A ‘feet’ of bioengineering
MIT creates gecko-inspired bandage

MIT researchers and colleagues have created a waterproof adhesive bandage inspired by gecko lizards that may soon join sutures and staples as a basic operating-room tool for patching up surgical wounds or internal injuries. Drawing on some of the principles that make gecko feet unique—such as the surface of the bandage, the same kind of nanoscale hills and valleys that allow the lizards to cling to walls and ceilings—layered over this landscape is a thin coating of glue that helps the bandage stick in wet environments, such as heart, bladder or lung tissue. And because the bandage is biodegradable, it dissolves over time and does not have to be removed.

The team is led by MIT Institute Professor Robert Langer and Jeff Karp, an instructor of medicine at Brigham and Women’s Hospital and Harvard Medical School. Both are also faculty members at the Harvard-MIT Division of Health Sciences and Technology (HST). Their colleagues include several other researchers from MIT, as well as from the University of Basel, Switzerland. In addition, Jeff Borenstein and David J.D. Carter from Draper Laboratory fabricated the nanomolds involved in the work, and Jay Vacanti and Cathryn Sundback performed all animal experiments with colleagues at Massachusetts General Hospital.

The work is described in the Feb. 11 online issue of the Proceedings of the National Academy of Sciences. “There is a big need for a tape-based medical adhesive,” said Karp. For instance, a surgical adhesive tape made from this new material could wrap around and seal the intestine after the removal of a diseased segment or after a gastric bypass procedure. It could also patch a hole caused by an ulcer. Because it can be folded and unfolded, it has a potential application in minimally invasive surgical procedures that are particularly difficult to suture because they are performed through a very small incision.

\[See GECKO\]

Celebrating MLK
Much has been done, much work remains, speakers say

At the annual breakfast celebration to honor the Rev. Dr. Martin Luther King Jr., hundreds of members of the MIT community listened as speakers echoed a similar theme: Much has been done to realize the slain civil rights leader’s vision of equality and opportunity, but much work remains—in America, in Greater Boston and at MIT.

In a speech titled “Diversity and Inclusion: Building a Solution Worthy of MIT,” President Susan Hockfield said many MIT administrations, including her own, had made sincere efforts to create the kind of diverse and inclusive community envisioned by King. But such efforts, she said, have “failed to create the serious, meaningful change” that the Institute desires.

“If this were any other kind of problem—an engineering problem, a scientific problem, an unsolved problem in mathematics or a problem of national defense—we would not be satisfied with well-intentioned but only incremental progress,” Hockfield said. “We have not yet made our community what it should be, and, to borrow a phrase from Dr. King, we cannot be satisfied until we do. I can tell you plainly: I will not be satisfied until we do.”

Hockfield noted that promoting diversity at MIT is more than just a moral obligation: it is central to MIT’s responsibility to prepare leaders for an increasingly interconnected world.

“In the end, we cannot be satisfied until, to everyone who earns a place at MIT, we are a community that says not, ‘You’re lucky to be here,’ but rather, ‘We’re lucky you came,’” she said.

“We need to make diversity work at MIT because it will make us better at what we do: broader and deeper as thinkers; more effective as collaborators; more creative as teachers; more understanding as friends; and wiser, less complacent, and more self-aware as human beings,” she said.

To that end, Hockfield announced she would convene a Diversity Leadership Congress comprising some 300 academic and administrative leaders at the Institute. The group will serve as a forum where experiences can be shared and where best practices from other organizations can be considered.

From this shared understanding, we will develop goals for changing the way we operate, and we will come away with a vivid sense that each of us bears direct responsibility for creating this kind of change,” she said, adding that she welcomed suggestions from the community on the goals and objectives of the congress.

The president told the breakfast audience that MIT was fortunate that it was not starting from scratch. Among notable highlights, Hockfield pointed out that the Institute had recently admitted the most diverse freshman class in its history and that a recent study of America’s top-ranked colleges and universities by The Journal of Blacks in Higher Education found that MIT had for the first time earned its highest yield for African-American students.

Hockfield also hailed aggressive efforts in the School of Architecture and Planning to attract and support underrepresented talent. She also credited Karl Reid, Steve Lerman and Christopher Jones for their efforts to recruit more underrepresented minority students and to improve their experience here.

Hockfield’s message regarding unfulfilled progress on issues of opportunity and inclusiveness was a theme expressed by many of the speakers at the breakfast.

In a passionate, intensely personal address, senior Janira Cotton questioned whether MIT had created an environment that successfully nurtures the type of education deemed vital by Dr. King—an education that cultivates both intelligence and character.

“I appreciate what MIT has done for me and what I have been able to do for it. But I know there is more to be done.”

\[See MLK\]
Seven junior MIT faculty have won 2008 Alfred P. Sloan Foundation Research Fellowships, which are intended to enhance the careers of the very best young faculty members in specified fields of science. Along with faculty at the University of California at Berkeley, MIT professors won more of the two-year, $50,000 Sloan Fellowships this year than individuals at any other school.

MIT faculty among this year’s Sloan Research Fellows are Edward S. Boyden, Benjamin Career Development Assistant Professor of Research in Education; Mikhail Gofman, Roger Dornbusch Career Development Assistant Professor of Economics; Manohil Kellis, Karl R. Van Tassel (1926) Career Development Assistant Professor of Electrical Engineering and Computer Science; Moham-mad Movassaghi, Firmech Career Development Assistant Professor of Chemistry; Aviv Regev, assistant professor of biology; Mech Jethal Yanik, assistant professor of electrical engineering; and Martin W. Zwi- celin, assistant professor of physics.

The fellowships were established in 1955 to pro vide support and recognition to early-career scientists and scholars, often in their first appointments to university faculties, who were endeavoring to set up laboratories and establish their independent research projects with little or no outside support. Financial assistance at this crucial point, even in modest amounts, often pays handsome dividends later in social and professional life.

The Sloan Research Fellowships support the work of exceptional young researchers early in their academic careers, and often at pivotal stages in their work,” said Sloan Foundation President Paul L. Joskow, Elizabeth and James Killian (1926) Professor of Economics and Mathematics. 

As an MIT student and two recent MIT graduates have been awarded 2008 Gates Cambridge Scholarships. Senior Talia Gershon, Naveen Krishnan SB ’07 and Ingrid Lawhorn SB ’06 are among 45 students who will study at the University of Cambridge.

Created in 2000 by the Bill & Melinda Gates Foundation, the Gates Cambridge Scholarships are awarded on the basis of intellectual ability, leadership capacity and desire to contribute to society through community service and by applying one’s talents and knowledge to improve the lives of others.

Cynthia Barnhart has been named president of the Institute for Operations Research and the Management Sciences (INFORMS). Barnhart, a professor of civil and environmental engineering and systems engineering, is co-director of MIT’s Operations Research Center and associate dean for academic affairs in the School of Engineering.

A hallmark of her one-year term will be the hosting of a series of public-policy presentations by prominent academic, governmental, and corporate officials and academic experts in the INFORMS annual meeting this coming fall. The presentations will show how operations-research analysts approach current challenges in airline congestion and transportation, health care, and energy and the environment.

Recent recipient of a prestigious Rhodes Scholarship and one of Glamour magazine’s top 10 college women of 2007, senior Melis Anahat has struck again. She is one of 20 students to be named to USA Today 2008 All-USA College Academic First Team. USA Today editor Ken Paulson describes the honor as recognizing “academic excellence and community service throughout the country and around the world.”

Poterba leads largest U.S. economic research group

James Poterba, MIT’s professor of economics and head of MIT’s Department of Economics, has been appointed president and chief executive officer of the National Bureau of Economic Research (NBER), a nonprofit organization dedicated to promoting greater understanding of how the economy works. The group is best known for its role in providing official dates for business cycles in the United States and declaring the start and end dates of U.S. recessions.

The appointment takes effect July 1, 2008. Poterba will succeed Martin Feldstein of Harvard University, who is retiring after leading the NBER for 30 years. “I am incredibly honored to serve as the next president of the NBER. I look forward to working with the program directors and research affiliates to maintain and enhance the NBER’s position as a global leader in producing relevant economic research,” Poterba said.

The announcement came as financial markets have been roiled by speculation that the U.S. economy may be entering—or already be in—a recession. As asked for comment, Poterba told the MIT News Office that there is much talk but precious little consensus about the economic situation, or whether at the NBER or elsewhere.

“One reflects a number of conflicting signals on current performance,” Poterba said of the lack of agreement on the issue. “Precisely because situations like this are not unusual, the NBER Business Cycle Dating Committee, which is the body that compiles the official historical record of when there have been recessions in the U.S. economy, only identifies recessions retrospectively. The committee waits until it has sufficient evidence to make a definitive call. While often disappointing to those who want to know the current state of the economy, this procedure generates a more accurate and reliable record of U.S. economic performance.”

Poterba is an expert on tax policy and financial economics. His recent work examines the effect of taxation on the financial behavior of households, particularly their saving and portfolio decisions. He has been especially interested in the analysis of tax-deferred saving programs such as 401(k) plans, and in the role of annuities in retirement saving and consumption.

In addition to his research, teaching and administrative roles at MIT, Poterba is the director of the Public Eco nomics Research Program at NBER, a fellow of the American Academy of Arts and Sciences and the Econo metric Society. He has served as a director of the American Financial Association and was a member of the executive commit tee of the American Economic Association. He served on the President’s Advisory Panel on Federal Tax Reform.

Poterba received a BA in economics from Harvard University and a PhD in economics from MIT, where he was a Marshall Scholar. He has been an Alfred P. Sloan Foundation Fellow, a Bat tary Fellow, a Center for Advanced Study in Behavioral Sciences Fellow and a Distinguished Visiting Fellow at the Hoover Institution at Stanford University. The NBER, which was founded in 1920, has nearly 1,000 research affiliates who are research economists at U.S. universities. They are involved in generating new statistical measurements, estimating quantitative models of economic behavior, developing public policies on the U.S. economy and projecting the effects of new legislation. The NBER is based in Cambridge, Mass.

NIH presidential search committee members according to the data from web.mit.edu/surveys/mitfaculty.

MIT’s 2008 Faculty Quality of Life Survey is currently underway. More than half of faculty and instructional staff have already answered the survey. The web survey, sponsored by the Office of the Provost and admin istered through the Committee of Institutional Research, addresses a number of faculty quality issues, such as views about the promotion and tenure process, mentoring and departmental climate.

The web survey asks faculty about the work they do, how well it is sup ported and the ways in which life outside MIT meshes with their work responsibilities. The last survey of this type, administered in 2004, achieved a 73 percent response rate; MIT hopes to exceed that rate this year. A high response rate will maximize the usefulness of the data, permitting analysis of trends at the school and departmental level.

Among other groups on campus, the MIT Initiative on Faculty Race and Diversity will use the survey results extensively. The initiative will use the survey to examine the climate for underrepresented minority faculty, as well as to analyze the impact of race, gender and ethnicity/cultural differences on various aspects of faculty life. In addition to this, faculty will be able to make a survey as a critical part of the study.

Although the survey alone is not expected to provide a comprehensive picture of the climate and experiences of faculty, the survey results will provide a great deal of valuable information will be obtained from it, as the survey covers a broad range of questions about faculty life, from teaching to research, to outside activities. The initiative will rely on the qualitative interviews with faculty to explore more in-depth ques tions and issues on race. The initiative will be sending the survey to all faculty, and faculty members will be offered the option to make it available at a later time. Previously submitted answers will be displayed for faculty to edit if they wish.

Faculty may access the survey by entering a URL, which can be found at web.mit.edu/surveys/mitfaculty.

Last chance to respond to faculty survey

James Poterba

MIT Tech Talk
Trip of a lifetime: MIT hosts next generation of science leaders

Anne Trafton
News Office

It’s not every day that high school students get the chance to visit MIT research labs and see concepts that they’ve learned about in classes come to life.

But that’s exactly what happened Thursday, Feb. 14, as high schoolers from around the country descended on MIT as part of the annual meeting of the American Junior Academy of Science (AJAS).

The AJAS meeting was held in conjunction with the annual meeting of the American Association for the Advancement of Science in Boston. Most of the 120 high school students in attendance won their way to Boston through science fair projects, which they presented at a poster session on Friday, Feb. 15.

On Thursday, the students got a taste of life and research at MIT, including lab tours, an afternoon at the MIT Museum and a talk by MIT Biology Professor Eric Lander.

Lander, director of the Broad Institute, offered students a glimpse of cutting-edge research in the field of genomics—something they will not learn about in their biology classes, he said.

“Textbooks always tell you about what we know, but what’s interesting is what we don’t know,” said Lander. “Textbooks don’t like to write about what we don’t know, because it’s hard to test you on it.”

Lander told the students that biology is in the midst of a revolution that will transform the field, much as the development of the periodic table of elements transformed the chemistry of the 1800s.

“The sequencing of the human genome, completed in 2003, is just the first step of that revolution,” Lander said.

Prompted to map human genetic variation and determine the function of all human genes, the sequencing project is already yielding results.

In about 10 or 15 years, scientists will have unprecedented resources and knowledge at their fingertips to help them study how human diseases arise and how to fight them, Lander said.

The high school students of 2025 are not going to be able to imagine what it was like to study biology in the 20th century,” he said.

After Lander’s talk, students flocked to the front of the Broad Auditorium to ask questions or have their photo taken with him. “His talk was incredible,” said Zach Silver, a student from Pine Crest High School in Fort Lauderdale, Fla.

“Captivating and engaging,” said Estefany Rios, a student from Coral Springs Charter High School. “I’m impressed that much of MIT’s research seems to be student driven.”

“Amazing,” she said. “It seems like the students have a lot of input as far as what kind of projects they would like to work on.”

The day at MIT was hosted by biology instructor Mandana Sassanfar and sponsored by the School of Science, School of Engineering, Department of Architecture and Planning, Department of Biology and MIT Museum.

Core curriculum changes discussed at faculty meeting

Anne Trafton
News Office

Three of the volleyball-sized satellites are now on board the International Space Station, where scientists will fine-tune the satellite’s performance before they are sent into space on their own. “It’s like driver’s ed for satellites,” Edwards explained.

In the Man-Vehicle Lab, the students got a peek at the lightweight, skintight spacesuit that Professor Davan Newman and her students are designing for future excursions in space.

Sachin Sharma, a sophomore at the Texas Academy of Science, said he enjoyed the tour of MIT’s astro-aero projects. “It’s very interesting and exciting,” he said. “MIT is a great place to be.”

Sharma won his way to the AJAS conference by designing a new type of blade for a wind turbine. He envisions that someday wind turbines could be used in space, possibly on Mars’ surface.

His research advisor, Cathy Bambanbali, a chemistry teacher at the Texas Academy of Science, said she was impressed that much of MIT’s research seems to be student driven.

“Stunning,” she said. “It seems like the students have a lot of input as far as what kind of projects they would like to work on.”

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Notable task force proposal, to allow first-year students time to study a foreign language or take music classes.

In other business, the Committee on the Undergraduate Program recommended making permanent the option for sophomores to take one “exploratory” course per semester. With the Sophomore Exploratory option, students can elect to convert from Grades to Listener status at any time before registration day of the following semester.

The exploratory option was originally introduced as a five-year experiment and is now in its fifth year. Deni Freeman, professor of electrical engineering and computer science, who presented the proposal, said that 25 percent to 30 percent of sophomores take an exploratory subject each term. Many of them use the option to explore a minor, a second bachelor’s degree or a new major.

The exploratory option is well used and well valued by the students, said Freeman.

However, he noted that many students and their advisors seem to be unaware of the option or confused by it, so plans are in the works to better inform students about it.

The faculty will vote on the motion to make the option permanent at its next meeting.

Stephen Bell, a professor of biology and chair of the Committee on Graduate Programs, and Steven Lerman, dean for graduate students, reported on a proposed option for graduate students to take courses outside of their degree subject with a Pass/F/D grading system.

The option is designed to allow grad students to gain skills in fields related to their major, which will help them with their research, said Lerman. The grading option would only be allowed for classes outside the student’s graduate program and Institute requirements, and the units for such courses would not count toward any degrees.

In addition, use of this option could be further restricted by individual departments.

The motion will be presented for a vote at the next faculty meeting.

Theresa Stowe, executive vice president and treasurer, and Seth Alexander, president of the MIT Investment Management Company, presented an overview of MIT’s financial planning framework and spending policy.

Stone said that MIT has closed a budget gap that required the use of unrestricted endowment funds in recent years. In 2007, the budget gap was $86 million, in 2008 it was $30 million and in 2009 the budget is projected to be balanced.

Alexander reported on a plan for MIT to adopt an endowment-spending rule that will reduce the variability in the annual flow of funds to the operating budget. He noted that the new plan incorporates the Institute’s goal of targeting (approximately) a 5 percent spending rate over time to balance current and future needs, so that the endowment will retain its purchasing power to fund MIT’s research.
Bacterial ‘battle for survival’ leads to new antibiotic
MIT discovery holds promise for treating stomach ulcers

Anne Trafton
News Office

War may actually be healthy for you (war between two microscopic bugs, that is).

MIT biologists have provoked soil-dwelling bacteria into producing a new type of antibiotic by pitting them against another strain of bacteria in a battle for survival.

The antibiotic holds promise for treatment of Helicobacter pylori, the bacteria most notably linked to stomach ulcers.

The work is reported in the February issue of the Journal of the American Chemical Society.

A combination of luck, patience and good detective work led researchers to the new antibiotic, according to Philip Lessard, research scientist in Profes-

sor Anthony Sinskey’s laboratory at MIT.

Sinskey’s lab has been studying Rhodococcus, a type of soil-dwelling bacteria, for many years. While sequencing the genome of one Rhodococcus species, they noticed that a large number of genes seemed to code for secondary metabolic products, which are compounds such as antibiotics, toxins and pigments.

However, Rhodococcus does not normally produce antibi-

otics. Many bacteria have genes for antibiotics that are only activated when the bacteria are threatened in some way, so the researchers suspected that might be true of Rhodococcus.

Kamihiko Kurosawa, a postdoctoral associate in the Department of Biology, decided to try to provoke the bacteria into synthesizing antibiotics by pitting them in stressful environments. He tried turning the temperature up and down, then altered the bacteria’s growth medium, but nothing worked.

Kurosawa then decided to stress the Rhodococcus bacteria by forcing them to grow in the presence of competing bacteria, a strain of Streptomyces. Streptomyces produces an antibiotic that normally kills other bacteria, but in one of the experimental test tubes, Rhodococcus started producing its own antibiotic, which wiped out the competing Streptomyces.

The researchers isolated the antibiotic, dubbed it rhodostreptomycin and started testing it to see what else it would kill. It proved effective against many other strains of bacteria, most notably Helicobacter pylori. Rhodostreptomycin is a aminoglycoside, composed of peculiar sugars, one of which has a carbon chain that has never been seen before. The ring structure could offer chemists a new target for modification, allowing them to synthesize antibiotics that are more effective and/or stable.

Even if [rhodostreptomycin] is not the best antibiotic, it provides new structures to make chemical derivatives of,” said Lessard. “This may be a starting point for new antibiotics.”

The mystery still to be solved is why Rhodococcus started producing this antibiotic. One theory is that the presence of the competing strain of bacteria caused Rhodococcus to “raise the alarm” and turn on new genes.

The version of Rhodococcus that produces the antibiot-

ic has a “megaplasmid,” or large segment of extra DNA, that it received from Streptomyces. A logical conclusion is that the plasmid carries the gene for rhodostreptomycin, but the researchers have sequenced more than half of the plasmid and found no genes that correlate to the antibiotic.

Another theory is that the plasmid itself served as the “innovator” that provoked Rhodococcus into producing the new antibiotic, but at some kind of interaction of the two bacterial genomes produced the new antibiotic.

“Somehow the genes in the megaplasmid combined with the genes in Rhodococcus and together they produced something that is somehow different,” said Lessard.

If scientists could figure out how that happens, they could start to manipulate bacterial genomes in a more methodical fashion to design new antibiotics.

The research was funded by the Cambridge-MIT Institute and the Malaysia-MIT Biotechnology Partnership Program.
Institute Professor Robert Langer and Professor Jeffrey Karp of Harvard-MIT Health, Science and Technology show off their gecko-inspired adhesive.

Anne Trafton
News Office

MIT researchers have explained why two mutations in the H1N1 avian flu virus allowed the disease to spread during the 1918 pandemic that killed at least 50 million people. The work could help scientists detect and contain a future bird flu outbreak among humans.

The team showed that the 1918 influenza strain developed two mutations in a surface molecule called hemagglutinin (HA). This, in turn, allowed it to bind tightly to receptors in the human upper respiratory tract.

This new work could aid researchers in monitoring the HA mutations in the H5N1 avian flu strains currently circulating in Asia. Epidemiologists fear these mutations could enable the virus to jump from birds and spread among humans—a possibility that could trigger millions more deaths than the 1918 pandemic.

Ram Sasisekharan, the Underwood Prescott Professor of Biological Engineering and Health Sciences and Technology, is the senior author of a paper on the work published in the Feb. 18 issue of the Proceedings of the National Academy of Sciences.

In January, Sasisekharan and colleagues reported in Nature Biotechnology that flu viruses can only bind to human respiratory cells if they match the shape of sugar (or glycans) receptors found on those cells.

The glycan receptors found in the human respiratory tract are known as alpha 2-6 receptors, and they come in two shapes—one resembling an open umbrella, another resembling a cone. To infect humans, the MIT team found that avian flu viruses must gain the ability to bind to the umbrella-shaped alpha 2-6 receptor.

In the current study, the team discovered that two mutations in HA allow flu viruses to bind tightly or with high affinity to the umbrella-shaped glycan receptors.

“The affinity between the influenza virus HA and the glycan receptors appears to be a critical determinant for viral transmission,” said Sasisekharan.

The researchers used the 1918 influenza virus as a model system to investigate the biochemical basis for hemagglutinin binding to glycans, which leads to viral transmission. They compared the virus that caused the 1918 pandemic (known as SC18) with a strain called NY18, which differs from SC18 by only one amino acid, and also the AV18 strain, which differs from SC18 by two amino acids.

Using ferrets (which are susceptible to human flu strains), researchers had earlier found that, while SC18 transmitted efficiently between ferrets, NY18 is only slightly infectious and AV18 not at all infectious.

These earlier findings correlate with the viruses’ ability to bind to umbrella-shaped alpha 2-6 glycan receptors, demonstrated in the current PNAS study.

NY18, which is only slightly infectious, binds to the umbrella-shaped alpha 2-6 receptors, but not as well as SC18, which is highly infectious. AV18, which does not infect humans, does not have any affinity for the umbrella-shaped alpha 2-6 receptors and binds only to alpha 2,3 receptors.

Another strain, TX18, binds to alpha 2-6 and alpha 2-3 but, because it binds with high affinity to the umbrella-shaped alpha 2-6 receptors, is much more infectious than NY18.

Researchers from the Centers for Disease Control and Prevention reported on the varying infectiousness of these strains last year, but the PNAS study is the first that explains the exact biochemical reason underlying these differences.

Other authors of the PNAS paper are Aravind Srinivasan and Karthik Viswanathan, postdoctoral associates in MIT’s Department of Biological Engineering (BE); Rahul Raman, research scientist in BE; Aarthi Chandrasekaran, graduate student in BE; S. Raghavan, visiting scientist in BE; Viswanathan Sasisekharan, visiting scientist in the Harvard-MIT Division of Health Sciences and Technology; and Terrence Tumpey of the Centers for Disease Control and Prevention.

The research was funded by the National Institute of General Medical Sciences and the Singapore-MIT Alliance for Research and Technology (SMART).

GECKO

Continued from Page 1

Gecko-like dry adhesives have been around since about 2001 but there have been significant challenges to adapt this technology for medical applications given the strict design criteria required. For use in the body, they must be adapted to stick in a wet environment and be constructed from materials customized for medical applications. Such materials must be biocompatible, meaning they do not cause inflammation, biodegradable, meaning they dissolve over time without producing toxins; and elastic, so that they can conform to and stretch with the body’s tissues.

The MIT researchers met these requirements by building their medical adhesive with a “biorubber” invented by Karp, Langer and others. Using micropatterning technology—the same technology used to create computer and microchip parts—researchers shaped the biorubber into different hill and valley profiles at nanoscale dimensions. After testing them on intestinal tissue taken from pigs, they selected the stiffest profile, one with pillars spaced just wide enough to grip and interlock with the underlying tissue.

Karp then added a very thin layer of a sugar-based glue to create a bond strong enough to attach even to a wet surface. The resulting bandage “is something we never expect to remove,” said Karp. Because of that difference, he continued, “we’re not mimicking the gecko”—which has sticky feet but can still lift its weight away from the ground—“we are inspired by the gecko to create a patterned interface to enhance the surface area of contact and thus the overall strength of adhesion.”

When tested against the intestinal tissue samples from pigs, the nanopatterned adhesive bonds were twice as strong as unpatterned adherives. In tests of the new adhesive in living rats, the glue-coated nanopatterned adhesive showed a more than 100 percent increase in adhesive strength compared to the same material without the glue. Moreover, the rats showed only a mild inflammatory response to the adhesive, a minor reaction that does not need to be overcome for clinical use.

Among other advantages, the adhesive could be infused with drugs designed to reduce the biorubber’s degradatives. Further, the elasticity and degradation rate of the biorubber are tunable, as is the pillared landscape. This means that the new adhesives can be customized to have the right elasticity, resilience and grip for different medical applications.

“T is an exciting example of how nanostructures can be controlled and, in so doing, used to create a new family of adhesives,” said Langer.

Other MIT authors of the paper are co-first authors Alborz Mahdavi, a former MIT lab technician now at the California Institute of Technology, Luis Ferreira, a former MIT postdoctoral fellow now at the University of Coimbra, Portugal; Jason W. Nichol and Edwin P. Chan, HST postdoctoral fellows; HST doctoral student Chris Bettinger; and MIT graduate students Srijum Ratnapan, Lozice Ciganuzha, Eli B. Joseph, Alex Galaktos and Seungpyo Hong, all from the Department of Chemical Engineering.

The work was funded by the National Institutes of Health, the Materials Research Science and Engineering Center (MRSEC) program of the National Science Foundation, and the MIT-Portugal program.

Redrawn transmission electron micrograph shows the 1918 influenza virus, which CDC researchers recreated in 2005.

MIT’s gecko-inspired medical adhesive consists of a “biorubber” base patterned to have pillars that are less than a micro-meter in diameter and three micrometers in height. Layered on top is a thin coating of a sugar-based glue. Tests in live rats suggest that the adhesive could be an effective operating-room tool for closing surgical wounds.

The glycan receptors found in the human respiratory tract are known as alpha 2-6 receptors, and they come in two shapes—one resembling an open umbrella, another resembling a cone. To infect humans, the MIT team found that avian flu viruses must gain the ability to bind to the umbrella-shaped alpha 2-6 receptor.
Math professor and crossword puzzle fiend Kiran Kedlaya works on Friday’s New York Times puzzle. He will compete in the American Crossword Puzzle Tournament on March 1.

There’s something similar to athletic training going on here. People are getting into shape, doing their daily puzzles, trying to get psyched up.

The New York Times crossword puzzles, which get more difficult as the week goes on, are the gold standard by which puzzle solvers judge themselves. For a really good solver, Monday’s puzzle would take about three minutes, while Friday and Saturday puzzles would take seven to 10 minutes, says Kedlaya. Sunday’s puzzle, which is larger, could take eight to 15 minutes.

Unlike Sudoku, another game popular with math-oriented people, crossword puzzles require knowledge of word meanings. Kedlaya suspects that is why they appeal to disparate groups of people like mathematicians and computer scientists, writers and editors, and musicians.

“There appears to be some conflation of math skills, music skills and language skills,” he says.

MIT’s crossword king girds for annual battle of wits
HR @ Your Service

Professional development is critical if employees are to keep growing in their work. It is something that they value as great workplace values and certainly benefits from as individuals return to the workplace with new experiences and insights. MIT has relationships with two excellent professional development programs for employees of color—the Partnership Inc. and the YMCA Black Achievers. Participants of these programs are sponsored by Human Resources.

The Partnership’s Associates Program trains young professionals to develop their leadership capacity by creating professional and civic opportunities in the early stages of their careers. The Fellows Program trains mid-career professionals to expand their leadership capacity. Several MIT staff members have participated in this program, and Chancellor Phillip Clay is a member of the board of directors. MIT staff members Karina Vielma and Rashmi Tiwari are two of the 2008 awardees, which comes as no surprise when you read about their contributions to the MIT community.

Vielma is an assistant dean in the Office of Minority Education and was nominated by Associate Dean and Director Karl Reid, a 2000 Partnership alumnus. In his nomination letter, Reid notes that Vielma is a creative and systematic thinker with great empathy for students. Her accomplishments include facilitating the Office of Minority Education’s Student Advisory Committee, the office’s graduate pipeline Laureates and Leaders Program, and suggesting new minority-student events for campus preview weekend. Vielma says she takes pride in producing opportunities for undergraduate, underrepresented students in the math, science and engineering fields.

The second Partnership associate, Rashmi Tiwari, is a program coordinator and analyst in the Office of Community Development and Substance Abuse Programs. Associate Dean Dean Daniel Trujillo, a 2007 Partnership alumnus, noted in his nomination letter that Tiwari has played a key role in the program since its conception, for its assessment and evaluation across the Division of Student Life. Her ability to communicate and practically apply research and evaluation strategies for others is remarkable. In addition, Tiwari creates connections across departments at MIT and functions as a mentor. Tiwari would eventually like to focus her work on how group membership affects individual behavior, as this topic areas drives her to make a wide swatch of educational and business areas.

The YMCA Black Achievers Program recognizes black professionals and connects these individuals with YMCA youth. The program aims to promote mentoring relationships and create a sustained community involvement by business and industry. Awardees are asked to volunteer in the program for a minimum of 10-month period.

Since 1979, numerous MIT faculty and staff have been recognized as YMCA Black Achievers. This year’s recipient, Mari- isha McDaniels, executive assistant in the Institute for Soldier Nanotechnologies, carries on this tradition. Arnold R. Henderson Jr., associate dean and co-director of Student Support Services, nominated McDaniels, who has been at MIT since 1987. McDaniels has consistently served as an invaluable member of the family and administrators who have sought to improve the MIT community and make it more inclusive. McDaniels has given 14 years of dedicated support to the Martin Luther King Jr. Celebration Breakfast, which, due to her efforts, is one of the most eagerly anticipated events of the year. She has served as a liaison for student groups and administrators and has worked closely with corporations to help them recognize minority students who are seeking employment. McDaniels notes that it has become "an integral part of my life to share what I have learned with others and give back to the community.

Three exceptional MIT employees who are growing and giving back. Think about who you might nominate for next year.

DUSP show eyes urban design, civil protest

In one image from the new DUSP exhibit, “Urban Design and Civil Protest,” a crowd has appropriated a prestigious public space in London as part of a 2007 peace protest. Exhibit creator Tali Hatuka uses visual and other media to explore how urban space is used as an instrument for civil protests. The exhibit opens Feb. 28 in the Compton Gallery.

“Urban Design and Civil Protest,” a new exhibition conceived as a multimedia laboratory for examining the social and spatial dynamics of protests, will be on view from Feb. 28 June in the MIT Museum Compton Gallery. The exhibit, created by visiting architect and urban designer Tali Hatuka, celebrates the 75th anniversary of MIT’s Department of Urban Studies and Planning. Hatuka’s study of urban protests includes a lexicon of their different shapes—they occur in circular, grid and concentric forms—and a code for identifying key moments during protests when the outcome turns to violence. In addition, the voices and faces of people engaged in protest bring the process alive for viewers. A sound installation from various events plays individuals and crowd voices in public space; a video screen projects messages, slogans and banners from protests around the world and still photographs capture singular, intense moments in a protesting crowd.

The Marie Curie Research Fellow in urban studies and planning, Hatuka received the PhD from Technion, the Israel Institute of Technology. Her research awards include the European Community Marie Curie Fellowship (2005-2008) and a Fullbright Postdoctoral Fellowship (2004-2005). The Compton Gallery is free and open daily 10:00 a.m. to 5:00 p.m.

After a bit more experience with actually setting up and operating the systems in the villages, the Solar Turbine Group’s plan is for local workers who have been collaborating on the project to take over manufacturing and launch a locally based business to produce the units for installation throughout the country.

“We already built a machine shop that supplies local electronic engineers,” Orosz says. “We’ve set up the seed of a company” that hopefully will become self-sustaining, he says, providing a useful product and generating local income.

The systems are designed to be competitive with existing solar photovoltaic systems or diesel generators for producing power, and provide the added bonus of hot water. Orosz hopes the systems will ultimately cost 10 percent to 15 percent less than the other systems for power alone.

“If the price is even in the ballpark of photovoltaics, we’re happy,” Orosz says, “because you get lots of hot water as well.”

In the World

Shedding a bright light on village needs

Bethel High School is a rural school in the tiny landlocked nation of Lesotho, which was once part of South Africa. The school draws students from many surrounding villages, and they live in dormitories during the school year. Though the winter temperatures often drop well below freezing, students in the dormitories only rarely have access to hot water, and the only power in the school comes from a diesel generator, which runs for about four hours a day to power a small computer lab, thanks to diesel fuel provided by the state.

The girls’ dorm, however, now has an extra amenity, thanks to work that some MIT students carried out during an 11-month stay last year. Amy Mueller and Matt Orosz, both graduate students in the Department of Civil and Environmental Engineering, designed and installed a concentrating solar system, which provides the girls with plenty of hot water.

The system was built last year at MIT’s D-Lab, with a lot of help from the D-Lab students. After initial testing here, just getting the components out to the remote site was quite an effort: the road-less community can only be reached by crossing a wide river on small boats, Mueller explains.

Nearby, in the tiny village of Ha Teboho, another concentrating solar heater that Orosz and Mueller installed near the communal village well also provides hot water on demand. “We can easily boil lots of water even during freezing weather,” Mueller says. But that’s just the beginning of their ambitious project.

The two students, along with others at MIT and local co-workers in Lesotho, have formed an organization called Solar Turbine Group International. Their original plan was for the systems to provide electrical power using Rankine-cycle heat engines, with hot water as an extra bonus. But in their work in the field they encountered numerous mechanical problems with the engine, and they decided to return to MIT to work out the bugs under more-controlled laboratory conditions.

“The arrays performed satisfactorily, but the engines did not,” says Orosz. “We fix the problems, ‘we figured we could make headway faster in this environment than over there.’”

In a return visit to Lesotho this summer, the students plan to add a more robust version of the generator to the large trough-shaped mirror systems, enabling them to produce enough power to recharge cell phones and batteries.

The initial systems are prototypes, designed to be relatively easy to build from inexpensive materials. The engine system, which works essentially like an air conditioner in reverse, is built largely of off-the-shelf car parts that are readily available near the site and can easily be repaired by local mechanics.

In the World

In the World
MLK

Continued from Page 1

done,” said Cotton, a chemical engineering student. “Our challenge as a higher institution is to ensure that every student is receiving the best education they need for what they must do.”

Kenneth Kweku Bota, second-year graduate student in the Department of Chemistry and the Whitehead Biomedical Institute, pointed out glaring inequalities between Cambridge’s twin academic towers—MIT and Harvard—and dilapidated public schools across the river in Dorchester, Mattapan and Roxbury.

“Here at MIT, we have literally thousands of books, computers and resources at our immediate disposal. However, so matter how smart and innovative we are in using them, we will not achieve and witness the full spirit of Dr. King unless we begin to commit ourselves to helping those who are less fortunate than we are,” Bota said.

Keynote speaker, Boston community activist and Harvard/MIT Division of Health Sciences and Technology alumna the Rev. Dr. Ray Hammond, a physician and founding pastor of Bethel African Methodist Episcopal Church in Boston, told the broadcast audience that much had been done to achieve the change envisioned by Dr. King, but much more work remained.

Hammond spoke in detail about ways in which colleges and universities can and must create more diverse and inclusive environments. He cited a model developed by Uri Treisman at the University of California in the late 1990s aimed at reducing the rate of failure among black and Hispanic students in calculus courses. The model, which involved creating multi-ethnic student workgroups, dramatically improved academic performance among black and Hispanic student participants.

“It’s a model that suggests we are cheating all of our students when we fail to work hard at developing diversity in the research university,” Hammond said.

Hammond, a native of Philadelphia, is well known in the Boston area for his leadership and involvement in community and youth activities. He is chair and co-founder of the Ten Point Coalition, an ecumenical group of clergy and lay leaders working to prevent violence and mobilize the Greater Boston community on behalf of at-risk youth. He also serves as executive director of Bethel’s Generation Excel program.

“The most exciting thing about the president’s proposal to bring together a broad group of leaders from MIT is in the form of the Diversity Leadership Congress,” Hammond also said she was excited about the president’s proposal to bring together a broad group of leaders from MIT in the form of the Diversity Leadership Congress.

“The congress will bring together people from different leadership levels and will make the issue of diversity a key topic of discourse on campus. I really think she is putting this issue at the forefront of the ones we need to tackle at MIT, and this essentially initiates that process,” Hammond told the News Office. “It will become something that we can all unify behind and add to our diversity efforts.”

“IT has not seen MIT with this level of activity directed toward—and these are my words—transformational behavior when it comes to faculty of color in my 30-odd years of serving here in this community,” the Rev. Dr. Ray Hammond told the News Office.

It was an exciting moment for Microsoft President Susan Hockfield, who stood at the podium to deliver an address titled, “We cannot be satisfied until, to everyone who earns a place at MIT, we are a community that says not, ‘You’re lucky to be here,’ but rather, ‘We’re lucky you came.’”

“Let us grow and live as a community that says not, ‘We’re lucky you’re here,’ but rather, ‘We’re lucky you came.’”

“We live and grow together as a community. When I say that to everyone who earns a place at MIT, we are a community that says not, ‘We’re lucky you’re here,’ but rather, ‘We’re lucky you came.’”

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MIT News Office

Five win MLK Leadership Awards

Sarah H. Wright
MIT News Office

Five members of the MIT community have won Dr. Martin Luther King Jr. Leadership Awards for 2008 in recognition of service that reflects the late civil rights leader’s ideals and vision.

Winners Zina Queen, administrative assistant in the George R. Harrison Physics Professor Michael S. Feld SB ’63, SM ’63, PhD ’67 and former Associate Dean for Undergraduate Education Leo Osgood Jr.

Audience members reacted positively to Hockfield’s call for greater change and her willingness to volunteer on committees charged with improving the quality of work life for support staff.

“Receiving the MLK Leadership Award means the world to me,” Queen said. “We live and grow together as a community. When I say that to everyone who earns a place at MIT, we are a community that says not, ‘We’re lucky you’re here,’ but rather, ‘We’re lucky you came.’”

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