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TechTalk
SERVING THE MIT COMMUNITY

Graybiel named Institute Professor

PHOTO / **DONNA COVENEY**

Institute Professor Ann Graybiel

Neuroscientist receives MIT's highest faculty honor

Greg Frost
News Office

Ann Graybiel, the Walter A. Rosenblith Professor of Neuroscience in the Department of Brain and Cognitive Sciences, has been named Institute Professor, the highest honor MIT can bestow on a member of the faculty.

Graybiel, who is also an investigator in the McGovern Institute for Brain Research, has been a member of the MIT faculty since 1973. She is the 14th current Institute Professor and the second to receive the honor this year.

"Even by the very high standards for appointment as an Institute Professor, Ann Graybiel stands out. Her work has been profoundly important, both in terms of fundamental science and consequences for human health," said MIT President Susan Hockfield. "Professor Graybiel's research has contributed profoundly to our understanding of the functional anatomy and physiology of the brain, particularly the brain regions involved in the control of movement. Her work has provided new insights to the neurobiological basis of a range of disorders, from Parkinson's disease to major depression."

> *Even by the very high standards for appointment as an Institute Professor, Ann Graybiel stands out.*
>
> **Susan Hockfield**
> **MIT president**

"Ann is admired among her colleagues for incorporating the most advanced approaches in molecular biology and systems neuroscience for answering fundamental questions about the brain and opening up new avenues for the treatment of many devastating disorders," said Bish Sanyal, chair of the MIT faculty. "In addition to admiring her research, all of us on the MIT faculty respect Ann for her broad intellect, dynamic personality, endless energy, remarkable commitment to teaching and training, and unyielding commitment to MIT."

"By any measure, Ann Graybiel has made scholarly contributions of exceptional distinction and demonstrated an unusual, interdisciplinary breadth of interest and accomplishment," said Provost L. Rafael Reif. "During her time at MIT, she has been an outstanding scientist and made key contributions as a founding member of the McGovern Institute. She has displayed personal qualities of friendship and collegiality, while serving as a role model for the next generation of neuroscientists."

▶Please see GRAYBIEL, **PAGE 8**

Graybiel the second Institute Professor this year

This past July, Associate Provost for Faculty Equity Barbara Liskov was also named an Institute Professor. See the coverage of Liskov's announcement on **PAGE 8.**

Setting the pace

MIT finds mechanism that allows two pacemakers to control breathing

Anne Trafton
News Office

Two pacemakers in the brain work together in harmony to ensure that breathing occurs in a regular rhythm, according to new research from MIT scientists.

That cooperation provides critical backup during respiratory stress, from the early trauma of birth to intense exercise and oxygen shortages, said Chi-Sang Poon, principal research scientist at the Harvard-MIT Division of Health Sciences and Technology (HST).

"The two-pacemaker system provides robustness and redundancy that protects us against a number of challenges from childhood to adulthood," said Poon, senior author of a paper on the work appearing in the online edition of the Proceedings of the

▶Please see PACE, **PAGE 6**

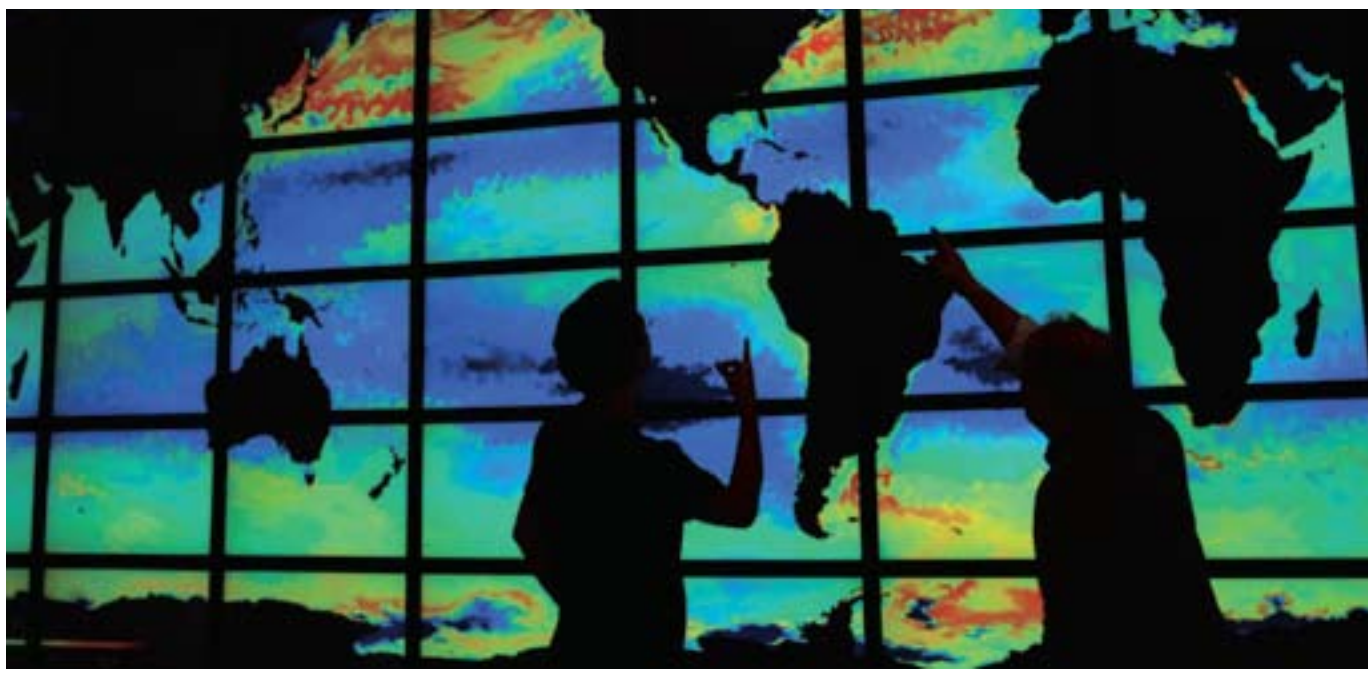


PHOTO / **DONNA COVENEY**

Seeing the big picture

A new high-resolution digital screen in the Stata Center will help visualize things — such as global maps and folded proteins among others — in a way that can't be done on a small monitor. Surveying the screen, made possible by a generous gift from the Moore Foundation, are Research Scientist Oliver Jahn and Principal Research Scientist Chris Hill who got this project off the ground and working. Senior Research Scientist Michael Follows of the Department of Earth, Atmosphere and Planetary Sciences heads up the project.

Events at MIT

Thursday, Nov. 6

• **"Reflections and Projections from 20 Years of LFM Leadership,"** a panel discussion. In 1988, MIT Sloan School of Management, MIT's School of Engineering, and industry created the Leaders for Manufacturing (LFM) program to help American manufacturers compete more effectively and address the erosion of competitiveness experienced by many industries. Over the past 20 years, LFM alumni have risen to leadership positions in manufacturing and operations around the globe. Today they apply LFM principles and practices on the factory floor, along the supply chain, and in other arenas such as dot-com enterprises, health care and the Human Genome Project. 4:15 p.m. in the Wong Auditorium. Open to the entire MIT community.

• **authors@mit: Sherry Turkle**, "The Inner History of Devices." 6 p.m. in 35-225.

• **Center for 21st Century Energy Fall 2008 Seminar Series.** Emmanuel Kasseris will speak on the topic of "Knock Limited Performance in Direct Injected Spark Ignited Engines Using Gasoline/Alcohol Blends." 4-5 p.m. in 37-212.

Friday, Nov. 7

• Deadline to submit proposals for 2008 **MIT 'Kick Butt' contest.** The goal of this contest is to build a deliberately overengineered mechanical apparatus that will perform the simple task of extinguishing a cigarette in an extremely indirect and convoluted fashion. *URL: http://medweb.mit.edu/about/news/smokeout.html*

Continued on **PAGE 3**

Singapore-MIT GAMBIT Game Lab students win Microsoft Dream-Build-Play Competition

A video game developed by the Singapore-MIT GAMBIT Game Lab has won first prize in the 2008 Microsoft XNA Dream-Build-Play game development competition.

The winning game, "CarneyVale: Showtime," was developed by a team of seven Singaporean students working in the Singapore office of the international game lab. The prize includes $40,000 and consideration for publication on the Microsoft XBox LIVE service.

This year's global Dream-Build-Play competition garnered more than 350 games from 100-plus countries, nearly doubling the number of community members who enrolled in and submitted Dream-Build-Play titles in last year's competition.

"I am very pleased with the results that have been shown by the interns from GAMBIT," said Teo Chor Guan, executive director of the Singapore lab. "It proves that Singapore students have the capability to produce a game that is of international stature."

> *[The win] proves that Singapore students have the capability to produce a game that is of international stature.*
>
> **Teo Chor Guan**
> **executive director, Singapore lab**

In "CarneyVale: Showtime," players can manipulate a wide variety of props to guide an acrobat through a circus arena, including trapeze-like grabbers and flying rockets. Points are collected by bursting trails of balloons and performing special acrobatic tricks; players can earn star ratings for completing level objectives and rising up the ranks. The game includes 12 unlockable achievements, 18 regular levels and a built-in map editor with nine slots for players to share custom maps with family and friends.

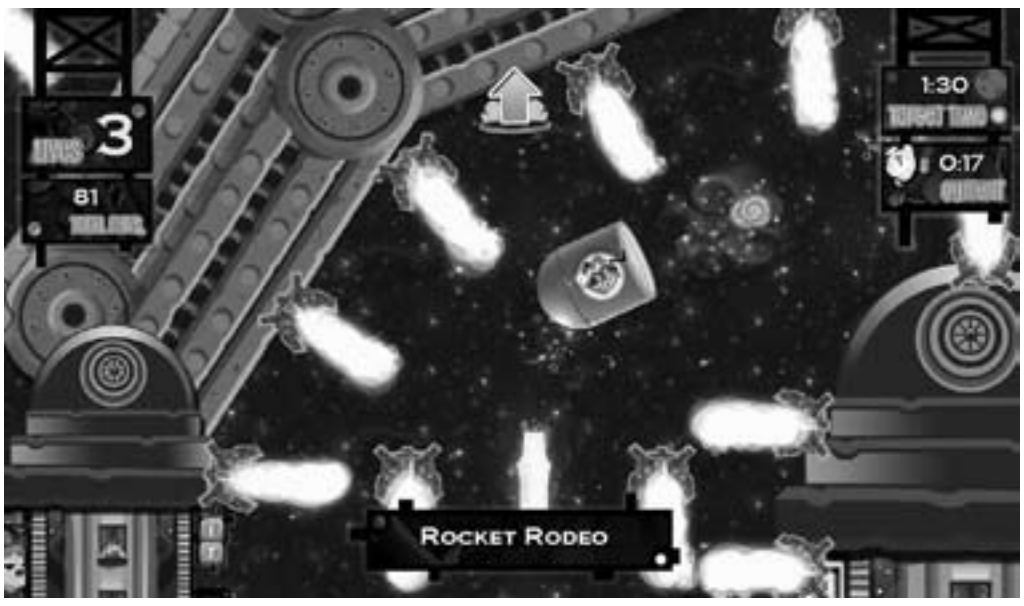
"CarneyVale: Showtime" is a follow-up to "Wiip," a game developed by a team of U.S. and Singaporean students in the GAMBIT summer 2007 game development program. In "Wiip," players wielded training whips as ringmasters in the circus world of CarneyVale. In Showtime, players return to CarneyVale as a circus acrobat performing acrobatic tricks and death-defying stunts through increasingly complex arenas.

"This is one of the first games where we attempt to combine rag-doll physics, platforming genre and player performance all into one single game," said Showtime programmer Bruce Chia. "It was definitely no easy task to innovate from well-established platform games like Super Mario Brothers while still keeping true to the genre. However, I believe we managed to pull it off. We are extremely happy to hear the good news and look forward to bringing the game to the public."

"We are delighted by Showtime's success," said William Uricchio, lead principal investigator for the GAMBIT lab at MIT. "It stands as proof of GAMBIT's concept and is a testament to the Singapore side of the operation."

"CarneyVale: Showtime" was developed by Chia (programming), Hansel Koh (programming), Lee Fang Liang (programming), Adrian Lim (programming), Desmond Wong (artist), Joshua Wong (producer), and Guo Yuan (audio). More information on Showtime is available at http://gambit.mit.edu/loadgame/showtime.php. More on the Microsoft Dream-Build-Play competition can be found at http://www.dreambuildplay.com. More on the Singapore-MIT GAMBIT Game Lab is available at http://gambit.mit.edu.

The Singapore-MIT GAMBIT Game Lab is a five-year research collaboration between the Massachusetts Institute of Technology and the Interactive Digital Media R&D Programme Office hosted by the Media Development Authority of Singapore.



Screenshots from the game "CarneyVale: Showtime."

IMAGE COURTESY OF THE GAMBIT GAME LAB

No Tech Talk on Nov. 12

Because of the Veterans Day holiday on Nov. 11, there will be no Tech Talk next week. For updated coverage of MIT news, please see our web site at web.mit.edu/newsoffice.

CORRECTION

A story in last week's Tech Talk incorrectly stated that there had been a possibility of six MIT alumni being in space at the same time this November, if the Hubble Telescope servicing mission had flown as planned. In fact, if the Hubble mission had not been delayed, it would have flown instead of the actual STS-126 mission that will carry two MIT alums to space on Nov. 14, and thus there still would have been just four alumni in space at the same time. Also, the story stated that six previous shuttle missions have had two MIT alums aboard; actually there were seven such missions.

Tech Talk regrets these errors.

Awards&Honors

Dedon paper named top scientific achievement

A paper co-authored by Peter Dedon, professor of biological engineering, has been named one of the top 10 global scientific achievements of 2007 by Scientific American China.

Dedon, in collaboration with researchers from MIT and China's Shanghai Jiaotong University, found that a group of bacterial genes gives them the ability to modify DNA by adding sulfur to the sugar-phosphate DNA backbone as a phosphorothioate. Such a modification had never been seen before in nature.

The paper was published in Nature Chemical Biology in November 2007. 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.

Graybiel wins Vanderbilt Prize in Biomedical Science

Institute Professor Ann Graybiel has won the Vanderbilt Prize in Biomedical Science, which honors and recognizes a woman scientist of national reputation who has a stellar record of research accomplishments and who is known for her mentorship of other women in science. Graybiel delivered a lecture, titled "Our Habitual Lives: How the Brain Makes and Breaks Habits," on Oct. 30 at Vanderbilt.

AgeLab director wins GSA award

MIT AgeLab Director Joseph Coughlin has been named as the 2008 recipient of the Gerontological Society of America's (GSA) Maxwell A. Pollack Award for Productive Aging. The Pollack Award recognizes mid-career researchers whose visionary work has demonstrated excellence in translating research into practical application or policy improving the lives of older people.

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DoE's Dehmer to discuss science's role in energy challenges

Patricia M. Dehmer, deputy director for science programs at the U.S. Department of Energy, will give a talk at MIT today titled "Facing Our Energy Challenges in a New Era of Science." Dehmer is the senior science official in the third-largest federal sponsor of basic research in the country, which funds research at 300 colleges and universities as well as at DoE laboratories.

Dehmer previously directed the DoE's Office of Basic Energy Science, and under her leadership that office's budget more than doubled to $1.2 billion a year. She led a five-year effort there to tie basic energy research more closely to real-world energy problems.

Before beginning work at the DoE's Office of Science in 1995, Dehmer already had a distinguished career in atomic, molecular, optical and chemical physics at Argonne National Laboratory in Chicago, with more than 125 peer-reviewed publications. She earned her PhD in chemical physics from the University of Chicago in 1972.

In her daylong visit to MIT, Dehmer will visit several energy research projects on campus and meet with President Susan Hockfield and with MIT Energy Initiative Director Ernest J. Moniz.

Her talk, which is open to the general public, will begin at 4:30 p.m. in 34-101.

IMAGE / **AURORA FLIGHT SCIENCES**

Into the wild blue yonder

An MIT-led team recently won a $2 million contract from NASA to develop concepts for commercial airliners that could go into service beginning around 2030. This sleek-looking airplane is among the team's preliminary concepts.

Armed with the grant, the team will conduct an 18-month study of ways to make passenger planes of the future quieter, greener and more energy efficient — a crucial need in this era of rising fuel prices.

Eight MIT faculty members from the Department of Aeronautics and Astronautics, including professor Edward Greitzer as principal investigator, as well as several students, will be working on the project in collaboration with engineers from Aerodyne Research, Aurora Flight Sciences, Boeing Phantom Works, and Pratt & Whitney.

New center prepares students for global success

Earlier this fall, three MIT juniors walked into the new Global Education Office (GEO) in Building 12 and asked: "Is this the office that knows about all things global?" These students were looking for help in understanding what global opportunities exist at MIT. With the formation of the Global Education and Career Development Center, which incorporates the GEO, the response to the students was "yes." In the past, the students would have visited several offices to get the answers they needed. Now, GEO can be a first point of contact for students who are exploring the possibilities to go global.

In July, the Office of the Dean for Undergraduate Education announced the formation of the Global Education and Career Development Center (GECDC), which comprises the GEO and the Career Development Center (CDC). While GEO and the CDC will offer distinct services for students and faculty, they will also operate as a one-stop organization, providing more expanded and unified programs and services. Their mutual goal is to help students and alumni develop the self-awareness and skills to become effective leaders in a diverse society and prepare for the globalized world of work.

The Global Education Office incorporates the programs and services of the Study Abroad and Distinguished Fellowships Office but is broader in scope. The mission of GEO is to advance global education at MIT. The office, in concert with the diverse international programs at MIT, will support a seamless experience for our undergraduates as they prepare for, proceed on, and return from a global experience. At the same time, the Career Development Center continues to provide career planning and employment search services similar to the MIT Career Office. Moving forward, the CDC will develop a more holistic and competency-based career development program that incorporates a global perspective.

In bringing together GEO and the CDC as a more integrated and collaborative organization, the GECDC will leverage the natural synergy between global educational experiences and holistic career development services. Through global education and internship experiences, counseling, workshops, classroom instruction, events, pre-professional advising, and connections to employers and graduate school, the GECDC will help students prepare to meet the challenges of the competitive global economy.

If you have any questions, please contact Melanie Parker (617-253-7519, mlparker@mit.edu), executive director of the GECDC. For question specific to GEO, please contact Malgorzata Hedderick (617-253-9358, malrh@mit.edu), associate dean, Global Education Office.

News in brief

2009 Benefits Open Enrollment starts next week

You voted on Election Day, but don't forget the next election: MIT Benefits Open Enrollment, where you make your benefits elections for 2009. This year, Benefits Open Enrollment takes place from 9 a.m. on Nov. 10 until 4 p.m. on Nov. 21. This two-week period provides the opportunity for all benefits-eligible faculty and staff to enroll or make changes to their medical and dental coverage, enroll in flexible-spending accounts, and review all benefits at MIT.

The good news is that in 2009, dental, vision and supplemental life insurance benefits — and their costs — will be unchanged. One focus during this year's open enrollment is on wellness. Improving our overall health and wellness helps stabilize health care costs for you and for MIT. Check out the many resources MIT offers, which are listed in the open enrollment newsletter sent to all faculty and staff; the newsletter can also be accessed at http://hrweb.mit.edu/benefits/. If you have questions, e-mail benefits-www@mit.edu or call 617-253-6151.

To enroll in your 2009 benefits, visit http://web.mit.edu/sapwebss/PS1/benefits_home.shtml, starting Nov. 10 at 9 a.m.

MIT Federal Credit Union seeks candidates for its Board of Directors

MIT Federal Credit Union, as a member-owned, not-for-profit financial cooperative dedicated to improving its members' lives, is seeking credit union members who are interested in serving on its volunteer board of directors. Three three-year terms on the board will be open for the 2009 election in the spring.

Members of credit unions elect a volunteer board of directors to oversee the credit union, which makes decisions with the members' best interest at heart, unlike bank directors and employees of the banks who are legally bound to make decisions that benefit stockholders, not customers.

If you are interested in serving on the MITFCU Board of Directors, please contact Maura Lavalle at mitfcu-nominate@mit.edu. The application submission deadline is Wednesday, Nov. 19, 2008.

Events at MIT

• **The Siemens Competition in Math, Science, and Technology**: Reception and Viewing of the Student's Research Projects. 5-6:30 p.m. in Twenty Chimneys, Stratton Student Center, Building W20, 3rd Floor. The Siemens Competition in Math, Science, and Technology is the nation's premiere math and science research competition for high school students.

Monday, Nov. 10

• **Evening of Opera at Whitehead Institute.** 6-7:30 p.m. in N25, Whitehead Institute for Biomedical Research (9 Cambridge Center, Cambridge). A special evening of operatic performance by Andrea Matthews, soprano; Philip Lima, baritone; William Merrill, pianist.

Wednesday, Nov. 12

• **BCS Special Colloquium: Translating Basic Science Advances into a Safe and Effective Treatment for Alzheimer's Disease.** Speaker: Richard Wurtman, MIT. 4-5:30 p.m. in 46-3002. This lecture series, held weekly during the academic year, features a wide array of speakers from all areas of neuroscience and cognitive science research. Social events that follow these colloquia bring together students, staff, and faculty to discuss the talk, as well as other research activities within BCS, at MIT and around the world.

• **Neuroscience Drug Discovery and Development: The Route to Disease-Modifying Therapies**. Speaker: Darryle D. Schoepp, PhD, Senior Vice President and Franchise Head, Neuroscience, Merck Research Laboratories. 5:30-9 p.m. in 32, Kirsch Auditorium.

Sunday, Nov. 16

• **"Open Chantey Sing."** Come sing sea music and chanteys with a room full of maritime enthusiasts, professional and amateur. Free and open to the public. Bring your voice and join in! This is a monthly event, starting Nov. 16 from 1-4 p.m. at the MIT Museum.
URL: http://www.nechanteysings.com

Tuesday, Nov. 18

• **"The Edge of Heaven"** ("Auf der anderen Seite"). Directed by Fatih Akin, followed by panel discussion with Nilüfer Göle (professor of sociology, EHESS, Paris), prominent expert on the European public culture in its encounter with Islam; Leslie Adelson (professor of German, Cornell), leading scholar in the field of Turkish-German literature; and Kurt Fendt (research director, MIT), digital media and culture specialist, director of the MIT European Short Film Festival. Panelists will engage in a reading of the film from the perspective of their intellectual and personal trajectories. These intersecting voices will highlight the in-between-ness of the film that cannot be grasped by any single cultural point of view. Open to the public free of charge. Screening at 6 p.m., panel at 8 p.m., Rm. 6-120. For additional, information call 617-253-4771.

Submit your events!

Log on to events.mit.edu to add your events to MIT's online calendar. Select events will be selected from the online calendar to be published in Tech Talk each Wednesday.

Magnetic fields record the early histories of planets

David Chandler
News Office

PHOTO / **DONNA COVENEY**

Professor Benjamin Weiss, of the department of Earth, Atmosphere and Planetary Sciences, holds a sample of the vesicular basaltic meteorite named D'Orbigny that he analyzed as part of his study.

Meteorites that are among the oldest rocks ever found have provided new clues about the conditions that existed at the beginning of the solar system, solving a long-standing mystery and overturning some accepted ideas about the way planets form.

The ancient meteorites, like disk drives salvaged from an ancient computer, still contain magnetic records about the very early history of planets, according to research by MIT planetary scientist Benjamin P. Weiss.

Weiss, the Victor P. Starr Career Development Assistant Professor of Planetary Sciences in the Department of Earth, Atmospheric and Planetary Sciences, and his five co-authors examined pieces of three meteorites called angrites, which are among the most ancient rocks known. The results of their study were published in Science on Oct. 31.

The analysis showed that surprisingly, during the formation of the solar system, when dust and rubble in a disk around the sun collided and stuck together to form ever-larger rocks and eventually the planets we know today, even objects much smaller than planets — just 160 kilometers across or so — were large enough to melt almost completely.

This total melting of the planet-forming chunks of rock, called planetesimals, caused their constituents to separate out, with lighter materials including silicates floating to the surface and eventually forming a crust, while heavier iron-rich material sank down to the core, where it began swirling around to produce a magnetic dynamo. The researchers were able to study traces of the magnetic fields produced by that dynamo, now recorded in the meteorites that fell to Earth.

"The magnetism in meteorites has been a longstanding mystery," Weiss said, and the realization that such small bodies could have melted and formed magnetic dynamos is a major step toward solving that riddle.

Until relatively recently, it was commonly thought that the planetesimals — similar to the asteroids seen in the solar system today — that came together to build planets were "just homogenous, unmelted rocky material, with no large-scale structure," Weiss said. "Now we're realizing that many of the things that were forming planets were mini-planets themselves, with crusts and mantles and cores."

That could change theorists' picture of how the planets themselves took shape. If the smaller bodies were already molten as they slammed together to build up larger planet-sized bodies, that could "significantly change our understanding" of the processes that took place in the early years of the nascent planets, as their internal structures were forming, Weiss said. This could have implications for how different minerals are distributed in the Earth's crust, mantle and core today, for example.

"In the last five or 10 years," Weiss said, "our understanding of the early history of the solar system has undergone a sort of mini-revolution, driven by analytical advances in geochemistry. In this study we used a geophysical technique to independently test many of these new ideas."

"Events happened surprisingly fast at the beginning of the solar system," he said. Some of the angrite meteorites in this study formed just three million years after the birth of the solar system itself, 4,568 million years ago, and show signs that their parent body had a magnetic field that was 20 to 40 percent as strong as Earth's today. "We are used to thinking of dynamo magnetic fields in rocky bodies as uncommon phenomena today. But it may be that short-lived planetesimal dynamos were widespread in the early solar system."

The paper was co-authored by Mitsui Career Development Assistant Professor of Geology Linda Elkins-Tanton, research scientist Eduardo A. Lima, postdoctoral researcher Laurent Carpozen, student James S. Berdahl, and Sabine Stanley, assistant professor of physics at the University of Toronto. The work was supported by a grant from the National Science Foundation's Instrumentation and Facilities Program.

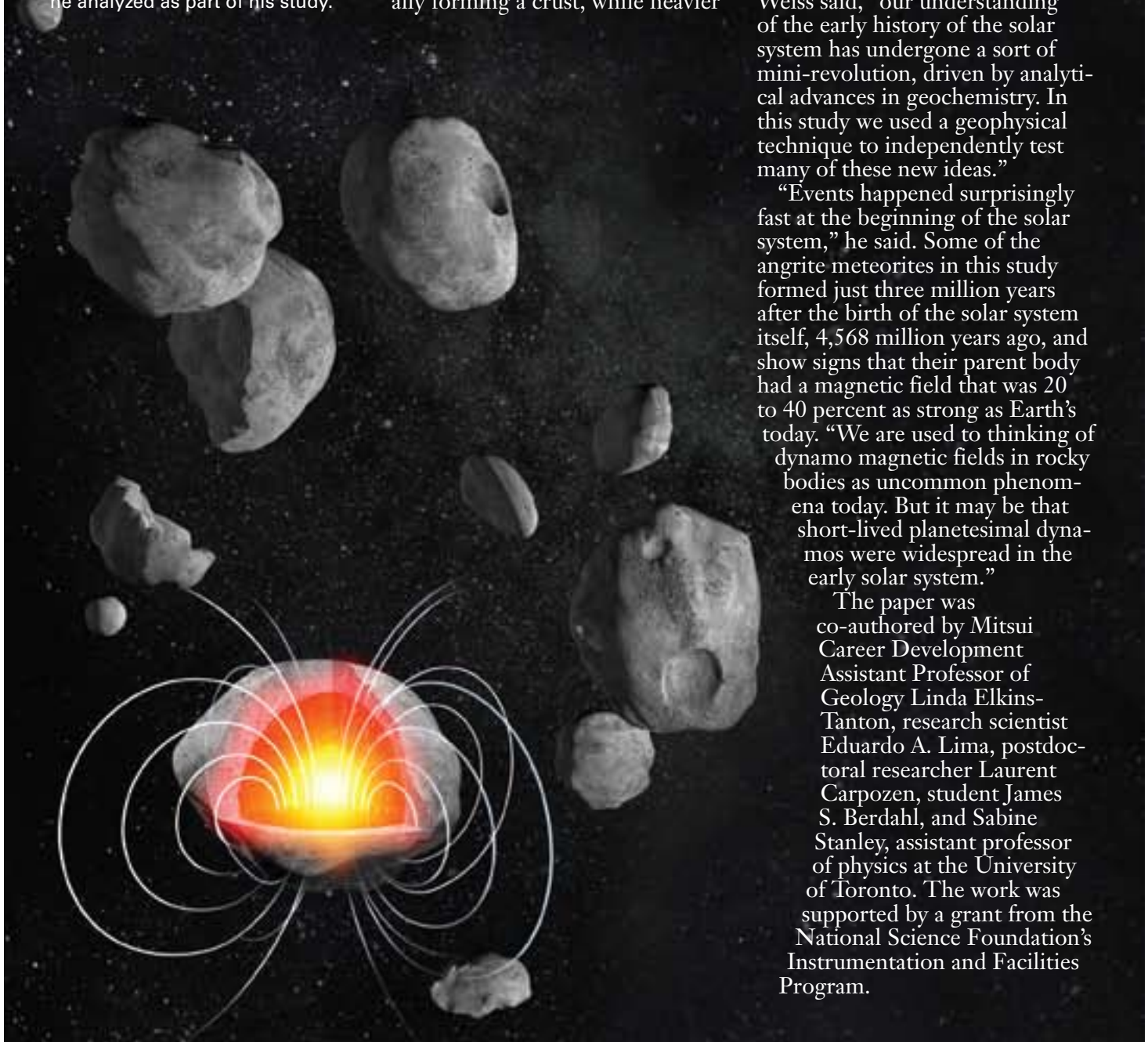


ILLUSTRATION / **DAMIR GAMULIN**

New research by Benjamin Weiss and colleagues indicates that many planetesimals larger than about 160 kilometers (270 miles) in diameter likely formed molten, convecting metallic cores and planetary magnetic fields. In many respects, planetesimals were essentially short-lived mini-planets.

Too much of a good thing?

Cells with extra chromosomes share detrimental traits; findings could help fight cancer

Anne Trafton
News Office

Mammalian cells with extra chromosomes share some common traits that could be exploited to develop cancer treatments, according to MIT biologists.

Having too many chromosomes, a condition known as aneuploidy, wreaks havoc on an organism, usually resulting in birth defects or death. However, it seems to confer an advantage on tumor cells, which are nearly always aneuploid.

"Now we can look for compounds that specifically kill aneuploid cells, or look for genes that, when you knock them down, kill aneuploid cells," said Angelika Amon, professor of biology and senior author of a paper describing the work, which appeared in the Oct. 31 issue of Science.

Angelika Amon

Amon and her colleagues have started screening such compounds and already identified one promising candidate.

In this study — the first to systematically examine the effects of aneuploidy in mammalian cells — the researchers looked at aneuploidy of four different mouse chromosomes (mice have 20 pairs of chromosomes).

They found that in addition to specific detrimental effects of each extra chromosome, aneuploidy seems to provoke a generalized response in all cells.

The aneuploid cells all divided very slowly, grew too large and displayed other metabolic changes that indicate the cells are under stress and need extra energy to cope with protein imbalances.

"We propose that these cells are chronically stressed," said Amon, who is a member of the David H. Koch Institute for Integrative Cancer Research.

That finding creates a paradox. Aneuploidy seems to give cells a proliferative disadvantage, yet aneuploid tumor cells tend to proliferate rapidly.

There are multiple theories that could explain this apparent paradox, Amon said. One is that even though aneuploid cells don't grow very well, they may still grow better than the normal cells surrounding them. As Amon explains it, "the one-eyed man is king in the country of the blind."

Another view, which is Amon's preferred theory, is that aneuploidy puts so much stress on the cell that it starts generating more mutations than normal, eventually driving it to become cancerous.

Lastly, it's possible that aneuploidy doesn't play a role in how cancerous cells develop — it's just a byproduct of tumor generation.

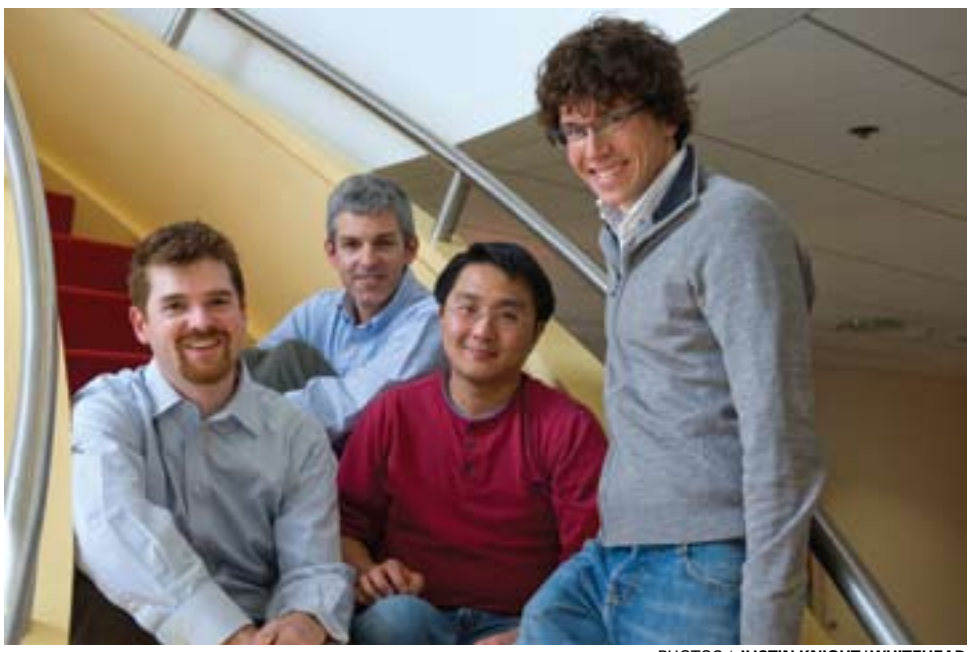
Lead author of the paper is Bret Williams, a postdoctoral associate in the Koch Institute. Other authors are Vineet Prabhu, a graduate student in biology; Karen Hunter, a 2006 MIT graduate and former technician in Amon's lab; Christina Glazier SB '07, a technician in Amon's lab; Charles Whittaker, a research scientist in the Koch Institute; and David Housman, a professor of biology and member of the Koch Institute.

The research was funded by the Howard Hughes Medical Institute, the Curt W. and Kathy Marble Cancer Research Fund, a David Koch Research Award and a David Koch Graduate Fellowship.

Immunity, from the cell's point of view

Chemical engineers study immune cells in unprecedented detail

Anne Trafton
News Office



PHOTOS / **JUSTIN KNIGHT/ WHITEHEAD**

J. Christopher Love, Craig Story, Chih-Chi Andrew Hu and Eliseo Papa designed and tested a system that "prints" the antibodies created by immune cells onto a glass slide coated with capture antibodies (photo below), producing protein microarrays.

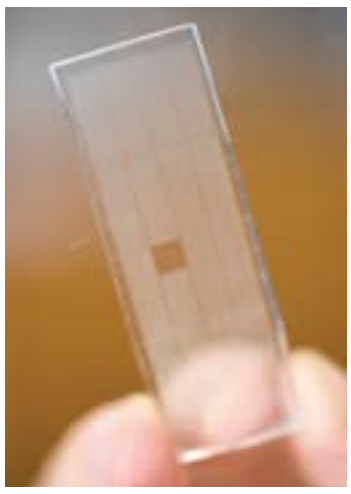
MIT engineers have painted the most detailed portrait yet of how single cells from the immune system respond to vaccination.

The work, reported in the online edition of the Proceedings of the National Academy of Sciences this week, could help researchers develop and test new vaccines for diseases including HIV, fungal infections and antibiotic-resistant bacterial infections.

"We're building a toolkit, which we can use to look at how an immune response develops successfully. Then we aim to use that information for reverse engineering vaccines that would invoke that same type of response," said J. Christopher Love, assistant professor of chemical engineering and senior author of the paper.

Vaccines usually consist of an inactivated virus or bacterium that provokes B cells from the immune system to generate antibodies that attack the infectious agent.

Currently, the only way to test whether a vaccine has worked is to examine a patient's blood sample for the presence of antibodies. However, such tests do not offer a comprehensive picture of the immune system's ability to fight off infection, Love said.



"We don't know the diversity of antibodies generated, and we don't know how well they're responding to the pathogen. We don't know how poised the immune system is to respond to challenges it might face," he said.

His team's new approach generates information, including the number of B cells present, whether they produce antibodies, the type of antibody they produce (for example, those that promote a long- or short-term response), the specificity (for a target such as a protein from a virus or bacterium), and affinity (strength of binding to the target).

"This is the first time that it's possible to look at the diversity of antibody responses from primary cells and measure a full set of their molecular characteristics directly," Love said. "This really does give you a snapshot."

Currently, three different lab tests are needed to get all of that information, and one of the tests requires a very large number of cells. The new method works with as few as 100,000 cells (the number in a small drop of blood).

In their PNAS study, the researchers took B cells from mice that received a series of protein injections mimicking vaccination. They positioned the cells into individual containers, arranged in a dense lattice, molded into a soft rubber. Borrowing from an artistic engraving technique used for printmaking, the researchers use that array of cells to "print" the antibodies produced by the cells onto the surface of multiple identical glass slides.

Each of those slides is exposed to different concentrations of the protein used for the model vaccine, allowing the researchers to measure how strongly each antibody binds to the target. They can then map those results back to the original immune cell, pinpointing precisely which cells produced which antibodies and how strong the cell's response was.

In addition to vaccine development, the technique could be used to build a profile of a patient's immune system and its response to treatment for allergies, cancer or infectious diseases. "You could potentially track how the immune system is responding over time," Love said.

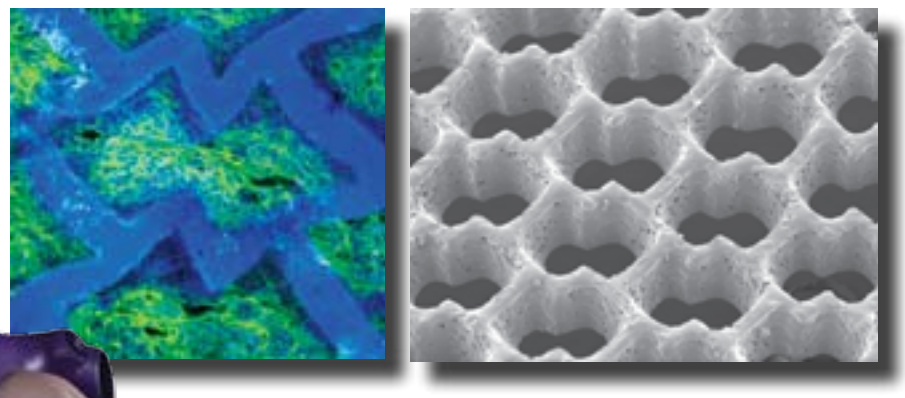
Lead author of the paper is Craig Story, former postdoctoral associate at the Whitehead Institute, now associate professor of biology at Gordon College. Other authors are Eliseo Papa, a graduate student in the Harvard-MIT Division of Health Sciences and Technology; Chih-Chi Andrew Hu, a postdoctoral fellow at the Whitehead Institute; Jehnna Ronan, a former Harvard undergraduate at the Whitehead Institute; and Hidde Ploegh, professor of biology and member of the Whitehead Institute.

The research was funded by the Broad Institute of MIT and Harvard, the National Institutes of Health, and the National Academies Keck Futures Initiative.

Mending broken hearts with tissue engineering

New scaffold approach could also aid engineering of other tissues

Elizabeth Thomson
News Office



IMAGES / **G.C. ENGELMAYR JR.**

LEFT: Confocal micrograph of an accordion-like honeycomb scaffold with cultured rat heart cells (scaffold is colored blue; seeded, living heart cells are colored green with blue nuclei).

RIGHT: Scanning electron micrograph of an accordion-like honeycomb scaffold for cardiac tissue engineering.

Broken hearts could one day be mended using a novel scaffold developed by MIT researchers and colleagues.

The idea is that living heart cells or stem cells seeded onto such a scaffold would develop into a patch of cardiac tissue that could be used to treat congenital heart defects, or aid the recovery of tissue damaged by a heart attack. The biodegradable scaffold would be gradually absorbed into the body, leaving behind new tissue.

The accordion-like honeycomb scaffold, reported in the Nov. 2 online edition of Nature Materials, is the first to be explicitly designed to match the structural and mechanical properties of native heart tissue. As a result, it has several advantages over previous cardiac tissue engineering scaffolds.

Further, the MIT team's general approach has applications to other types of engineered tissues. "In the long term we'd like to have a whole library of scaffolds for different tissues in need of repair," said Lisa E. Freed, corresponding author of the paper and a principal research scientist in the Harvard-MIT Division of Health Sciences and Technology (HST). Each scaffold could be tailor-made with specific structural and mechanical properties. "We're already on the way to a few other examples," Freed said.

With respect to the current work, "previous scaffolds did not necessarily possess structural or mechanical properties consistent with the native myocardial [heart muscle] structure," said George C. Engelmayr Jr., lead author of the paper and an HST postdoctoral fellow. Heart muscle, he explained, is "directionally dependent" — meaning its cells are aligned in specific directions.

The researchers reasoned that "borrowing more closely from nature's lessons," as they write in Nature Materials, might lead to a tissue with properties closer to the real thing. So, using a laser similar to that used for eye surgery, they created a scaffold with directionally dependent structural and mechanical properties.

The scaffold has three principal advantages over its predecessors. First, its mechanical properties closely match those of native heart tissue. For example, it is stiffer when stretched circumferentially as compared to longitudinally.

Engelmayr found that he could essentially "dial in" specific mechanical properties for the polymer scaffold by varying the time it is allowed to set, or cure. He noted that with this ability, coupled with the flexibility of the laser technique, "we might be able to come up with even better pore shapes with better mechanical properties."

In a second advantage, the team found that a patch of tissue created from neonatal rat heart cells cultured on the scaffold showed directionally dependent electrophysiological properties similar to native tissue. In other words, when an electrical field was applied the engineered patch contracted more readily in one direction than in another.

In a third advantage, "the scaffold itself has an intrinsic ability to guide the orientation of cultured heart cells," Freed said (in 2004, Freed was part of another MIT team that showed that heart cells cultured on a traditional scaffold could also be coaxed into alignment, but only with electrical stimulation).

The researchers note that the scaffold used in the experiments described above has some limitations. For example, they write, it is "too thin to address reconstruction of full-thickness myocardium." However, as they report in Nature Materials, they have already begun addressing those problems by creating new honeycomb scaffolds that, among other things, allow much thicker, multilayered tissue structures.

Other authors of the Nature Materials paper are MIT Institute Professor Robert Langer; Mingyu Cheng, currently at Children's Hospital Boston; Christopher J. Bettinger, '03, MNG '04, PhD '08, currently at Stanford University; and Jeffrey T. Borenstein of the Charles Stark Draper Laboratory.

This work was sponsored by the National Institutes of Health, NASA, and Draper Laboratory.

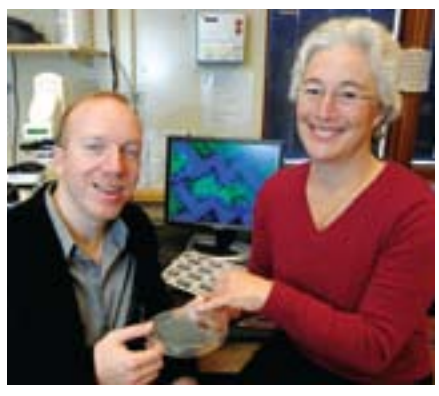


PHOTO / **DONNA COVENEY**

MIT's Lisa Freed, George Engelmayr Jr. and colleagues report a new scaffold (shown on monitor) for tissue engineering of the heart.

Soros: crisis underscores need for regulation

Stephanie Schorow
News Office correspondent

Financier, philanthropist and political activist George Soros told an MIT audience on Oct. 27 that the current financial crisis underscored the need for regulation, even while he warned of the pitfalls of regulation and insisted on the impossibility of predicting the economic future.

"The prevailing perception of the market actually affects the so-called fundamentals that market prices are supposed to impact," Soros said during a wide-ranging conversation moderated by Ricardo Caballero, the Ford International Professor of Economics and head of the Department of Economics. "That is the nature of financial systems. Bubbles are a particular manifestation of this."

Because financial markets are not a natural but a human phenomenon, "the idea that you should be able to predict the future is nonsense," he told a packed audience in Kresge Auditorium.

"I don't get the market right," admitted Soros, later adding, "The reason I do well is I learn from my mistakes."

Soros said the recent meltdown of global financial markets — something the former hedge fund manager described in dire terms — undercut the belief that markets could be entirely self-regulating. That misconception arose, ironically, from the resolution of past financial crises: "These periodic financial crises served as successful tests of the misconception of market fundamentals," he said.

The burst of the housing bubble in the United States was, Soros said, a relatively small event but it was a "detonator that set off a much bigger explosion. And that superbubble has been growing for at least 25 years."

PHOTO / **DONNA COVENEY**

International financier and philanthropist George Soros, right, had a conversation with Ford International Professor of Economics and head of the Department of Economics Ricardo J. Cabellero at Kresge Auditorium on Tuesday, Oct. 28.

Soros, whose new book is titled "The New Paradigm for Financial Markets," criticized former Federal Reserve Chairman Alan Greenspan for keeping interest rates "too low for too long" and for holding fast to the idea that it was better to "pick up the pieces" rather than impose regulations on the market.

Caballero also asked the question that was on the mind of many in the audience: "How do we fix the system?"

Certainly, financial markets will always undergo bubbles and bursts, but "unless the United States leads an international effort to stabilize the system, the system will not continue," Soros asserted.

While Soros argued that "the ideology that markets are perfect is wrong," he added, "regulations are also imperfect, in fact they are more imperfect than the market … you don't want to regulate more than you have to. But I think you have to regulate credit as well as money."

During an audience question and answer session, Soros was questioned about his financial past as well as his analysis. MIT Sloan School of Management student Gary Cao asked Soros about his role during "Black Wednesday" in 1992, when the financier made $1 billion as the British pound collapsed.

"I played by the rules. I was a key member of the market. I was doing what other people in the market were doing, with no negative moral implications," Soros replied. "At the time, as a citizen, I was concerned about making the rules better. And I'm still concerned."

Another questioner noted that Soros had written other books predicting economic doom. Yes, Soros said amid laughter, he made such predictions in 1987 and 1997 and "the third time the wolf came."

In response to a question about the impact of the financial crises on nascent democracies in volatile areas of the world, Soros sounded a hopeful note, saying that the United States could play a positive role but "for that we have to change fundamentally what we stand for and recognize that … we have an obligation to the world which we have absolutely abandoned."

Yet, Soros also said that the United States would cease to be the world's undisputed dominant force. "The veto power that we have in the International Monetary Fund will disappear. We will be downsized. At the same time, hopefully, we will have a better working system and opponents will be more downsized than we will."

PACE: MIT discovers breathing pacemaker mechanism

Continued from **Page 1**

National Academy of Sciences this week.

Abnormities of the two pacemakers may be related to some cases of "crib death" in babies and some forms of central sleep apnea, which can affect premature infants and the elderly, Poon said.

Scientists have known that two areas of the brain, the pre-Botzinger complex (preBotC) and the parafacial respiratory group (pFRG), control breathing. However, researchers have hotly debated how these two regions work together and which one plays a greater role in setting the pace.

The new MIT model, which Poon has dubbed the "handshake model," reconciles several different views.

In Poon's model, developed with graduate student Steffen Wittmeier, lead author of the paper, both brain regions work together to regulate respiration during infancy, but the preBotC takes control during adulthood.

Early in life, both pacemakers are needed. After birth, and throughout infancy, the pFRG triggers preBotC, resulting in strong, rhythmic breaths. Without pFRG, breathing can be weak and erratic, Poon said.

However, after childhood, the preBotC region takes over as the dominant pacemaker. Only under respiratory stress, such as during shortage of oxygen, does pFRG kick in and help regulate breathing rhythm.

The new model is called the "handshake model" because the two pacemakers send signals back and forth to trigger each other. "It's not just a one-way street," Poon said.

The fail-safe network provides critical backup and appears to be evolutionarily conserved, as it is also found in reptiles, birds and amphibians.

During infancy, when both pacemakers are regulating breathing, the pFRG takes the lead role, exciting the preBotC to initiate inhalation. During inhalation, the preBotC inhibits pFRG but the pFRG rebounds at the end of inhalation. The process starts over when pFRG excites preBotC again at the end of exhalation.

Later on, in adulthood, pFRG becomes less important and preBotC becomes more independent. The exception is during respiratory stress, such as a shortage of oxygen. In those situations, the system becomes a "reverse handshake," with both pacemakers functioning and preBotC taking the lead.

"This is a beautiful example of a yin-yang relationship," said Poon, with pacemakers exciting and inhibiting one another. "You want to be stable so you can have harmony."

Other authors of the paper are Gang Song, research scientist in HST, and James Duffin of the University of Toronto.

The research was funded by the National Institutes of Health.

Human genes sing different tunes in different tissues

Biologists find almost all genes express multiple messenger RNAs

Anne Trafton
News Office

Scientists have long known that it's possible for one gene to produce slightly different forms of the same protein by skipping or including certain sequences from the messenger RNA. Now, an MIT team has shown that this phenomenon, known as alternative splicing, is both far more prevalent and varies more between tissues than was previously believed.

Nearly all human genes, about 94 percent, generate more than one form of their protein products, the team reported in the Oct. 22 online edition of Nature. Scientists' previous estimates ranged from a few percent 10 years ago to 50-plus percent more recently.

PHOTO / **DONNA COVENEY**

Graduate student Eric Wang and associate professor Christopher Burge used a gene-sequencing machine to find that nearly all human genes undergo differential splicing.

"A decade ago, alternative splicing of a gene was considered unusual, exotic … but that's not true at all, it's actually a universal feature of human genes," said Christopher Burge, senior author of the paper and the Whitehead Career Development Associate Professor of Biology and Biological Engineering at MIT.

Burge and his colleagues also found that in most cases the mRNA produced depends on the tissue where the gene is expressed. The work paves the way for future studies into the role of alternative proteins in specific tissues, including cancer cells.

Human genes typically contain several "exons," or DNA sequences that code for amino acids, the building blocks of proteins. A single gene can produce multiple protein sequences, depending on which exons are included in the mRNA transcript, which carries instructions to the cell's protein-building machinery.

Two different forms of the same protein, known as isoforms, can have different, even completely opposite functions. For example, one protein may activate cell death pathways while its close relative promotes cell survival.

The researchers found that the type of isoform produced is often highly tissue-dependent. Certain protein isoforms that are common in heart tissue, for example, might be very rare in brain tissue, so that the alternative exon functions like a molecular switch. Scientists who study splicing have a general idea of how tissue-specificity may be achieved, but they have much less understanding of why isoforms display such tissue specificity, Burge said.

Scientists have also observed that cells express different isoforms during embryonic development and at different stages of cellular differentiation. Burge's team is now studying cells at various stages of differentiation to see when different isoforms are expressed.

Isoform switching also occurs in cancer cells. One such switch involves a metabolic enzyme and contributes to cancer cells burning large amounts of glucose and growing more rapidly. Learning more about such switches could lead to potential cancer therapies, Burge said.

Until now, it has been difficult to study isoforms on a genome-wide scale because of the high cost of sequencing and technical issues in discriminating similar mRNA isoforms using microarrays. The team took mRNA samples from 10 types of tissue and five cell lines from a total of 20 individuals and generated more than 13 billion base pairs of sequence, the equivalent of more than four entire human genomes.

The sequencing was done by researchers at biotech firm Illumina, using a new high-throughput sequencing machine.

Lead authors of the paper are graduate student Eric Wang, of the Harvard-MIT Division of Health Sciences and Technology, and former MIT postdoctoral fellow Rickard Sandberg, now at the Karolinska Institutet in Sweden. Other authors are Christine Mayr, a postdoctoral associate at the Whitehead Institute; Stephen Kingsmore of the National Center for Genome Resources; and Shujun Luo, Irina Khrebtukova, Lu Zhang and Gary Schroth of Illumina.

The research was funded by the National Institutes of Health, the Knut & Alice Wallenberg Foundation and the Swedish Foundation for Strategic Research.

IMAGES / **MIT LIBRARIES, NEWS OFFICE**

MIT planning for 150th in 2011

R.J. Tyler
Institute Events

Planning has begun in earnest for MIT's sesquicentennial in 2011, when the Institute will celebrate 150 years of education and research.

MIT150 planning began in the fall of 2006. From that autumn until June 2008, Kathryn Willmore, former vice president and secretary of the Corporation, chaired a planning committee that defined the principles, scope, central events, and theme of the celebration. The planning committee comprised faculty members from all five schools, students representing the Undergraduate Association, the Graduate Student Council, and the class of 2011, and staff with related expertise or administrative responsibilities.

Sesquicentennial planning principles were developed and adopted by the planning committee in January 2007. They include creating a celebration that will be distinctive and participatory, will focus on demonstrating the values of MIT, celebrating the past and envisioning the future, breaking stereotypes, communicating to the world, and being as "green" as possible. The top priorities in programming events and activities are to be reflective of history, to look to the future and to cement science and engineering as the cornerstones of an MIT education.

There are two branches to the planning going forward: programming and operations. A steering committee will guide and advise active programming and operations subcommittees that will execute all stages of planning. While some projects are already underway, all committees will be staffed and begin working by December 2008.

Professor David Mindell, director of the Program in Science, Technology, and Society, will serve as faculty director of MIT150. He will oversee the direction of the planning and chair the steering committee. The sesquicentennial's senior director is Gayle Gallagher, who will conduct all initiatives, programs and administration. She will be assisted by Ted Johnson in the role of director of planning and operations, and supported by staff in Institute Events, the Information Center, Conference Services and Community Services.

MIT150 steering committee members

Richard Amster
Paul Baranay '11 (UA designate)
Cynthia Barnhart
Dedric Carter
Erich Caulfield
John Durant
Stephen Graves
Paul Gray
Mark Jarzombek
Philip Khoury
Kirk Kolenbrander
Daniel Li '11
Kathryn Liede
Jeff Newton
Oaz Nir, G (GSC designate)
Hazel Sive
Blanche Staton
Ann Wolpert

Planning activities and initiatives

Celebrations will start with a kickoff event during IAP, include a capstone event during the founding week in April, and culminate on Commencement and alumni weekend. A web site that will assist MIT groups in planning associated activities is under development and will be made available to the community in the next 12 months. A theme — or tagline — for the sesquicentennial has been approved by the president; it will be made public in 2010, along with an official logo. Community members are asked to remember these resources when making plans: images, graphic element downloads, and a style sheet for MIT150 "umbrella" activities will be available on the internal planning web site. Any groups or DLCs that will celebrate anniversaries in 2011 will have a particular interest in coordinating with MIT150 and may start to plan soon; please contact Ted Johnson for more information or counsel in how to get started.

The class of 2011 was designated the Sesquicentennial Class, and a representative will be part of the steering committee. While there are still many activities and events to be determined, some key events and initiatives have begun. They include books, expansion of the Cambridge Science Festival during April, an arts and sciences festival, an oral history project, an external and public web site, and the Global Service Challenge.

Mindful of the mission of MIT, the planning committee developed the Global Service Challenge in conjunction with the Public Service Center, the Edgerton Center, and the Lemelson-MIT Program. The IDEAS Competition is the model that will be scaled up over the next two years to accommodate the anticipated size of the Global Service Challenge. Challenge teams will seek solutions to specific problems they have observed: Whether the problems are abroad or at home in Cambridge, the solutions must bring a measurable improvement to the quality of human life. The name of the project was chosen to emphasize that this is less of a competition than it is a collective effort to serve humanity. Community members (alumni, faculty, staff and students) who may be interested in participating in the Global Service Challenge should start thinking now about the composition of their teams and what problem they would like to solve. For more information, please contact the MIT150 office at 617-253-2011.

Refining open education: new book free online

In the spirit of open education, MIT Press and the Carnegie Foundation for the Advancement of Teaching have published a new book about the movement and made it available online, free of charge.

The book, "Opening Up Education," contains a collection of essays about the benefits and challenges of creating open-education programs. Such initiatives typically put course content online, in the form of lecture notes and multimedia presentations. "But it's not about just making things freely available," said Toru Iiyoshi, one of the book's editors and a consulting scholar for the Carnegie Foundation. It's also about "making things more transparent ... so that people can better understand how to improve education."

Ultimately, Iiyoshi hopes the book promotes conversation between the three groups who work in open education: technologists, content creators and educators. "My personal motivation is to bring these three communities together to find common issues and build on each other's work," he said. Readers have already submitted a number of questions to the book's online discussion forum.

A hard copy of the book can be purchased, but those who prefer an electronic copy can access the book for free online. "We wanted to stay true to the spirit of open access," said Vijay Kumar, co-editor of the book and director of MIT's Office of Educational Innovation and Technology. The two versions should appeal to different markets, he said. The digital version can be searched by keyword and contains extensive links, while the paper copy will be particularly handy for those with slow Internet connections.

Kumar said open education is needed now more than ever, in part to keep education relevant to a new generation of students. A lot of informal learning is going on via social networks and they should be leveraged through open-education programs. There are also growing communities of students who wish to learn but cannot be supported by traditional infrastructure. In India, for example, Kumar said there simply aren't enough secondary schools.

But developing open-education programs can be difficult. One of the key challenges addressed in the book is sustainability. "It's important to ensure that material created with one set of technology is not rendered useless to the next wave of technology," said Kumar, who also sits on the advisory committee for MIT's OpenCourseWare project, which has made a wealth of content freely available online.

CLASSIFIED ADS

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

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Twice as nice

Liskov's appointment in July marks two new Institute Professors in one year

Ann Graybiel is the second professor named an Institute Professor this year. In July, Barbara Liskov was named an Institute Professor; below is the official announcement from the MIT News Office.

Barbara H. Liskov, the associate provost for faculty equity and Ford Professor of Engineering, was named an Institute Professor in July, the highest honor awarded by MIT's faculty and administration.

Liskov, who also heads the Programming Methodology Group in the Computer Science and Artificial Intelligence Laboratory, has been an MIT faculty member since 1972.

"Barbara is revered in the MIT community for her role as scholar, mentor and leader," President Susan Hockfield said. "Her pioneering research has made her one of the world's leading authorities on computer language and system design. In addition to her seminal scholarly contributions, Barbara has served MIT with great wisdom and judgment in several administrative roles, most recently as associate provost for faculty equity."

PHOTO / **DONNA COVENEY**

Professor of Management Lotte Bailyn, left, stands with Institute Professor Barbara Liskov and her husband, Nate Liskov, during the celebration of Liskov's promotion to Institute Professor in July.

"I am overwhelmed and extremely pleased to receive this great honor," Liskov said after receiving the honor. "I am very grateful for the support of my wonderful colleagues and to MIT for making it all possible."

"Barbara's appointment as Institute Professor recognizes her central role as both an esteemed researcher and a leading citizen in the MIT community," Provost L. Rafael Reif said. "We all respect her ability to find elegant solutions to the most complex problems, whether in the classroom, in the lab or in her committee work. Her quick mind and penetrating questions always point the discussion in the right direction."

Reif also described Liskov's legacy in educating and inspiring students: "Barbara has taught countless undergraduates and graduate students who have gone on to help lead top universities, research labs and IT companies. As a computer scientist, she has made a tremendous impact not only through her groundbreaking research, but through the legions of those she has taught along the way."

Liskov's research interests lie in programming methodology, programming languages and systems and distributed computing. Her current research focuses on Byzantine-fault-tolerant storage systems, peer-to-peer computing and support for automatic deployment of software upgrades in large-scale distributed systems.

As associate provost for faculty equity, Liskov has focused on faculty diversity and gender issues across the Institute, including the recruitment, retention, promotion and career development of minority and women faculty.

"Barbara is a role model for younger faculty members in the way she is able to do outstanding research, teach very important courses, and still serve the Institute through her participation in various important committees," said Bish Sanyal, chair of the faculty. "I was very impressed with the letters of support for her from across the Institute, including from all five schools. People who nominated her included faculty from all levels — deans, past presidents, department heads and lab directors just to name a few."

Liskov is a member of the National Academy of Engineering and a fellow of the American Academy of Arts and Sciences and the Association for Computer Machinery (ACM). She received the Society of Women Engineers' Achievement Award in 1996 and the IEEE John von Neumann medal in 2004. She received the ACM SIGPLAN Programming Languages Achievement Award in 2008, where she was cited for having "changed the way that a generation of engineers thought about and constructed large software systems."

In 2002, Liskov was named by Discover magazine as one of the 50 most important women in science.

Liskov received her BA in mathematics at the University of California at Berkeley in 1961, and was the first American female awarded a PhD from a computer science department — which she earned in 1968 at Stanford University.

Institute Professorships

The process for selecting Institute Professors involves an ad hoc faculty committee convened by the chair of the faculty and the president. That committee evaluates each nominee, in part by soliciting opinions from professionals in the nominee's field. The committee's recommendations are reviewed by the Academic Council and approved by the Executive Committee of the Corporation.

In addition to the prestige associated with the title, an Institute Professor has a distinct measure of freedom to define the scope and nature of his or her responsibilities. Reporting directly to the provost, an Institute Professor does not have regular departmental or school responsibilities. As a result, the appointment provides a special opportunity to work across departmental boundaries.

In addition to Graybiel and Liskov, the other current Institute Professors and their traditional areas of study are Emilio Bizzi, brain and cognitive sciences; John M. Deutch, chemistry; Peter A. Diamond, economics; John H. Harbison, music and theater arts; Robert S. Langer, chemical engineering, biological engineering, mechanical engineering; Barbara Liskov, electrical engineering and computer science; John D.C. Little, management; Thomas Magnanti, management and electrical engineering and computer science (EECS); Joel Moses, EECS and the Engineering Systems Division (ESD); Phillip A. Sharp, biology; Isadore M. Singer, mathematics; Daniel I.C. Wang, chemical engineering; and Sheila E. Widnall, aeronautics and astronautics and ESD.

The 10 Institute Professors Emeriti are Noam Chomsky, Mildred S. Dresselhaus, Jerome I. Friedman, Morris Halle, Chia-Chiao Lin, Mario Molina, Paul A. Samuelson, Nevin S. Scrimshaw, Robert M. Solow and John S. Waugh.

GRAYBIEL: Neuroscientist awarded MIT's highest faculty honor

Continued from **Page 1**

PHOTO / **DONNA COVENEY**

Head of the Department of Brain and Cognitive Sciences and Paul E Newton (1965) Professor of Neuroscience Mriganka Sur, left, led a toast to newly named Institute Professor Ann Graybiel, alongside Robert Desimone, director of the McGovern Institute, during a party given in Graybiel's honor on Monday.

Unlocking the brain's secrets

Graybiel has revolutionized scientists' understanding of the functional anatomy and physiology of the brain and, more specifically, of the large forebrain region known as the basal ganglia.

When Graybiel started out, it was known that Parkinson's and Huntington's diseases were caused by malfunctions of the basal ganglia. Many researchers assumed that the basal ganglia controlled only physical motion and gesture.

It is in large part thanks to Graybiel's research, however, that scientists have come to see the basal ganglia as playing a key role in a much broader scope of activities, including learning, memory and formation of habits. Her insights have helped further researchers' understanding of disorders such as Tourette Syndrome, obsessive compulsive disorder and attention deficit disorder — and why, for example, good habits are so hard to make and bad habits so hard to break.

"It's a great puzzle," Graybiel said in a 2006 interview, commenting on the remaining mysteries of the basal ganglia. "Somehow the same or related circuitry that gets damaged in Parkinson's disease is also involved in habit formation, addiction and procedural learning."

Graybiel received her PhD in 1971 from MIT. She is a member of the National Academy of Sciences, the Institute of Medicine, and the American Academy of Arts and Sciences. Graybiel was named a recipient of the 2001 National Medal of Science, the nation's highest science and technology honor.

In 2002, Graybiel was awarded the James R. Killian Faculty Achievement Award, which recognizes extraordinary professional accomplishment by full-time members of the MIT faculty.

In 2004, Graybiel received the Woman Leader of Parkinson's Science award from the Parkinson's Disease Foundation, and in 2006, she was named the Harold S. Diamond Professor by the National Parkinson Foundation in recognition of her contributions to the understanding and treatment of Parkinson's disease.

"Ann has been a giant in neuroscience for many years, and she remains at the top of her field," said Robert Desimone, the Doris and Don Berkey Professor of Neuroscience and director of the McGovern Institute for Brain Research. "I cannot stress enough how Ann incorporates the most advanced approaches in molecular biology and systems neuroscience for answering fundamental questions about the basal ganglia and their role in Parkinson's disease, addiction, learning disorders, and schizophrenia."