurship taught by Legatum Center founder and faculty director Alex "Sandy" Pentland.



The new Howtoons book sprang from a class project.

The projects range from rockets and goggles to simple electric motors, a marshmallow-shooting blowgun, and a simple way of making homemade ice cream. The materials are mostly everyday items like plastic bags and bottles, rubber bands and paper clips.

Bonsen and Griffith enlisted the help of cartoonist Nick Dragotta, who has worked for comic-book powerhouses Marvel and DC, to put the projects into visual form. The idea is to make the instructions as visually self-explanatory as possible, so that kids anywhere can use them without having to read the words (although the book will also be translated into several languages). Eventually, new versions specifically designed for the materials, culture and climate of other countries will also be produced.

Tucker and Celine were designed to be "realistic kids, but drawn in a superhero style," Bonsen says. The idea was to have them "be able to do anything—fix things, make things," he says, and thus provide an example for young readers to adopt the same kind of creative, can-do approach to their surroundings.

"We want to inspire them," Bonsen says, "to think about the world around them not as it is, but as it could be."