Plants’ potency revealed by MIT research

Green, leafy spinach may soon power more than Popeye’s biceps

Deborah Halber
News Office Correspondent

For the first time, MIT researchers have incorporated a plant’s ability to convert sunlight to energy into a solid-state electronic “spinach sandwich” device that may one day power laptops and cell phones.

At the heart of the device is a protein complex dubbed Photosystem 1 (PSI). Derived from spinach chloroplasts, PSI is 10 to 20 nanometers wide. Around 10,000 of them would sit on the head of a pin. “They are the smallest electronic circuits I know of,” said researcher Marc A. Baldo, assistant professor of electronic engineering and computer science at MIT.

Baldo and other researchers from MIT, the University of Tennessee and the U.S. Naval Research Laboratory, including electrical and biomedical engineers, nanotechnology experts and biologists, collaborated on the world’s first solid-state photosynthetic solar cell. The work was reported in NanoLetters, a publication of the American Chemical Society.

“We have crossed the first hurdle of successfully integrating a photosynthetic protein molecular complex with a solid-state electronic device,” Baldo said. “Plants’ ability to generate energy has been optimized by evolution, so a spinach plant is extremely efficient, churning out a lot of energy relative to its size and weight. But combining biological and non-biological materials in one device has stymied researchers in the past. Biological materials need water and salt to survive—both are liabilities for electronics.”

From wet to dry

A new twist in the current work is a membrane of peptide surfactants—similar to the main ingredient in soap—that helped the photosynthetic complex self-assemble and stabilize while the circuit was fabricated. So far, scientists and engineers’ efforts to harness the photosynthetic properties of green plants have been most successful with naturally soft organic materials in liquid solutions. But organic solar cells are to be practical for commercial devices, they need to be integrated with solid-state electronics.

The researchers ground up ordinary spinach and purified it with a centrifuge to isolate a protein deep within the cell. From this protein, they then isolated the PSI component. A red pigment associated with PSI collects electrons from the light, a green pigment called chlorophyll passes electrons to PSI, and PSI collects other electrons to form hydrogen gas.

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In work that emphasizes the need for stronger regulation of herbal drugs, an international team of MIT scientists and colleagues has unraveled the yin and the yang of ginseng, or why the popular alternative medicine can have two entirely different, opposing effects on the body.

In work that emphasizes the need for stronger regulation of herbal drugs, an international team of MIT scientists and colleagues has unraveled the yin and the yang of ginseng, or why the popular alternative medicine can have two entirely different, opposing effects on the body.

Conflicting scientific articles report that ginseng can both promote the growth of blood vessels (key to wound healing) and thwart that process. The latter is important because preventing the formation of blood vessels can be enlisted against cancer. Tumors are fed by blood ves- sels; cutting off their supply can kill them.

In the Sept. 7 issue of Circulation: The Journal of the American Heart Association, the researchers from the United States, England, the Netherlands and Hong Kong explain these dual effects for the first time.

Chemical fingerprints of four different varieties of ginseng—American, Chinese, Korean and Sasa—show that each has different proportions of two key ingredients. Additional studies showed that a preponderance of one ingredient has positive effects on the growth of blood vessels; more of the other component tips the scale the other way.

“We found that this composition really matters for the ultimate outcome,” said Shiladitya Sengupta, a postdoctoral associate in the Biological Engineering Division (BED).

Further, the team found that the way ginseng extracts are processed can also alter the compositional ratio. “This is a very clear-cut example of why we need regulations standardizing herbal thera-pies through compositional analysis,” said Professor Ram Sasekharan of BED. With the new results, “we can now rationally isolate the components to focus on a specific effect, such as promot- ing blood-vessel formation.”

In the United States, herbal medicines are currently regu-lated under the 1984 Dietary Supplement and Health Educa-tion Act, which does not require standardization or prior approval from the Food and Drug Administra-tion. “You can basically crush it and sell it,” Sasekharan said.

The new results could also lead to medicines patterned after ginseng’s key components. As the researchers write in Circulation, the identification of one of these ingredients “opens up the

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Two MIT students make Glamour magazine’s Top 10 College Women list

Denise Brehm
News Office

Two seniors at MIT were named to Glamour magazine’s Top 10 College Women list and are profiled in the magazine’s October issue, which hit newsstands Sept. 14.

Swati Maria Saini, a senior in management and brain and cognitive sciences from Tracy, Calif., was recognized for her work helping people with diabetes and for her achievements as a Truman scholar, vice president of the Society for Women Engineers, a cheerleader, and a cam-pus emergency medical technician (EMT).

Laurel Yong-Hwa Lee, a senior in brain and cognitive sciences from Bothell, Wash., received the honor for her groundbreaking research on the immune response and for coordinating medical care for 11 women’s shelters and orphanages in Honolulu.

The awards recognize women who have demonstrated extraordinary leadership and excellence in their personal and professional lives.

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NEWS

INTERNET UNBOUND

Connecting to the Internet on campus got easier this summer.

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CLASS OF 2009

President Charles M. Vest and other faculty members formally welcome the freshman class.

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EDUCATING VOTERS

Grad student creates online voting guide to the sci/tech issues at stake in the presidential elections.

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CHILD’S PLAY

The new playground at the Stata Center’s day care facility pleases its small constituency.

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HISTORY PROJECT MAKES HISTORY

Professors Dower and Miyagawa’s project about Commodore Perry’s journey to Japan takes a turn for Broadway via Boston’s MFA.

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PICK A PUMPKIN

Annual glass pumpkin patch returns Sept. 18.

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Wireless network service expanded

Information Services and Technology

T echnology and IS&T initiated a new program in May to increase the coverage and speed of the campus wireless network. The program provided about 500 new wireless access points and upgraded the existing 700 access points to make them faster.

The main group of buildings along the Infinite Corridor will have complete high-speed wireless network coverage this fall; other parts of the campus will have partial coverage. Since this is basically radio technology, there may be some “cold” spots where access doesn’t work. These can be reported to IS&T by sending mail to unwired@mit.edu. T h r e e e x i s t e n c e h a l f s — E a s t C a m p u s , B e x l e y and Baker House—were recently renovated and now have complete wireless coverage. Wireless access points were installed in lounges and common areas this summer in five other dormitories—Burton House, MacGregor, Next House, New House and Randal Hall.

MIT’s wireless deployment began about four years ago and focused primarily on classrooms, libraries and popular common spaces. IS&T started the new program last spring in response to requests from the community for wider coverage and faster connectivity. Working with the Office of Housing, the Dean for Student Life, and many depart- ments, labs and centers, IS&T plans to provide a nearly complete wireless campus by the end of 2005.

For information on how to connect to MITNet using wired or wireless systems, go to http://web.mit.edu/isst/start/mitnet/*get-connected.html. To view precise coverage locations, go to http://web.mit.edu/network/wireless-map.html.

Nominations open for Doherty Professorship

The selection committee for the Doherty Professorship in Ocean Utilization is accepting nominations from department heads for non-tenured faculty members from any department.

Endowed by the Henry L. and Grace Doherty Charitable Foundation, the two-year chair provides funding for non-tenured faculty to undertake marine-related research that advances innovative uses of the ocean’s resources. There are no restrictions on the area of research, and any aspect of marine use and/or management may be addressed, whether social, political, environmental, economic or technical.

Those appointed to the chair receive $25,000 per year for two years, beginning July 1. The recipient cannot hold another MIT-funded chair at the same time.

Anette Hosoi, an assistant profes sor of mechanical engineering, was awarded the Doherty in 2004 to study particle-laden flows in the ocean. Her findings are expected to increase understanding of the risks in offshore construction and ocean exploration.

Department heads may submit one nomination every year. The deadline is October 28. Anyone wishing to be nominated should contact his or her department head. For more information, please contact Kathy de Zengotita at 253-5095 or kdze@mit.edu.

Dealing with malware

“Malware” is a term for any software that gets installed on your computer and performs unwanted tasks, often for some third party’s benefit. These programs can cause any thing from simple annoyances (pop-up advertising) to serious system corruption and damage (stealing passwords or introducing viruses and worms). Additionally, some malware is designed to transmit information about your web-browsing habits to advertisers or other third parties.

Currently, only Windows machines are susceptible to most adware or spyware programs (two types of malware). VirusScan Enterprise 8.0 for Windows (available at http://owr.mit.edu/software) contains integrated anti-spyware functionality. However, your computer may still be at risk, since no one product can catch all malware. To find out more about malware and how to deal with it, go to the IS&T web site.

Apple catalog available on ECAT

With support from the MIT Procurement Depart ment and IS&T, Apple Computer’s ECAT catalog is now available for faculty and staff to purchase Institute and personal pur chases. Through this catalog, community members have access to the same MIT-allowed Apple desktop computers and laptops, as well as the entire line of Apple products. The new catalog lets purchasers customize configure systems and is periodically updated by SAP.

Having this direct relationship with Apple will improve order accuracy, reduce delivery time and provide better pricing for institutional orders. For questions or comments about this service, contact Mary Bacci at mamato@mit.edu or Laura Simmons at simmons@mit.edu, or for assistance with selecting and configuring an Apple system, contact an MIT presses consultant at 253-7086.

Countdown to retiring support for Windows 2000

Microsoft will end mainstream support for Windows 2000 on March 31, 2005. In anticipation of this, IS&T will stop providing full support for Windows 2000 as of December 31. Windows 2000 users should plan to make the tran sition to Windows XP Professional this fall. For details, go to http://itinfo.mit.edu/product/name-windows.

Digitalk is compiled by Information Services and Technology
Frosh urged to solve the world’s problems

Denise Brehm

MIT faculty advised freshmen to pursue their personal educational interests, then use what they learn to help the world at the freshman convocation on Sept. 1.

President Charles M. Vest welcomed his 15th freshman class to MIT during the annual gathering in Kresge Auditorium by encouraging the students to use their knowledge of science and engineering to tackle society’s biggest problems.

“Develop your individual talents but also please look beyond yourselves,” Vest said. “Master your disciplines, but think creatively about their applications.”

“We live in a world that is dangerous but full of hope, a world that is increasingly dependent on science and technology and defined by advances in science and technology. Foremost in our minds these days is peace and security. But it is a time for optimism, not a time to get mired down in problems and fears. It is a time to take on the challenges,” Vest said.

Striking a more personal note was Professor David Mindell, who showed slides from some of his deep sea archaeological voyages and encouraged the frosh to make their education conform to their real interests. “Doing what you love is the essence of a great education,” said Mindell, the Dibner Associate Professor of the History of Engineering and Manufacturing in MIT’s Science, Technology and Society Program, and an associate professor in the Systems Engineering Division. “Don’t feel constrained by how people have done things in the past.”

Mindell entered Yale as a freshman 21 years ago with the intention of majoring in electrical engineering. And he did. But during his freshman year one of his mentors helped him realize that a focus on engineering didn’t preclude learning more about his other passion—literature. So Mindell took a double major (“the single most important decision of my career”) and wrote his senior thesis on Thomas Pynchon’s “Gravity’s Rainbow.” A key metaphor of that post-modern novel is based in engineering, said Mindell, who just happened to have the education to recognize it.

“Now he looks at the ways that technology affects our world. And he uses his electrical engineering background to develop underwater robots and sonar technologies to map out ancient shipwrecks at the bottom of the ocean floor. His second piece of advice was to develop relationships...”

CLASS OF 2008 BY THE NUMBERS

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Shape-shifting cell protein helps us remember and forget

Researchers at the Picower Center for Learning and Memory are one step closer to understanding how brain synapses make chameleon-like changes in their structure and composition depending on the input they receive.

Yasunori Hayashi, assistant professor of brain and cognitive sciences, seeks to understand how brain cells accomplish their remarkable plasticity. His work on the shape-shifting cell protein called actin, appeared in Nature Neuroscience on Sept. 5. This knowledge may one day make it possible to enhance learning and memory by manipulating neurons at a molecular level.

In the fraction of a second it takes one brain cell to communicate with another, a lot happens. Chemical neurotransmitters are released from the signaling side of the synapse and bind to the receiving side, which triggers certain proteins to be assembled or disassembled. Long-term changes in the structure of brain cells create long-term memories and lifetime learning, while other changes destroy unneeded connections to eliminate unneeded information.

A cellular protein called actin is responsible for helping synapses keep their shape. Hayashi and colleagues speculate that actin works with other mechanisms to help synapses assemble proteins on the postsynaptic, receiving end of a transmission.

Actin itself is transformed from ball-like globular to stringy filament forms (G-actin and F-actin), which do radically different things during key brain processes. How actin behaves and what it does is not well understood because no one has been able to see this conversion in synapses in living neurons.

Using a method called fluorescent resonance energy transfer (FRET) in combination with a state-of-art microscopic technique called two-photon laser scanning microscopy, Hayashi was able for the first time to observe the change in equilibrium between G-actin and F-actin. By attaching a protein derived from jellyfish, he modified actin so that G-actin glows blue and F-actin in yellow. Change in color from blue to yellow means a conversion from G-actin to F-actin.

“Without FRET, we couldn’t see this kind of change,” Hayashi said.

Hayashi’s laboratory zapped the fibers of a pre-synaptic cell in the rat hippocampus, the brain region associated with formation of new memory, with intense electrical stimulation. This initiates a biochemical process creating a physical change that can last for hours or even days in the postsynaptic receiving cell, either potentiation or depotentiation. These two key brain processes are long-term potentiation (LTP) and long-term depression (LTD), which many believe are the basis for learning and memory. LTD causes long-lasting changes by helping build new connections among brain cells and LTP helps destroy unneeded connections.

Low-frequency stimulation created a reaction like LTD, while the intense electrical stimulation mimicked LTP.

Hayashi and colleagues Ken-Ichi Oka-moto, postdoctoral associate in the Picower Center for Learning and Memory, and Takeharu Nagai and Atsushi Miyawaki of the RIKEN Brain Sciences Institute in Japan, found that LTD induction induces F-actin, which in turn enforces synaptic spines and increases their ability to transmit information. In contrast, LTP induction shifts the equilibrium toward G-actin, resulting in a loss of actin in the pre-synaptic cell, the one receiving the message from the pre-synaptic cell.

“If we could manipulate actin equilibrium, we may some day be able to manipulate synaptic plasticity, affording significant control over the learning power of the brain,” Hayashi said.

The Picower Center for Learning and Memory at MIT is a research entity within MIT’s School of Science, with faculty members holding academic appointments in the Department of Brain and Cognitive Sciences, the Department of Biology, or both. It focuses the talents of a diverse array of brain scientists on a single mission: unravelling the mechanisms that drive the quintessentially human capacity to remember and to learn, as well as related functions like perception, attention and consciousness.

This work is supported by RIKEN and the Ellison Medical Foundation.
MIT students write voter’s guide to science and technology issues

An MIT graduate student is the creative force behind a new voter’s guide to the science and technology issues in the upcoming presidential election.

Daniel Collins, a Ph.D. student in civil and environmental engineering, created the project for Student Pugwash USA, which produced the online guide to highlight the importance of science and technology in the political decisions voters will face in November. The MIT Student Pugwash team, including the group’s president Chris Sequeira, wrote the guide this summer.

Drawing from government records, campaign statements and media reports, the guide provides background on the candidates’ positions on a variety of issues, including bioterrorism, stem cell research and renewable energy. It will be expanded and updated as the elections near.

Collins sees the guide as an opportunity to get voters, particularly students, to talk about the issues and become active in the democratic process. He sees Student Pugwash USA as the ideal group to offer the resource, being a non-partisan group that has raised ethical and political awareness of science and technology for 25 years.

“We advocate neither a party nor a platform,” said Collins, a New Zealand citizen who cannot vote for the American president. “We hope people will become better informed on the issues important to them. We also hope that people will take more of an interest in issues they don’t usually think about and make their decisions based on the best available information. It’s an investment well beyond these elections.”

The University of Virginia Student Pugwash chapter will host a conference on the guide this fall.

For more information, contact electionguide2004@mit.edu or visit http://web.mit.edu/pugwash/election-guide2004.
The return of students brings fresh energy to campus every September, but a small lot just off Vassar Street was abuzz with activity a little early this year.

The fresh-faced students on this 5,000-square-foot campus do not carry backpacks or chat with friends on cell phones. Their average height is about three feet and they share a keen interest in tricycles.

These students are not here to study but rather to learn by doing. They are the children of faculty, students and others who work at MIT, and they are being introduced to the kind of academic and social environment that will be their home for the next several years. The children, who are in kindergarten through fourth grade, arrived at MIT on September 8 for a week-long introduction to the campus and its resources.

Monday was set aside for a brief orientation and to become acquainted with the facilities on campus. Tuesday and Wednesday were devoted to educational and social activities, including a visit to the Family Science Center, the Children’s Museum of Science and Industry and the MIT Museum. Wednesday afternoon and Thursday were left free for parents to explore the Kendall Square area on their own.

The children were impressed with the variety of activities available on campus and the dedication of the faculty and students who work with them. Many of the children were excited to see the new facilities on campus, including the newly renovated buses and the newly opened dining hall.

The children also enjoyed interacting with the faculty and staff who work at MIT, and they were eager to learn more about the work they do. Many of the children expressed an interest in becoming scientists and engineers when they grow up, and they were encouraged to pursue their dreams.

The children were also impressed with the beauty of the campus and the opportunity to see parts of it they had never seen before. They were also impressed with the variety of activities available on campus and the dedication of the faculty and students who work with them. Many of the children were excited to see the new facilities on campus, including the newly renovated buses and the newly opened dining hall.

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The sixth annual Travel Vendor Fair will be held on Tuesday, Sept. 21 in Lobby 13 from 10 a.m. – 2 p.m. The event is free and open to all employees and students. The fair offers information for individuals interested in travel on MIT business or who are responsible for making travel arrangements for others.

Faculty meeting scheduled
Agenda items for the faculty meeting on Wednesday, Sept. 15 include a vote to establish an S.B. degree in architecture and materials, by Professor Mark Schuster; the annual update on budget and finances, by Provost Robert Brown; a report on OpenCourseWare, by Professor Steven Lerman and Anne Margulies; and comments from President-elect Susan Hockfield. The meeting is scheduled for 3:30 p.m. in Room 123 of the Stata Center.

Libraries hold special events
In honor of travel and transportation milestones such as the 100th anniversary of the New York City subway, the MIT Libraries invites community members to embark on their own journeys of discovery by exploring the libraries' extensive collections of travel guides, atlases, maps, photos and music from all over this world and even out of this world. During Libraries Week (Sept. 20-24), the Libraries will also offer 3 p.m. study breaks with snacks and the opportunity to get to know librarians in different fields—Monday in the Humanities and Science libraries (14S-100), Tuesday in Barker Engineering Library (250-060), Wednesday in Dewey Library (250-100) and Thursday in Rotch Library (7-230). For more information, see the Libraries' web site.

Excellence Awards workshops
Team and individual nominations for the annual MIT Excellence Awards are being accepted at web.mit.edu/hr/rewards/excellence and are due Oct. 13. The awards recognize outstanding accomplishments by students and staff. Each lunch discussion is being held to help people who have questions about the nomination process or who want help with the nomination form. Lunches are scheduled for Sept. 23, 12:30-1:30 p.m. in Room W20-201; Sept. 24, noon-1 p.m. in Room 522-160 (Lincoln Lab); Sept. 29, noon-1 p.m. in Room 22-100 (Oct. 6, 12:30-1:30 p.m. in Room 16-151. For more information, contact Sandeep Anand at 253-2986 or rewards@mit.edu.

Course catalogues available
The MIT Course Catalogue is available in print, on CD and online at http://web.mit.edu/catalogue. Students can pick up a copy of the print catalogue or CD at the Student Services Center. Faculty and staff can get a copy of the print catalogue at their department headquarters or in a Distributed Mail Center. CDs are available from the Reference Publications Office in E28-100. Copies for alumni are available at the Alumni Center (Room 10-110). Other people can purchase the printed catalogue by going to the MIT Coop or the MIT Press Bookstore, or by mail-order from the MIT Press Bookstore (253-5249) or web.mit.edu/ocs.

SAPweb down
If an SAP Production system update is scheduled to take place from 10 p.m. Friday, Sept. 17 to 7 a.m. Sept. 20, SAP, ECAT, and all SAPweb activity including employee self-service, requisitioning, journal vouchers, and credit card verification will be inadmissible during this maintenance period.

Classifieds
Members of the MIT community may submit one classified ad for free, but not two weeks in a row. Ads should be 30 words maximum; they will be cut for clarity. Submit by email to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Monday. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Monday. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Monday. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Monday.

 Pune: Room for sale in 3rd flr flat. 1A flat. 1.5 bath. 200 sqyd. 4,000. 24 Sept.

 Boston: Room for rent. 1BR apt. Very close to MIT. 3 mins walk to MIT. 800. 2003. 35-235-0325 for pictures and info.

 Shuguang Zhang (left), associate director of the Center for Biomedical Engineering, holds a spinach solution, the active component in a completed solar cell. Recent graduate Patrick Kiley, holding a completed chip, and Professor Marc Baldo of electrical engineering and computer sciences complete the team.
The musical, a revisionist staging of the musical "South Pacific," will be featured in the lobby of Studio 54 when the Roundabout Theater presents Stephen Sondheim’s "Pacific Overtures" beginning Nov. 12.

The exhibit in the theater’s lobby will provide theater-goers with greater historical context for the musical—a play which captures the culture clash that would ultimately reshape the world in the 20th century, said Miyagawa, the Kochi-Manjiro Project Professor of Japanese Language and Culture. Ellen Sebring and Scott Shunk are designing the physical exhibit.

Dower, the Ford International Professor of History, whose masterpiece on post-war Japan “Embracing Defeat” won the 1999 Pulitzer Prize, has developed an innovative approach to history using the images from the period of study. He and Miyagawa received this year’s Class of 1960 Innova award on Broadway, which shows both sides of the encounter. The video stills above show the young man before and after pulling out his hair (left) and his frantic-drawing classmate (right). While nervousness is familiar to most adolescents acting out societal taboos and darkly humorous scenarios in hyper-realistic tableaux. On view through Sept. 19, the presentation will feature director Miyamoto and Dower, who will present views of the historic encounter between Japan and the U.S. that occurred when Commodore Perry sought to open up the secluded island to the world. Peter Grilli, president of the Japan Society of Boston will moderate.

Dower will present the artwork that he and Miyagawa created for their exhibition, which shows both sides of the encounter. Sponsors of “Black Ships and Samurai on Broadway” include the MFA and the Consulate General of Japan, as part of the Japan/Dowery “Embracing Defeat” won the 1999 Pulitzer Prize, has developed an innovative approach to history using the images from the period of study. He and Miyagawa received this year’s Class of 1960 Innova award on Broadway, which shows both sides of the encounter. The video stills above show the young man before and after pulling out his hair (left) and his frantic-drawing classmate (right). While nervousness is familiar to most adolescents acting out societal taboos and darkly humorous scenarios in hyper-realistic tableaux. On view through Sept. 19, the presentation will feature director Miyamoto and Dower, who will present views of the historic encounter between Japan and the U.S. that occurred when Commodore Perry sought to open up the secluded island to the world. Peter Grilli, president of the Japan Society of Boston will moderate.

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The Great Glass Pumpkin Patch


Celebrating the Vesty Years

An MIT community event with food, music and festivities throughout the afternoon. The program begins at 3 p.m.

Natyanjali

MIT Natya’s annual program of traditional classical Indian dance. Tickets: $7 and $5. Make reservations online.

Artistry of Swiss Bridge Design

Some of the most acclaimed bridges in the United States are products of Swiss design, including Boston’s own Leonard P. Zakim Bunker Hill Bridge, which was designed by Swiss-born Christian Menn. The photo at right shows the Chandoline Bridge over the Rhone River, Switzerland, another of Menn’s designs.

Editor’s Choice

Go Online! For complete events listings, see the MIT Events Calendar at: http://events.mit.edu.